

**SPECIAL PUBLICATION 5-A**

**SAND, GRAVEL, AND  
QUARRY AGGREGATE RESOURCES  
COLORADO FRONT RANGE COUNTIES**

by

**S. D. Schwochow, R.R. Shroba, and P.C. Wicklein**



**COLORADO GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES  
STATE OF COLORADO  
DENVER, COLORADO**

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DENVER, COLORADO

**1974**



Post Office Box 2645  
Denver, Colorado 80201  
June 30, 1974

LETTER OF TRANSMITTAL

Mr. John W. Rold  
State Geologist and Director  
Colorado Geological Survey  
1845 Sherman Street  
Denver, Colorado 80203

Subject: Completion of the report "SAND, GRAVEL, AND QUARRY AGGREGATE RESOURCES, COLORADO FRONT RANGE COUNTIES."

Dear Mr. Rold:

This report and the 3 enclosed 1:250,000-scale resource maps are hereby transmitted to the Colorado Geological Survey by the contractor geologists, Stephen D. Schwochow, Ralph R. Shroba, and Phillip C. Wicklein, as authorized by the 1973 Colorado House Bill 1529. The contract was administered by Mr. A. L. Hornbaker, Mineral Deposits Geologist, Colorado Geological Survey. The maps in this report were compiled from the 212 maps in Special Publication 5-B, "Atlas of Sand, Gravel, and Quarry Aggregate Resources, Colorado Front Range Counties," by S. D. Schwochow, R. R. Shroba, and Phillip C. Wicklein.

Sincerely,



Phillip C. Wicklein  
Project Consultant



Stephen D. Schwochow  
Consultant



Ralph R. Shroba  
Consultant

PCW/psb

## PREFACE

This report is in direct response to the charge given to the Colorado Geological Survey by H.B. 1529 to make a study of sand, gravel, and quarry aggregate deposits in the populous counties, including maps that may be generally circulated. The maps and accompanying text are designed to serve as aids to city and county planning commissions in studying the location of commercial mineral deposits and in developing master plans for the extraction of such deposits, consistent with the overall land-use plan and incorporating the multiple sequential land-use concept.

The report on sand, gravel and aggregate resources, phase 1 of H.B. 1529, is only a prelude to phase 2, the development of the master plan. Ideally, there should be continued input from the Colorado Geological Survey to the planning commissions concerning interpretation of map data and recommendations related to aggregate demand projections, future resource areas, and mineral economics. Unfortunately, adequate staffing for such input is not presently available.

The Survey will prepare, with input from various disciplines including the planning commissions, guide lines that should be considered in developing the master plans for extraction. Liaison among neighboring counties and regional councils of government is essential to resolve problems of regional and mutual concern.

A.L. Hornbaker  
Mineral Deposits Geologist  
Colorado Geological Survey



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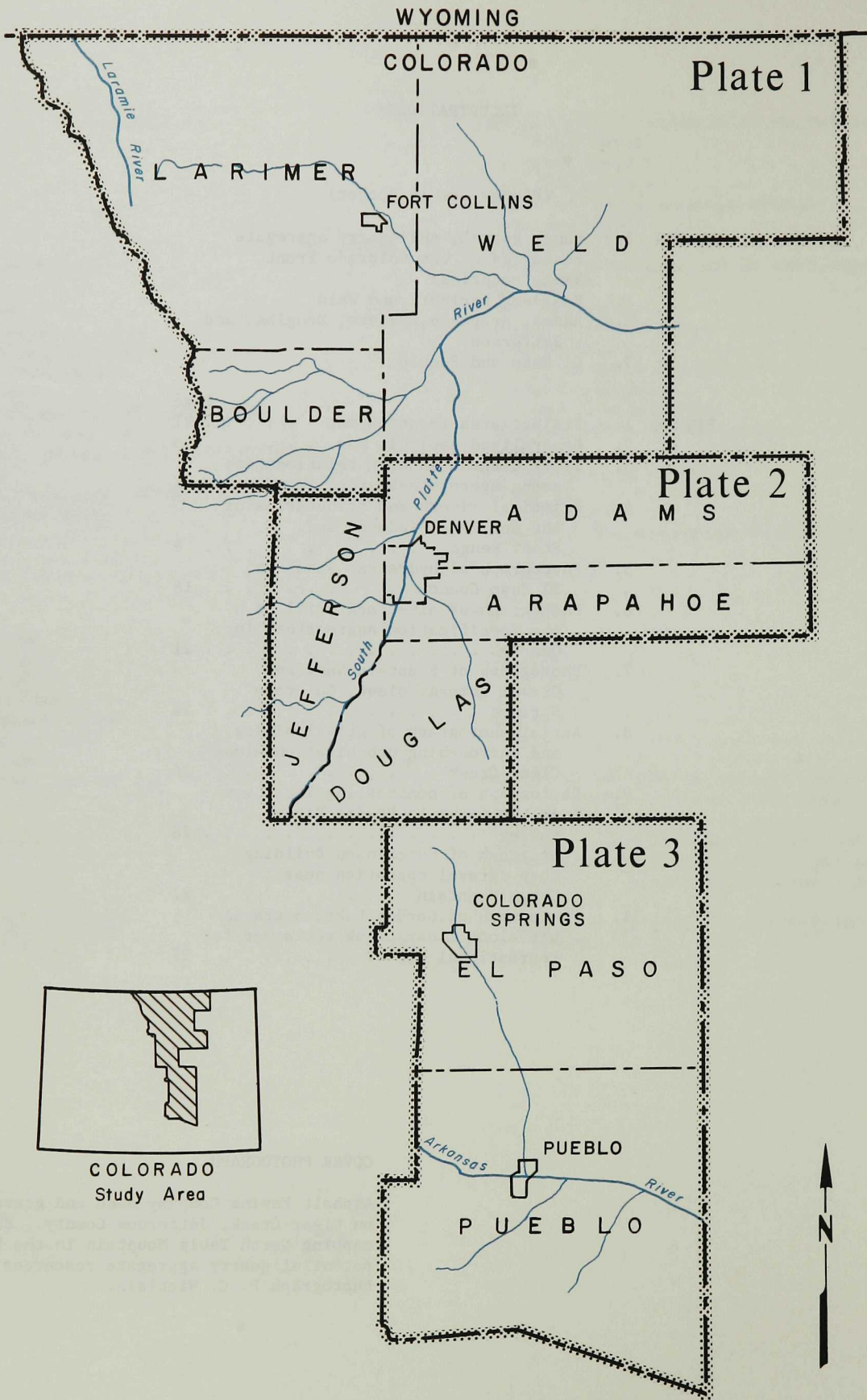
(Plates are in pocket)

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COVER PHOTOGRAPH

Asphalt Paving Company sand and gravel operation on Clear Creek, Jefferson County. Basalt flows capping North Table Mountain in the background are potential quarry aggregate resources. Photograph P. C. Wicklein.





Project area location map

Figure 1

## SUMMARY AND CONCLUSIONS

Sand and gravel deposits in the Front Range counties are associated with alluvial-fan, upland-mesa, dune, valley-fill, stream-terrace, and flood-plain landforms. Deposits of clean sand and gravel lie in flood plains and stream terraces along the South Platte and Arkansas Rivers and their principal tributaries. These flood-plain and terrace deposits generally are mined for concrete and asphalt aggregates. Upland gravels and alluvial fans, normally sources of road base and fill material, are located along present stream courses, interstream divides, and the mountain front, and contain significant amounts of incompetent rock, calcium carbonate (caliche), silt, and clay.

Most quarry aggregate is produced in the mountains of western Jefferson and El Paso Counties and consumed in metropolitan Denver and Colorado Springs. These Metropolitan growth areas will probably continue to use even more crushed rock in the future.

Adams, Boulder, El Paso, Jefferson, Larimer, Pueblo, and Weld Counties have sufficient reserves of sand, gravel, or quarry aggregate at present to meet future needs, but all these counties experience problems in integrating aggregate production with other land uses. The continual loss of aggregate resources by urbanization is the principal cause for problems in mineral conservation in these counties.

Arapahoe, Denver, and Douglas Counties do not have significant reserves of gravel or quarry aggregate. Most of the aggregate they consume will come from outside these counties.

Sand and gravel are basic to the construction of our homes, schools, hospitals, churches, shopping centers, streets and highways, airfields, and bridges. In addition, sand and gravel play an important role in the areas of sewage treatment, water pollution and filtration, agriculture, landscaping, transportation, manufacturing, recreation, and petroleum production. We, the consumers, cannot take for granted that our supplies of these materials are inexhaustible. The input of technical, governmental, and environmental groups is required to establish a workable master plan that will conserve adequate supplies of aggregate to meet future demands.

## INTRODUCTION

### Authorization

This study was authorized by article 36 of chapter 92, C. R. S. 1963, known as the "Colorado Open Mining Land Reclamation Act." Article 36 provides:

*"92-36-3. Geological survey to make study. After July 1, 1973, the Colorado geological survey shall contract for a study of the commercial mineral deposits in the populous counties of the state in order to identify and locate such deposits. Such study shall be of*

*sand, gravel, and quarry aggregate, and shall be completed on or before July 1, 1974, and shall include a map or maps of the state showing such commercial mineral deposits, copies of which may be generally circulated. Any commercial mineral deposits discovered subsequent to July 1, 1974, may be, upon discovery, included in such study."*

### Purpose and Scope

The purpose of this report is to provide the populous Colorado Front Range counties with regional resource maps and an explanatory text to be used with 1:24,000-scale sand, gravel, and quarry aggregate land-use maps.

This part of the study was started on September 4, 1973, and completed June 28, 1974. The study area of approximately 16,000 sq mi includes Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, Pueblo, and Weld Counties (Fig. 1).

### Previous and Present Studies

In 1961, the Inter-County Regional Planning Commission, now Denver Regional Council of Governments, published a drainage-course plan for the Denver Region that discussed future sand and gravel requirements of the area, conservation of sand and gravel, and the economics of transportation. Sheridan (1967) reported the impact of urbanization and outlined many problems of the aggregate industry in Denver. Several Colorado Water Conservation Board Basic-Data Reports and university theses are valuable information sources for parts of the study area.

The U. S. Geological Survey has prepared many water-supply papers and geologic maps within the study area over the past century. Varnes and Larrabee mapped the sand and gravel deposits of Colorado in 1946 at a scale of 1:500,000. Colton and Fitch (1974, in press), and Trimble and Fitch (1974a, 1974b, in press) show the distribution of gravel and crushed-rock aggregate in the Front Range Urban Corridor on 1:100,000-scale topographic maps. A report by J. M. Soule (1974, in preparation) analyzes the economics of aggregates in relation to transportation and urbanization in the Front Range Urban Corridor. The U. S. Geological Survey gravel maps and economic report are being prepared in cooperation with, and are financed in part by the Colorado Geological Survey. W. P. Rogers and D. C. Shelton are presently preparing an aggregate resource map as part of a Colorado Geological Survey land-use study for the Fort Collins-Loveland-Greeley area, Weld and Larimer Counties, Colorado.

### Method and Techniques

On the basis of interviews with several sand and gravel producers and with the staff members of the Colorado Geological Survey, the authors decided that:

1. The sand and gravel resources mapping should be primarily geologic so that the work will remain current and useful over any time period.



2. The study should include the mapping of every landform with which significant amounts of aggregate are associated.

3. The deposits shown on the maps should be designated according to land form and the quality of the aggregate.

4. The quality designations should be independent of the location of the deposit.

5. Maps should be designed in such a way that they may be used both as geologic maps and as resource quality maps.

6. Maps should be prepared at one scale for planning and at another scale so that a county or region may be presented on a single map.

7. A text should be prepared that discusses the geology of sand, gravel, and quarry aggregates; the deposits in their geologic setting; and the distribution and nature of deposits within each county.

Photogeologic methods are well suited to the identification and inventory of landforms associated with aggregate deposits. Landforms and their associated aggregate deposits are easily identified on air photographs, and extremely large areas may be evaluated over a very short period of time. Landforms such as flood plains, valley fills, stream terraces, upland mesas, alluvial fans, and sand dunes were identified on aerial photographs and their outlines transferred onto 1:24,000-scale 7½-min quadrangle base maps. Field observations and supplemental data were printed directly on maps. Photogeologic base maps were field checked and individual landforms were evaluated for associated aggregate.

Each landform type shown on the maps is marked with an appropriate letter. Upland landforms are marked with a *U*, alluvial fans with an *A*, flood plains with an *F*, stream terraces with a *T*, valley fills with a *V*, and wind-blown sand dunes with an *E*. Numbers following the landform letter designation indicate aggregate quality. Clean, sound, coarse gravel deposits are marked with the number 1. Coarse gravel deposits containing significant amounts of incompetent rock, silt, clay, and calcium carbonate (caliche) are marked with the number 2. The fine-aggregate sand deposits are marked with the number 3, and unevaluated aggregate deposits with the number 4.

In developing the numbered quality grading system used in our explanations, representatives from several large sand and gravel companies were interviewed and asked to define the current physical and economic limits of commercial sand and gravel deposits. Although opinions differ among the companies, and all the factors affecting commerciality were not considered, we utilized the following general criteria for identifying commercial deposits:

1. Five-acre tracts with at least 15 ft of gravel can be considered to be economic.
2. The maximum stripping ratio for commercial valley deposits approaches one unit of overburden for each three units of resource (1:3).
3. The maximum stripping ratio for terrace and upland deposits can be one to one (1:1).
4. Large tracts of high-quality aggregate without overburden may be as little as 2 ft thick and still constitute a commercial deposit.

5. Commercial gravel deposits should contain a minimum of 30 percent gravel-size material by weight.

The above factors are intended only as guidelines and do not represent the only standards used to determine commercial mineral deposits as defined in section 92-36-2, C. R. S. 1963.

All Front Range aggregate deposits are potentially commercial. Commerciality of a deposit depends upon the supply, location, and demand for the aggregate, as well as existing and intended land use, population distribution, and road maintenance requirements. For example, an upland gravel deposit with a high concentration of calcium carbonate (caliche) may not be commercial to a producer of concrete aggregate but quite desirable for use as road-base material by the county highway department in areas of highly expansive soils. Likewise, a sand dune field covering several hundred square miles is not commercial over the entire area but may be a valuable source of material for local highway construction. Commerciality of deposits may change with time, zoning, and urban growth patterns. Therefore, we have mapped all the potential aggregate resources along the Front Range and graded individual deposits so that each county can select those principal resources required for the future.

Only areas with the geologically most suitable rock for quarry aggregate are shown on field maps. Although operating stone quarries lie within these potential resource areas, some quarries operate in areas of less suitable rock for economic or environmental reasons.

Two hundred ten of the 271 quadrangles examined for aggregate resource were prepared and distributed as basic-data resource maps to the planning commissions of the appropriate cities and counties. These maps are available from the respective counties or the Colorado Geological Survey. The enclosed 1:250,000-scale resource maps (Plates 1, 2, and 3) were compiled from the basic-data maps.

To supplement well data in the Lone Tree Creek and Big Thompson River valleys, 37 holes were drilled in cooperation with the Colorado Geological Survey's Windsor Environmental Geology Project during January 1974. The drill was a truck-mounted 4-in. auger. Samples were examined and logs written on the drill site. Drilling data appear on the basic-data resource maps.

The boundaries of deposits that are shown on the 1:24,000-scale basic-data maps are subject to change. Any deposits discovered subsequently to July 1, 1974, may be included in this study (section 92-36-3, C. R. S. 1963). As additional data becomes available, some deposits may be proved to be non-commercial. In such cases, boundaries can be changed on the original Colorado Geological Survey maps.

#### Acknowledgments

The authors are indebted to several persons and organizations without whose help this report could not have been completed.

Robert H. Gast supervised the graphics, reproduction, and publishing phases of this report. His suggestion of a desk-size atlas and his continuing

attention to details, methods, and costs were instrumental in completing the project on schedule and within budget limitations.

The Colorado Geological Survey staff advised, assisted, and encouraged the authors throughout the study. Mr. A. L. Hornbaker, Mineral Deposits Geologist, administered the contract and advised in the preparation of the report. Mr. D. C. Shelton provided valuable information about the aggregate resources of the Cache la Poudre River valley. John W. Rold, Colorado State Geologist, and D. K. Murray, Mineral Fuels Geologist, critically reviewed the manuscript. Susan H. Allen and Pamela Sue Bryarly typed the manuscript.

We are particularly indebted to Wallace R. Hansen, the Front Range Urban Corridor Project staff, Messrs. Glenn R. Scott, Norman M. Denson, Bruce Bryant, and Edward T. Ruppel of the U. S. Geological Survey for technical data and consultations.

The Colorado Division of Highways, the Colorado Division of Mines, the Colorado Division of Water Resources, and the Colorado Land Use Commission provided us with services and pertinent data on sand and gravel quality, location, and thickness.

Personnel from all the Front Range Counties and Regional Councils of Governments provided suggestions and data helpful to this study.

The following companies aided our study by reviewing our mapping and answering questions about deposits, economics, and production: Asphalt Paving Company, Golden; Barker Sand and Gravel Company, Fort Collins; Brannan Sand and Gravel Company, Denver; Broderick and Gibbons, Inc., Colorado Springs; Castle Concrete Company, Colorado Springs; Certified Concrete Company, Pueblo; Cherry Creek Sand Specialties Company, Denver; Colorado Lien Company, Livermore; Consolidated Rock, Inc., Denver; Cooley Gravel Company, Arvada; Daniels Sand Division of the Transit Mix Concrete Company, Colorado Springs; Flatirons Gravel Company, Boulder, Fort Collins, and Greeley; Fountain Sand and Gravel Company, Colorado Springs and Pueblo; Golden Gravel Company, Longmont; Greeley Sand and Gravel Company, Greeley; Mobile Pre-Mix Sand and Gravel Company, Commerce City; Mountain Aggregates, Inc., Platteville; Platte Valley Sand and Gravel Company, Northglenn; Peter Kiewit Sons Company, Littleton; Rio Grande Company, Denver; Schmidt Construction, Inc., Colorado Springs; Specification Aggregates, Inc., Golden; Sterling Sand and Gravel Company, Fort Collins; United Minerals Corporation, Greeley; Valley Concrete Company, Rocky Ford; and Western Paving Construction Company, Denver.

A special committee composed of producers, planners, consultants, and interested citizens was established to advise the authors on land-use planning, zoning, reclamation, and production problems. The individual members of this committee will also be concerned with implementing article 36 of chapter 92, C. R. S. 1963 at the county and local level after July 1, 1974. Members of this committee are: Al Abner, Pueblo Regional Planning Commission; Earl Brubaker, Certified Concrete; Jim Cooley, Cooley Gravel Company; Gene Fisher, Pueblo City Planning; Gary Fortner, Weld County Planning Commission; Celia Fuller, Pueblo Regional Planning Commission; Mac

Graham Jr., Western Paving Construction Company; Bruce Hanna, Flatirons Gravel Company; Tim Heins, Denver Regional Council of Governments; Merle Hoeft, Adams County Planning Dept.; John Ivey, Amuedo and Ivey; Dave Klotz, Denver Regional Council of Governments; Burman Lorenson, Weld County Planning; State Representative Larry O'Brian, a consulting geologist and principal author of House Bill 1529; Vince Porreca, Boulder County Planning; John Sawyer, Colorado Springs Transit Mix; Patrick Skinner, Pikes Peak Area Council of Governments; Tom Sundaram, El Paso County Planning Department; Bob Wolf, Western Paving; Fred Woodring, Managing Director of the Colorado Sand and Gravel Producers Association; and Fran Yehle and Annelou Neunzert, Jeffco Gravel Committee.

We are grateful to Tom Gray, Colorado Division of Highways District Geologist at Pueblo; and Messrs. James Martin and A. W. Rueff, Missouri Geological Survey, for many valuable suggestions during the planning stage of the study.



PHYSIOGRAPHY AND GEOLOGY OF THE COLORADO FRONT  
RANGE COUNTIES

dune sand, and loess in the plains region.

The project area encompasses approximately 16,000 sq mi of mountains, foothills, and plains in east-central Colorado and lies within the Southern Rocky Mountains and Great Plains physiographic provinces. The major streams draining the region are the South Platte, Arkansas, and Laramie Rivers (Fig. 1).

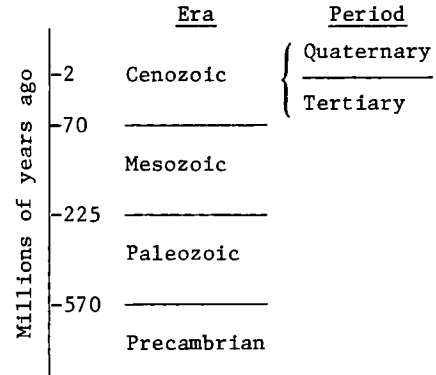
The Front Range, which is the easternmost mountain range in Colorado, extends from the Arkansas River northward into Wyoming, where it is known as the Laramie Range. In the Colorado Springs area the name Rampart Range often is applied. Most of the Front Range reaches over 7,000 ft in elevation, with numerous rugged peaks over 12,000 ft high. Many of the higher valleys and peaks in the northern portion of the Front Range were extensively modified by intense alpine glaciation during the Quaternary (Thornbury, 1967). (Refer to the generalized geologic time scale at the end of this section.)

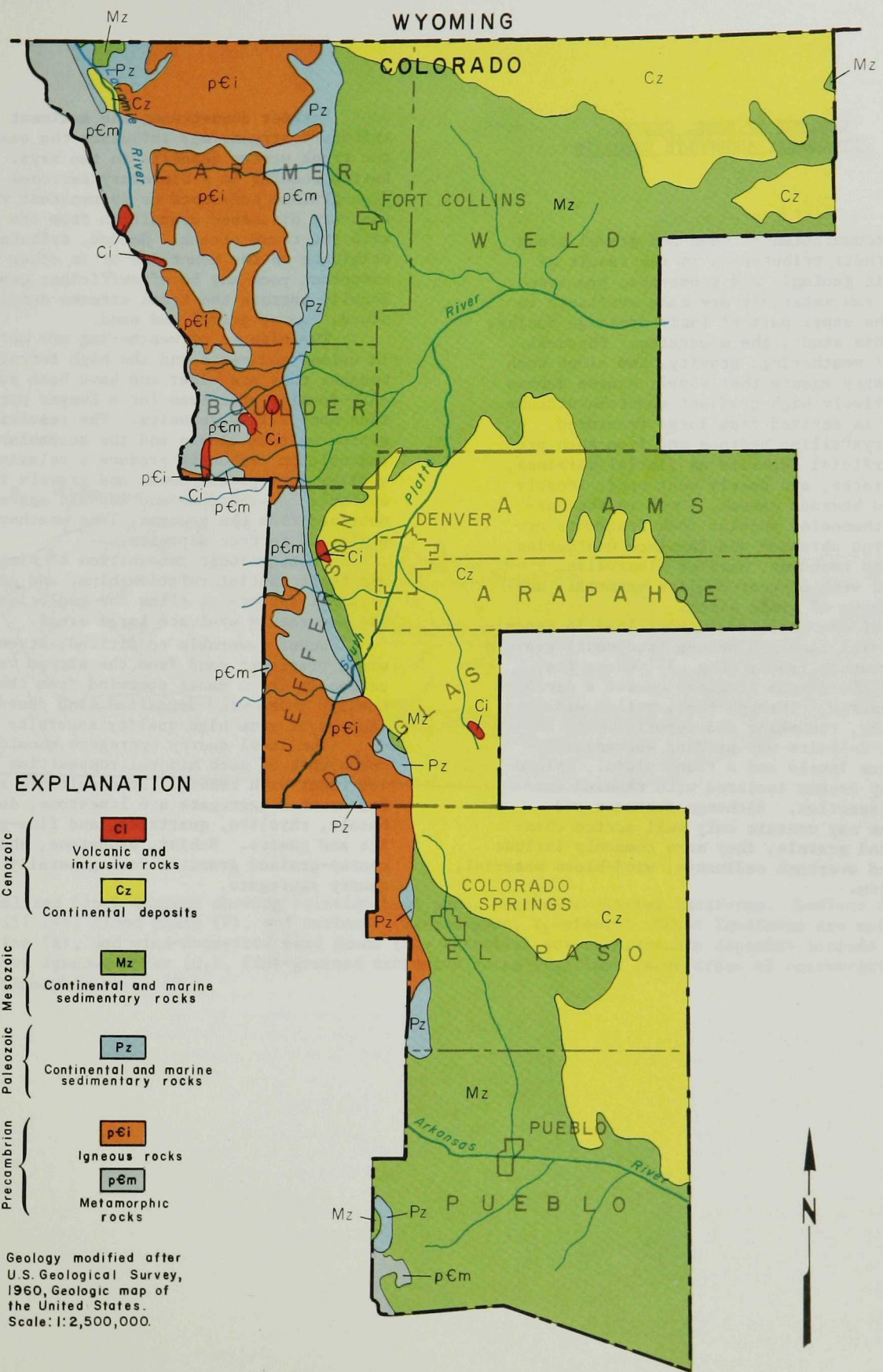
The core of the Front Range consists of Precambrian meta-sedimentary and layered meta-igneous crystalline rocks that include gneiss, schist, and quartzite; these, in turn, have been intruded by a series of massive granite plutons and smaller Tertiary intrusive bodies of varying composition (Lovering and Goddard, 1950). Draped over these basement rocks are the steeply eastward-dipping sandstones, shales, and limestones of Paleozoic and Mesozoic ages that form the north-south trending foothills belt (Fig. 2).

The Great Plains east of the hogbacks can be divided into 3 regions: 1) the Colorado Piedmont, 2) the interstream uplands between the South Platte and Arkansas Rivers, and 3) the High Plains along the Wyoming border. These regions range in elevation from about 4,300 ft along the broad Arkansas River Valley at Fowler to about 5,500 ft, where the gravel-capped pediments abut against the foothills, to over 7,500 ft in the Black Forest area near Colorado Springs. The region east of the mountain front once was mantled by an extensive Tertiary alluvial plain that blanketed the entire Great Plains area. In the Colorado Piedmont this thick sedimentary cover has been removed by the action of the South Platte and Arkansas River systems, exposing vast areas of Upper Cretaceous (latest Mesozoic) shale, claystone, and interbedded sandstone and limestone. North of this area the Tertiary cover remains beneath the High Plains surface. Gently sloping late Tertiary formations of sand and gravel, sandstone, clay and siltstone crop out along the prominent escarpment that separates the Colorado Piedmont from the High Plains (Weist, 1965).

The bedrock within the interstream area between the South Platte and Arkansas Rivers consists of a thick sequence of early Tertiary sediments that range from claystone to coarse-grained arkose and conglomerate; extrusive volcanic rocks occur in the vicinity of Castle Rock.

During the Quaternary, surficial processes related to stream erosion and deposition, glaciation, slope movement, and wind action produced a wide variety of deposits that include moraines, outwash terraces, talus, and colluvium in the mountains and flood plains, terraces, pediment gravels, colluvium,



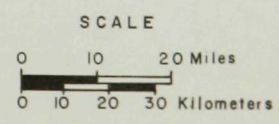


**EXPLANATION**

- |             |            |  |
|-------------|------------|--|
| Cenozoic    | <b>Ci</b>  | Volcanic and intrusive rocks             |
|             | <b>Cz</b>  | Continental deposits                     |
| Mesozoic    | <b>Mz</b>  | Continental and marine sedimentary rocks |
| Paleozoic   | <b>Pz</b>  | Continental and marine sedimentary rocks |
| Precambrian | <b>pEi</b> | Igneous rocks                            |
|             | <b>pEm</b> | Metamorphic rocks                        |

Geology modified after U.S. Geological Survey, 1960, Geologic map of the United States. Scale: 1:2,500,000.

Generalized geologic map  
Figure 2



GEOLOGY OF SAND, GRAVEL,  
AND QUARRY AGGREGATE DEPOSITS

The accumulation of sand and gravel along rivers and their tributaries is the result of several basic geologic and geomorphic processes. Most of the raw materials are made available to rivers in the upper part of their drainage basins, or, as in this study, the mountains. Physical and chemical weathering, gravity, and slope wash are the primary agents that supply coarse debris to the relatively high-gradient mountain streams. This debris is derived from large fractured masses of crystalline bedrock and from such pre-existing surficial deposits as glacial moraines, outwash terraces, and deeply weathered, loosely consolidated bedrock masses. Once in the narrow stream channels, angular rock fragments or clasts undergo abrasion and in-place weathering, which lead to rounding, smaller clast size, breakdown of weak or poor-quality material, and a greater range of grain sizes.

Much of the coarser sediment load is deposited as alluvial fans and upland (pediment) gravels near the mountain front, (Fig. 3), where the lowering of the stream gradient causes a decrease in stream energy. Through time, valley widening and deepening, reworking and deposition of the valley-fill deposits may produce successively lower terrace levels and a flood plain. Upland deposits may become isolated with renewed erosion and dissection. Although terraces and flood plains may contain only well sorted channel sands and gravels, they more commonly include fine-grained overbank sediments, wind-blown material, and colluvium.

Farther downstream, the sediment loads of tributary streams may influence the quality of the trunk stream deposits in two ways. First, tributaries heading in sedimentary terranes transport fine-grained sediments or incompetent rock fragments that are dispersed downstream from the confluence with the trunk stream. Second, tributaries that originate in the mountains or in other areas of competent rock may be of sufficient gradient to locally upgrade the trunk stream deposits with sand, coarse gravel and sand.

The effects of weathering are more pronounced in upland sediments and the high terrace deposits because they are older and have been subjected to soil-forming processes for a longer period of time than most valley deposits. The resulting decomposition of rock clasts and the accumulation of fines and calcium carbonate produce a relatively low-quality aggregate. Sands and gravels that are more suitable for concrete and asphalt aggregate can be obtained from the younger, less weathered floodplain and terrace deposits.

Photogeologic recognition of simple landforms and their spatial relationships, and study of their physical appearance allow the geologist to rapidly and accurately evaluate large areas.

Under favorable conditions, strong prevailing winds transport sand from the stream valleys and redeposit it as dunes downwind from the source. Locally these wind-deposited sand dunes provide sources of some high-quality specialty sands.

The ideal quarry aggregate should be a sound, tough rock of such mineral composition that it will not react with cement. Some suitable rock types for crushed aggregate are limestone, dolomite, basalt, rhyolite, quartzite, and fine-grained granite and gneiss. Schist, sandstone, shale, and coarse-grained granitic rock generally make poor quarry aggregate.

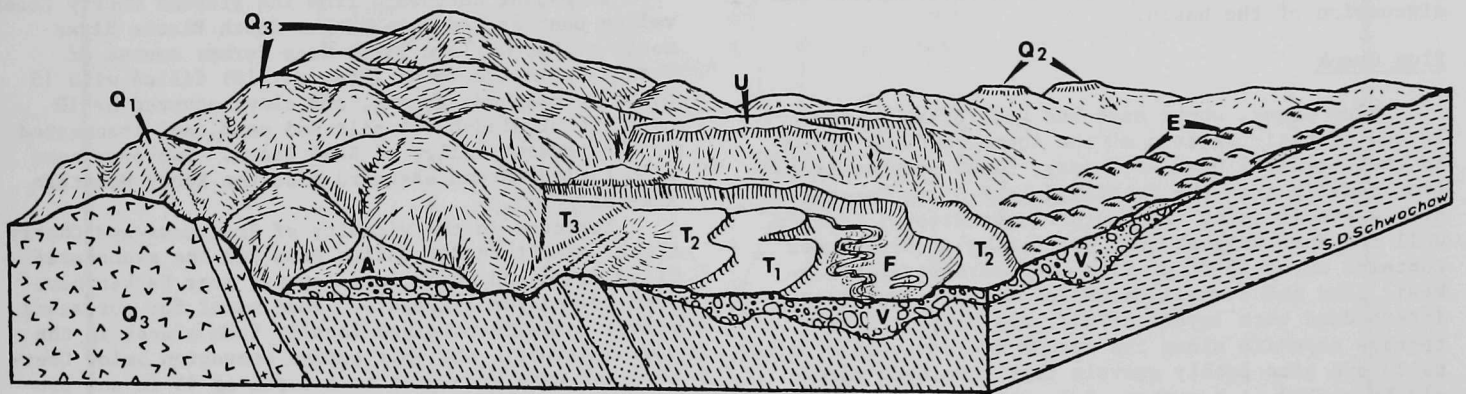


Figure 3. Idealized block diagram showing relationships among aggregate-bearing landforms. Lowland forms include valley fill (V), flood plain (F), and terraces ( $T_1$ -youngest;  $T_3$ -oldest). Other landforms are upland gravels (U), alluvial fan (A), and wind-deposited sand dunes (E). Potential quarry-aggregate deposits include fine-grained intrusive igneous rocks ( $Q_1$ ), fine-grained extrusive rocks ( $Q_2$ ), and large areas of coarse-grained igneous and metamorphic rocks ( $Q_3$ ).

## SAND AND GRAVEL RESOURCES OF THE SOUTH PLATTE RIVER BASIN

The South Platte River Basin includes those parts of Weld, Larimer, Boulder, Denver, Adams, Arapahoe, Jefferson, and Douglas Counties drained by the South Platte River and its tributaries. The principal tributaries of the South Platte River within the study area are, from the headwaters downstream, Plum Creek, Bear Creek, Cherry Creek, Sand Creek, Clear Creek, St. Vrain Creek, Big Thompson River, Cache la Poudre River, Lone Tree Creek, Beebe Draw, Crow Creek, Box Elder Creek, Lost Creek, Kiowa Creek, Bijou Creek, Pawnee Creek, and Cedar Creek (Fig. 4). The sand and gravel deposits within each principal tributary drainage are discussed starting with Plum Creek and progressing down the South Platte River. A discussion of sand and gravel deposits associated with the mainstream South Platte River concludes the discussion of the basin.

### Plum Creek

Plum Creek, whose east and west branches head in the granitic terrain of the southern Front Range in south-central Douglas County, flows northwestward from Sedalia into the Chatfield Lake State Recreation Area where it joins the South Platte River. Limited well log data suggest that the valley of Plum Creek contains about 45 ft of fine- to coarse-grained arkosic sand and a small amount of fine-grained gravel interbedded with layers of silt and clay. Thick terrace deposits along the stream are composed of clean sands and some pebbly gravels that have been extensively worked at a number of locations. The substantial amount of fines in the upland deposits west of Plum Creek will limit their potential uses to sub-base and road metal for local use.

### Bear Creek

Bear Creek, which heads in the mountains of Clear Creek County, flows eastward through Jefferson County and emerges from the foothills at Morrison. It continues eastward and joins the South Platte River at Sheridan, a southwest Denver suburb. East of the hogbacks at Morrison, Bear Creek is joined by Turkey Creek, another stream heading in the mountains to the southwest.

On the south side of the valley downstream from Mount Carbon are several long, narrow remnants of terrace deposits of marginal quality probably not exceeding 12 ft in thickness. Equivalent terraces lying north of the creek upstream from Mount Carbon contain excellent pebbly gravels but with significant fines. The low terrace between Bear Creek and Turkey Creek also contains about 10 ft of cobbly and bouldery gravel. Mount Carbon is an old high remnant of Bear Creek gravels and interbedded sands more than 15 ft thick. The flood-plain and valley-fill deposits contain 8 to 36 ft of good quality gravels.

Except for several inactive operations on the Bear Creek flood plain in Lakewood, most of the gravel pits are located on the terrace edges between the hogbacks and Mount Carbon. Gravel from most of these pits has been used as concrete aggregate.

### Cherry Creek

Cherry Creek, whose upper tributaries head in the Black Forest region of El Paso County, flows northward past Franktown and northwestward into Denver where it joins the South Platte River. The Dawson Arkose crops out extensively in the drainage basin and constitutes the main source of sediment carried by the stream. The valley of Cherry Creek between Franktown and Cherry Creek Lake State Recreation Area contains 35 to 50 ft of fine- to coarse-grained arkosic sand and a small amount of fine-grained gravel all overlain by 10 to 15 ft of non-resource. Below Cherry Creek Lake State Recreation Area, the valley fill is reported to contain 20 to 90 ft of sand and gravel. Although only sand has been extracted in this area, well logs indicate that some gravels occur at depth.

Extending northward from the present Cherry Creek valley east of Glendale to the South Platte River north of Dupont is a 90-ft-deep former course of Cherry Creek (De Voto, 1968, p. 118) filled with 15 to 80 ft of sand, gravel, and clay, covered by 10 to 40 ft of wind-blown silt and sand, and transected by the present valley of Sand Creek. Two prominent tributaries extend eastward into the Rocky Mountain Arsenal.

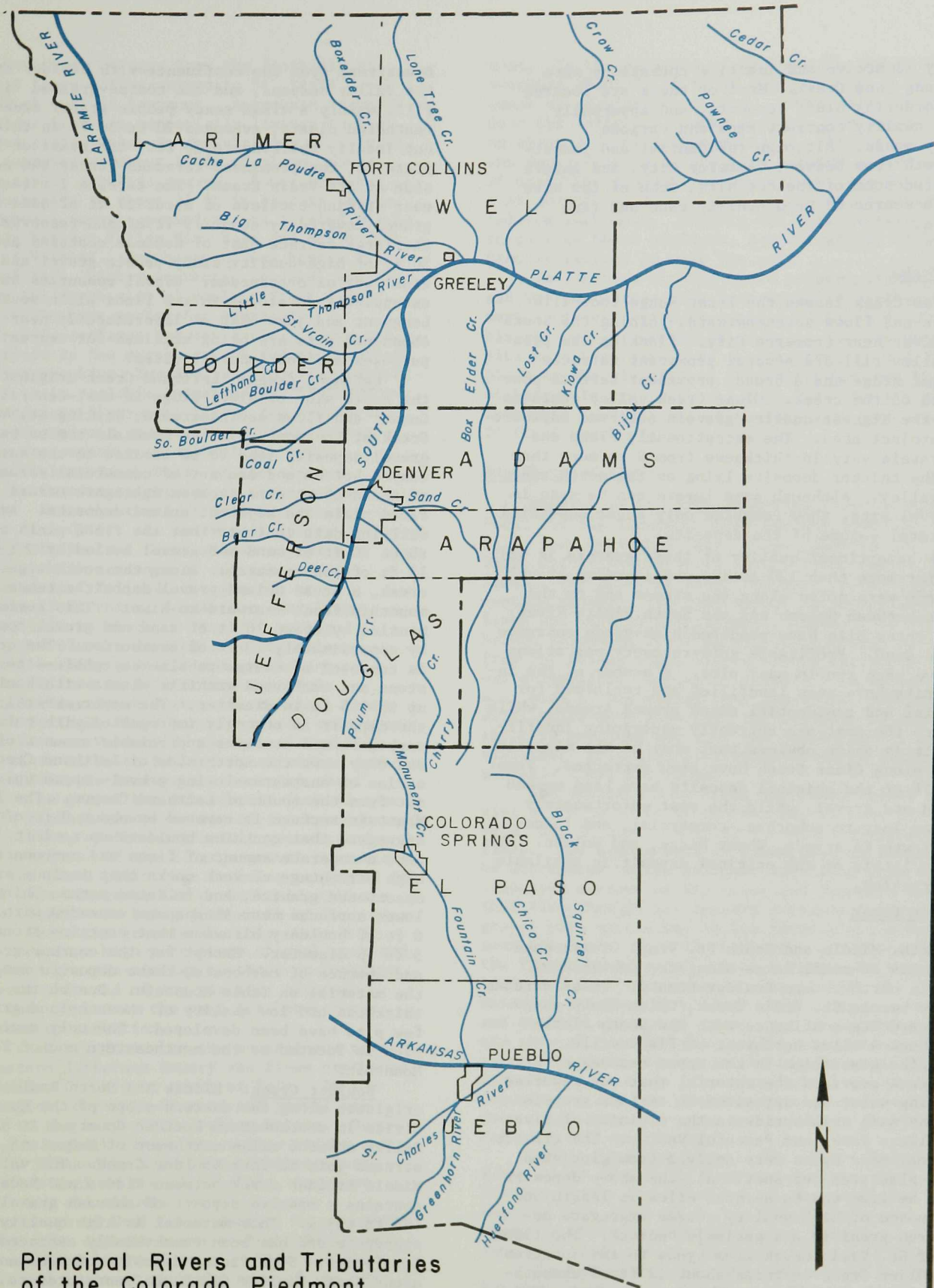
Terraces in the vicinity of Franktown and Cherry Creek Lake State Recreation Area and the associated flood plain and one upland deposit near Parker have been worked for aggregate. Road metal for surfacing gravel roads is obtained locally from places in the Dawson Arkose. The only active operation below Cherry Creek Lake excavates to a depth of 45 ft and produces high quality concrete sand and a variety of specialty sands used for plastering, filtration, sandblasting, stucco, and golf course trap sand. Along Cherry Creek, at University Boulevard in Denver, a large site that had been mined for sand and subsequently used as a sanitary landfill now supports Cherry Creek Shopping Center. Another reclaimed sand pit on Leetsdale Drive at Quebec Street now supports new condominiums.

Generally recognized as an excellent source of sand, the Cherry Creek valley in Denver County has been completely lost to urbanization, and that part of the valley in Arapahoe County below Cherry Creek Dam is rapidly undergoing residential development.

### Sand Creek

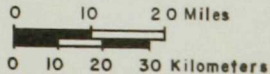
Several miles east of Aurora, in Arapahoe County, Coal Creek and Murphy Creek join to form Sand Creek, which flows northwestward and joins the South Platte River at Commerce City northeast of Denver. The prominent bluffs bordering the valleyfill on the south contain more than 35 ft of relatively clean sands with some interbedded gravel lenses. The flood-plain and valley-fill deposits contain from 12 to more than 25 ft of sand and gravel. Extending from Lowry Air Force Base north to Stapleton Airport is a former tributary valley of Sand Creek filled with 8 to 23 ft of sand and gravel and buried by 8 to 30 ft of wind-blown sand and silt.





Principal Rivers and Tributaries  
of the Colorado Piedmont  
and Front Range

Figure 4



Only 13 active and inactive operations were noted along Sand Creek. Most of these are located in the bordering bluff deposits, and apparently produced quality concrete sand and various specialty sands. Although residential and industrial growth from Denver, Commerce City, and Aurora has covered some of the deposits, much of the area remains a source of good quality sand and fine aggregate.

#### Clear Creek

Clear Creek leaves the Front Range foothills at Golden and flows northeastward, joining the South Platte River near Commerce City. Flanking the principal valley fill are several prominent terraces near Wheat Ridge and a broad, prominent terrace near the mouth of the creek. Clear Creek valley contains some of the highest quality gravels observed anywhere in the project area. The exceptionally clean and sound gravels vary in thickness from 8 to more than 30 ft, the thicker deposits lying on the north side of the valley. Although sand layers can be seen in many gravel pits, they comprise only about one-third of the total volume of the deposits.

The exceptional quality of these gravels is well known, for more than 120 active and inactive gravel operations were noted along the stream and on the terraces between Golden and the South Platte River. Most of these pits have produced high-grade concrete rock and sand. Profitable gold-recovery operations also have been run in many pits. A number of the inactive pits have been landfilled and reclaimed for commercial and residential sites around Arvada, while others to the east are currently undergoing landfilling. It is quite obvious that most of the mineable gravels along Clear Creek have been extracted. Fewer than half of the original deposits have been worked for sand and gravel, while the rest unfortunately have been lost to suburban, commercial, and industrial growth in Arvada, Wheat Ridge, and Golden. Today very little of the original deposit is available for extraction.

#### St. Vrain Creek

North, Middle and South St. Vrain Creeks head in a series of small lakes along the Continental Divide in northwestern Boulder County. These streams merge to become St. Vrain Creek, which flows eastward toward its confluence with the South Platte River about 4 miles northwest of Platteville.

Alpine glaciation in the upper reaches of St. Vrain Creek provided the material that was reworked by running water and deposited as terrace gravels along the main tributaries in the vicinity of Riverside, Allens Park, and Peaceful Valley. The gravels downstream near Lyons were derived from glaciated and non-glaciated terranes. All the above deposits tend to be from one to several miles in length and are composed of high quality coarse aggregate derived from granitic and gneissic bedrock. The flood plain of St. Vrain Creek from Lyons to the junction with Boulder Creek contains about 12 ft of unweathered granitic pebbles and cobbles in a matrix of clean sand. Overburden thickness is about 1 or 2 ft.

Downstream from the confluence with Boulder Creek, the valley deepens, and the coarse-grained alluvial fill, mainly a clean sandy pebble gravel free of weathered clasts, averages 20 to 30 ft in thickness but locally thickens to 50 ft. Northeast of Interstate 25, two prominent terraces border the east side of St. Vrain Creek. The terrace 2 miles north-east of Rinn consists of about 27 ft of sand and gravel covered by about 19 ft of non-resource, and the large terrace east of Gowanda contains about 50 ft of high-quality, sandy pebble gravel and several feet of overburden. Gravel resources have been extensively developed in the flood plain south of Longmont and just west of Interstate 25 near Rinn. Abandoned pits are being utilized for recreational purposes and for landfill sites.

Lefthand Creek: Lefthand Creek originates along the north side of Niwot Ridge in west-central Boulder County and flows northeastward, joining St. Vrain Creek at Longmont. In the mountain region sand and gravel deposits tend to be limited to the narrow canyon bottom and are not of commercial value. East of the hogback area, coarse aggregate occurs in the flood plain and adjacent upland deposits. Available well-log data indicate that the flood plain contains about 20 ft of sand and gravel buried by 2 to 13 ft of non-resource. Along the south side of the creek, a broad upland gravel deposit extends from the mountain front eastward to Niwot. This surface is mantled by about 20 ft of sand and gravel concealed by approximately 10 ft of overburden. The gravel is composed of coarse pebble- to cobble-size sandstone and weathered granitic clasts with boulders up to 1.5 ft in diameter. The upper several feet of the deposit is strongly impregnated with calcium carbonate and contains appreciable amounts of silt and clay. On the north side of Lefthand Creek, a series of eastward-sloping gravel-capped uplands fan out from the mouth of Lefthand Canyon. The Table Mountain surface is covered by about 8 ft of coarse aggregate that contains boulders up to 1 ft in diameter, a moderate amount of fines and carbonate, and a high percentage of weak rocks that include sandstone, decomposed granite, and foliated metamorphics. The lower surfaces near Altona are veneered with about 6 ft of bouldery alluvium that contains stones up to 5 ft in diameter. Except for the coarser grain size and absence of carbonate, these deposits resemble the material on Table Mountain. Due to the limited thickness and low quality of these upland gravels, few pits have been developed. The only active operation is located at the northeastern end of Table Mountain.

Boulder Creek: Middle and North Boulder Creeks originate along the eastern slope of the Continental Divide in southwestern Boulder County. At Boulder Falls, about 6 miles northeast of Nederland, these streams join to form Boulder Creek. The valley of Middle Boulder Creek between Eldora and Nederland contains a massive deposit of outwash gravel at least 100 ft thick. This material is high quality coarse aggregate and has been commercially extracted at two localities. Significant deposits of sand and gravel along North Boulder Creek are restricted to the area near Lakewood Reservoir.

Boulder Creek emerges from the foothills at Boulder and flows northeastward to St. Vrain Creek several miles east of Longmont. Aggregate resource along Boulder Creek is essentially limited to the broad flood plain, which in the vicinity of Valmont Butte is composed of about 15 ft of clean, sound pebbly to cobbly granitic gravel. Downstream the deposit decreases to about 11 ft in average thickness. Numerous gravel operations are located on the flood plain between Valley View Road and North 75th Street near Valmont. Northeast of Gun Barrel Hill, a series of thin, highly weathered gravels caps the uplands on the north side of Boulder Creek. Only one deposit has been worked for aggregate.

The upland surfaces between Boulder Creek and Mesa Reservoir to the north are covered by alluvium derived from Sunshine, Twomile, and Fourmile Canyons. Because of their variable thickness and high percentage of sandstone fragments, fines, and decomposed granitic and gneissic clasts, these deposits are unsuitable for concrete or asphalt aggregate.

South Boulder Creek heads on the eastern slope of the Continental Divide in western Gilpin County. Near the towns of Tolland, Rollinsville, and Pine Cliff, the eastward-trending valley of South Boulder Creek widens exposing a relatively thick sequence of outwash gravels. In the vicinity of Tolland, the gravels are greater than 17 ft thick; downstream near Pine Cliff, they thin to about 10 ft. The pebbly and cobbly gravels are derived from crystalline bedrock—mainly granites and gneisses—and tend to be free of deleterious material.

South Boulder Creek leaves the mountain front at Eldorado Springs, flows northeastward, and joins Boulder Creek near Valmont Butte east of Boulder. The flood plain of South Boulder Creek widens downstream from Eldorado Springs and contains about 15 ft of coarse gravel beneath several feet of overburden. In places, minor amounts of incompetent sandstone clasts, weathered granitic gravel, and fines are present. Of the 2 large gravel operations active on the flood plain, one is being reclaimed for commercial use. Terraces lie on both sides of the creek, the largest one being just south of Base Line Reservoir. There the gravels are only about 5 ft thick and contain a high percentage of weak rock and fines. Upland gravels similar to those on Davidson Mesa are very thin and of low quality, although some have been worked in the past for base-course in local road construction.

Coal Creek originates in the mountainous terrane of northwestern Jefferson County and flows northward, joining Boulder Creek just north of Erie. In the mountain region, deposits of sand and gravel are restricted to the very narrow valley bottom. Downstream of the hogback region the valley widens, and the creek is flanked by a variety of stream-lain material which include the flood plain, terraces, upland gravels, and alluvial fans.

At the mouth of Coal Creek Canyon, an extensive alluvial fan-like deposit known as Rocky Flats mantles an area of at least 15 sq mi. This alluvium is thickest and coarsest near the apex of the fan and becomes thinner and finer-grained toward the

east. In the vicinity of Highway 93, the gravel averages about 15 ft thick and contains an abundance of cobble-size clasts. Seven miles to the east, near the Jefferson County Airport, the deposit thins to about 5 ft of pebbly material. The deposits that cap Rocky Flats and Lake Mesa consist almost entirely of unweathered quartzite gravel, but contain significant amounts of fines, and, in places, considerable calcium carbonate. Despite the vast reserve of aggregate on these surfaces, current gravel extraction is limited to only one pit.

The section of Coal Creek between Highway 93 and the confluence with Rock Creek is flanked by a series of terraces that contain 10 to 15 ft of pebbly and cobbly quartzitic gravel. Several small pits have been developed on the terraces and flood plain in the vicinity of Superior. Between the towns of Lafayette and Erie, the Coal Creek valley contains less than 10 ft of aggregate buried by more than 20 ft of overburden.

#### Big Thompson River

Heading in the high mountains north of Estes Park, the Big Thompson River emerges from the foothills near Boedecker Lake, flows eastward past Loveland, and joins the South Platte River east of Milliken. The deposits under and east of Loveland do contain gravels, but they appear to have significant fines and caliche development. Because the overburden thickness tends to rapidly increase northward from the valley edge, only a narrow terrace strip was delineated. A similar terrace lies on the southeast side of the valley near Johnstown. Several drill holes here show that the resource is not as thick as expected and that the overburden is substantial. This high overburden:resource ratio will probably limit its value.

The deposits seen along the river itself consist of 10 to 20 ft of coarse, sound, granitic gravels, but in most places they contain significant fines. The high amount of fines can, in large part, be attributed to the sediment additions from such tributary streams as Dry Creek and Buckhorn Creek that flow through sedimentary terranes. About 30 gravel pits were noted in the flood-plain deposits near Loveland. Most of these pits are operated by the Flatirons Sand and Gravel Company and Loveland Ready-Mix Concrete Company. Essentially all of the material produced from these pits is used as concrete and asphalt aggregate. Just west of Interstate 25 are several inactive gravel pits now converted to recreational facilities in the Big Thompson Ponds State Wildlife Area. The flood-plain and valley-fill deposits of the Big Thompson River are obviously prime aggregate resources and should be considered for mineral conservation.

Little Thompson River: The Little Thompson River heads near Rocky Mountain National Park in Larimer County and flows out of the mountains and hogback area south of Carter Lake Reservoir. From there it flows northeastward past Berthoud and Johnstown and joins the Big Thompson River at Milliken.

The valley deposits observed at the Boulder-Larimer county line contain significant fines and

abundant sedimentary rocks. Based on the poor aggregate observed here, and the fine-grained alluvium seen downstream, no commercial deposits are believed to exist east of Berthoud. However, additional drilling is needed to verify this prediction. Extending southeastward from the mouth of Little Thompson Canyon, a series of gravel-mantled uplands (including Table Top Mountain) rises high above the surrounding terrain and may represent a portion of the ancient channel of the Little Thompson River. These deposits consist of about 10 ft of pebbly and cobbly gravel containing a moderate amount of fines and weak sandstone fragments.

The terraces near the Larimer-Boulder County line also contain abundant fines and sedimentary clasts. Although 2 gravel pits were noted on one of the terraces, the poor quality of the material restricts their use to road dressing and miscellaneous fills. Gravel has been mined at 3 localities on Table Top Mountain. The upland deposits north of the river around Berthoud and on the divide south of Dry Creek do not appear to contain any commercial sand or gravel resources.

The valley deposits observed at the Boulder-Larimer county line contain significant fines and abundant sedimentary rock fragments. Based on the poor aggregate observed here, and the fine-grained alluvium seen downstream, no commercial deposits are believed to exist east of Berthoud. However, additional drilling is needed to verify this prediction. Extending southeastward from the mouth of Little Thompson Canyon, a series of gravel-mantled uplands (including Table Top Mountain) rises high above the surrounding terrain and may represent a portion of the ancient channel of the Little Thompson River. These deposits consist of about 10 ft of pebbly and cobbly gravel containing a moderate amount of fines and weak sandstone fragments.

#### Cache la Poudre River

The Cache la Poudre River heads on the Continental Divide in Rocky Mountain National Park and flows northward to Kinikink, then eastward from there through the mountains and foothills where it emerges at Laporte. Flowing southeastward past Fort Collins and Windsor, the river joins the South Platte River east of Greeley. For convenience, the river basin has been divided into two portions: 1) upper, extending from the headwaters to the mountain front; and 2) lower, from the mountain front to the South Platte River.

In the mountains most of the significant flood-plain, terrace, and alluvial fan deposits lie between Spencer Heights (4 miles southwest of Kinikink) and Indian Meadows. Several other terrace deposits occur at Kelley Flats, Fort Collins Mountain Recreation Area, Dutch George Flats, and Big Narrows Campground. Ordinarily these deposits are sound and quite coarse, consisting of granite, gneiss, and schist boulders up to 5 ft in diameter—material that would be set aside as "oversize" in gravel pits on the plains. These gravels, in places, may exceed 30 ft in thickness. The finer grained matrix is very silty but

does contain significant amounts of sand. The numerous, small alluvial fans, built out onto the river terraces at the mouths of short tributary streams, consist of abundant silt, some sand, and angular cobbles and boulders.

East of Kinikink, one large gravel pit was seen in the terrace deposits. A few small borrow pits can be seen in the alluvial fans along the river. Material from these pits probably was used for miscellaneous fills and road dressing on unpaved, secondary roads leading away from the river valley. Numerous small borrow pits have also been dug in the colluvial slopes adjacent to some of these unpaved roads. Along Colorado Highway 14 near the mouth of Joe Wright Creek, the Larimer County Highway Department is crushing bouldery colluvial and talus-slope debris and fractured bedrock for road base.

Although the flood-plain and terrace deposits in the mountains do show potential for aggregate, difficult access, mining in a narrow valley, handling oversized material, and environmental problems probably will limit most mining activities here. Alluvial fan and colluvial deposits are, at best, only suited very locally for miscellaneous fills and road dressing.

In the lower part of the river basin, the major flood-plain and valley-fill deposits consist of clean, sound, cobbly gravels and medium- to coarse-grained sands that range in thickness from 10 to 20 ft at Fort Collins to about 50 ft at Greeley. The overburden may attain a thickness of 9 ft, as at Windsor.

Three terrace levels can be distinguished north of the river between Fort Collins and Windsor. The 6-mile-long lower terrace begins near the mouth of Boxelder Creek and contains 8 to 32 ft of sand and gravels, locally cemented, and quite silty. The intermediate terrace begins near Timmath, widens near Windsor, and extends downstream to Greeley. As much as 30 ft of gravel occurs in this terrace; however, in most places the overburden is quite thick, creating an overburden:resource ratio as high as 7:1. Remnants of the highest terrace lie between Timmath and Windsor and contain about 10 ft of cobbly to bouldery gravels impregnated in the upper several feet by calcium carbonate (caliche). The quality of the sand and gravel in the low terrace over which much of Greeley is built has been influenced by the South Platte River but does contain 20 to 30 ft of clean, sound, pebbly to cobbly gravel and high-quality coarse sand. Deposits at the south end of this terrace are the result of South Platte River deposition and, therefore, contain much finer grained aggregate than the coarser northern part which is the result of Cache la Poudre deposition. Several remnants of a higher terrace, also containing very clean gravel and sands lie south of the river along a 4-mile stretch west of Greeley.

Numerous gravel pit operations were noted in the deposits in this area—33 around Fort Collins, 10 near Timmath, 6 near Windsor, and 39 at Greeley. About two-thirds of these operations are located adjacent to the river. In Fort Collins the finished products include concrete and asphalt aggregate, plaster sand, cement sand, concrete slab bedding, washed rock, base course and subbase, and decorative

stone (flagstone, crushed sandstone, feldspar, and quartz sand). Pit run, crusher cleanup, and silt sand are also sold. Much of the material produced in Greeley is used for concrete and asphalt aggregate and for base course.

West of Greeley, in the thick, clean terrace gravels south of the river, are 8 gravel pits operated by the Colorado Department of Highways. To the south are 3 other pits in upland deposits of exceptionally high quality.

The flood-plain and valley-fill deposits of the lower Cache la Poudre River obviously are the prime aggregate resources in this area and definitely should be considered for mineral conservation. North of the river the lowest and highest terraces appear to be significant resources, although not of high-quality aggregate. Even though a number of pit operations are located here, it is doubtful that the gravels can be easily upgraded. The amount of fines and caliche will be significant limiting factors in their use. The deposits in the middle terrace have little likelihood of ever being worked mainly because of the thick overburden. The terraces south of the river at Greeley have great potential although, as implied above, much of the lower terrace has been lost to urbanization.

Altogether, the reserves in the lower river valley are adequate to meet the demands of the area. There is a possibility that some of the materials might be transported by unit train to such aggregate-scarce areas as Denver. The feasibility of this operation, however, will require further study.

Boxelder Creek: Boxelder Creek heads in the southern end of the Laramie Range in Colorado, flows southeastward to Fort Collins, and joins the Cache la Poudre River.

South of Gilman Mountain the stream emerges from the hogback area and has built a massive alluvial fan toward the southeast. The gravels contain significant fines, weak rocks, and, several miles down-slope, a caliche. Well logs indicate that the gravels range from 30 to more than 60 ft in thickness, with overburden as great as 20 ft. Across Boxelder Creek from this fan is Rawhide Flats, probably a large alluvial fan of Rawhide Creek origin.

Along the upper reaches of Boxelder Creek are several small terrace remnants containing about 20 ft of silty sand and gravel but with abundant weak (sedimentary) clasts. Somewhat more suitable gravels lie in the high terrace north of Wellington at the confluence of Boxelder Creek and Coal Creek.

Although recorded depths and thicknesses appear erratic in the well logs in the valley north of Wellington, they reveal a rather deep canyon filled with nearly 100 ft of gravel and clay. In areas west of Wellington and north of Black Hollow Junction, the logs show 30 to 100 ft of valley-fill deposits. The overburden here, however, is so thick that these areas were excluded as potential resources.

Very few gravel pits were noted in the Boxelder Creek valley. Two pits were seen in terrace deposits—one southwest of Gilman Mountain and one operated by the Larimer County Highway Department north of Wellington. Two pits were observed on the alluvial fan west of Boxelder Creek. In the flood-plain and valley-fill deposits, one gravel pit was noted

east of Buckeye, and one was noted north of Arrowhead. Although the pit near Arrowhead is shown in a Cache la Poudre terrace on the map, the deposits are characteristic Boxelder gravels.

It is unlikely that the immense alluvial fans along Boxelder Creek will be considered for more than local needs, such as road base and miscellaneous fills. The potential of the flood-plain and valley-fill deposits south of Wellington is somewhat questionable because of the thick overburden and the proximity of the high-quality gravels along the Cache la Poudre River near Fort Collins.

#### Lone Tree Creek and the High Plains

Lone Tree Creek heads in the Laramie Range of southern Wyoming, flows eastward to an area near Cheyenne, and then southward into Colorado. The stream turns southeastward and joins the South Platte River several miles east of Greeley. This complex drainage system includes the valleys now occupied by Lone Tree Creek, Eaton Draw, Spring Creek, lower Owl Creek, and upper Spottlewood Creek. To supplement the scarce well information in certain areas of the valley, several lines of holes were drilled in conjunction with the Colorado Geological Survey's Windsor Environmental Geology Project.

Several impressive, southeast-trending upland surfaces flank upper Lone Tree Creek valley. The 2 long surfaces east and west of Carr are covered by 6 to 10 ft of pebbly to cobbly gravels containing substantial fines and calcium carbonate. Across the valley 7 miles southwest of Carr is an 18-mile-long mesa capped by 10 to 15 ft of pebbly to cobbly gravels and relatively clean, coarse-grained gravelly sands partially covering a 6- to 15-ft-thick resistant ledge of cobbly to bouldery conglomerate of the Chadron Formation (White River Group).

More than 10 ft of clean, sandy, cobbly and bouldery gravels are exposed on several terrace levels developed along a 10-mile stretch in the vicinity of Carr.

South of Carr, a large prominent terrace and an upland surface divide Lone Tree Creek valley into two branches. Cross channels connect the two branches at several places between Carr and Greeley. Well logs and drill holes in the valley fills record up to 40 ft of clean sand and pebbly to cobbly gravels, the thicker deposits lying in the western valley. Exposures along the truncated end of the western valley fill just east of Greeley show thick, fine-pebble gravels that probably contain considerable fines. Overburden becomes significant east of Pierce and exceeds 20 ft in thickness at higher levels between Eaton and Greeley.

Between Pierce and the South Platte River are 3 elevated areas that separate the 2 main valleys. These features appear to be loess-covered bedrock highs that acted as islands or interstream divides during one or more stages of the valley's history. The cross channels that probably separate these highs suggest a large-scale braided stream network.



Only 24 gravel pit operations were noted along Lone Tree Creek and its associated streams. One of the largest pits is located on a Lone Tree Creek terrace 6 miles south of the state line. Gravel from this site was used in the construction of Interstate 25 in this area. Other pits occur east of the towns of Carr, Nunn, Pierce, and Ault. Northeast of Pierce are several large pits operated by the Weld County Highway Department. A large operation northeast of Eaton once was a source of concrete aggregate but now produces only road base. North of Nunn are 2 large borrow pits in the west valley fill and central terrace. Most of the material from the small pits in this area probably was used for road base, although some might have been used in the construction of U. S. Route 85 here, or even as concrete and asphalt aggregate in the towns along U. S. 85.

The authors believe that the eastern valley fill and associated terraces in the vicinity of Carr comprise valuable high-quality aggregate resources. On the basis of test drilling, that part of the western valley fill upstream from the first cross channel (southwest of Carr) was denoted as a predominantly fine-aggregate resource (V3). A V1 designation was given to the fill south of the cross-channel on the basis of well logs, test drilling, and the interpretation that this once was the major Lone Tree channel. The V1 classification was retained on both valley fills downstream from an area 4 miles north of Nunn, where the entire valley noticeably widens and where the predicted braiding or meandering fully develops. Much more drilling will, however, be required to locate the actual channels. Around Eaton the valleys were somewhat arbitrarily given a V4 designation because of lack of exposures, absence of gravel pits, and the fact that the overburden has thickened to the point where it could be a limiting factor. Where the deposits were observed northeast of Greeley, the small size of the gravels probably will prevent their use as aggregate.

The problems in attempting to evaluate such a vast resource area as that along Lone Tree Creek are indeed difficult. First, the landforms are so large that any one of them could yield a large amount of usable material. Second, much of this area is agricultural land and may prove to be more valuable than the underlying deposits when compared to the high-quality gravels along the Cache la Poudre River. Third, being a thick gravel fill, the Lone Tree deposits represent an important source of water for the stock and crops of the area. The effects of large-scale gravel operations and their reclamation on the ground-water regime cannot be determined without further study. Fourth, the nature of this buried system will require considerably more test drilling and geophysical study to locate the coarse channel deposits and hence, to determine the most attractive pit sites. Land use and economic comparisons with other areas will be required to adequately determine Lone Tree Creek's potential for mineral land conservation.

The point at which Lone Tree Creek enters Colorado marks the division between 2 principal physiographic provinces—the Colorado Piedmont and the

High Plains. In Colorado the boundary is marked by a spectacular escarpment on which are exposed sands, gravels, and conglomerates of the Ogallala Formation of late Tertiary age. The High Plains Escarpment is the southern edge of a vast continuous sheet of coarse sediments that extends northward into Wyoming and farther northeastward into Nebraska. Where observed in Colorado, the cobbly and bouldery deposits are more than 100 ft thick and are quite variable in soundness, cementation, and percent fines. Rising above the principal Ogallala mesa are a number of higher isolated mesas of the same general lithology. The only gravel pit noted in this area is on one of these mesas west of U. S. Route 85 near the state line. It is not recommended that the entire Ogallala outcrop area be considered for mineral conservation, but only the higher mesas, because they appear to contain a sufficient volume of gravel to meet all of the local needs, and because they are more easily attainable.

#### Crow Creek

Crow Creek flows southward into Weld County from Wyoming and joins the South Platte River 4 miles downstream from Kersey. Porter, Little Simpson, Geary, Willow, Coal, and Wildhorse Creeks form the headwaters of Crow Creek.

The upper Crow Creek drainage basin is an area of broad alluvial fans. The middle reaches of the drainage are characterized by narrow upland remnants and the lower reaches by stream terraces and valley-fill deposits. Lower Crow Creek valley is covered by grain and livestock farms. A large area of sand dunes extends from the Crow Creek valley southeastward to the South Platte River. Much of the sand was derived from the broad Crow Creek valley and transported by prevailing northwesterly winds.

Along Porter Creek and Little Simpson Creek lie the dissected remnants of a large alluvial fan complex whose source was ancient Porter Creek in Wyoming. South of these erosional remnants are more recent alluvial fans also of Porter Creek origin. The potential of the younger fans is questionable, but at best, they are fine-aggregate resources. No pit operations were observed in these units.

The upland deposits along Willow Creek and Geary Creek and their tributaries are mostly thin, fine-aggregate resources. In several of the thicker remnants 5 operations have produced coarse sand and fine gravel that apparently were used for road base. Because the flood plains of these streams appear to contain mostly very fine-grained alluvium, they were not mapped.

Stream terraces along Wildhorse and Coal Creeks contain thin, fairly clean sands and gravels that probably do not extend more than 9 miles north of Colorado Route 14. Four small gravel pits were noted in the principal terrace. Again the flood plains consist mostly of very fine-grained alluvium (non-resource). Thin upland gravels on several hilltops and surfaces along Coal Creek 6 to 13 miles north of Purcell were excluded because of their thinness and deep weathering.

In the vicinity of Hereford, massive fan-shaped upland deposits border both sides of Crow Creek. The fan on the east side of Crow Creek originates near Arcola, Wyoming, 13 miles northwest of Hereford. This deposit is a pebbly gravel with moderate amounts of sand. The other major fan heads in Porter Creek 10 miles west-northwest of Hereford and contains large amounts of sand and minor amounts of pebbly material. Very few pits are located on these fan-shaped surfaces south of the Colorado-Wyoming state line.

Although there are no important large commercial operations in the Crow Creek Valley, one sand pit was noted about 2 miles northeast of Barnsville. Aggregate in the Crow Creek drainage is important for local road maintenance, but it is unlikely that it will ever be an important aggregate-producing area of the Front Range. The cropland and ground-water resources may ultimately be the most favorable uses of the lower Crow Creek valley.

#### Beebe Draw

Beebe Draw heads in northwestern Adams County as a buried valley, flows northward through Weld County, and joins the South Platte River near Kersey.

Smith and others (1964, p. 119) report that the 70- to 100-ft-deep fill of Beebe Draw consists of cobbles and boulders at depth grading upward to increasingly finer gravel, sand, and clay. Grain and livestock farms are concentrated on the valley fill of Beebe Draw.

The great amounts of sand that were transported southeastward from the South Platte River valley by strong northwesterly winds formed prominent dunes that have migrated across Beebe Draw. The extensive dune sands and low-quality upland gravels west of Beebe Draw apparently have not been utilized for aggregate.

#### Box Elder Creek

Box Elder Creek flows northward through Arapahoe and Adams Counties and into Weld County, joining the South Platte River 5 miles downstream from Kersey. Large grain and livestock farms have been developed on the valley fills of Box Elder Creek and its tributaries. Smith and others (1964, p. 121) report up to 85 ft of gravel, sand, and clay in the valley fill. As in the case of Beebe Draw, winds have carried sand and fine-grained material out of the valley and across the bedrock uplands, often damming smaller stream valleys. Although the dune areas do not produce clean quality sand, some has been used for road base; however, it is unlikely that the material will be used for more than local needs in the foreseeable future. No gravel operations were observed in the Box Elder drainage. It is likely that the farming and the ground water upon which it depends will be more important and valuable than any commercial aggregate that might be designated.

#### Lost Creek

Lost Creek heads near Prospect Valley in southeastern Weld County and flows northward to join the South Platte River about 3 miles above Masters. The broad valley fills in the upper reaches of Lost Creek are covered by grain and livestock farms. There are no good exposures of aggregate along stream courses, and extensive exploration will be required to locate any sand and gravel in the thick alluvial fill. The lower reach of Lost Creek between Prospect Valley and the South Platte River is dammed by extensive dune fields that cover many tens of square miles. No sand or gravel pits were observed anywhere in the drainage.

#### Kiowa Creek

Kiowa Creek heads in southern Elbert County, flows northward through Arapahoe, Adams, and Weld Counties, then turning, flows eastward into Morgan County where it joins the South Platte River. The farm-covered valley fill of Kiowa Creek is not known to have produced any aggregates. Extensive exploration will be required to determine if any gravels are buried in the valley. In Weld County, Kiowa Creek is flanked by several square miles of wind-deposited sands that were probably utilized when Interstate 80 was constructed through this area.

#### Bijou Creek

The source area of Bijou Creek lies in northern El Paso and southern Elbert Counties. Bijou and West Bijou Creeks flow northward into Arapahoe County and join in Adams County. Bijou Creek enters the South Platte River near Fort Morgan in Morgan County.

Coarse sand aggregate is produced from broad interstream uplands along Bijou Creek in southeastern Arapahoe County. A few large pits have been developed on the eastern edge of an upland deposit between Wilson Creek and Bijou Creek 2 miles southwest of Deer Trail; and a few other small pits have been developed 12 miles south of Strasburg on the eastern edge of another upland bordering West Bijou Creek. Thick deposits of wind-blown silt and sand cover most of this surface and only the eastern edge is shown as a resource on Plate 2.

Farms cover most of the broad valley-fill and stream-terrace deposits along Bijou Creek in Arapahoe and Adams Counties. These deposits consist of fine to coarse sands and have not been developed for aggregate. Concrete aggregate used in this area comes from the South Platte River north of Denver.

#### Pawnee and Cedar Creeks

Cedar and North Pawnee Creeks head in the Pawnee Buttes area of northeastern Weld County. This extensive upland is bounded by prominent escarpments on its western and southern margins and is mantled by unconsolidated sands and gravels of the Ogallala Formation of late Tertiary age. This material consists primarily of clean sand, with minor amounts of granitic pebbles and cobbles, and measures at least 20 ft in thickness.

Just south of the High Plains Escarpment and somewhat parallel to it are a series of long, narrow, sinuous hills composed of clean sand and minor amounts of fine- to coarse-grained crystalline gravel. These deposits, probably exceeding 20 ft in thickness, represent ancient channel fills that were cut into the underlying siltstone bedrock (Norman Denson, 1974, personal communication; Galbreath, 1953). North of Raymer are several minor southeasterly-trending upland deposits that exceed 6 ft in thickness and are composed of calcareous gravelly sand. Extensive deposits of well-sorted dune sand occur in the area south of Stoneham. The principal use of aggregate extracted in the Pawnee Buttes-Raymer area is the surfacing of county roads.

#### South Platte River

The South Platte River drains nearly three-fourths of the entire project area. The South Fork South Platte River flows southeastward through South Park to Elevenmile Canyon Reservoir, where it turns northeastward. It leaves the Front Range and enters the Colorado Piedmont province at Kassler, a small town about 25 miles southwest of Denver. The overall drainage is toward the northeast to the vicinity of Greeley, where the river turns eastward, eventually joining the North Platte River 225 miles downstream at North Platte, Nebraska.

In most places the river's flood plain averages about 1 mile in width and is flanked by distinct terraces that are separated by fairly prominent scarps and that usually lie south and east of the river. Former courses of the river and its tributaries are indicated by series of small gravel-capped hills that parallel the present course, by unusually thick deposits recorded in wells located on broad terraces, and by maps of bedrock topography published in water reports. As the river deepened its channel into older valley-fill deposits, considerable fine-grained material was made available for wind transport; consequently, large, conspicuous sand-dune fields blanket much of the area south and east of the river, usually concealing portions of terraces and tributary valleys. For purposes of discussion, the South Platte River is divided into three sections: 1) Denver reach (Kassler to Brighton), 2) Platteville reach (Brighton to Greeley), and 3) Kersey reach (Greeley to Weld-Morgan County line).

In the Denver reach, the river flows directly through Denver and most of its suburbs. The flood-plain and lower terrace deposits generally are composed of sound, clean, pebbly and cobbly gravels and clean, well-graded sands. As much as 50 ft of resource is recorded in the wells in Littleton. Even near the valley margins the thickness may reach 20 ft. Downstream, the deposits become thinner (20 to 40 ft) and finer grained. On the river near Hazeltine, cobbly gravel is rare, and sand is more abundant.

An interesting gravel deposit in the Denver area is the Broadway alluvium (Hunt, 1954, p. 104; Scott, 1960), which forms a high extensive terrace lying almost exclusively east of the river. In the Commerce City area the deposit consists of 10 to

15 ft of pebbly gravel and fairly clean sand. However, overburden, in the form of wind-blown sand and silt, appears to thicken rapidly toward the south-east. Further downstream, in the Henderson area, the percentage of fines increases noticeably, and the gravel size decreases. This decline in quality is also evidenced by the decrease in the number of gravel pits northward from Dupont. Because it overlies the older, principal valley-fill gravels seen along the river, the Broadway alluvium could be considered as overburden where its quality becomes marginal. Indeed, this is the case in the Henderson area, which has complicated the mapping of economic Broadway deposits there. Northeast of Henderson, the terrace widens and continues downstream for many miles; however, because of decreasing grain size, it is mapped as a fine-aggregate resource.

Upland deposits near the river occur in Littleton along Massey Draw and Dutch Creek, and on small gravel-capped hills between Northglenn and Brighton. The thick Massey Draw gravels contain significant fines and some weathered rock but currently are being processed at a plant just south of the creek on Garrison Street. The gravels on the hills southwest of Brighton are thin, deeply weathered, and locally cemented, but have been excavated in several places.

Nearly 100 active and inactive gravel pits were noted along the South Platte River and its terraces in the Denver reach. Most of the material has been used by both private firms and governmental agencies for concrete aggregate and asphalt mix. Until recently, overburden (topsoil), squeegee (coarse sand) and fines had accumulated in some areas. At present, these materials also are in great demand for use as street sand, asphalt sand, backfill, and concrete slab bedding. Many operations along the river also run gold-recovery systems. Although most of the aggregate produced is used in the metropolitan area, some is shipped by rail as far as Limon and Cheyenne Wells, in eastern Colorado.

A number of depleted areas within Denver have undergone sanitary landfilling and subsequently have been converted to industrial sites. Several pits in Sheridan and Englewood currently are undergoing sanitary landfilling. Even though Denver County continues to produce some sand and gravel, most of the high-quality deposits unfortunately have been lost to urbanization. A similar encroachment problem is apparent in some of the suburbs. Although Chatfield Lake, currently under construction on the South Platte River in Littleton, will cover 1150 acres of valuable gravel land and will affect an additional 3350 acres of land, mining is currently in progress there. Possibilities exist for simultaneous underwater excavation and recreational development (Pickels, 1970, p. 50).

The flood-plain and lower terrace deposits in the Denver area obviously are prime sources of high-quality aggregate. As mentioned above, however, much of the resource has been lost to urbanization. Between Denver and Brighton, the valley gravels gradually become finer grained and contain increasing amounts of sand and clay. The limit of definite commercial value was approximated

on the basis of field observations, personal communications, and the distribution of gravel pits. The broad, high terrace between Plum Creek and the river near Chatfield Lake is an enormous reserve of good quality fine aggregate.

The Broadway terrace deposits within Denver are largely unevaluated, but the numerous gravel pits on the terrace edge north of Sand Creek indicate that the deposit is a prime resource. Downstream, the gravels are finer grained and contain more sand and fines. In the Hazeltine-Henderson area, the quality is marginal, based on data from several consultants. Therefore, only a narrow strip of commercial material was delineated. Even though good quality gravels exist in the old valley fill beneath the Broadway, the deteriorating quality of the alluvium will be a serious limiting factor for gravel extraction in this area. Where the terrace widens northeast of Henderson, the landform is quite distinct; a sizeable portion of it may, however, be found noncommercial when more data are available.

In the Platteville reach, the flood plain widens to  $1\frac{1}{2}$  miles and overlies 25 to 80 ft of valley-fill sands and gravels. The mile-wide Broadway terrace equivalent (Kersey terrace) east of the river overlies 27 to 100 ft of terrace and valley-fill sand and gravel containing interbedded clays and silts. Between Platteville and the St. Vrain Creek confluence, the terrace widens markedly to about  $2\frac{1}{2}$  miles. Exposures on the terrace edge show more than 20 ft of clean, fine- to coarse-grained sands and sandy, pebbly gravels. However, the gravels account for only 10 to 20 percent of the exposed deposit. Data from the large terrace between the South Platte River and St. Vrain Creek show that the west side, influenced by St. Vrain Creek, contains coarser material than the east side, which was influenced more by the South Platte River.

The bedrock topographic maps of Smith and others (1964) and exceptionally thick deposits recorded in well logs both indicate several, deep former channels of the South Platte River and its tributaries in this area. One principal channel extends from Fort Lupton to an area southeast of Evans, where it is joined by another channel that emerges from the St. Vrain Creek valley 13 miles upstream. The buried channel of Beebe Draw enters the river valley at Lower Latham Reservoir and joins the main river channel northeast of Kersey. Although the upper 20 ft or more of the Kersey terrace deposits are fine-aggregate resources, coarser gravels probably exist in the ancient channels. Their depth, water-table conditions, and existing land use may make them uneconomic.

A number of sand and gravel pits in the lower Platteville reach occur on the edge of the Kersey terrace. Some of the inactive sand pits east of Wattenberg and around Platteville have been converted to landfills and cattle feed lots. The sand has been used as road salt and could be a component of road base. Sixteen pits in the Greeley-Evans area have produced excellent coarse sand and pebbly gravel. Two other operations currently are extracting gravel on the flood plain at Evans. Although gravels may occur locally near the surface and in buried channels along the river, the overall valley low-

lands in this reach probably contain fine-aggregate resources. The Kersey terrace deposits and others just east of Greeley have yielded excellent materials; but because of their small grain size, they will not meet all specifications for concrete aggregate. The channel gravels buried beneath the Kersey terrace have little chance of being utilized for reasons stated earlier.

The South Platte River flows southeastward through the Kersey reach after a curious change in direction east of Greeley. Southeast of Kersey, both the flood plain and Kersey terrace diminish in width to 1 mile or less. Although more than 15 ft of clean, coarse sand was seen on the Kersey terrace, some pebbly and cobbly gravels may occur at depth. Below the level of the Kersey terrace lies the Kuner terrace which also contains clean, coarse sands. The deposits in the flood plain and valley fill may exceed 100 ft in thickness and vary considerably in grain size. South of Kersey, near the mouth of Box Elder Creek, are 2 small upland deposits containing 8 ft of good quality gravel impregnated with calcium carbonate.

Great amounts of sand and finer grained material have been blown out of the stream valleys and deposited across the bedrock uplands on both sides of the river valley as extensive dune fields. In addition to mantling portions of the river's flood plain and terraces, the sand dunes, as much as 100 ft high, have partially buried the tributary valleys of Beebe Draw, Crow Creek, Box Elder Creek, Lost Creek, Kiowa Creek, Bijou Creek, and others east of the project area.

Only 7 sand pits were noted on the Kersey terrace in this reach. The material extracted apparently was used for road dressing. No pits were noted on the Kuner terrace or on the flood plain, but 2 were seen in the sand dunes west of Empire Reservoir.

Because the alluvial deposits of the South Platte River and its tributaries constitute the principal aquifers in this area, grain and livestock farming have been extensively developed on the broad Kersey terrace and valley lowlands. Although additional drilling and geophysical studies are needed to accurately determine the extent of coarse aggregate, it is unlikely that these deposits will be of substantial commercial value because 1) the value and potential of the present farmland may exceed the value of aggregate, 2) coarse gravel is not readily attainable in this area, and 3) good quality coarse sand is in ample supply near the markets upstream.

## SAND AND GRAVEL RESOURCES OF THE ARKANSAS RIVER BASIN

The Arkansas River Basin includes those parts of El Paso and Pueblo Counties drained by the Arkansas River and its tributaries (Fig. 4). The principal tributaries of the Arkansas River in the study area are Fountain Creek, St. Charles River, Chico Creek, and the Huerfano River. The sand and gravel deposits within each tributary drainage system are discussed starting with Fountain Creek at Pueblo and progressing down the Arkansas River to the Huerfano River. A discussion of sand and gravel deposits associated with the mainstream Arkansas River concludes the discussion of the basin.

### Fountain Creek

The source of Fountain Creek is in the mountains west of Colorado Springs. At Colorado Springs, Fountain Creek turns south and joins the Arkansas River at Pueblo 30 miles away. Fountain Creek and its tributaries drain a north-south strip of El Paso and Pueblo Counties extending from the Palmer Lake area on the north through Colorado Springs to Pueblo.

Within the drainage basin of Fountain Creek are alluvial fan, upland, flood-plain, stream terrace, valley-fill and wind-blown types of sand and gravel deposits. The most important alluvial fan and upland mesa gravel deposits extend from the mountain front eastward to Fountain Creek. Close to the mountains, the upland deposits contain decomposed boulders and large amounts of silt and clay. Generally, these deposits are poor sources of high-quality sand and gravel, but may be important producers of base course or road dressing material. Some aggregate in these deposits might be upgraded to meet asphalt specifications. Upland mesa deposits generally improve in quality with distance from the mountain front, and many of the gravel pits developed on these mesas produce high-quality concrete aggregate. Several mesas contain up to 30 ft of sand and gravel; however, in places up to 10 ft of wind-deposited material (loess) may cap the aggregate. The most important operations on these upland deposits are the Broderick and Gibbons pits located on "The Mesa" in northwest Colorado Springs and the Schmidt Construction Inc. pits located on a large mesa 2 miles southwest of Fountain.

Upland deposits on both sides of Fountain Creek below Security produce aggregate suitable for asphalt, and in some cases these aggregates may be upgraded to concrete specifications. Most upland mesa gravel deposits in the Colorado Springs area have been lost to urbanization or lie within the Air Force Academy and Fort Carson Military Reservation. The only major gravel deposits other than uplands in the Colorado Springs area lie within the flood plain of Fountain Creek and on the stream terraces of Fountain and Monument Creeks.

Colorado Springs lies on broad stream terraces of Fountain and Monument Creeks; only flood plains and terraces of the lower reaches of Fountain Creek contain significant reserves of sand and gravel. The most important sand and gravel operations on Fountain

Creek are located between Colorado Springs and Fountain. There are only a few aggregate pits on Fountain Creek between Fountain and Pueblo. Drilling along this stretch has disclosed gravels both in the flood plain and on stream terraces (Tom Ledgerwood, 1973, personal commun.).

Several high quality sand deposits lie east of Monument and Fountain Creeks in the Colorado Springs area. Sand dunes mantle 2 large areas of clean, coarse-grained water deposited (alluvial) sands. One of these areas is southeast of the U. S. Air Force Academy between Cottonwood and Pine Creeks. Fountain Sand and Gravel Company produces 600 tons of *hydraulic sand* each week from this area for use in hydraulic fracturing operations in oil field reservoirs (Fig. 5). They also produce blast sand, well pack sand, filter sands, pipeline sand, engine sand, and other specialties requiring a clean, dry, close-specification, high-silica sand (R. W. Sack, The Fountain Sand and Gravel Company, 1974, personal commun.). The other area of sand deposits is located between Colorado Springs and Security near the mouth of Sand Creek. These sands are mined and then mixed with coarse gravels and quarry rock to meet various aggregate specifications. About 60 percent of the quarry aggregate mix is made up of this sand-size material. Daniels Sand Company, Schmidt Construction Company, and Castle Concrete Company are the principal operators in the Sand Creek area.



Figure 5. Fountain Sand and Gravel Company hydraulic sands in El Paso County. This deposit supplies the petroleum industry in the United States and Canada with coarse-grained quartz sands that are used to increase the recovery of oil. The pit is located 1 mile east of the south entrance of the U. S. Air Force Academy. Photograph by P. C. Wicklein.

Northeast of Colorado Springs near the headwaters of Sand Creek, alluvial-fan, upland, valley-fill, and flood-plain deposits of coarse sands derived from the Dawson Arkose highlands of northern El Paso County are commercial and are presently being mined for aggregate. Coarse sand also is being mined from the south end of a large sand-capped mesa 5 miles northeast of the mouth of Fountain Creek at Pueblo.

We suggest that a follow-up study be conducted to determine the origin and extent of the Cottonwood Creek and Sand Creek deposits and how much of these particular aggregates are required for the future needs of Colorado Springs and the petroleum industry.

#### St. Charles River

The St. Charles River enters southwestern Pueblo County from the west, flows generally northeast, and joins the Arkansas River 2 miles east of Pueblo. Upland deposits are important sources of sand and gravel in the Rye, Colorado City, and Beulah areas.

Upland mesas in the Rye-Colorado City area are capped by deposits of sand and gravel. These deposits commonly range between 5 and 20 ft in thickness with 4 to 6 ft of overburden. The content of calcium carbonate, incompetent rock, silt and clay varies among deposits. The few widely scattered aggregate deposits in southwestern Pueblo County are needed for road maintenance and community development in that area.

Good gravels are found in the upland and terrace deposits along North, Middle, South, and Squirrel Creeks, near Beulah, Colorado. Many of these upland sand and gravel deposits exceed 10 ft in thickness but contain significant amounts of incompetent rock, silt, and clay.

Near Pueblo, high stream terraces on both sides of the St. Charles are important potential sources of sand and gravel. The flood plain of the St. Charles River, generally a poor source of aggregate, contains good quality aggregate west of Interstate 25. Lower terraces along the St. Charles west of Interstate 25 also are sources of good quality sand and gravel, and a few deposits near Burnt Mill have been worked. No significant deposits of sand or gravel were found in the flood plain or in the stream terraces of Greenhorn Creek.

#### Chico and Black Squirrel Creeks

Chico Creek and its principal tributary, Black Squirrel Creek, drain a large part of eastern El Paso and northeastern Pueblo Counties. Northeastern El Paso County is drained in part by Big Sandy Creek and a few other creeks not related to Chico Creek; however, these other areas are so similar to the Chico-Black Squirrel drainage system that they will be included in this discussion. Nearly the entire eastern part of El Paso County and northeastern Pueblo County is covered by fine-aggregate sand resources. Deposits vary from coarse pebbly sands of the flood-plain, stream-terrace, valley-fill, alluvial-

fan and upland deposits to fine wind-deposited dune sands. It appears that the sand in these deposits originally was derived from the highlands of Dawson Arkose located in north-central El Paso, southeastern Douglas, and southern Elbert Counties. Upland deposits are up to 20 ft thick and have practically no overburden. These deposits also generally contain a large percentage of silt and clay. Along Colorado Highway 50 near the Arkansas River in northeastern Pueblo County, many pits have been developed on the scarps of these upland deposits. Alluvial-fan deposits consist of reworked aggregate or slope wash derived directly from outcrops of Dawson Arkose. Stream-terrace and flood-plain deposits may represent primary, secondary, or even tertiary deposits of aggregate derived from Dawson Arkose. The large dune fields in this area were deposited by dominant northwesterly winds that transported sand from the flood plain of Black Squirrel Creek. Small individual sand dunes scattered across the coarse-sand upland deposits generally are associated with sand blowouts. The widespread sand aggregates of this region are important in maintaining the road systems in El Paso County and Pueblo County.

#### Huerfano River

The Huerfano River, nearly 100 miles long, heads in the Sangre De Cristo Mountains 65 miles southwest of Pueblo, flows northeastward and joins the Arkansas River south of Boone. Despite the river's impressive length, mappable sand and gravel deposits in Pueblo County extend only 20 miles upstream from the Arkansas confluence. Further upstream, the river flows through narrow canyons incised as much as 300 ft into sandstones, shales, and limestones.

Although one water well along the river penetrated 32 ft of flood-plain and valley-fill deposits, greater depths were recorded near the river mouth, but these are, in part, due to Arkansas River deposition. Only sand and silt were seen along the river channel, and high quality coarse aggregate is not anticipated at depth because the source materials for a considerable distance upstream consist of fine-grained, incompetent sedimentary rocks.

The high terrace deposits flanking both sides of the river vary from 5 to 10 ft in thickness, although one small remnant measured 15 ft. In most places significant calcium carbonate has developed, and the gravels contain abundant fines and weak rocks. As much as 8 ft of silt and clay is exposed on the lower terrace.

Capping the Hooker Hills 6 miles from the river mouth are deeply weathered, silty upland gravels up to 15 ft thick. Thinner upland remnants lie at a lower level between the Hooker Hills and the river.

Of the 6 sand and gravel pits noted in the Huerfano River valley, all but one are located on the higher terrace level. The best quality material was observed in the two pits nearest the river mouth. Although part of an Arkansas River terrace, the material here undoubtedly was influenced by the Huerfano River at some time in the past.



Compared with the vast amounts of high-quality sand and gravel available along the Arkansas River, the relatively poorer quality deposits along the Huerfano River have little potential for more than local road repair, fills, and earth embankments.

#### Arkansas River

The Arkansas River, which heads in the mountains of northern Lake County near Leadville, enters the plains at Canon City and flows eastward across eastern Fremont and Pueblo Counties. The flood plain and terraces along the Arkansas River between the western boundary of Pueblo County and the confluence with the St. Charles River contain extensive deposits of sand and gravel. Tributary streams, with the exception of the Red Creek and Turkey Creek drainages which contain limited reserves of sand and gravel, tend to be devoid of commercial quality aggregate. The flood plain of the Arkansas River consists of approximately 25 ft of clean, sound sand and gravel beneath 4 to 12 ft of fine-grained overburden. This aggregate is being recovered from a flooded pit near the junction with Blue Ribbon Creek just west of Pueblo.

Upstream from the town of Goodnight, stream terraces tend to be limited in areal extent and are composed of about 10 ft of pebbly to cobbly granitic gravel that includes a small amount of calcium carbonate, silt, and clay in the upper few feet of the deposit. Overburden thins toward the edge of the terraces. The broad terraces along the south side of the river between Goodnight and the St. Charles River are made up of about 16 ft of sand and gravel lying beneath 5 to 30 ft of wind-deposited silty sand that thickens with increasing distance from the flood plain. The aggregate resource on the terrace segments between Goodnight and Salt Creek has been entirely lost to urbanization.

The wide, prominent terrace lying south of the river extends downstream past the St. Charles and Huerfano Rivers toward Fowler. The deposits beneath the terrace vary from 6 to 20 ft in thickness and consist of fairly clean pebbly to cobbly gravels with equal amounts of sand. The southern or upslope limit of the terrace is uncertain because of thickening deposits of clay, silt, and sand derived from the river valley by wind transport and from several northeastward flowing tributary streams that head in the fine-grained terrain to the south. Two lower terraces lie on the north side of the river and in places contain more than 15 ft of clean sands and gravels.

Between the St. Charles and Huerfano Rivers, about 4 miles south of the Arkansas River, lies a series of small gravel-capped hills, probably the remnants of a former position of the Arkansas River. Although they are old, high upland gravels, these deposits are not so deeply weathered as might be expected.

Most of the 21 active and abandoned gravel operations noted on the high terrace south of the river lie within  $\frac{1}{4}$  mile of the river bluffs. There the overburden is thin to nonexistent, and access to Pueblo is excellent on U. S. Highway 50 and Colorado Highway 96. Seven other operations were noted

on the high terrace at and southeast of Boone. The gravels extracted from these areas have been used for concrete and asphalt aggregate throughout the Pueblo area. Even with the abundance of high-quality river terrace gravels, 4 operations have been started on the relatively high-quality upland gravels south of the river. It is likely that these gravels will continue to be of importance in the Pueblo area. Most of the activity will be concentrated on the terraces and probably within the  $\frac{1}{2}$ -mile strip described above. The flood-plain and lower terrace deposits appear to have great potential but will require much more testing and evaluation as to ground water depth, grain size limitations, and land use.

#### SAND AND GRAVEL RESOURCES OF THE LARAMIE RIVER BASIN

Heading in the high glaciated peaks of the Medicine Bow Mountains in western Larimer County (Fig. 4), the Laramie River flows northward into Wyoming and northeastward toward Laramie.

In general, most of the flood-plain, terrace, and alluvial fan deposits along the river are of poorer quality than most seen along other mountain streams and along comparable rivers on the plains. The terraces flanking the river downstream from Stub Creek are more prominent than those upstream. Just above Stub Creek is a valley constriction caused by a series of glacial end moraines. Downstream the higher terraces are well defined and consist of 10 to 20 ft of pebbly, cobbly, and bouldery gravel with significant silt and clay, weak sedimentary clasts and decomposed igneous rock. Field observations suggest that the thickness of the gravels decreases rapidly away from the river.

Numerous small alluvial fans have been built out onto the terrace by tributary streams and may contain up to 15 ft of silt, sand, and angular boulders.

In several exposures along the river, the flood-plain deposits appear to contain some pebbly and cobbly gravels and sands of undetermined thickness.

One gravel pit was noted in sandy, pebbly, and cobbly terrace sediments south of the Stub Creek confluence. In the fall of 1973, the Larimer County Highway Department was borrowing terrace gravel for local road repair just west of Four Corners. East of Gleneyre School, on the southern end of Crazy Mountain, is an operation in deeply weathered and disintegrated granite (grus).

The alluvial fan gravels along the river probably have no potential as sources of aggregate because of their high amount of fines, oversize material, and the necessary upgrading. They can be used locally for road dressing. The terrace deposits are of slightly better quality; but because of the sedimentary clasts and decomposed rocks in them, it is doubtful whether they could be easily upgraded for high-quality aggregate. However, since most of the roads in the valley are gravel-based these terraces and the weathered granite of Crazy Mountain should be excellent sources of road base and subbase. The deposits are more than adequate to meet the local needs in the valley, provided that no rapid growth is projected for the area.

## QUARRY AGGREGATE

Quarry aggregate is any crushed rock produced from a bedrock quarry. The principal Front Range rock types that may be suitable for quarry aggregate are granite, gneiss, basaltic rock, quartzite, limestone, dolomite, rhyolite, and conglomerate. Sandstone, shale, and schist are generally unsuitable for quarry aggregate. The major quarries producing aggregate in the Denver area are the Cooley Gravel Company quarry at Morrison and the Specification Aggregate, Inc. quarry at Golden. Both quarries are located in an area of Precambrian gneisses and schists (Plate 2). The only major aggregate producer north of Denver is the Andesite Rock Company quarry located in fine-grained intrusive rock near Lyons (Plate 1).

There are several aggregate-producing quarries in the Colorado Springs area. The Schmidt Construction, Inc. quarry is located in Pikes Peak granite; and Castle Concrete Company's Snyder, Queen's Canyon, and Lennox-Breed quarries are in Paleozoic limestones and dolomites of the Rampart Range (Plate 3).

### Gneisses and Schists

The quality of quarry aggregate in the outcrop areas of the Precambrian gneisses and schists varies considerably from place to place. The principal quarries are in Jefferson County.

The Morrison Quarry, operated by the Cooley Gravel Company, lies on a 200-acre tract along Strain Gulch, about 1½ miles south of Morrison. Although intensely fractured in places, the granite, gneiss, and schist that are quarried here do require periodic blasting. Rock products from the quarry include road base, quarry fines (structural fill), and surge rock.

The Specification Aggregates, Inc., quarry is located above the Old Heidelberg Inn, 2 miles south of Golden off U.S. Highway 40 (Fig. 6). About two-thirds of the crushed and uncrushed granite and gneiss quarried here is used as riprap for the Chatfield Lake State Recreation Area in Littleton. Other products include concrete aggregate, road base, and asphalt binder.

Highly fractured biotite gneiss, garnet gneiss, and granite lenses are exposed in a 100-ft excavation at the Clear Creek quarry, which is located adjacent to U. S. Highway 6, half a mile west of Golden in Clear Creek Canyon. Angular talus debris and coarse crushed rock are used for riprap. Coarse sand and finer crushed rock are used for concrete aggregate, base course, and ballast (Van Horn, 1957; Hickey, 1950). A smaller quarry in similar rock types lies across the canyon on Colorow Hill, west of Lookout Mountain.

Two other rock quarries are situated in the highly fractured gneisses and schists in the Turkey Creek and Deer Creek canyons, southwest of Denver.

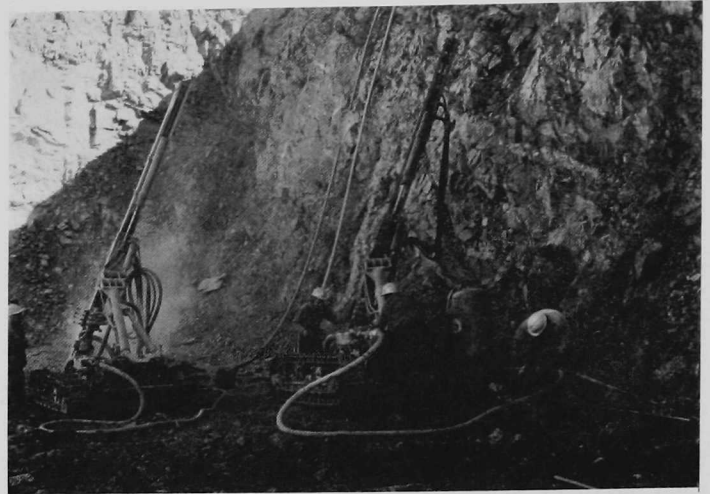


Figure 6. Air-track drilling in the Specification Aggregates Inc. Quarry, Jefferson County. Quarry aggregate is important to the Denver market. Photograph by A. L. Hornbaker, Colorado Geological Survey.

### Granitic Rocks

Boulder Creek Batholith: The outcrop area of the Boulder Creek batholith is primarily in Boulder County. This rock is a medium- to fine-grained granodiorite and might be developed as a quarry aggregate in a few places. A few small outcrops of younger fine- to medium-grained Silver Plume granite in the same area might also be utilized as quarry aggregate.

Sherman Granite: The mountainous part of Larimer County lying north of the Cache la Poudre River and east of the Laramie River is the principal outcrop area of the Sherman Granite in Colorado. Weathering has produced a deep layer of grus (decomposed granite) over much of the Sherman Granite in this region. This grus, used as road-surfacing material on many local roads, is generally mined from the sides of road cuts near the site of intended use. Some grus pits were found in Larimer County, but road-surfacing aggregate appeared to be the principal use made of the material. Aggregate for paved county roads is obtained from stream deposits near Fort Collins; however, it is possible that grus may be just as satisfactory for asphalt aggregate.

Pikes Peak Batholith: The Pikes Peak Batholith of Jefferson, Douglas, and El Paso Counties is a complex coarse-grained granitic intrusive. Although most of the Pikes Peak Batholith is too coarse grained to make a quality crushed aggregate, Schmidt Construction Inc. is quarrying a biotite-poor, medium-grained phase of the granite in Turkey Creek Canyon 15 miles southwest of Colorado Springs. This aggregate meets Colorado Division of Highways specifications for concrete aggregate and is being shipped as far east as Limon.

Schmidt Quarry is the only major quarry in granite of the Rampart Range; however, exploration of the batholith may reveal other areas where the rock is also suitable for quarry aggregate.

#### Basaltic Flows and Intrusives

All the potential basaltic and andesitic quarry aggregate occurs in central Jefferson County and eastern Boulder County. North and South Table Mountains in Golden are ancient lava flows that cover an area of nearly 3½ sq mi. The two upper flows total about 150 ft in thickness and are composed of hard, dense, resistant shoshonite, a fine-grained potassium-rich basalt. These flows were quarried at 4 localities on South Table Mountain and at one on North Table Mountain. Van Horn (1957) states that the rock has been used for concrete aggregate, riprap, road metal, and building stone. Hard, durable monzonite in the so-called "Ralston Dike" north of Golden also was quarried for concrete aggregate, riprap, and road metal. Alteration and weathered zones, slope stability, esthetic and land-use problems will be serious limiting factors to the development of these quarry aggregates in Jefferson County.

The fine-grained, potential quarry aggregates in eastern Boulder County include the basaltic dike at Valmont Butte, east of Boulder, and the andesitic intrusive in the mountains southwest of Lyons. Rock from the quarry near Lyons is crushed and used for road material, concrete aggregate, septic-system rock, filter media, riprap, and decorative stone. The rock quarried at the west end of Valmont Dike around the turn of the century was used as building stone and in cobblestone pavement.

#### Quartzite

The Coal Creek quartzite in Jefferson County is an extremely hard and tenacious rock that, upon crushing, produces clean, angular fragments and very little dust. These qualities and the proximity to the Boulder-Denver market make this rock very attractive as quarry aggregate. Road access and environmental concerns may, however, severely limit the location of potential quarry sites.

#### Limestones and Dolomites

Some of the Paleozoic limestones and dolomites of the Front Range make excellent concrete aggregate. Outcrops of these rocks are found in Jefferson, Douglas, and El Paso Counties, but large quarries are developed in El Paso County only, near Colorado Springs. The Lennox-Breed and Queen's Canyon quarries are well-known quarries, but the Snyder Quarry is planned as an underground operation. Aggregate from these quarries is important to the Colorado Springs market and has been used in the construction of the NORAD complex and Air Force Academy. Plates 2 and 3 show the location of these rocks and the principal quarries.

#### Rhyolite

Rhyolite lava flows cap mesas through out much of eastern Douglas County. This rock was quarried near Castle Rock, and has had limited use as building stone, rubble masonry, riprap, and veneer in private homes and small public buildings (Lindvall, 1968). Testing might demonstrate this rock's suitability for crushed aggregate. Although this rock is now located far from principal urban growth centers, it is strategically located in a potential growth area between Denver and Colorado Springs.

#### Conglomerates

Conglomerates are cemented clastic rocks containing rounded rock fragments that correspond in size to gravel or pebbles. Four units in the study area might be classified as conglomerates. With the exception of the Green Mountain Conglomerate, conglomerates were omitted from the regional maps but appear on the 7½-min quadrangles in the atlas.

In the Colorado Springs-Castle Rock area, the Colorado Springs member of the Dawson Arkose is conglomeratic. This formation is mined in a few places where the material is poorly consolidated; however, in most places the rock would require blasting and crushing. Since no evidence was found that the formation has been crushed for aggregate anywhere along the Front Range, the unit is not shown on the maps that accompany this report.

The Castle Rock conglomerate, which crops out in the Castle Rock area, is similar to the Colorado Springs member of the Dawson Arkose in that it will require blasting and crushing before it can be utilized as aggregate.

The Green Mountain formation is a 650-ft-thick deposit of conglomerate, claystone, and sandstone on Green Mountain located in the Lakewood-Golden area of Jefferson County. The Green Mountain Conglomerate is shown on Plate 2 as an unevaluated upland deposit. A large part of the formation lies within a Lakewood city park, and there is no evidence the formation ever has been mined for aggregate. Mining the Green Mountain Conglomerate will require that certain engineering and environmental problems be overcome.

Several hills along Lone Tree Creek 5 miles south of Carr are capped by conglomerates of the White River Group. There is no evidence that these conglomerates ever have been mined for aggregate; however, the conglomerates might be utilized as riprap, but blasting would be required.

## AGGREGATE RESOURCES OF THE FRONT RANGE COUNTIES

### Adams

The valleys of Beebe Draw, Box Elder Creek, Kiowa Creek, and East and West Bijou Creeks, in eastern and central Adams County, contain thick deposits of gravel and sand that grade upward into fine-grained alluvium. Eolian sands, in places, partially bury the valleys. These valley deposits probably will not become significant because of the thick overburden and the importance of the area's farmlands and ground-water resources.

In southwestern Adams County, the flood-plain and terrace deposits along Sand Creek have yielded excellent sand, but the city of Aurora covers about half the resources there.

Appendix 2 summarizes the production of sand and gravel, and crushed rock in the Front Range counties for the years 1954-71. Adams has consistently been one of the leading gravel-producing counties in Colorado. Annual production exceeded 3,000,000 tons for several of the last 15 yr. Most of the material was mined from the Clear Creek valley between Sheridan Boulevard in Arvada and the South Platte River. The gravel supply in this area, however, is nearly exhausted.

The South Platte River in Adams County extends from 52d Avenue in Denver to Brighton. Whereas virtually all of the terrace and flood-plain deposits south of 72d Avenue have been lost, considerable mining has occurred at the Clear Creek confluence and on the edge of the Broadway terrace between 72d Avenue and 136th Avenue.

Despite the declining quality of the river gravels north of Denver, new mining operations north of 104th Avenue indicate that the flood-plain and lower terrace gravels will become increasingly important to the suburban growth demands in the Denver metropolitan area. The surplus sand and fines will become very significant if and when the problems of full-scale quarry-aggregate operations in Boulder and Jefferson Counties are solved.

### Arapahoe

In eastern and central Arapahoe County, the valley-fill deposits in Box Elder, Kiowa, East Bijou, and West Bijou Creeks probably will not become significant resources for reasons stated above in the Adams County summary. The upland sands and gravels along Bijou and West Bijou Creeks are used as road dressing and base material. The valley fills of Sand Creek and Cherry Creek, in the western part of the county, contain thick, high-quality specialty sands.

In the southwestern corner of the county, the South Platte River extends from Littleton, near the Massey Draw confluence, to Yale Avenue, in Englewood. Much of the high-quality river gravel has been mined in Sheridan, at the Chatfield Golf Course, and on the terrace east of Columbine Hills. Most of the sites in Sheridan

are in some phase of sanitary landfilling. In spite of the relatively heavy gravel mining in this area, a number of deposits have been lost to urbanization, notably those gravels lying beneath Wolhurst Country Club, Columbine Valley, Centennial Race Track, and several commercial districts in Littleton and Englewood. Due to pressures of suburban expansion, few gravel lands along the river yet remain available for mining. Serious attention must be given to these valuable tracts--the only remaining sources of coarse aggregate within the county.

### Boulder

Boulder County ranks among the leading Front Range counties in the production and consumption of sand and gravel. The county may contain sufficient reserves to satisfy demands imposed by future growth, provided that urban expansion is directed away from the major areas of aggregate resources. The main sources of high-quality gravel within the county occur east of the mountain front in flood plains of the major streams, including Boulder, South Boulder, and St. Vrain Creeks. The flood plain gravels along Coal and Lefthand Creeks are of unknown quality and may contain some silt and clay. Numerous upland gravels located in the eastern portion of the county tend to be thinner, of more limited areal extent, and include more deleterious material than the flood plain deposits. These lower quality aggregates may be best used for road base, subbase, surfacing material, and fill. These uses would permit reserving the supplies of high-quality flood-plain gravel for concrete aggregate and asphalt mix.

The mountainous portion of the county tends to be deficient in sand and gravel, although several large deposits are located in the vicinity of Nederland. Utilization of this material could help reduce construction costs of future roads and mountain developments. An alternate and more costly source of aggregate would be the quarrying and crushing of granite bedrock.

### Denver

The City and County of Denver now extend over many of the valuable sand and gravel deposits along the South Platte River, Sand Creek, Cherry Creek, and Bear Creek. Although production figures for the county are scanty, tonnages certainly have decreased in recent years mainly because of rapid urbanization. Whereas many deposits were lost to this urbanization, a number of depleted pits within the city were profitably reclaimed by sanitary landfilling and by subsequent development into industrial, commercial, residential, and recreational sites. Landfilling already has begun in the only active gravel pit within the city.

To meet the demands of the expanding metropolitan area, the possibilities are very real that aggregate will be brought in by unit train from areas as far away as Greeley. With the growing importance and potential of quarry aggregate west of Denver, caused, in part, by the diminishing supply of coarse gravel in neighboring counties, the sand and fine-ag-

gregate deposits along Cherry Creek, Sand Creek, and the South Platte River will become more valuable.

Analyses of the Denver problem and recommendations for its solution have been outlined by the Colorado Sand and Gravel Producers Association (1957), the Inter-County Regional Planning Commission (1961), and the U. S. Bureau of Mines (Sheridan, 1967). Other growing areas along the Front Range should learn from this example of inadequate zoning and mismanagement of aggregate resources.

#### Douglas

Douglas County, although not subject to section 92-36-5, C. R. S. 1963, was included in this study because of its rapidly increasing population and its strategic location between Denver and Colorado Springs. Abundant resources of fine aggregate occur in the terraces along Plum and Cherry Creeks; gravel deposits in the county are limited to the area adjacent to the South Platte River. Future supplies of coarse aggregate might be obtained from limestone in the mountains near Westcreek and Larkspur (Plate 2). Rhyolite flows in the vicinity of Castle Rock have been mined for building stone. Further testing might establish the suitability of this rock for concrete aggregate.

#### El Paso

El Paso County produces and consumes large quantities of sand, gravel, and quarry aggregate. The principal deposits in the county producing high-quality aggregate are Castle Concrete's Queen's Canyon and Lennox-Breed quarries west of Colorado Springs, the Schmidt Construction Quarry 15 miles southwest of Colorado Springs, the gravel-capped upland mesas west of Fountain Creek, and the large sand deposits in the southeastern part of Colorado Springs. Most high-quality gravel deposits in the county have been covered by the urban sprawl of Colorado Springs or lie within the U. S. Air Force Academy or the Fort Carson Military Reservation. Upland gravel deposits apparently cannot supply the demand for aggregate in Colorado Springs; therefore, quarry aggregate supplies a large part of the market, and increasing amounts of gravel are trucked into Colorado Springs from the Arkansas Valley, 40 miles to the south (Fig. 7). A great deal of the sand mined in the southeastern part of Colorado Springs is mixed with quarry aggregate. Three tons of sand are required for each 2 tons of quarry aggregate. Other sands northeast of the Colorado Springs area are mined and mixed with gravels brought in from the Arkansas Valley.

Widespread deposits of low-quality sands in the eastern half of El Paso County provide a large part of the aggregate required for maintaining the state and county highway systems. The large number of sand pits in northeastern El Paso County (Plate 3) indicate how pits have been conveniently developed for road maintenance. These widespread deposits substantially reduce the cost of county road maintenance.

The Fountain Sand and Gravel Company deposits located north of Colorado Springs near the south entrance of the Air Force Academy are of growing national importance. Material from these unique coarse-

grained quartz sand deposits is used for fracturing petroleum-bearing reservoirs to increase the flow or yield of oil and gas. It is the unusually large size of the individual spherical sand grains that make this deposit unique. Demand for this coarse-grained sand is growing rapidly throughout the United States and Canada.

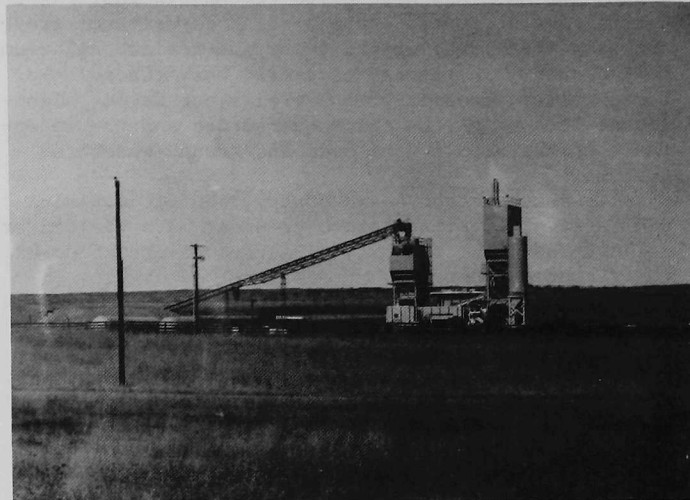


Figure 7. The Fountain Sand and Gravel Company plant northeast of Colorado Springs processes slag and gravels trucked from Pueblo 40 miles away. Photograph by P. C. Wicklein.

The most important aggregate deposits in El Paso County are located near Colorado Springs. Finding a solution to the problem of conservation of deposits near Colorado Springs that will satisfy the present landowners will not be easy. Planning will require a great deal of effort on the part of local government, with considerable input from the aggregate-producing industry and landowners.

Aggregate deposits in the eastern and northern parts of El Paso County are generally important only to the maintenance of the highway systems. Detailed plans involving the conservation of key deposits in this area should be developed in close cooperation with the county and state highway departments. Any El Paso County plan for the conservation of aggregate deposits should also consider Pueblo County, which provides aggregate to the Colorado Springs market. A more complete picture of aggregate resources of El Paso County may be obtained from the discussions on sand and gravel resources of the Arkansas River Basin and Pueblo County.

#### Jefferson

Annual sand and gravel production from Clear Creek and Bear Creek has exceeded 2,000,000 tons in recent years. Activity along Clear Creek is confined to the flood plain and terraces between Tabor Street and the Coors Brewery in Golden. More than 2,000 acres of flood-plain gravel land were lost due to the expansion of Arvada and Wheat Ridge. Two le-



vels of terrace gravels on the north side of the valley have been worked extensively, west of Eldridge Street. Urbanization and heavy mining have left little land available for gravel extraction.

Factors such as percent fines, variable thickness and overburden, and oversize material probably have limited the mining activities along Bear Creek. Although a significant amount of land yet may be available, more drilling and test data are needed in order to determine the degree of upgrading required for the best utilization of these resources.

Very significant quantities of high-quality gravel and sand lie in the terraces and flood-plain of the South Platte River above the Chatfield Lake damsite. Possibilities exist that gravel mining may continue within the maximum flood-inundation limits after completion of the recreation area.

The Rocky Flats alluvial-fan and associated upland deposits represent a large untapped reserve of sound, durable gravel. Although the gravels contain significant clay, one commercial operation has begun on a Rocky Flats remnant along Barbara Gulch, near Colorado Highway 93.

Stone and crushed-rock production has increased in recent years because of the openings of the Morrison and Specification Aggregates, Inc., quarries in the Golden-Morrison area. North and South Table Mountains, Ralston Dike, and the Coal Creek quartzite are large deposits of potential, high-quality quarry aggregate that will become increasingly important in the Denver metropolitan area as coarse gravel resources diminish.

Jefferson County is in the fortunate position to encourage development of the Bear Creek, South Platte River, and Rocky Flats deposits to help offset the depletion of the Clear Creek gravels. At the same time, some of the economic, engineering, legal, and environmental problems associated with quarrying might be solved.

### Larimer

Larimer County contains large reserves of high-quality gravel in the terraces and flood plain along the Cache la Poudre and Big Thompson Rivers between the foothills and the Larimer-Weld County line. These deposits have been extensively worked in the vicinity of Fort Collins and Loveland. Aggregate associated with Boxelder Creek, Little Thompson River, and the Laramie River are of limited value because they include large amounts of fines and weak rock or are buried beneath thick deposits of fine-grained alluvium. This material is suitable for road base, subbase, and for surfacing gravel roads.

In the mountain region, limited amounts of good quality stream gravels occur in the upper Cache la Poudre valley between Indian Meadows and Spencer Heights. Material high in fines and oversize clasts can be obtained from the alluvial fans and colluvial-slope deposits that are built over the stream terraces. Granite might be considered as a potential source of crushed aggregate for local use.

### Pueblo

Pueblo County has sufficient reserves of high-quality sand and gravel for its own future needs and for export to Colorado Springs in El Paso County. Urban expansion over gravel deposits need not be the problem in Pueblo that it is in the Colorado Springs and Denver areas if proper action is taken. The principal sources of high-quality gravels in Pueblo County are the flood plain and stream terraces of the Arkansas River. Extraction of this sand and gravel along the Arkansas will always present a conflict with the use of the land for agriculture; however, potential conflicts with urban development can be avoided by directing urbanization away from the stream terraces and onto the unwatered uplands above the river. Utilization of the isolated undeveloped upland gravel deposits south of the Arkansas River should be undertaken early to avoid conflicts with urban growth.

Stream terraces along the lower St. Charles River probably will be important sources of sand and gravel for the future growth of Pueblo. Because these terrace deposits have not been developed as crop land, the only potential land-use conflict with sand and gravel extraction is future urbanization.

That part of the Arkansas River above Pueblo owned by the U.S. Government is lost as a source of gravels. However, several other terrace and flood-plain deposits on the upper Arkansas are important for the future growth of the area.

Upland deposits near Turkey Creek and between U.S. Highway 50 and the Arkansas River in northwestern Pueblo County are important now and will become increasingly important in the future as nearby land is developed. Upland deposits in southwestern Pueblo County are necessary for maintaining the local road system and supplying the Rye-Colorado City growth area. Deposits along the upper St. Charles River near Beulah provide aggregate for maintaining local roads.

Sparsely settled southeastern Pueblo County relies upon the stream terraces and upland deposits of the Huerfano and Arkansas Rivers for all of its sand and gravel needs. Sedimentary rocks are crushed locally for road aggregate. Unpopulated northeastern Pueblo County is covered by large areas of upland and wind-deposited sands. These deposits more than maintain the present road system. Most of this part of Pueblo County is owned by the State of Colorado, and aggregate reserves here should satisfy at least the short-term needs of the area.

### Weld

Weld County, which comprises about one-fourth of the study area, contains extensive reserves of sand and gravel. Annual production of aggregate over the past 10 yrs has ranged between 250,000 and 2,400,000 tons. Deposits of high-quality aggregate occur in the western one-third of the county. These deposits include pebbly sands in the flood plain and terraces along the South Platte River below Brighton and gravels along Lone Tree Creek and the lower reaches of Boulder Creek, St. Vrain Creek, Big Thompson River, and the Cache la Poudre River. These reserves are adequate to meet the needs of the area. Some of these raw materials could be shipped by unit

train to aggregate-deficient areas such as metropolitan Denver.

Vast dune fields in the southeastern part of the county partially bury segments of Beebe Draw, Crow Creek, Box Elder Creek, Lost Creek, and Kiowa Creek. These valley deposits are not considered to be of substantial economic significance because of the thick overburden, adequate supply of coarse sand near large urban markets, and value of present farmland and ground-water resources.

The upland and alluvial-fan deposits along the northern boundary of the county might be best utilized for local road construction and maintenance.

#### THE ROLE OF HB 1529 IN

#### LAND-USE PLANNING AND THE AGGREGATE

#### INDUSTRY IN COLORADO

Sand and gravel rank first in value and amount among the nonmetallic, non-fuel mineral commodities produced in this country. These raw materials are basic to the construction of our homes, schools, hospitals, churches, shopping centers, streets and highways, airfields, and bridges. In addition, they play important roles in the areas of sewage treatment, water filtration, agriculture, landscaping, transportation, manufacturing, recreation, and petroleum production. We consumers cannot take for granted that our supplies of these resources are inexhaustible. It must be realized that sand and gravel are the result of geologic processes, that their distribution is limited, that they can be mined only where they occur naturally, that they are essential to all kinds of construction, and that proper steps must be taken to ensure that adequate supplies are kept available to meet present and future demands. The assurance that future generations will have optimum aggregate resources will necessarily entail certain problems.

All the conflicts of priority that arise among the sand and gravel industry, government, and the citizenry will never be completely solved. As in other areas, such problems that exist along the Colorado Front Range stem from several causes:

- 1) Urban and suburban expansion is motivated most strongly by short-term profit, with little regard to the presence of sand and gravel deposits or of potential geologic hazards.
- 2) Flood plains and low terrace lands appeal to many home buyers and developers; but often such lands also represent prime sources of high-quality sand and gravel, as well as areas of flood hazards.
- 3) Areas of extensive aggregate extraction that once were beyond most growth areas are now surrounded by new developments, forcing gravel trucks to operate through residential zones and already congested commercial districts (Fig. 8).



Figure 8. Spreading urbanization eventually conflicts with once isolated sand and gravel operations. View to west up the Clear Creek valley toward Golden and the Front Range. Photograph by M. E. Gardner, U. S. Geological Survey.

- 4) Urbanization, as it covers valuable aggregate deposits, forces extractors to mine farther away from principal markets. The increased haulage costs are paid for by the consumer.
- 5) As urbanization and mining proceed away from metropolitan areas, the agricultural sector becomes involved in land-use conflicts (Fig. 9). Flood-plain and terrace lands in many places provide rich soil and irrigation water for farming.



Figure 9. Existing land-use conflicts between farm land, gravel deposits, and industrialization in the flood plain of the Cache la Poudre River. View to the northwest across the Cache la Poudre River flood plain toward the Kodak plant, Weld County. Photograph by W. P. Rogers, Colorado Geological Survey.

- 6) In past years, sand and gravel companies have not been required to rehabilitate the land they have mined.
- 7) In the search for new aggregate sources, extractors have encountered strong resistance from environmental groups concerned with the effects of mining, truck traffic, proximity to residential areas, blasting, rehabilitation of mined areas, and potential damage to existing ecosystems.

Although the problems and considerations are complexly interrelated, solutions may come about sooner through public awareness of the importance of sand and gravel, through adequate legislation and planning funds, and through the cooperative efforts of various technical, social, industrial, and governmental groups. More emphasis should be placed on the fact that mined lands have important economic potential for everyone. For example, the concept of multiple or sequential land use has long been realized in many parts of the country. Some aggregate lands can be mined, landfilled, and developed for residential, industrial, and agricultural use (Fig. 10). Other mined lands can be converted directly into attractive recreational sites (Fig. 11). The overall result of sequential use of lands underlain by aggregate deposits is an increased value to the community that may be spread over many decades.



Figure 10. Hutchinson Building Corporation sand and gravel operation on the future site of their Green Mountain subdivision. Sequential utilization of land conserves resources and maximizes profits. Gravel-capped Mount Carbon and Bear Creek valley are in the middle ground. View is to the south from Alameda Parkway near Green Mountain, Jefferson County. Photograph by P. C. Wicklein.



Figure 11. Western Paving Construction Company's Gordon Lake property at 64th Avenue and Pecos Street, Adams County. The lake is on the site of an abandoned sand and gravel pit in Clear Creek valley. Photograph by M. E. Gardner, U. S. Geological Survey.

With the passage of House Bill 1529 and of the Open Mining Land Reclamation Act of 1973 (Appendix 3), Colorado has taken a positive step toward mineral-aggregate conservation and land use. These laws will effectively complement such recent legislation as the 1972 Senate Bill 35 and the 1974 land-use act, House Bill 1041. Utilizing the basic mapping herein provided, the particular governing agencies are directed by HB 1529 to prepare master plans that will preserve valuable aggregate deposits by zoning for mineral extraction or by prohibiting zoning changes that would hinder extraction. In order to properly plan for resource utilization, a time frame for planning should be established. It has been suggested by advisory committee members that the next 20 yrs may be a logical unit of time upon which to base plans. In addition, estimates of the quantities of minable gravels and estimates of annual consumption for the planning period should be made in conjunction with gravel producers, contractors, and public works organizations.

The input of various disciplines is essential to the success of each master plan. The continuing efforts of geologists, hydrologists, engineers, geophysicists, geographers, agriculturalists, environmentalists, economists, and gravel producers, as well as that of various governmental and civic groups, can be of immeasurable value during the development, implementation, and revision of each plan. Liaison among neighboring counties, including those not under HB 1529 jurisdiction, is vital in resolving problems of regional or mutual concern. Successful mineral-aggregate conservation and land-use planning depend upon teamwork and the cooperation of all Colorado citizens.

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APPENDIX 1

Table of grain-size terminology

Wentworth			Unified Soil Classification			Modified Unified Soil Classification			
Component	mm	in.	U. S. sieve series	mm	in.	U. S. sieve series	mm	in.	Component
Gravel	Boulder	256	10				256	10	Boulders
	Cobble			3-in.	76.1	3	76.1	3	Cobbles
Gravel		64	2 1/2	3/4-in.	19.0	3/4	19.0	3/4	Coarse
			2 1/2-in.						Fine
Pebble		4	5/32	#4	4.76	0.187	4.76	0.187	
				#5					
Granule		2	5/64	#10	2.00	5/64	2.00	5/64	Coarse
	Very Coarse	1	0.0394	#18					
Sand	Coarse	1/2	0.0197	#35					Medium
Sand	Medium	1/4	0.0098	#60					
	Fine	1/8	0.0049	#120					Fine
Sand		1/16	0.0025	#230					
Silt	1/256	0.00015	#400						Fines (silt & clay)
Clay									

The grain size terms used in this report are adapted from two other common systems. The first system is the Wentworth scale, which is based on a modified geometric progression. The gravel cutoff is placed at 2 mm (5/64-in.; #10 screen) and that for sand is placed at 1/16 mm (0.0025 in.; #230 screen). This is the standard scale used in most geologic descriptions. The second scale is the Unified Soil Classification, an engineering scale with the gravel cutoff at 4.76 mm (0.187 in.; #4 screen) and the sand cutoff at 0.074 mm (#200). This report uses the Unified Soil Classification modified by the addition of the Wentworth gravel terms. For visual classification (as in the map explanation) the 1/4-in. size may be used as equivalent to the #4 sieve size (Asphalt Institute, 1969, p. 69-86).

## APPENDIX 2

Production of sand and gravel, stone and crushed rock<sup>1</sup> in the Front Range counties.  
(thousand short tons)

Year	Adams s/g	Adams s/cr	Arapahoe s/g	Arapahoe s/cr	Boulder s/g	Boulder s/cr	Denver s/g	Douglas s/g	Douglas s/cr <sup>2</sup>	El Paso s/g	El Paso s/cr	Jefferson s/g	Jefferson s/cr	Larimer s/g	Larimer s/cr	Pueblo s/g	Pueblo s/cr	Weld s/g	Weld s/cr
1954	1400	-	564	-	-	-	-	145	-	674	-	658	-	349	-	940 <sup>4</sup>	-	-	-
1955	W	-	763	-	-	-	-	60	-	518	-	660	-	333	-	986 <sup>4</sup>	-	-	-
1956	2358	-	1430	-	505	-	-	312	-	994	-	987	-	493	-	986 <sup>4</sup>	-	-	-
1957	2345	-	1640	-	399	-	340	67	-	1317	-	2037	-	291	-	992 <sup>4</sup>	-	-	-
1958	1648	-	1693	-	619	-	-	136	-	1826	574.6	1534	-	749	-	2454	-	-	-
1959	3229	W	1521	0.25	839	4.79	-	321	2.15	1315	W	1458	3.11	476	827.78	1133	1.13	1243	4.28
1960	3344	22.54	1288	-	527	4.32	-	288	3.24	1377	W	2044	4.67	833	791.66	1042	12.49	1102	4
1961	3330	7.92	1683	4.05	535	8.48	-	562	0.70	1113	W	1985	12.19	457	866.31	571	0.04	1101	13.25
1962	3644	3.29	1482	6.52	591	8.77	-	553	1.09	917	W	2422	30.42	468	887.53	722	-	818	4.72
1963	3178	0.56	1093	0.22	692	37.34	W	526	59.79	1291	W	1988	21.15	1337	864.90	1257	11.34	800	58
1964	-	2.77	1383	40.87	1025	31.20	W	507	6.9	1547	508.4	1995	27.14	730	804.17	912	0.72	2400	7.85
1965	2797	1.55	1227	9.97	1169	131.21	-	635	24.39	1171	523.3	2251	13.36	1432	668.64	1210	1.57	403	0.89
1966	2717	2.21	1024	14.37	1387	44.94	-	608	86.07	1409	450.5	2199	25.47	973	671.62	2008	11.95	873	10.78
1967	3057	2.98	1011	23.42	1789	45.04	-	754	17.93	1023	W	1620	56.27	1099	727.48	1033	W	525	52.27
1968	3401	0.50	1212	2.30	1244	97.22	-	435	W	1550	W	2407	23.55	1098	496.97	1032	W	699	2.91
1969	2582	1.72 <sup>3</sup>	858	0.96	1770	11.85	-	407	10.62	1285	W	2191	88.66	678	520.62	943	-	545	-
1970	2794	W	1562	-	1596	228 <sup>5</sup>	W	611	15 <sup>6</sup>	1453	-	2228	W	676	W	1299	-	668	-
1971	3047	-	1386	-	3051	W	129	1312	W	3010	-	2117	W	1130	560	1093	3 <sup>3</sup>	250	3 <sup>3</sup>

<sup>1</sup>Stone sold or used by producers<sup>2</sup>Silica rock<sup>3</sup>Granite<sup>4</sup>Sand, gravel, clay<sup>5</sup>Sandstone, limestone, granite<sup>6</sup>Dolomite, quartz, traprock, other

W = information withheld

- = no data listed

Sources of information: U. S. Bureau of Mines Minerals Yearbooks, 1959-1971. Colorado Division of Mines Annual Reports, 1954-1958.

## COLORADO

### OPEN MINING LAND RECLAMATION ACT

The following statutes concern the reclamation of land affected by the mining of natural mineral deposits of limestone used for construction purposes, coal, sand, gravel and quarry aggregate, by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed and reclamation to take place during the after such activities. The act and the provisions thereof are effective on and after July 1, 1973. They are printed for information and compliance.

**92-13-1. Short title.** – This article shall be known and may be cited as the “Colorado Open Mining Land Reclamation Act of 1973”.

**92-13-2. Declaration of policy.** – It is hereby declared to be the policy of this state to provide, during the mining process and after mining operations have been completed, for the reclamation of land subjected to surface disturbance by open mining and thereby conserve natural resources, aid in the protection of wildlife and aquatic resources, and establish recreational, home, and industrial sites, to protect and perpetuate the taxable value of property, and to protect and promote the health, safety, and general welfare of the people of this state.

**92-13-3. Definitions.** – (1) As used in this article, unless the context otherwise requires:

- (2) “Overburden” means all of the earth and other materials which lie above natural mineral deposits of limestone used for construction purposes, coal, sand, gravel, and quarry aggregate, and also means such earth and other materials disturbed from their natural state in the process of open mining.
- (3) “Open mining” means the mining of natural mineral deposits of limestone used for construction purposes, coal, sand, gravel, and quarry aggregate, by removing the overburden lying above such deposits and mining directly from the deposits thereby exposed. The term includes, but is not limited to, such practices as open cut mining, open pit mining, strip mining, quarrying, and dredging.
- (4) “Operator” means any person, firm, or corporation engaged in and controlling an open mining operation.
- (5) “Affected land” means the area of land from which overburden shall have been removed, or upon which overburden has been deposited, or both, on or after July 1, 1969.
- (6) “Refuse” means all waste material directly connected with the cleaning and preparation of substances mined by open mining.
- (7) “Ridge” means a lengthened elevation of overburden created in the open mining process.
- (8) “Peak” means a projecting point of overburden created in the open mining process.

(9) “Department” means the department of natural resources or such department, commission, or agency as may lawfully succeed to the powers and duties of such department.

(10) “Executive director” means the executive director of the department of natural resources, or such officer as may lawfully succeed to the powers and duties of such executive director.

(11) “Board” means the land reclamation board established by section 92-13-14.

(12) “Reclamation” means the employment during and after an open mining operation of procedures reasonably designed to minimize as much as practicable the disruption from the open mining operation and to provide for the rehabilitation of any such surface resources adversely affected by such open mining operations through the rehabilitation of plant cover, soil stability, water resources, and other measures appropriate to the subsequent beneficial use of such mined and reclaimed lands.

**92-13-4. Necessity of permit – application to existing permits.** – (1) It shall be unlawful, after July 1, 1973, for any operator to engage in new open mining without first obtaining from the department a permit so to do, in such form as provided in this article. Permits granted prior to July 1, 1973, shall be subject to the provisions of this article. No other governmental office of the state or any political subdivision of the state shall have the authority to grant the issuance of a permit. However, the department shall not grant a permit in violation of city, town, county, or city and county zoning or subdivision regulations.

(2) An operator shall be deemed to be engaged in new open mining when he removes or deposits any amount of overburden or refuse on or after July 1, 1973.

**92-13-5. Application for permit – bond – fee.** (1) Any operator desiring to engage in new open mining shall make written application to the board for a permit. The permit, if approved, shall authorize the operator to engage in open mining upon the area of land described in his application until June thirtieth of the fifth year following approval of the permit.

- (2) (a) An operator desiring a permit shall file an application which shall state:
  - (b) The legal description and area of land to be affected by the operation;
  - (c) The owner or owners of the surface of the area of land to be affected;
  - (d) The owner or owners of the substance to be mined;
  - (e) The source of the applicant’s legal right to enter and open mine on the land affected by the permit;
  - (f) The address of the general office and the local address or addresses of the applicant;
  - (g) Whether the applicant or any affiliated person holds or has held any other permits under this article, and an identification of such permits;
  - (h) The detailed description of the method of operation to be employed;
  - (i) The size of the area or areas to be worked at any one time; and

- (j) The timetable giving the periods of time which will be required for the various stages of the operation.
- (3) (a) The application for a permit shall be accompanied by two copies of an accurate map of the area affected. The map shall:
- Be made by a qualified person, registered land surveyor, or professional engineer;
  - Identify the area which corresponds with the application;
  - Show adjacent deep mining and adjacent surface owners;
  - Be made to a scale of not less than one hundred feet to the inch and not to exceed six hundred sixty feet to the inch;
  - Show the name and location of all creeks, roads, buildings, oil and gas wells and lines, and power and communication lines on the area of affected land and within two hundred feet of all boundaries of such area;
  - Show the total area to be involved in the operation including the area to be mined and the area of land affected;
  - Show the topography of the area with contour lines of sufficient detail to portray the direction and rate of slope of the land in question;
  - Indicate the general type, thickness and distribution of soil over the area in question.
  - Show the type, character, and density of present vegetation covering the area in question;
  - Show the depth and thickness of the coal, sand, gravel, quarry aggregate, or limestone used for construction purposes, to be mined and the thickness and type of the overburden to be removed; and
  - Show the expected physical appearance of the area to be mined and the area of land affected, correlated to the timetable required by paragraph (j) of subsection (2) of this section.
- (4) A basic fee of fifty dollars plus fifteen dollars for each acre or fraction thereof of the area of land to be affected by the operation shall be paid before the issuance of the permit and shall accompany the application. The application shall also be accompanied by a bond meeting the requirements of section 92-13-8.
- (5) (a) Upon receipt of an application, fee, and bond or security as required by this article, the board shall review the application and accompanying maps and issue a permit if:
- The method of operation, physical appearance, and timetable are reasonable in view of the public interest in physically attractive surroundings and completion of the operation as soon as practicable;
  - The operator makes a satisfactory showing to the board that his operation will not adversely affect the stability of any man-made structure on the area of the affected land and within two hundred feet of all boundaries of such area;

(d) In the case of an application for a permit to extract sand, gravel, and quarry aggregate, the extractor shall complete such extraction and begin reclamation within five years after the initial permit is issued. All reclamation is to be completed within three years after the date the operator advises the board that reclamation has commenced as provided in section 92-13-6 (1) (a) (i).

(6) An operator may within the term of a permit apply to the board for a permit renewal or for an amendment to the permit increasing or decreasing the acreage to be affected. There shall be filed with any application for amendment a map and form with the same content as required for an original application, and the application shall be accompanied by a basic fee of ten dollars plus a fee of fifteen dollars for each acre or fraction thereof by which the original area is to be increased and a supplemental bond for such additional acreage. If the area of the original application is reduced, the amount of the bond shall proportionately be reduced. Renewal applications shall contain the information required in the original application if different from that in the original application or renewal. The renewal permit shall show the area mined or disturbed and the area reclaimed since the original permit or the last renewal. Applications for renewal or amendment of a permit shall be reviewed by the board in the same manner as provided in subsection (5) of this section with regard to applications for new permits.

**92-13-6. Duties of Operator.** - (1) (a) Every operator to whom a permit is issued pursuant to the provisions of this article may engage in open mining upon the lands described in the permit, upon the performance of and subject to the following requirements with respect to such lands:

- On or before July 1 of each year the operator shall submit a reclamation plan and map showing the affected area and other pertinent details, such as roads and access to the area, and reclamation accomplished. All maps shall show quarter section, township, and county lines within the scope of the map, access to the area from the nearest public road, a meridian, a title containing the name of the operator and his address, the scale of the map, the name of the person or engineer who prepared the map, the date, and the township, range, and county. The reclamation plan prepared by the operator shall be based upon provisions for, or satisfactory explanation of, all general requirements for the type of reclamation chosen. The details of the plan shall be appropriate to the type of reclamation designated by the operator and based upon the advice of technically trained personnel experienced in that type of reclamation on open mined lands and upon scientific knowledge from research in reclaiming and utilizing open mined lands.
- Grading shall be carried on by striking off ridges to a width of not less than fifteen feet at the top and peaks to a width of not less than fifteen feet at the top. In all cases, an even or gently undulating skyline will be a major objective.
- Earth dams shall be constructed in final cuts of all operations, where practical, if necessary to impound water, if the formation of such impoundments will not interfere with mining operations or damage adjoining property.
- Acid forming material in the exposed face of a mineral seam that has been mined shall be covered with earth or spoil material to a depth which will protect the drainage system from pollution, unless covered with water to a depth of not less than four feet.
- All refuse shall be disposed of in a manner that will control stream pollution, unsightliness, or deleterious effects from such refuse, and water from the mining operation shall be diverted in a manner designed to control siltation, erosion, or other damage to streams and natural watercourses.

- (g) On all affected land, the operator, subject to the approval of the board, shall determine which parts of the affected land shall be reclaimed for forest, range, crop, horticultural, recreational, industrial, or other uses, including food, shelter, and ground cover for wildlife. Prior to approving any new reclamation plan or approving a change in any existing reclamation plan as provided in this section, the board shall confer with the local board of county commissioners and the board of supervisors of the soil conservation district if the open mining operation is within the boundaries of a soil conservation district. Reclamation shall be required on all the affected land.
- (h) If the operator's choice of reclamation is forest planting, he may, with the approval of the department, select the type of trees to be planted. Tree planting shall be carried out based on a spacing of approximately ten feet by ten feet, and approximately four hundred thirty-five trees per acre. Planting methods and care of stock shall be governed by good planting practices. If the operator is unable to acquire sufficient planting stock of desired tree species from the state or elsewhere, at a reasonable cost, he may defer planting until planting stock is available to plant such land as originally planned, or he may select an alternate method of reclamation.
- (i) The operator shall construct fire lanes or access roads when necessary through the area to be planted. These lanes or roads shall be available for use by the planting crews, and shall serve as a means of access for supervision and inspection of the planting work.
- (j) On lands owned by the operator, the operator may permit the public to use the same for recreational purposes in accordance with the limited landowner liability law contained in article 4 of chapter 62, C.R.S. 1963, except in areas where such use is found by the operator to be hazardous or objectionable.
- (k) If the operator's choice of reclamation is for range, he shall strike off all the peaks and ridges to a width of not less than fifteen feet, in accordance with the other requirements of this article, prior to the time of seeding. To the greatest extent possible, the affected land shall be restored to slopes commensurate with the proposed land use and shall not be too steep to be traversed by livestock, subject to the approval of the board. The legume seed shall be properly inoculated in all cases. The area may be seeded either by hand, power, or the aerial method. The species of grasses and legumes and the rates of seeding to be used per acre shall be determined primarily by recommendations from the agricultural experiment stations established pursuant to article 13 of chapter 124, C.R.S. 1963, and experienced reclamation personnel of the operator, after considering other research or successful experience with range seeding. No grazing shall be permitted on reclaimed land until the planting is firmly established. The board in consultation with the landowner and the local soil conservation district, if any, shall determine when grazing may start.
- (l) If the operator's choice of reclamation is for agricultural or horticultural crops which normally require the use of farm equipment, the operator shall grade off peaks and ridges and fill valleys, except the highwall of the final cut, so that the area can be traversed with farm machinery. Preparation for seeding or planting, fertilization, and seeding or planting rates shall be governed by general agricultural and horticultural practices, except where research or experience in such operations differs with such practices.
- (m) If the operator's choice of reclamation is for the development of the affected area for homesite, recreational, industrial, or other uses, including food, shelter, and ground cover for wildlife, the basic minimum requirements necessary for such reclamation shall be agreed upon by the operator and the board.
- (n) (i) All reclamation provided for in this section shall be carried to completion by the operator with all reasonable diligence and shall be completed prior to the expiration of three years after the date on which the operator advises the board that reclamation work has commenced, except that:
- (ii) No planting of any kind shall be required to be made on any affected land being used or proposed to be used by the operator for the deposit or disposal of refuse until after the cessation of operations productive of such refuse, or proposed for future mining, or within depressed haulage roads or final cuts while such roads or final cuts are being used or made, or any area where permanent pools or lakes have been formed;
- (iii) No planting of any kind shall be required on any affected land, so long as the chemical and physical characteristics of the surface and immediately underlying material of such affected land are toxic, deficient in plant nutrients, or composed of sand, gravel, shale, or stone to such an extent as to seriously inhibit plant growth and such condition cannot feasibly be remedied by chemical treatment, fertilization, replacement of overburden, or like measures. Where natural weathering and leaching of any such affected land, over a period of ten years after the end of the year in which open mining was completed thereon, fails to remove the toxic and physical characteristics inhibitory to plant growth, or if, at any time within such ten-year period, the board determines any of such affected land is and during the remainder of said ten-year period will be unplantable, the operator's obligations under the provisions of this article with respect to such affected land may, with the approval of the board, be discharged by reclamation of an equal number of acres of land previously mined and owned by the operator not otherwise subject to reclamation under this article. With the approval of the board, the operator may substitute, for all or any part of the affected land to be reclaimed, an equal number of acres of land previously mined and not reclaimed. If any area is so substituted, the operator shall submit a map of the substituted area, which map shall conform to all of the requirements with respect to other maps required by this article. Upon completion of reclamation of the substituted land, the operator shall be relieved of all obligations under this article with respect to the land for which substitution has been permitted.
- 92-13-7. **Entry upon lands for inspection.** – The board, bureau of mines of the state of Colorado, the chief inspector of coal mines, or their authorized representatives may enter upon the lands of the operator at all reasonable times for the purpose of inspection to determine whether the provisions of this article have been complied with.
- 92-13-8. **Bond of operator – amount – sufficiency of surety – violations-compliance.** (1) Any bond required under this article to be filed by the operator shall be in such form as the board prescribes, payable to the state of Colorado, conditioned that the operator shall faithfully perform all requirements of this article and comply with all rules and regulations made in accordance with the provisions of this article. Such bond shall be signed by the operator as principal and by a good and sufficient corporate surety authorized to do business in this state. The penalty of such bond shall be in such amount as the board deems necessary to insure the performance of the duties of the operator under this article with respect to the affected land. If a county or municipality requires, in the opinion of the board, an adequate reclamation plan and a bond sufficient to carry out that plan, evidence of such plan and bond shall be acceptable to the board. In lieu of such bond, the operator may deposit cash and government securities with the board in an amount equal to that of the required bond on conditions as prescribed in this subsection (1). In the discretion of the board, surety bond requirements may also be fulfilled by using existing reclaimed areas if owned by the operator in excess of cumulative permit or mined acres that have been reclaimed under the provisions of this article



and approved by the board. The penalty of the bond or amount of cash and securities shall be increased or reduced from time to time, as provided in this article. Such bond or security shall remain in effect until the mined acreages have been reclaimed, approved, and released by the board.

(2) A bond filed as above prescribed shall not be cancelled by the surety without giving at least sixty days' notice to the board prior to the anniversary date of its intent to limit exposure to existing circumstances as of the next anniversary date. In such event the operator shall provide substitute surety covering operations or post cash bond in lieu thereof.

(3) If the license to do business in this state of any surety upon a bond filed with the board pursuant to this article shall be suspended or revoked, the operator, within sixty days after receiving notice thereof from the board, shall substitute for such surety a good and sufficient corporate surety licensed to do business in the state. Upon failure of the operator to make substitution of surety, the board shall have the right to suspend the permit of the operator to conduct operations upon the land described in such permit until such substitution has been made.

(4) The board shall have the power to reclaim, in accordance with the provisions of this article, any affected land with respect to which a bond has been forfeited.

(5) Whenever an operator shall have completed all requirements under the provisions of this article as to any affected land, he shall notify the board. If the board shall release the operator from further obligations regarding such affected land, the penalty of the bond shall be reduced proportionately.

**92-13-9. Violations – administrative procedures – appeals from orders of the board.** – (1) Whenever the board determines that an operator has not complied with the provisions of this article, the board shall, by private conference, conciliation, and persuasion, endeavor to remedy such violation. In case of the failure of such conference, conciliation, and persuasion to remedy any alleged violation, the board may cause to have issued and served upon the operator alleged to be committing such violation a written notice which shall specify the provision of this article which such operator allegedly is violating, and a statement of the manner in and the extent to which said operator is alleged to be violating this article, and shall require the operator so complained against to answer the charges of such formal complaint at a hearing before the board at a time not less than thirty days after the date of the notice. The board shall issue subpoenas at the request of the charged operator, requiring the attendance of witnesses and the production of such papers and documents as are relevant to such hearing. At such hearing, the charged operator may appear in person or by counsel, testimony shall be taken under oath and recorded stenographically, and the charged operator may cross-examine witnesses. A copy of the record of such hearing shall be furnished to the charged operator upon payment of the cost thereof. The board shall enter such order as it deems appropriate to effectuate the purposes of this article and shall forthwith mail a copy thereof to the charged operator or the operator's attorney of record. If such order of the board is not complied with in the required time, the board may then commence proceedings under section 92-13-13.

(2) An operator subjected to any order of the executive director or the board, including an order of refusal to issue or amend a permit, as the case may be, may institute proceedings to have such order reviewed in a court of competent jurisdiction in accordance with the provisions of section 3-16-5, C.R.S. 1963. The filing of such court proceedings shall stay the enforcement of such order.

**92-13-10. Fees and forfeitures – deposit.** – All fees and forfeitures collected under the provisions of this article shall be deposited in the general fund.

**92-13-11. Administration.** – In addition to the duties and powers of the department prescribed by the provisions of article 16 of chapter 3, C.R.S. 1963, as amended, it shall have full power and authority to carry out and administer the provisions of this article.

**92-13-12. Rules and regulations.** – The board may adopt and promulgate reasonable rules and regulations respecting the administration of this article and in conformity therewith.

**92-13-13. Bond forfeiture proceedings – prerequisites – penalties.** – (1) Subject to the provisions of section 92-13-9, the attorney general, upon request of the board, shall institute proceedings to have the bond of the operator forfeited for violation by the operator of an order entered pursuant to section 92-13-9. Before making such request of the attorney general, the board shall notify the operator in writing of the alleged violation of or noncompliance with such order and shall afford the operator the right to appear before the board at a hearing to be held not less than thirty days after the receipt of such notice by the operator. At the hearing the operator may present for the consideration of the board statements, documents, and other information with respect to the alleged violation. After the conclusion of the hearings, the board shall either withdraw the notice of violation or shall request the attorney general to institute proceedings to have the bond of the operator forfeited as to the land involved.

(2) Any person required by this article to have a permit who engages in new open mining without previously securing a permit to do so as prescribed by this article, is guilty of a misdemeanor, and upon conviction thereof shall be fined not less than fifty dollars nor more than one thousand dollars. Each day of operation without the permit required by this article shall be deemed a separate violation.

**92-13-14. Land reclamation board – created.** – (1) There is hereby created as a part of the division of mines in the department of natural resources the land reclamation board.

(2) The board shall consist of five members: The executive director of the department of natural resources, who shall be chairman; the deputy commissioner of mines; the chief inspector of coal mines; the state geologist; and a member of the state soil conservation board designated by such board. The members of the board shall receive no additional compensation for their services on the board but shall be reimbursed for necessary expenses incurred in the performance of their duties on the board.

(3) The board shall exercise its powers and perform its duties and functions specified in this article under the department of natural resources as if the same were transferred to the department by a type I transfer as such transfer is defined in the "Administrative Organization Act of 1968", being article 28 of chapter 3, C.R.S. 1963.

**92-13-15. Duties of the board.** – (1) (a) The board shall:

- (b) Meet at least once each month;
- (c) Carry on a continuing review of the problems of open mining and land reclamation in the state of Colorado;

(d) Develop and promulgate standards for land reclamation plans and substitution of affected lands as provided in section 92-13-6;

(e) Administer the land reclamation fund and determine the order of priority of reclamation of previously open mined lands as funds are available.

(2) It shall be the duty of the department of agriculture, department of higher education, state soil conservation board, Colorado geological survey, division of game, fish, and parks, the university of Colorado, Colorado state university, Colorado school of mines and the state forester to furnish the board and its designees, as far as practical, whatever data and technical assistance the board may request and deem necessary for the performance of total reclamation and enforcement duties.

**92-13-16. Powers of board.** – The board may: Initiate and encourage studies and programs through the department and in other agencies and institutions of state government relating to the development of less destructive methods of open mining; better methods of land reclamation; more effective reclaimed land use; and coordination of the provisions of this article with the programs of other state agencies dealing with environmental, recreational, rehabilitation, and related concerns.

**92-13-17. Operators – succession.** – (1) (a) Where one operator succeeds another at any uncompleted operation, the board may release the first operator from all liability as to that particular reclamation operation and may release his bond as to such operation if:

(b) Both operators have been issued a permit with respect to the operation;

(c) Both operators are in full compliance with the requirements of this article as to all of their operations within this state; and

(d) The successor operator assumes as part of his obligation under this article all liability for the reclamation of the land affected by the operation and his obligation is covered by an appropriate bond as to such affected land.

**92-13-18. Permit refused defaulting operator.** – No permit for new open mining shall be granted to any operator who is currently found to be in violation of the provisions of this article with respect to any operation in this state.

**92-36-1. Legislative declaration.** – (1) (a) The general assembly hereby declares that:

(b) The state's commercial mineral deposits are essential to the state's economy.

(c) The populous counties of the state face a critical shortage of such deposits.

(d) Such deposits should be extracted according to a rational plan, calculated to avoid waste of such deposits and cause the least practical disruption of the ecology and quality of life of the citizens of the populous counties of the state.

(2) The general assembly further declares that, for the reasons stated in subsection (1) of this section, the regulation of commercial mineral deposits, the preservation of access to and extraction of such deposits, and the development of a rational plan for extraction of such deposits are matters of concern in the populous counties of the state. It is the intention of the general assembly that the provisions of this article have full force and effect throughout such populous counties, including, but not limited to, the city and county of Denver and any other home rule city or town within each such populous county but shall have no application outside such populous counties.

**92-36-2. Definitions.** – (1) As used in this article, unless the context otherwise requires:

(2) "Commercial mineral deposit" means a natural mineral deposit of limestone used for construction purposes, coal, sand, gravel, and quarry aggregate, for which extraction by an extractor is or will be commercially feasible and regarding which it can be demonstrated by geologic, mineralogic, or other scientific data that such deposit has significant economic or strategic value to the area, state, or nation.

(3) "Extractor" means any individual, partnership, association, or corporation which extracts commercial mineral deposits for use in the business of selling such deposits or for use in another business owned by the extractor or any department or division of federal, state, county, or municipal government which extracts such deposits.

(4) "Populous county or populous counties of the state" means any county or city and county having a population of sixty-five thousand inhabitants or more according to the latest federal decennial census.

**92-36-3. Geological survey to make study.** – After July 1, 1973, the Colorado geological survey shall contract for a study of the commercial mineral deposits in the populous counties of the state in order to identify and locate such deposits. Such study shall be of sand, gravel, and quarry aggregate, and shall be completed on or before July 1, 1974, and shall include a map or maps of the state showing such commercial mineral deposits, copies of which may be generally circulated. Any commercial mineral deposits discovered subsequent to July 1, 1974, may be, upon discovery, included in such study.

**92-36-4. Master plan for extraction.** – (1) (a) The county planning commission for unincorporated areas and for cities and towns having no planning commission or the planning commission for each city and county, city, or town, within each populous county of the state, shall, with the aid of the map or maps from the study conducted pursuant to section 92-36-3, conduct a study of the commercial mineral deposits located within its jurisdiction and develop a master plan for the extraction of such deposits, which plan shall consist of text and maps. In developing the master plan, the planning commission shall consider, among others, the following factors:

(b) Any system adopted by the Colorado geological survey grading commercial mineral deposits according to such factors as magnitude of the deposit and time of availability for and feasibility of extraction of a deposit;

(c) The potential for effective multiple-sequential use which would result in the optimum benefit to the landowner, neighboring residents, and the community as a whole;

(d) The development or preservation of land to enhance development of physically attractive surroundings compatible with the surrounding area;

(e) The quality of life of the residents in and around areas which contain commercial mineral deposits.

(f) Other master plans of the county, city and county, city, or town;

(g) Maximization of extraction of commercial mineral deposits; and

(h) The ability to reclaim an area pursuant to the provisions of article 13 of this chapter.

(2) A planning commission shall cooperate with the planning commissions of contiguous areas and the land reclamation board created by section 92-13-14 in conducting the study and developing the master plan for extraction.

(3) (a) A county planning commission shall certify its master plan for extraction to the board of county commissioners or the governing body of the city or town where the county planning commission is acting in lieu of a city or town planning commission. A planning commission in any city and county, city, or town shall certify its master plan for extraction to the governing body of such city and county, city, or town.

(b) After receiving the certification of such master plan and before adoption of such plan, the board of county commissioners or governing body of a city and county, city, or town shall hold a public hearing thereon, and at least thirty days' notice of the time and place of such hearing shall be given by one publication in a newspaper of general circulation in the county, city and county, city, or town. Such notice shall state the place at which the text and maps so certified may be examined.

(4) The board of county commissioners or governing body of a city and county, city, or town may, after such public hearing, adopt the plan, revise the plan with the advice of the planning commission and adopt it, or return the plan to the planning commission for further study and rehearing before adoption, but, in any case, a master plan for extraction of commercial mineral deposits shall be adopted for the unincorporated territory and any city and county, city, or town in each populous county of the state on or before July 1, 1975.

**92-36-5. Preservation of commercial mineral deposits for extraction.** - (1) After July 1, 1973, no board of county commissioners, governing body of any city and county, city, or town, or other governmental authority which has control over zoning shall, by zoning, rezoning, granting a variance, or other official action or inaction, permit the use of any area known to contain a commercial mineral deposit in a manner which would interfere with the present or future extraction of such deposit by an extractor.

(2) After adoption of a master plan for extraction for an area under its jurisdiction, no board of county commissioners, governing body of any city and county, city, or town, or other governmental authority which has control over zoning shall, by zoning, rezoning, granting a variance, or other official action or inaction, permit the use of any area containing a commercial mineral deposit in a manner which would interfere with the present or future extraction of such deposit by an extractor.

(3) (a) Nothing in this section shall be construed to prohibit a board of county commissioners, a governing body of any city and county, city, or town, or any other governmental authority which has control over zoning from zoning or rezoning land to permit a certain use, if:

(b) Said use does not permit erection of permanent structures upon, or otherwise permanently preclude the extraction of commercial mineral deposits by an extractor from, land subject to said use.

(4) Nothing in this section shall be construed to prohibit a board of county commissioners, a governing body of any city and county, city, or town, or other governmental authority which has control over zoning from zoning for agricultural use, only, land not otherwise zoned on July 1, 1973.

(5) Nothing in this section shall be construed to prohibit a use of zoned land permissible under the zoning governing such land on July 1, 1973.

The following extracts of various portions of the Colorado statutes are quoted to provide additional amplification or qualifying information regarding mined land reclamation activities and related responsibilities. They are added in the order of their appearance in the statutes.

**3-28-24. Department of natural resources - creation.** - (3) (f) (v) The land reclamation board, created by article 13 of chapter 92, C.R.S. 1963, and its powers, duties, and functions are transferred by a *type I* transfer to the department of natural resources as a part of the division of mines.

**64-1-3. Objectives of the survey - duties of the director.** - (3) The state geologist shall conduct a study and prepare a map or maps as provided in section 92-36-3, C.R.S. 1963.

(4) The state geologist shall, upon receiving a preliminary plan pursuant to section 106-2-37 (1) (i), C.R.S. 1963, or a major activity notice pursuant to section 139-59-25, C.R.S. 1963, review such plan or notice to determine whether the development or activity which is the subject of such plan or notice will interfere with the extraction of commercial mineral deposits as defined in section 92-36-2, C.R.S. 1963. If the state geologist determines that a potential for such interference exists, he shall, within twenty-four days after mailing such plan or notice, notify the appropriate board of county commissioners or governing body of a municipality of the existence of such potential interference.

**106-2-5. Adoption of master plan - contents.** - (3) The master plan of a county or region, with the accompanying maps, plans, charts, and descriptive and explanatory matter, shall show the county or regional planning commission's recommendations for the development of the territory covered by the plan and may include: the general location, character, and extent of streets or roads, viaducts, bridges, parkways, playgrounds, forests, reservations, parks, airports, and other public ways, grounds, places, and spaces; the general location and extent of public utilities and terminals, whether publicly or privately owned, for water, light, power, sanitation, transportation, communication, heat, and other purposes; the acceptance, widening, removal, extension, relocation, narrowing, vacation, abandonment, or change of use of any of the foregoing public ways, grounds, places, spaces, buildings, properties, utilities, or terminals; the general character, location, and extent of community centers, townships, housing developments, whether public or private, and urban conservation or redevelopment areas; the general location and extent of forests, agricultural areas, flood control areas, and open development areas for purposes of conservation, flood and water supply, sanitary and drainage facilities, flood control, or the protection of urban development; and a land classification and utilization program. The master plan of a county or region shall also include a master plan for the extraction of commercial mineral deposits pursuant to section 92-36-4, C.R.S. 1963.

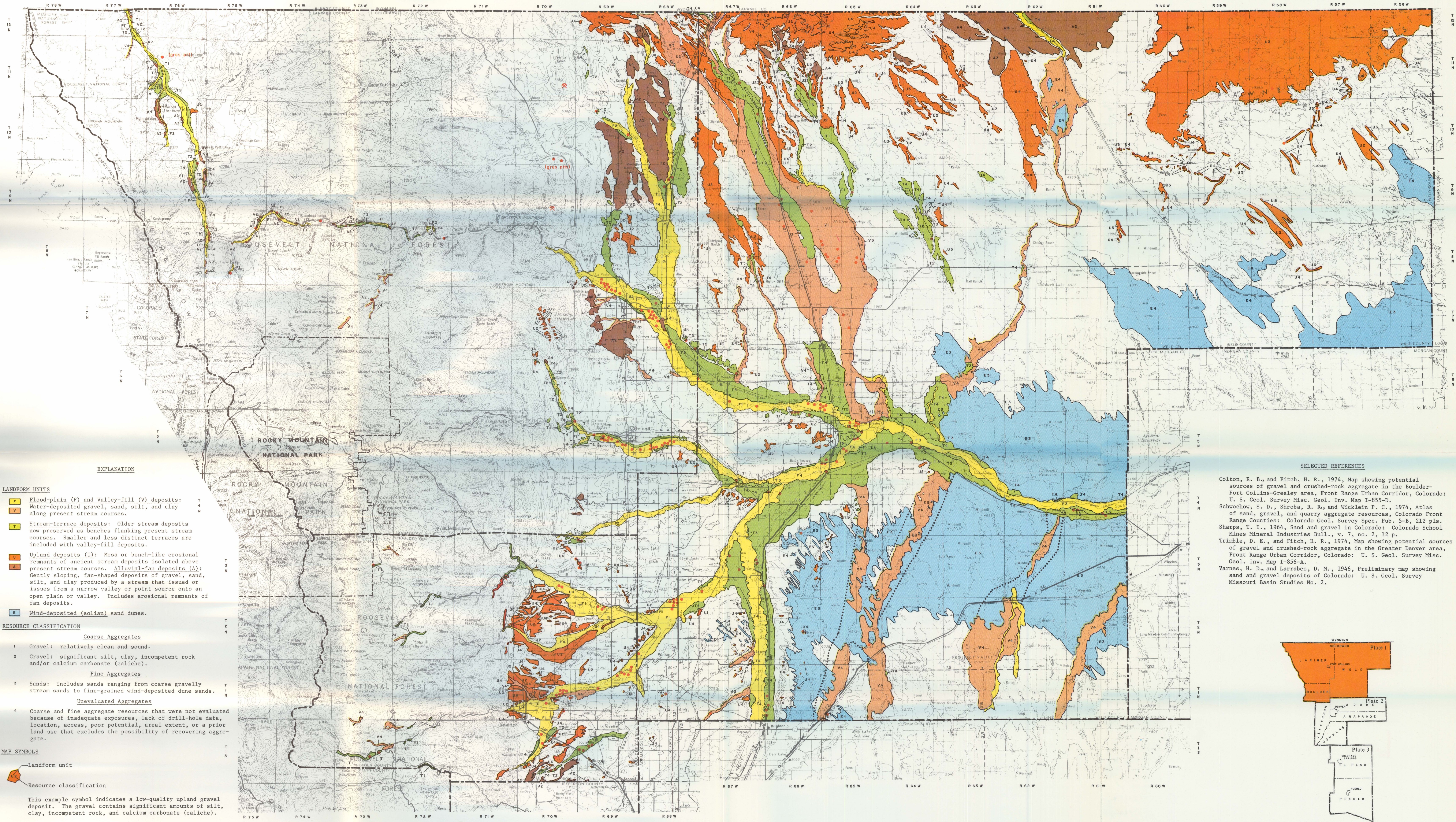
**106-2-12. Regulation of size and use - districts.** - (1) Except as otherwise provided in section 92-36-5, C.R.S. 1963, when the county planning commission of any county makes, adopts, and certifies to the board of county commissioners plans for zoning the unincorporated territory within any county, or any part thereof, including both the full text of a zoning resolution and the maps, after public hearing thereon, the board of county commissioners, by resolution, may regulate, in any portions of such county which lie outside of cities and towns, the location, height, bulk and size of buildings and other structures, the percentage of lot which may be occupied, the size of yards, courts, and other open spaces, the uses of buildings and structures for trade, industry, residence, recreation, public activities, or other purposes, and the uses of land for trade, industry, residence, recreation, or other purposes and for flood control. In order to accomplish such regulation, the board of county commissioners

may divide the territory of the county which lies outside of cities and towns into districts or zones of such number, shape, or area as it may determine, and within such districts, or any of them, may regulate the erection, construction, reconstruction, alteration, and uses of buildings and structures and the uses of land, and may require and provide for the issuance of building permits as a condition precedent to the right to erect, construct, reconstruct, or alter any building or structure within any district covered by such zoning resolution.

**139-59-25. Major activity notice.** – Whenever a subdivision or commercial or industrial activity is proposed which will cover five or more acres of land, the governing body of the municipality in which the activity is proposed shall send notice to the Colorado land use commission, the state geologist, and the board of county commissioners of the county or counties in which the improvement is located of the proposal prior to approval of any zoning change, subdivision, or building permit application associated with such a proposed activity. Such notice shall be in a standard form, shall be promulgated as a rule and regulation prescribed by the land use commission, and shall contain such information as the land use commission shall prescribe.

**139-60-1. Grant of power.** – (1) Except as otherwise provided in section 92-36-5, C.R.S. 1963, for the purpose of promoting health, safety, morals, or the general welfare of the community, the legislative body of each city and incorporated town is empowered to regulate and restrict the height, number of stories, and size of buildings and other structures, the percentage of lot that may be occupied, the size of yards, courts, and other open spaces, the density of population, and the location and use of buildings, structures, and land for trade, industry, residence, or other purposes. Such regulations may provide that a board of adjustment may determine and vary their application in harmony with their general purpose and intent and in accordance with general or specific rules therein contained. Subject to the provisions of subsection (2) of this section, and to the end that adequate safety may be secured, said legislative body shall also have power to establish, regulate, restrict, and limit such uses on or along any storm or floodwater runoff channel or basin, as such storm or floodwater runoff channel or basin has been designated and approved by the Colorado water conservation board, in order to lessen or avoid the hazards to persons and damage to property resulting from the accumulation of storm or floodwaters. Any ordinance enacted under authority of this article shall exempt from the operation thereof any building or structure as to which satisfactory proof shall be presented to the board of adjustment provided for in this article that the present or proposed situation of such building or structure is reasonably necessary for the convenience or welfare of the public.





**EXPLANATION**

- LANDFORM UNITS**
- Flood-plain (F) and Valley-fill (V) deposits: Water-deposited gravel, sand, silt, and clay along present stream courses.
  - Stream-terrace deposits: Older stream deposits now preserved as benches flanking present stream courses. Smaller and less distinct terraces are included with valley-fill deposits.
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  - Wind-deposited (eolian) sand dunes.
- RESOURCE CLASSIFICATION**
- Coarse Aggregates**
    - 1 Gravel: relatively clean and sound.
    - 2 Gravel: significant silt, clay, incompetent rock and/or calcium carbonate (caliche).
  - Fine Aggregates**
    - 3 Sands: includes sands ranging from coarse gravelly stream sands to fine-grained wind-deposited dune sands.
  - Unevaluated Aggregates**
    - 4 Coarse and fine aggregate resources that were not evaluated because of inadequate exposure, lack of drill-hole data, location, access, poor potential, areal extent, or a prior land use that excludes the possibility of recovering aggregate.

**MAP SYMBOLS**

- Landform unit
- Resource classification
- Location of active or inactive gravel and sand pits.
- Potential quarry aggregate resource area. Only the areas of most suitable rock for quarry aggregate are shown. Although some operating stone quarries lie within these potential resource areas, some quarries have been located in less suitable rock for environmental and economic reasons.
- Carbonates
- Volcanics and Intrusives
- Quartzite
- ✂ Active and inactive stone quarries.
- Approximate boundaries of buried stream valleys.

**SELECTED REFERENCES**

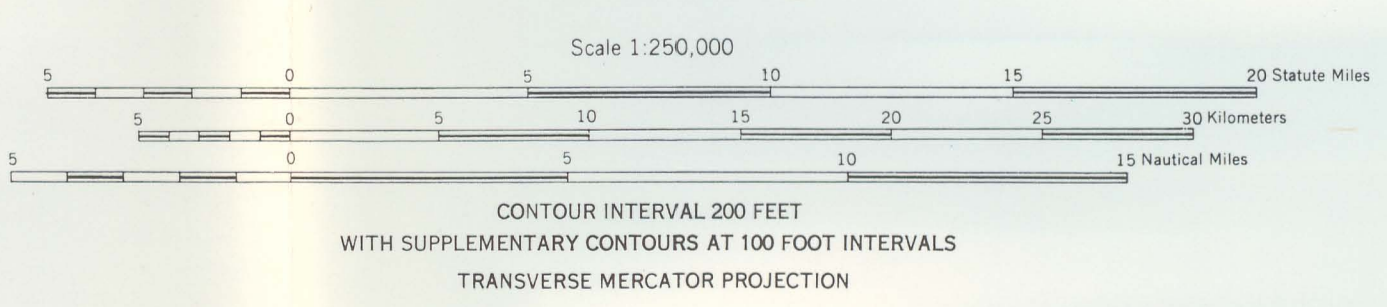
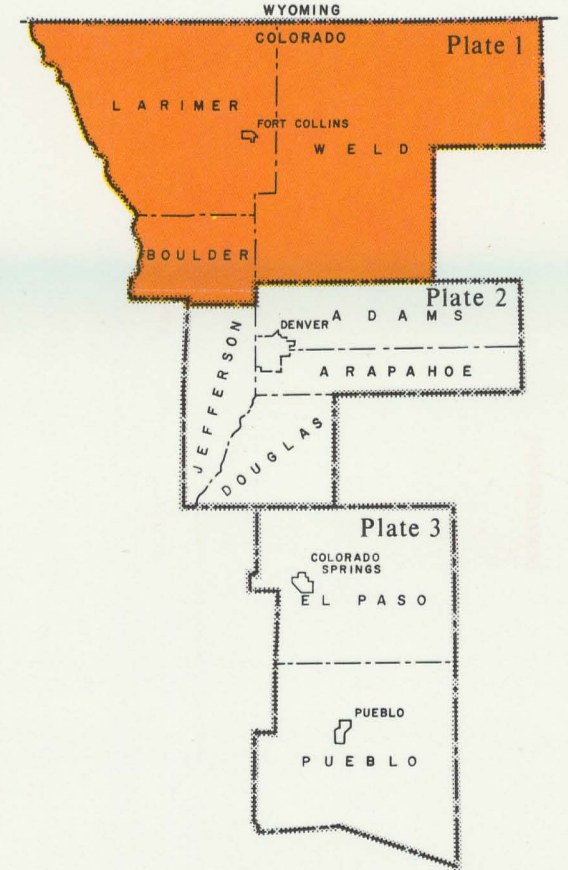
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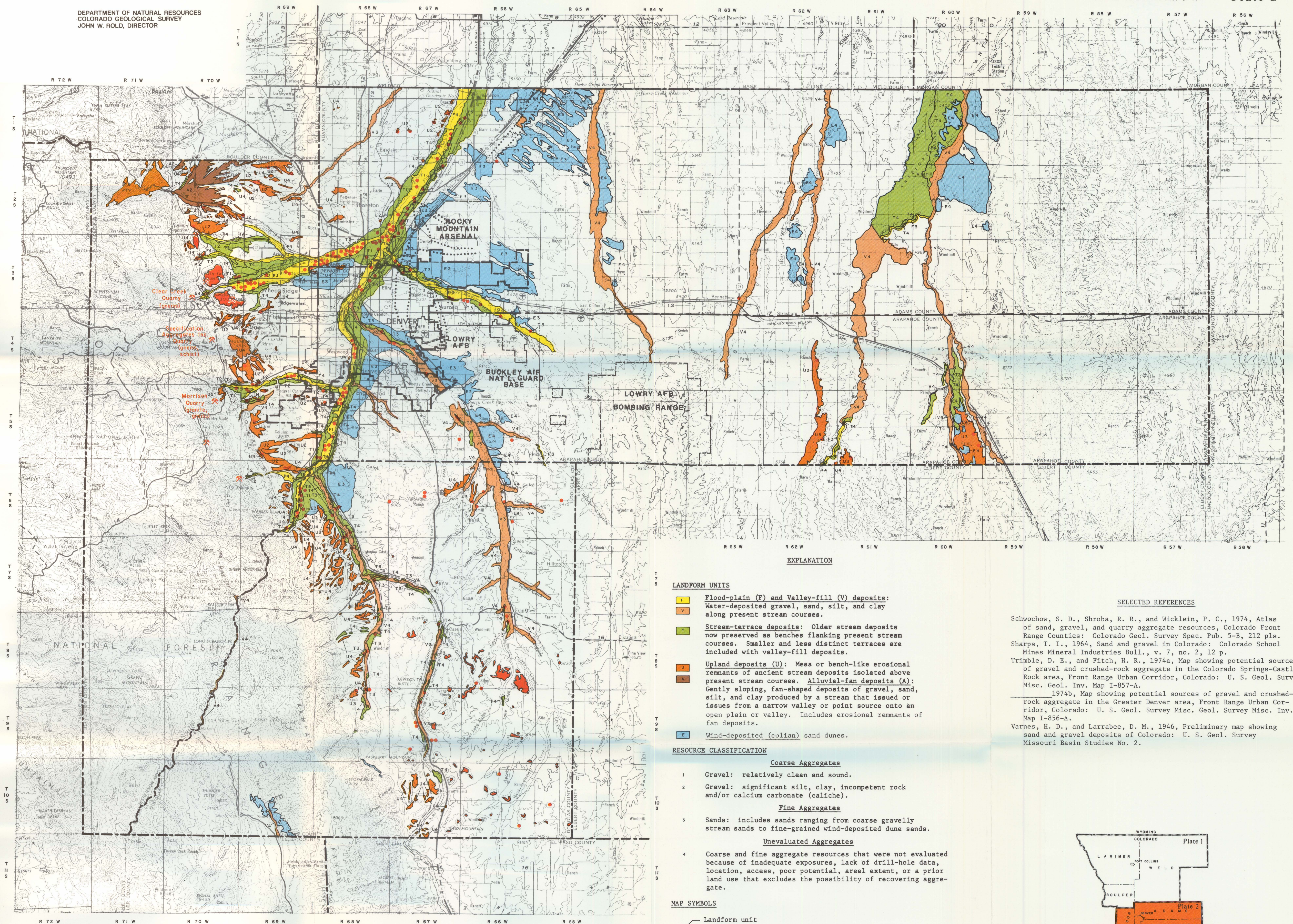


**SAND, GRAVEL, AND QUARRY AGGREGATE RESOURCES OF THE COLORADO FRONT RANGE COUNTIES**

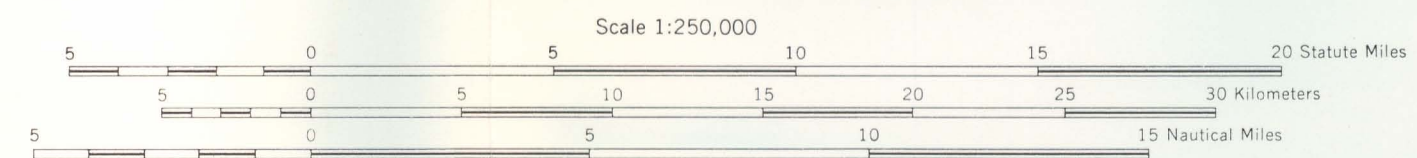
BY  
 S. D. Schwochow, R. R. Shroba and P. C. Wicklein  
 1974  
 Graphics by Robert H. Gast



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



Base Map by the Army Map Service and U. S. Geological Survey



## SAND, GRAVEL, AND QUARRY AGGREGATE RESOURCES OF THE COLORADO FRONT RANGE COUNTIES

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### EXPLANATION

#### LANDFORM UNITS

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- E Wind-deposited (eolian) sand dunes.

#### RESOURCE CLASSIFICATION

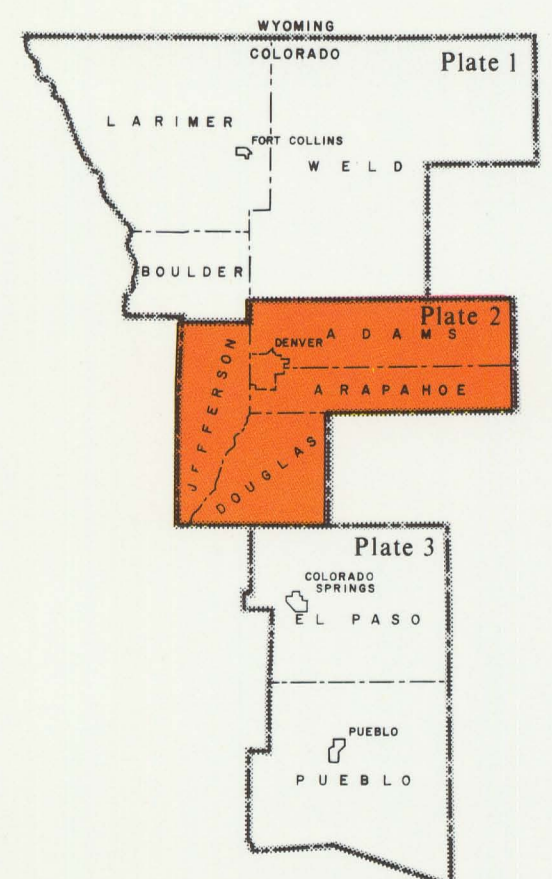
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- Unevaluated Aggregates**
  - 4 Coarse and fine aggregate resources that were not evaluated because of inadequate exposures, lack of drill-hole data, location, access, poor potential, areal extent, or a prior land use that excludes the possibility of recovering aggregate.

#### MAP SYMBOLS

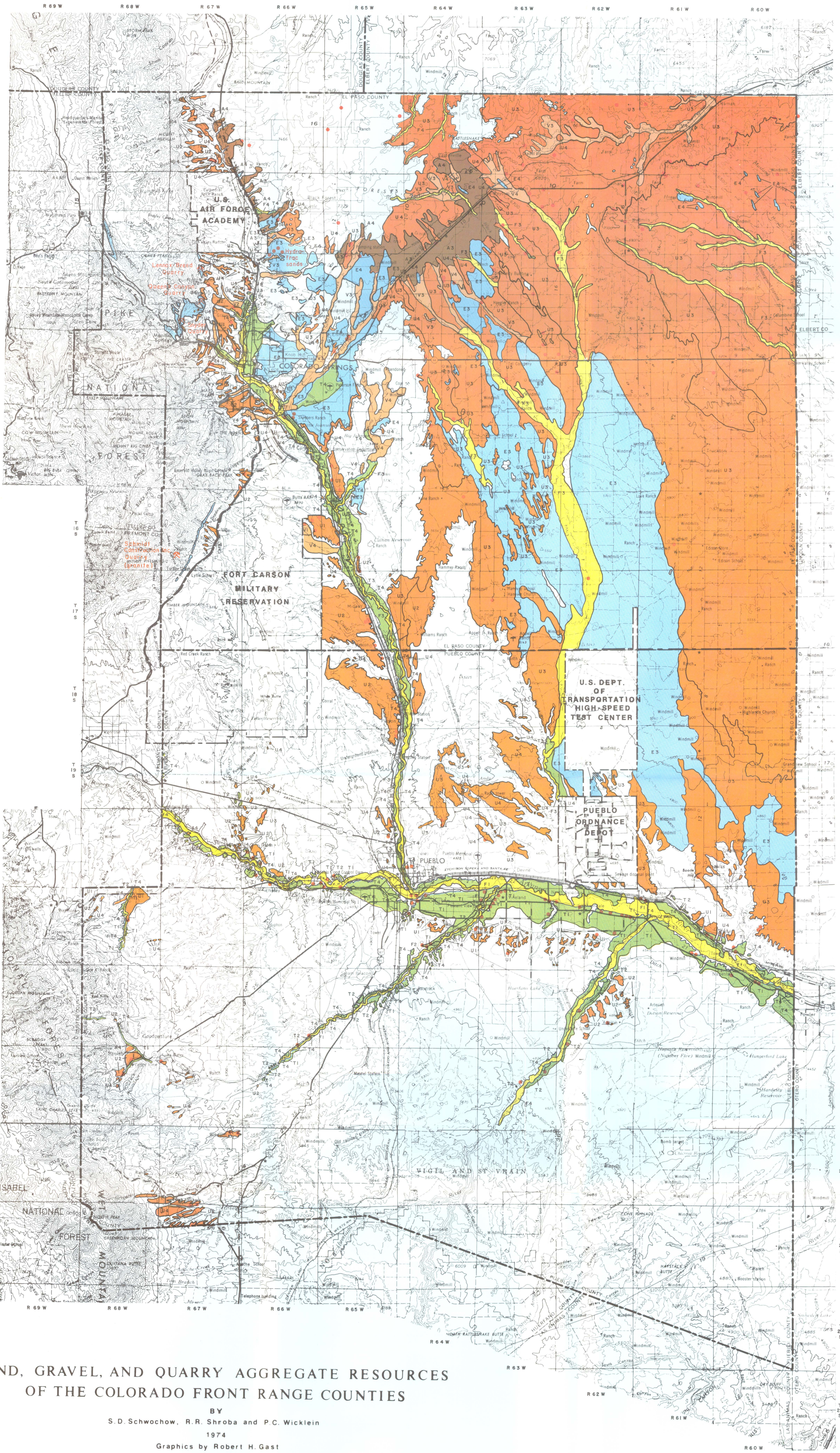
- U2 Landform unit
- Resource classification
- Location of active or inactive gravel and sand pits.
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- Volcanics and Intrusives
- Quartzite
- Active and inactive stone quarries.
- ⋯ Approximate boundaries of buried stream valleys.

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EXPLANATION

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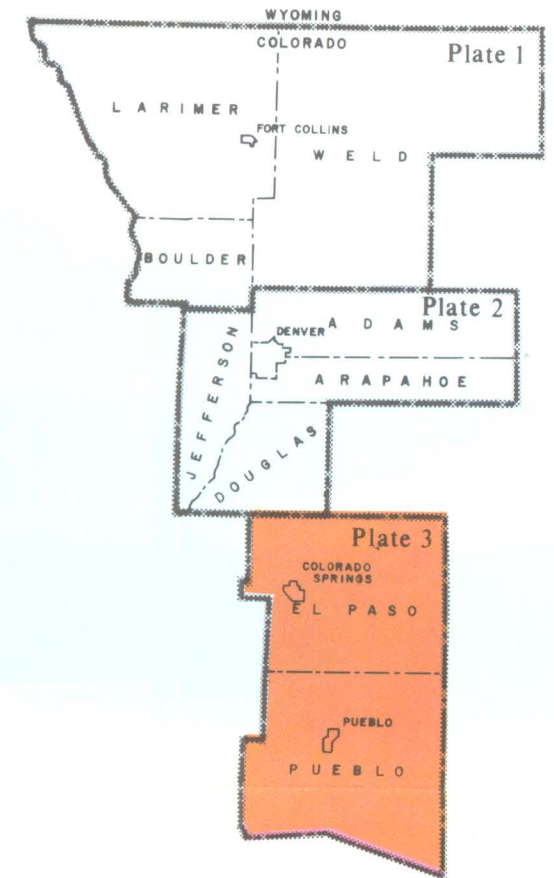
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MAP SYMBOLS

- Landform unit
- Resource classification
- This example symbol indicates a low-quality upland gravel deposit. The gravel contains significant amounts of silt, clay, incompetent rock, and calcium carbonate (caliche).
- Location of active or inactive gravel and sand pits.
- Potential quarry aggregate resource area. Only the areas of most suitable rock for quarry aggregate are shown. Although some operating stone quarries lie within these potential resource areas, some quarries have been located in less suitable rock for environmental and economic reasons.
- Active and inactive stone quarries.

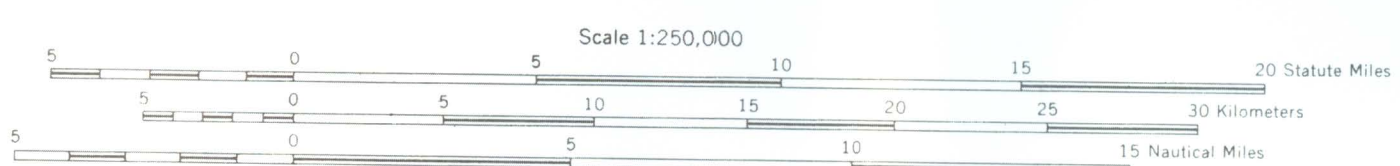
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CONTOUR INTERVAL 200 FEET  
 WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS  
 TRANSVERSE MERCATOR PROJECTION

Base Map by the Army Map Service and U. S. Geological Survey



SPECIAL PUBLICATION 5-B

**ATLAS OF SAND, GRAVEL, AND  
QUARRY AGGREGATE RESOURCES  
COLORADO FRONT RANGE COUNTIES**

by

**CGS LIBRARY**  
by **Schroeder, B. J., and Wicklein**



COLORADO GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES  
STATE OF COLORADO  
DENVER, COLORADO

1974

PRICE \$10.00

## STATE OF COLORADO

John D. Vanderhoof, *Governor*

## DEPARTMENT OF NATURAL RESOURCES

Thomas W. Ten Eyck, *Executive Director*

### COLORADO GEOLOGICAL SURVEY

John W. Rold, *Director and State Geologist*

### MISSION OF THE COLORADO GEOLOGICAL SURVEY

The Colorado Geological Survey was legislatively re-established in February 1969 to meet the geologic needs of the citizens, governmental agencies and mineral industries of Colorado. This modern legislation is aimed at applying geologic knowledge toward the solution of today's and tomorrow's problems of an expanding population, mounting environmental concern and the growing demand for mineral resources.

### SPECIFIC LEGISLATIVE CHARGES ARE

- "Assist, consult with and advise state and local governmental agencies on geologic problems."
- "Promote economic development of mineral resources."
- "Evaluate the physical features of Colorado with reference to present and potential human and animal use."
- "Conduct studies to develop geological information."
- "Inventory the state's mineral resources."
- "Collect, preserve and distribute geologic information."
- "Determine areas of geologic hazard that could affect the safety of or economic loss to the citizens of Colorado."
- "Prepare, publish and distribute geologic reports, maps and bulletins."

SPECIAL PUBLICATION 5-B

**ATLAS OF SAND, GRAVEL, AND  
QUARRY AGGREGATE RESOURCES  
COLORADO FRONT RANGE COUNTIES  
CGS LIBRARY**  
by

S. D. Schwochow, R.R. Shroba, and P. C. Wicklein



*S. D. Schwochow  
Ralph Shroba  
Phil Wicklein  
Robert A. Gast*

COLORADO GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES  
STATE OF COLORADO  
DENVER, COLORADO

1974

PRICE \$10.00



Post Office Box 2645  
Denver, Colorado 80201  
June 30, 1974

LETTER OF TRANSMITTAL

Mr. John W. Rold  
State Geologist and Director  
Colorado Geological Survey  
1845 Sherman Street  
Denver, Colorado 80203

Subject: Completion of the "ATLAS OF SAND, GRAVEL, AND QUARRY AGGREGATE  
RESOURCES, COLORADO FRONT RANGE COUNTIES."

Dear Mr. Rold:

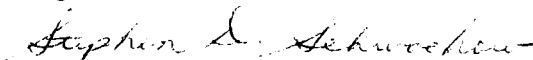
This atlas of 212 preliminary 1:75,000-scale resource maps was prepared by Stephen D. Schwochow, Ralph R. Shroba, and Phillip C. Wicklein under contract to the Colorado Geological Survey as authorized by the 1973 Colorado House Bill 1529. The contract was administered by Mr. A. L. Hornbaker, the Colorado Geological Survey Mineral Deposits Geologist. The maps were prepared utilizing photogeologic methods and published data. All photogeologic maps were prepared and field checked during the fall and winter of 1973-1974. Maps and data prepared by the U. S. Geological Survey staff for the Front Range Urban Corridor study were utilized in preparing 74 of the quadrangles in this atlas.

Individual revised 1:24,000-scale copies of these maps have been sent to the appropriate city, county, and regional planning agencies. These maps are available from the appropriate counties or the Colorado Geological Survey. This atlas was prepared as a convenient reference document and should be a valuable aid to your geologic staff, sand and gravel producers, geologic consultants, contractors, realtors, and government agencies. The atlas should be used in conjunction with "Sand, Gravel and Quarry Aggregate Resources of the Colorado Front Range Counties", Colorado Geological Survey Special Publication 5-A.

Sincerely,



Phillip C. Wicklein  
Project Consultant



Stephen D. Schwochow  
Consultant



Ralph R. Shroba  
Consultant

## PREFACE

Last year House Bill 1529 charged the Colorado Geological Survey to

*"contract for a study of the commercial mineral deposits in the populous counties of the state in order to identify and locate such deposits. Such study shall be of sand, gravel, and quarry aggregate, and shall be completed on or before July 1, 1974, and shall include a map or maps of the state showing such commercial mineral deposits, copies of which may be generally circulated. Any commercial mineral deposits discovered subsequent to July 1, 1974, may be, upon discovery, included in such study."*

Carrying out this contract required the comprehensive photogeologic and field geologic evaluation of 271 quadrangles in Larimer, Weld, Boulder, Jefferson, Adams, Denver, Arapahoe, El Paso and Pueblo Counties. Douglas County was not included in the statutory charge, but because of its nearness to and relationship to the sand and gravel supply and demand problems of the area, it was included in the project.

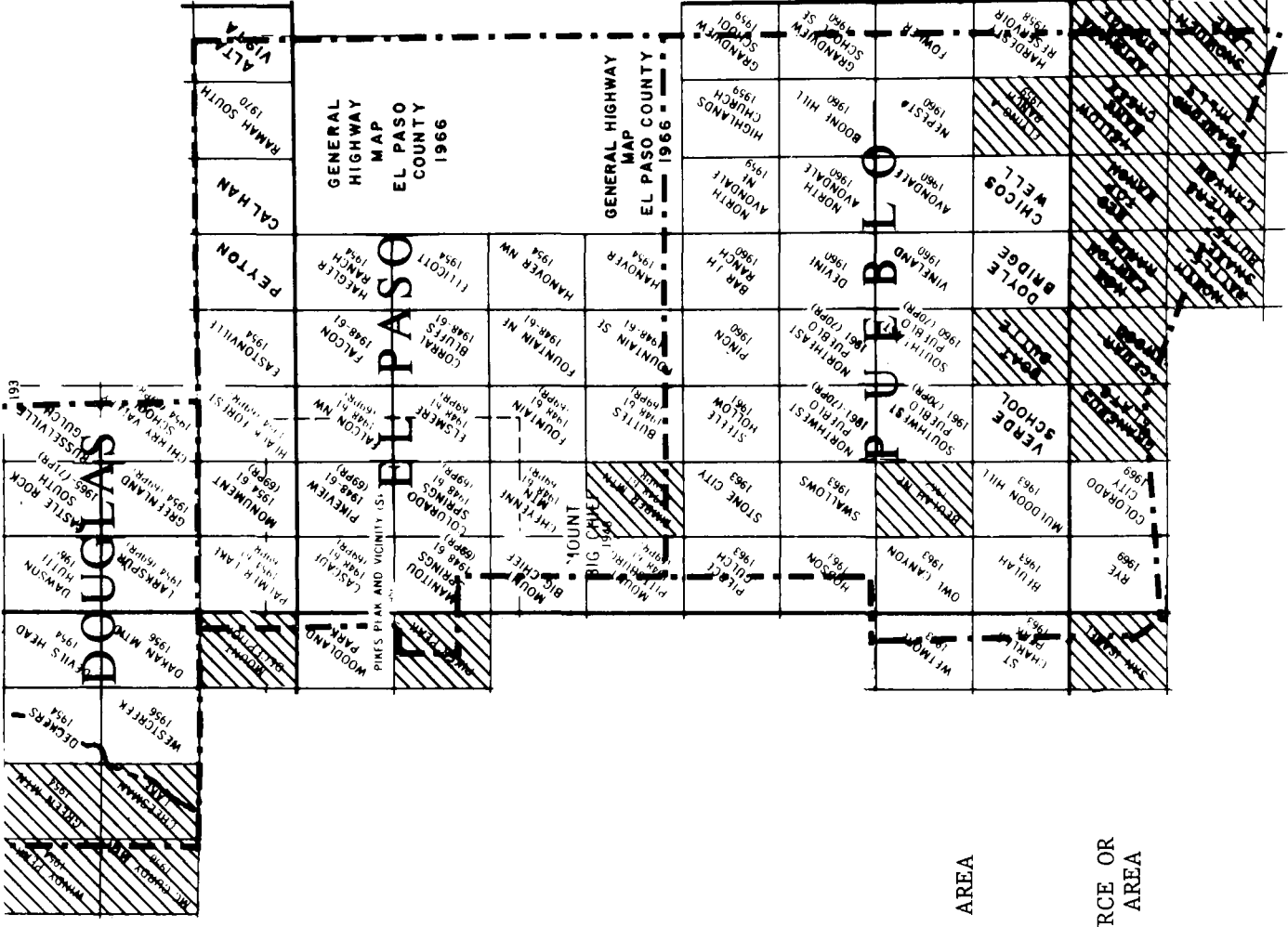
Results of this study are being distributed in three different ways:

First, a text and 3 1:250,000-scale regional maps have been completed by the consultants for publication by the Colorado Geological Survey as Special Publication 5-A.

Second, detailed 1:24,000-scale quadrangle maps have been prepared and distributed to the appropriate counties and cities within the project area. Copies of these detailed resource maps are held on open file in the Colorado Geological Survey offices, and may be purchased there or acquired from the appropriate county planning offices.

Third, this atlas, which is a compilation of reduced-scale preliminary maps, is intended to provide a convenient substitute for the more expensive and bulky detailed maps. It is available through the Colorado Geological Survey as Special Publication 5-B. The 1:75,000-scale preliminary maps presented in this atlas were produced during the step reduction of 1:24,000-scale field maps to 1:250,000-scale composite regional maps. Quadrangles in the atlas appear in alphabetical order by name. Because of the size of these 1:75,000-scale maps, the authors believe this atlas will be a convenient and valuable reference for the Colorado Geological Survey staff, sand and gravel producers, geologic consultants, contractors, realtors, and governmental agencies. An explanatory text and detailed acknowledgments to the geologists, governmental agencies and gravel producers, without whose help this project would have been impossible, appear in Colorado Geological Survey Special Publication 5-A, SAND, GRAVEL, AND QUARRY AGGREGATE RESOURCES OF THE COLORADO FRONT RANGE COUNTIES by S. D. Schwochow, R. R. Shroba, and P. C. Wicklein, 1974.





# INDEX MAP

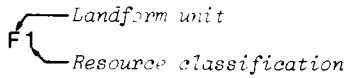
PURCH 1960

WITHDRAWN

RESOURCE AREA

NON-RESOURCE OR  
WITHDRAWN AREA

# EXPLANATION \*



## LANDFORM UNITS

- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
  
- U Upland deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
  
- M Man-made deposits  
(slag, tailings, spoils....)

## RESOURCE CLASSIFICATION

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

- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock,  
calcium carbonate.

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

- 3 Sand

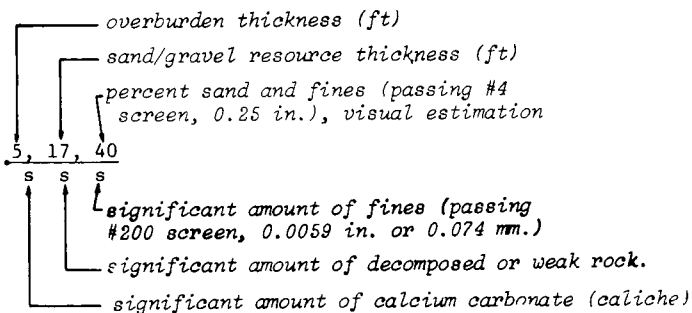
### Unevaluated Resource

- 4 Probable aggregate resource

## MAP SYMBOLS

- Operating gravel and/or sand pit
- ▲ Abandoned gravel and/or sand pit
- ⊗ Operating stone quarry
- ⊗ Abandoned stone quarry
- ▨ Potential quarry aggregate resource area
- $\frac{2}{17}$  Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.  
"g" indicates gravel; "s" indicates sand  
"x" in symbol denotes unevaluated or unknown property.  
"WG" denotes Colorado Geological Survey Windsor/Sand and Gravel projects' drill hole
- Landform boundary, solid where known or observed; dashed where approximate or inferred.

## STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT



"x" in symbol denotes unevaluated or unknown property

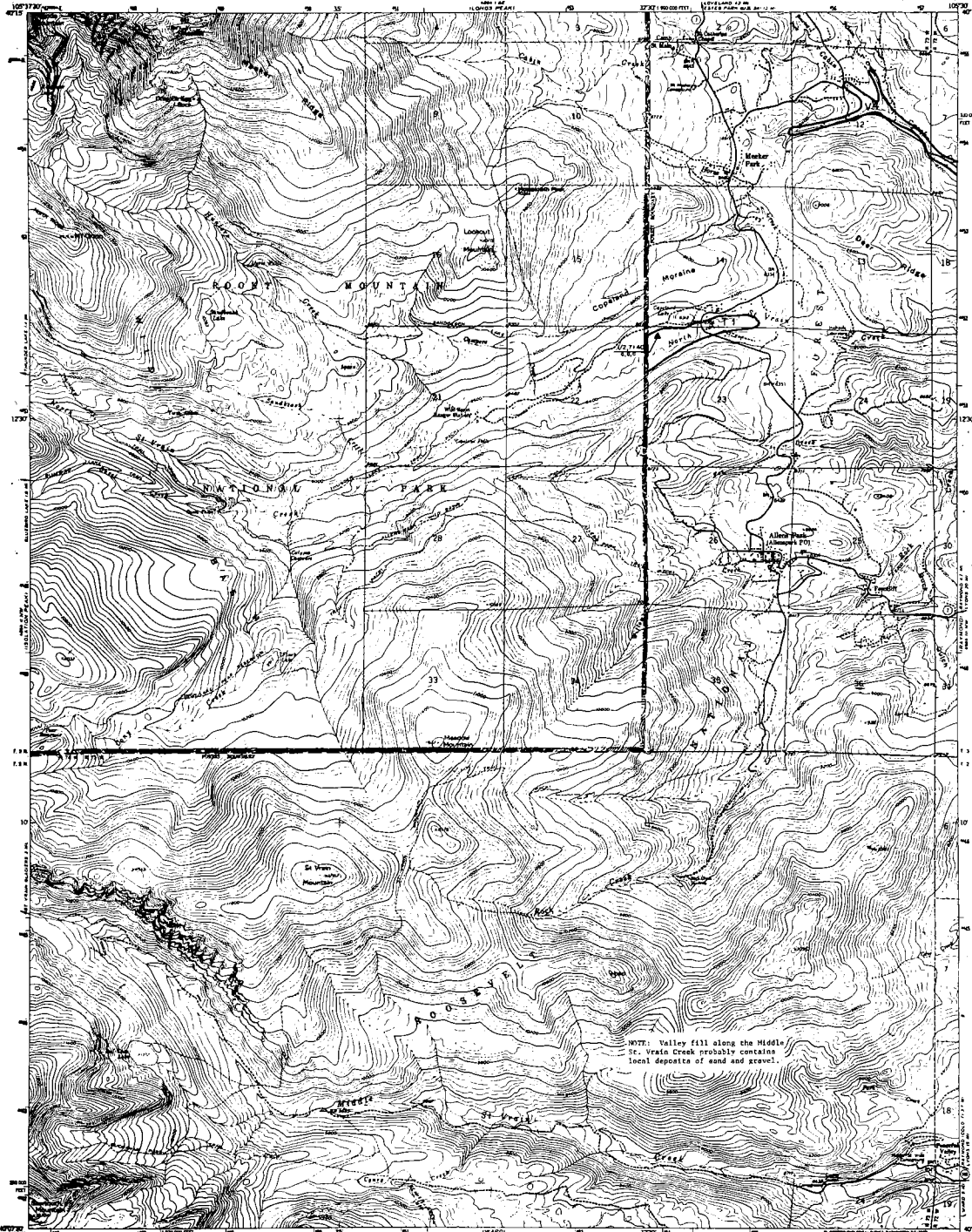
"a" in symbol denotes property absent or insignificant

\* Definition and derivation of terms and map units, explanation of field methods, explanatory text and regional maps are contained in the companion volume, Colorado Geological Survey Special Publication 5-A.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

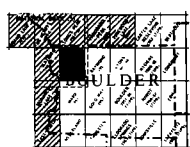
ALLEN'S PARK QUADRANGLE  
COLORADO-BUILDERS CO.  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Landform unit**  
 Resource classification
- LAYERED DEPOSITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Moraine deposits (along crevasses, etc.)
- RESOURCE CLASSIFICATION**
- CONCRETE AGGREGATE**  
 (all figures are estimated on 40 acre, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, medium carbonates
- PILE AGGREGATE**  
 (all figures are estimated on 40 acre, 40% maximum on 40 acre, visual estimation)
- 3 Sand
- Unutilized Resources**
- 4 Probable aggregate resource
- WELL SYMBOLS**
- ⊙ Operating gravel and/or sand pit
  - ⊙ Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource or a related well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - ⊙ "i" indicates gravel; "s" indicates sand
  - ⊙ "x" in symbol denotes unutilized or unknown property.
- Notes:** American Colorado Geological Survey (Water Resources and Geology Division) 1973. Landform boundary, solid where known or inferred; dashed where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (spacing of 40 acre, 0.25 in. or 0.074 m.)
  - significant amount of fines (spacing of 40 acre, 0.008 in. or 0.074 m.)
  - significant amount of decomposed or weak rock
  - significant amount of calcine carbonate (asterisk)
  - \* in symbol denotes unutilized or unknown property
  - \* in symbol denotes property absent or unavailable



■ QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

See from U. S. Geological Survey  
 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Medium-duty
- Light-duty
- Unimproved dirt
- State Route

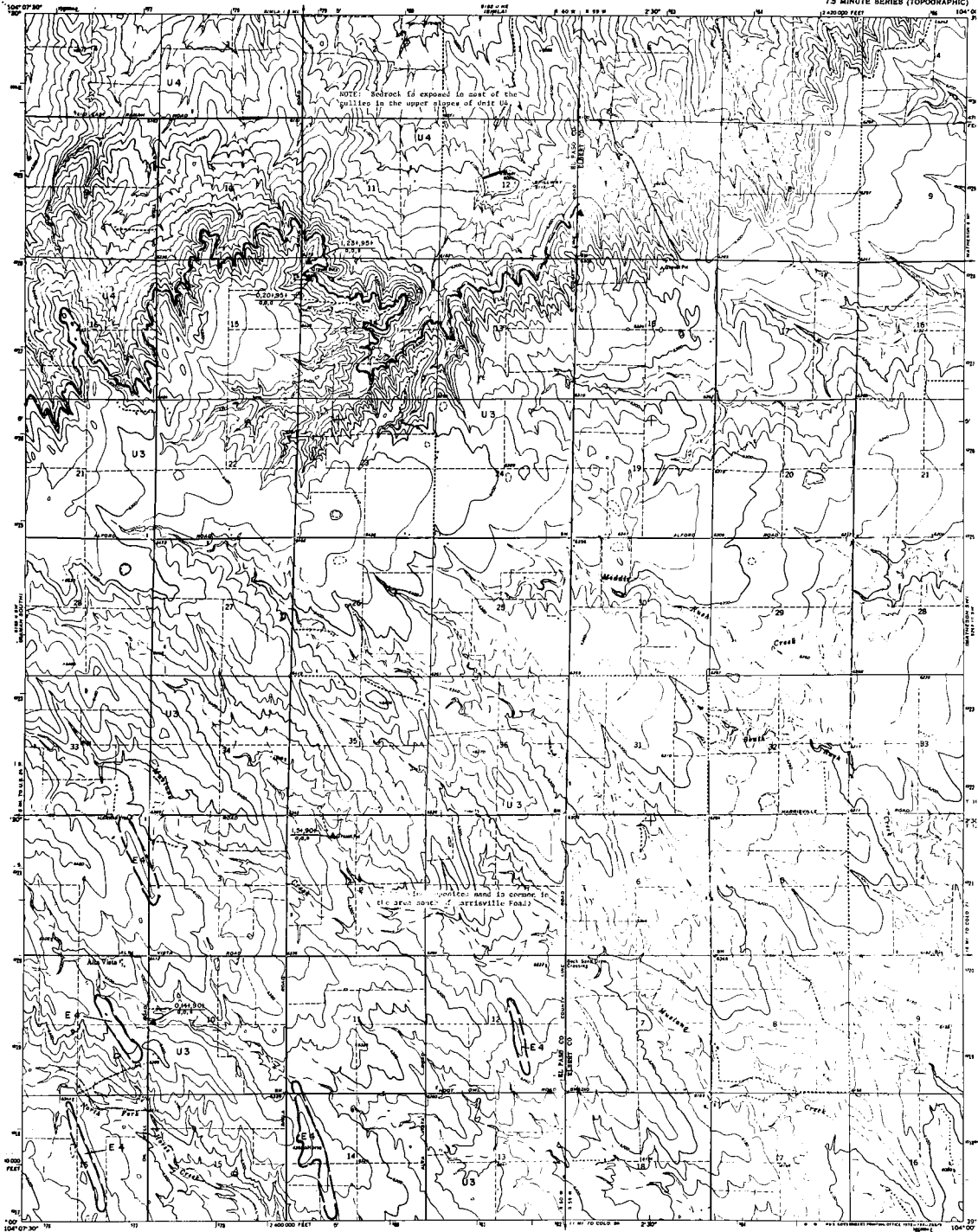
ALLEN'S PARK, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

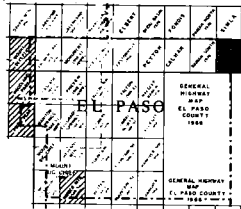
ALTA VISTA QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
1:25000 FEET

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



## EXPLANATION

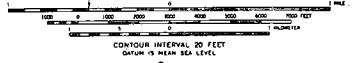
- Uniform units  
Resource classification
- LITHOLOGIC UNIT**
- F Fluvial deposits
  - T Stream terrace deposits
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (loess)
  - M Non-mine deposits (clay, siltstone, granite, ...)
- RESOURCE CLASSIFICATION**
- CROWN QUANTITIES**  
(See page 205 regarding 84 square, actual extraction)
- 1 Crown: relatively clean and good
  - 2 Crown: significant fines, decomposed rock, calcium carbonate.
- FINN QUANTITIES**  
(See page 205 regarding 84 square, 426 retained on #200 screen, actual extraction)
- 3 Low
- Probable Aggregate Resource**
- 4
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with average bedrock thickness (ft) and assigned resource thickness (ft), obtained from well logs.
  - "C" indicates ground; "M" indicates sand
  - "I" in symbol denotes unincorporated or unknown property.
  - "\* " denotes Colorado Geological Survey standardized and Crown projects' drill hole.
  - Land-use boundary, solid where known or dashed where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL CHARACTERIZATION OF SYMBOLS**
- Numbered (thickness (ft))
  - Numbered (maximum thickness (ft))
  - Percent sand and fines (spacing of crown, 2.75 in.; actual extraction)
  - Significant amount of fines (spacing 1500 screen, 2.000 in. or 0.075 mm.)
  - Significant amount of decomposed or well rock.
  - Significant amount of calcium carbonate (calcite).
  - "M" in symbol denotes unincorporated or unknown property.
  - "I" in symbol denotes property absent or incomplete.



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph S. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

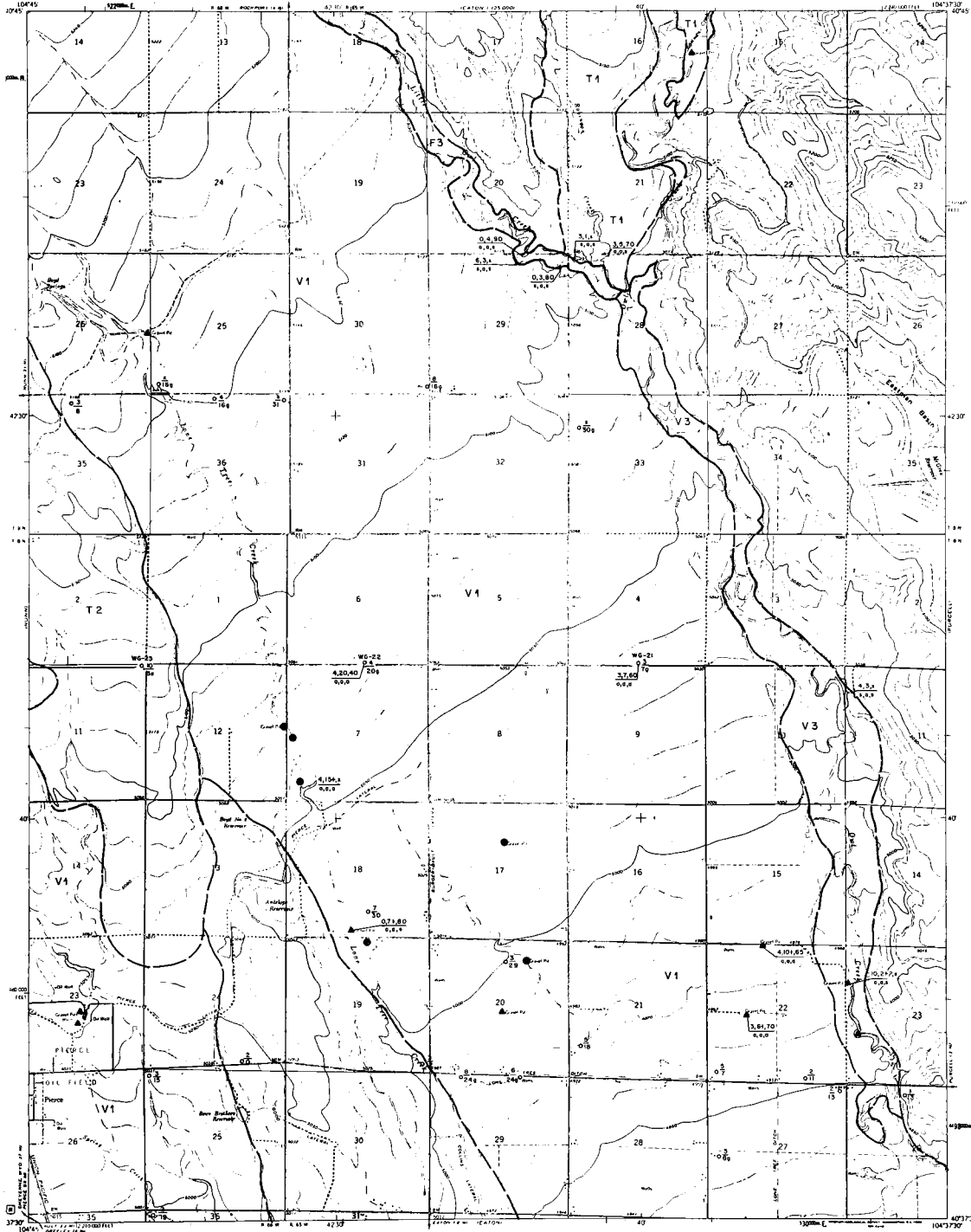
- Primary highway
- Hard surface
- Secondary highway
- Hard surface
- Unimproved road
- Interstate Route
- U S Route
- State Route
- Light duty road, hard or improved surface

ALTA VISTA, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

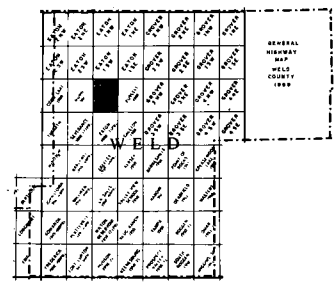
ANTELOPE RESERVOIR QUADRANGLE  
COLORADO-WELD CO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

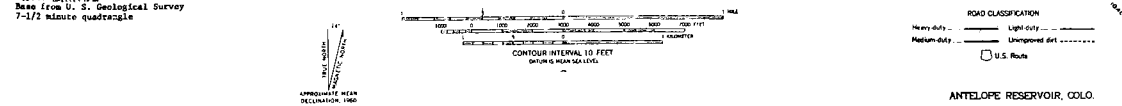
- CONTOUR INTERVAL**  
Assume classification
- LANDFORMS**  
F Floodplain deposit  
T Stream terrace deposit  
V Valley fill (F & T)  
U Upland deposits  
A Alluvial fan  
E Wind-deposited sand (eolian)  
M Man-made deposits (slag, tailings, spoil...)
- AGGREGATE CLASSIFICATION**  
**COARSE SANDGRAVEL**  
Cut based 300' vertical on 44' screen, usual estimation  
1 Gravel: relatively clean and sand  
2 Gravel: significant fines, decomposed rock, calcareous concrete  
**FINE SANDGRAVEL**  
Represented 600' vertical on 44' screen, 60% retained on 100' screen, usual estimation  
3 Sand  
**Overvalued Resources**  
4 Probable aggregate resource
- MAP SYMBOLS**  
● Existing gravel and/or sand pit  
○ abandoned gravel and/or sand pit  
○ Existing stone quarry  
○ Abandoned stone quarry  
○ Potential quarry aggregate resource area  
○ Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs  
"u" indicates gravel; "s" indicates sand  
"u" in symbol denotes unvaluated or unknown property  
"w" denotes Colorado Geological Survey "wilderness and scenic protection" still held  
Landowner boundary, well where known or apparent; dashed where approximate or inferred.
- SECTION LOCATION AND GEOLOGICAL DESCRIPTION OF SECTION**  
overburden thickness (ft)  
underground resource thickness (ft)  
percent sand and fines (based on 44' screen, 0.25 cu. ft., usual estimation)  
significant amount of fines (based on 600' screen, 0.25 cu. ft. or 0.075 cu. yd.)  
significant amount of decomposed or weak rock  
"u" in symbol denotes unvaluated or unknown property  
"w" in symbol denotes wilderness property absent or designated



- QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WYDORRAN AREA

REFERENCE:  
Hatchey, L.A., and Schneider, P.A., Jr., 1972, Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-687.

Mapped by: Stephen D. Schwabach  
Date: June 30, 1974

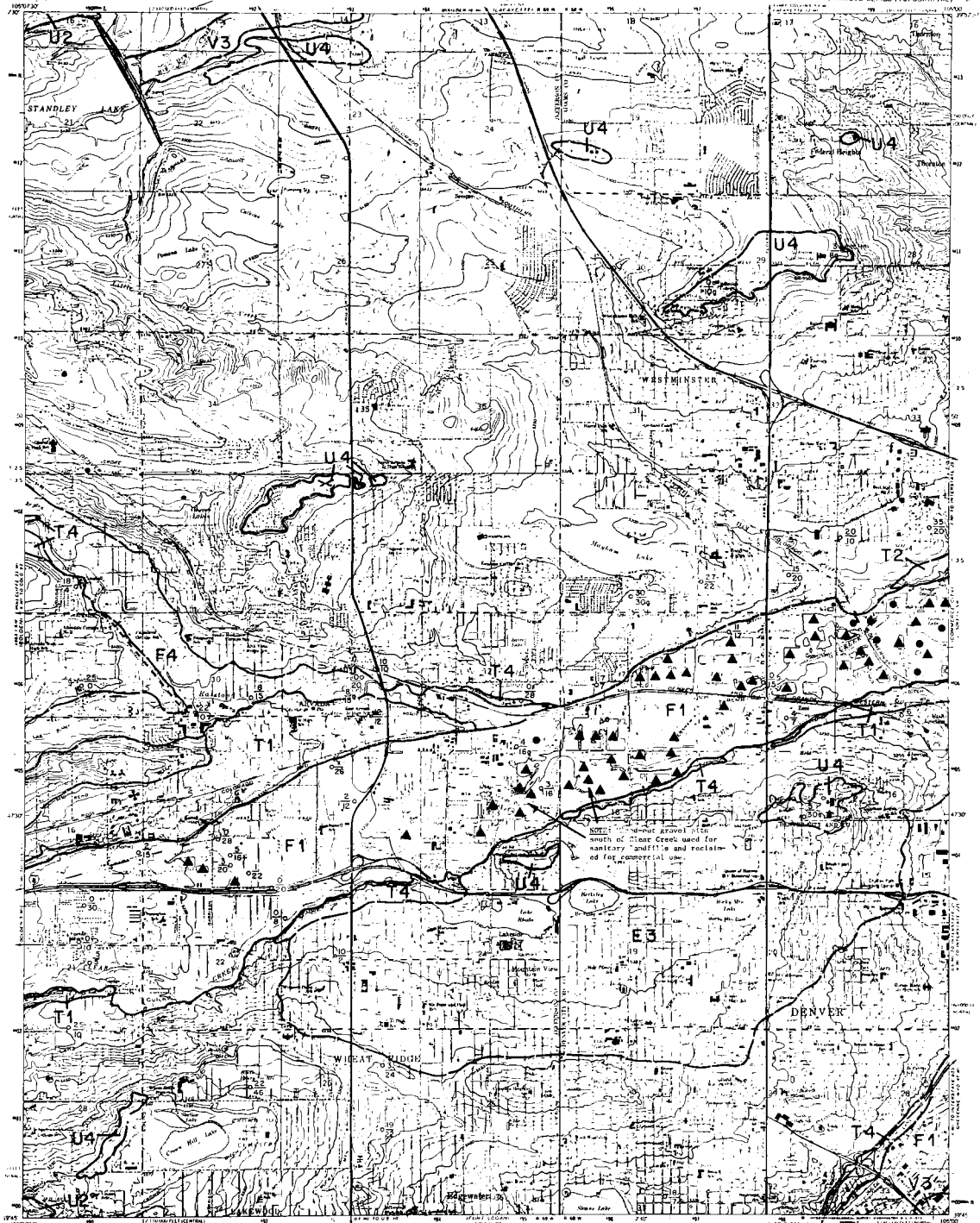


ANTELOPE RESERVOIR, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

ARVADA QUADRANGLE  
COLORADO  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Topographic units**  
Topographic classification
- LANDFORMS (F1)**  
 F Fluvial deposit  
 T Trench or scarp deposit  
 V Valley fill (F & T)  
 U Unconsolidated  
 A Alluvial fan  
 E Eolian-deposited sand (terrestrial)  
 M Marine deposits (beach-ridge, spits, etc.)
- RESOURCE CLASSIFICATION**
- Gravel Resources**  
 1 Gravel, relatively clean and smooth  
 2 Gravel, significant fines, decomposed rock, calcareous cementation
- Sand Resources**  
 3 Sand  
 4 Probable aggregate resource
- MAP SYMBOLS**  
 \* Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operational stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Retained well or vertical location with over-burden thickness (ft) over sand/gravel resource  
 Shaded area (ft) over sand/gravel resource  
 "x" indicates gravel, "s" indicates sand  
 "i" in symbol denotes intermitted or unknown supply  
 "m" denotes Colorado Geological Survey "Water/Sand and Gravel" project's data  
 Land use boundary, solid where known or abstract, dashed where representation is inferred

- STATION LOCATION AND GEOLOGICAL DESCRIPTION OF SYMBOL**
- overburden thickness (ft)  
 sand/gravel resource thickness (ft)  
 percent sand and "m" (percent of gravel)  
 percent gravel and "s" (percent of sand)  
 significant amount of decomposed or weak rock  
 significant amount of calcareous cementation  
 "i" in symbol denotes intermitted or unknown supply  
 "m" in symbol denotes property abstract or unapproved



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
 Lindvall, R.N., 1972, Geologic map of the Arvada quadrangle, Adams, Denver, and Jefferson Counties, Colorado; U.S. Geol. Survey Misc. Field Studies Map MF-348.  
 and  
 Hunt, C.B., 1954, Plateaus and Recent deposits in the Denver area, Colorado; U.S. Geol. Survey Bull. 998-C, pl. 3.

**References:**  
 Chase, C.H., and McConaghy, J.A., 1972, Generalized surficial geologic map of the Denver area, Colorado; U.S. Geol. Survey Misc. Geol. Inv. Map I-731.  
 Inter-County Regional Planning Commission, 1961, Drainage courses plan for the Denver region - Part 1, sand and gravel resources; Denver, Colo., Inter-County Reg. Plan. Comm. pl. 1.  
 Hamilton, J.L., and Owens, W.G., 1972, Geologic aspects, soils and related foundation problems, Denver metropolitan area, Colorado; Colorado Geol. Survey Environmental Geology Rept. 1, pl. 1.  
 Triebel, D.E., and Fitch, H.A., 1974, Map showing potential sources of gravel and crushed-rock aggregates in the Greater Denver Area, Front Range Urban Corridor, Colo.; U.S. Geol. Survey Misc. Geol. Inv. Map I-850-A.

Maped by: Stephen D. Schwochow  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



U.S. GEOLOGICAL SURVEY  
 DEPARTMENT OF THE INTERIOR

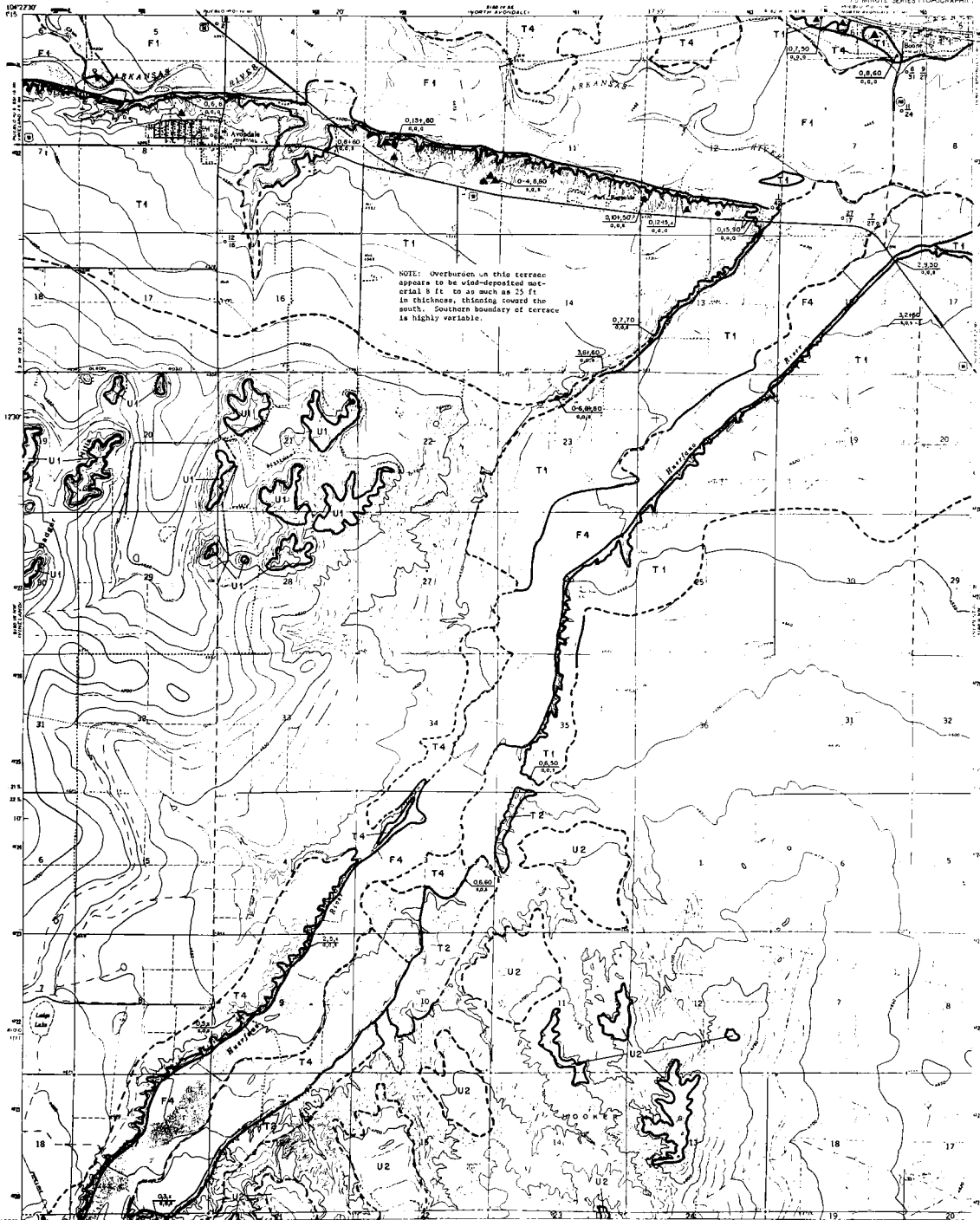
**ROAD CLASSIFICATION**  
 Heavy-duty Light-duty  
 Medium-duty Unimproved dirt  
 Interstate State U.S. Route State Route

ARVADA COLO

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

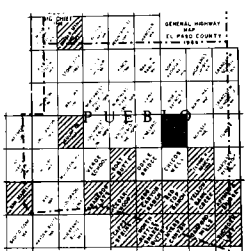
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HULL, DIRECTOR

AVONDALE QUADRANGLE  
COLORADO-PUEBLO CO.  
15 MINUTE SERIES TOPOGRAPHIC



## EXPLANATION

- LEGEND**
- Road classification
  - RESOURCE CLASSIFICATION**
  - MINERAL RIGHTS**
    - F1 Fluvial deposit
    - T Terrace deposit
    - V Valley fill (F & T)
    - U Unconsolidated
    - A Alluvial fan
    - E Wind-deposited sand (eolian)
    - M Man-made deposits (slag, tailings, spoils, etc.)
  - RESOURCE CLASSIFICATION**
    - 1 Crown: relatively clean and sound
    - 2 Crown: significant fines, decomposed rock, local outcrops
    - 3 Sand
    - 4 Potential Resource
    - 5 Feasible aggregate resource
  - MINERAL RIGHTS**
    - A Operating gravel and/or sand pit
    - AB Abandoned gravel and/or sand pit
    - Q Operating stone quarry
    - QK Abandoned stone quarry
    - QA Potential quarry aggregate resource area
    - 2 Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs. "n" indicates gravel, "s" indicates sand
    - "\*" In symbol denotes unutilized or unknown property
    - "\*\*" denotes Colorado Geological Survey identified and Crown project
    - drill hole
    - Landform boundary, solid where known or observed, dashed where approximate or inferred
  - STATUS, LOCATION AND GENERAL DESCRIPTION OF ROAD**
    - overburden thickness (ft)
    - road/gravel resource thickness (ft)
    - potential sand and gravel resource thickness (ft)
    - overburden thickness (ft) over sand/gravel resource thickness (ft)
    - significant amount of fines (passing #20 screen, 0.850 mm)
    - significant amount of decomposed or weak rock
    - "n" in symbol denotes unutilized or unknown property
    - "\*" in symbol denotes property absent or insignificant



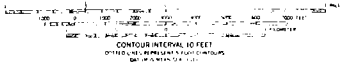
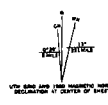
**ROAD CLASSIFICATION**

- Main Duty
- Medium Duty
- Light Duty
- Unpaved dirt
- Saw Path

Mapped by: Stephen D. Schwetsov  
Date: June 30, 1974

AVONDALE, COLO.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



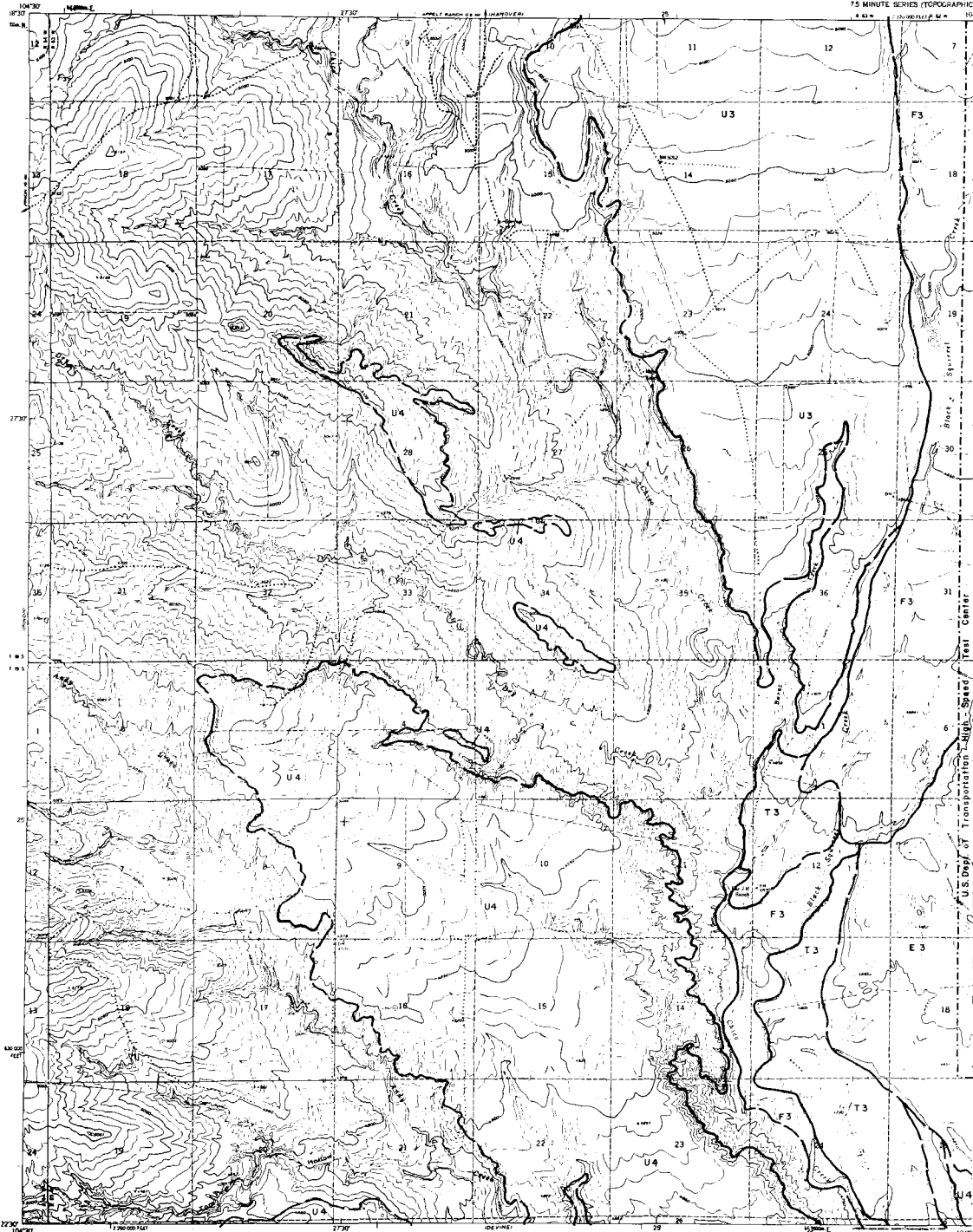
**ROAD CLASSIFICATION**

- Main Duty
- Medium Duty
- Light Duty
- Unpaved dirt
- Saw Path

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

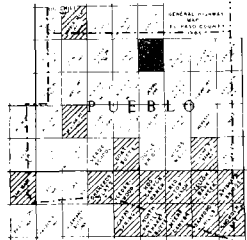
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLE, DIRECTOR

BAR JH RANCH QUADRANGLE  
COLORADO-PUEBLO CO  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)  
4 1/2" x 6 1/2" (11.4 x 16.5 CM)



## EXPLANATION

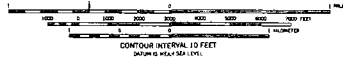
- Landform units
  - Rhythmic cross-functorion
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mesa-and deposit
  - (old-terrace, apron, ...)
- ROCK CLASSIFICATION**
  - 1 **GRAVEL** (minimum 48" in diameter)
    - 1 Coarse, calcareous clays and sands
    - 2 Coarse, argillaceous fines, decomposed rock, calcium carbonate.
  - 2 **FINE SANDS** (greater than 20 mesh, 48" in diameter, 60% retained on 20 mesh screen, stream sediment)
    - 3 Sand
  - Unconsolidated Deposits**
  - 4 Probable aggregate resources
- AGGREGATE RESOURCES**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with owner's permission (T) only sand/gravel resource (U) (T) obtained from well logs.
  - "T" indicates gravel "U" indicates sand
  - "\*" is symbol denotes unconsolidated or unknown property
  - "M" denotes Colorado Geological Survey Mesozoic and Cretaceous projects
  - Drill hole
  - Landform boundary, solid where known or observed; dashed where approximation or inferred.
- STATION LOCATION AND ORIENTAL DESCRIPTION OF SYMBOLS**
  - Colorado Adkins 75' sand/gravel resource (T) (U) (T) (U)
  - present spot and lines (spacing 48" corner, 0.25 in.,) interval indication
  - significant amount of fines (spacing 2500 corner, 0.25 in., 0.25 in.)
  - significant amount of silicious carbonate (outline)
  - "\* " in symbol denotes unconsolidated or unknown property
  - "M " in symbol denotes property subject to litigation



- QUADRANGLE LOCATION
- NON-RESOURCE OR MIDDRAIN AREA

Mapped by: Stephen D. Schuchow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



APPROXIMATE MEAN  
DECLINATION, 1980

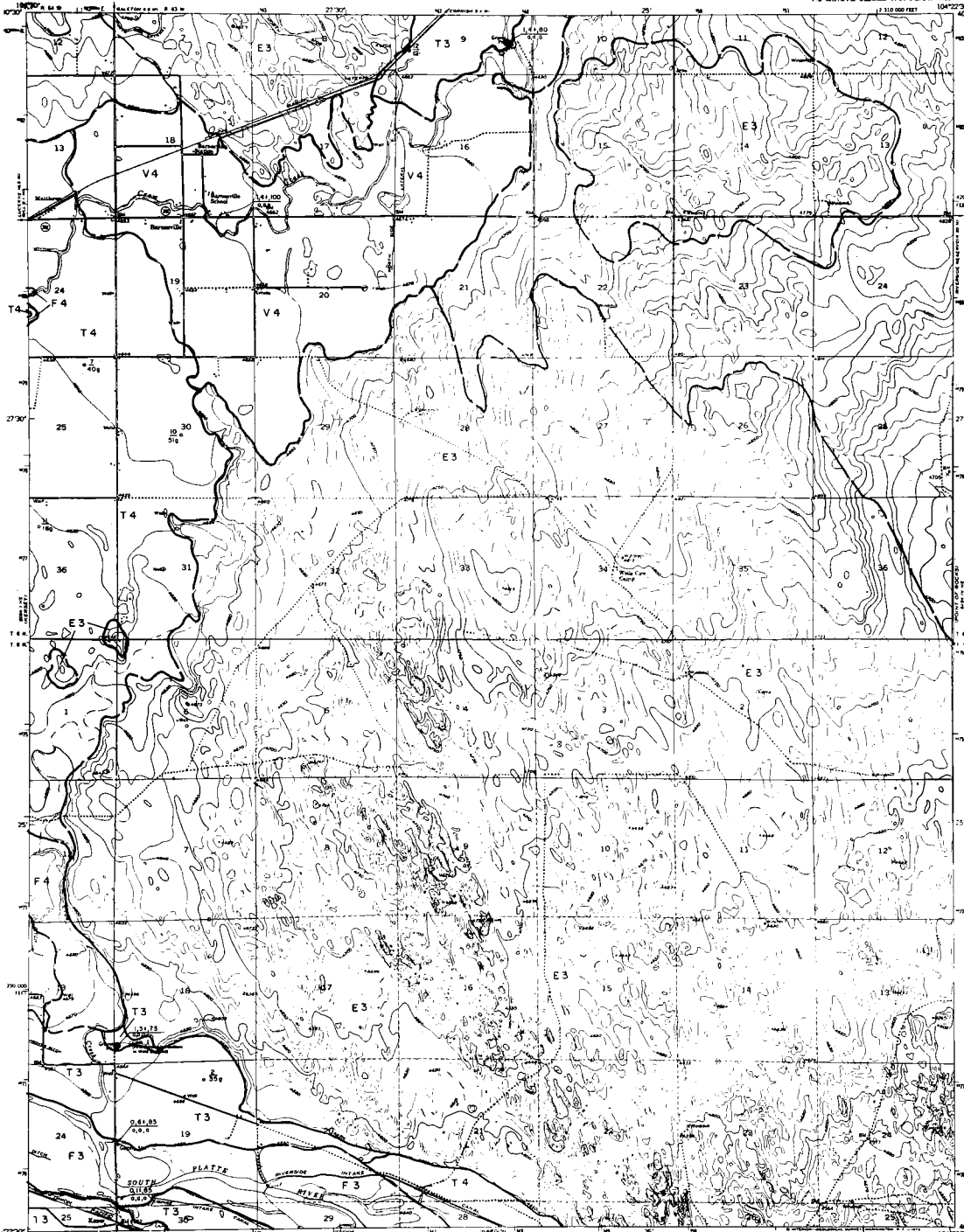
Unprojected G.S. ....

BAR JH RANCH, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

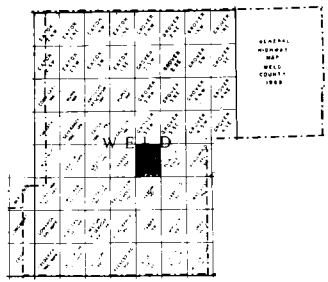
BARNESVILLE QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
1:100,000 (FEET)

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



EXPLANATION

- CONTOUR UNIT  
--- Elevation Classification
- LITHOLOGICAL UNITS  
F Floodplain deposit  
T River terrace deposit  
W Water fill (F or T)  
U Alluvial deposit  
A Alluvial fan  
E Wind-deposited sand (colluvial)  
M Hummock deposits (sand, silt, clay, etc.)
- RESOURCE CLASSIFICATION  
1. GRAVEL RELATIVELY CLEAN AND SOUND  
2. GRAVEL: SIGNIFICANT FINE, DECOMPOSED ROCK, CALCIUM CARBONATE  
3. SAND  
4. PROBABLE AGGREGATE RESOURCE
- MAP SYMBOLS  
\* Operating gravel and/or sand pit  
○ Abandoned gravel and/or sand pit  
○ Operating stone quarry  
○ Abandoned stone quarry  
□ Potential quarry aggregate resource area  
○ Related well or drill-hole location with overburden thickness (ft) and gravel resource thickness (ft), obtained from well logs.  
"T" indicates gravel, "S" indicates sand  
"In symbol" denotes unmineralized or unknown property  
"W" denotes Colorado Geological Survey "Water and Gravel" project's drill hole  
--- Land-use boundary, solid where known or abstracted, dashed where approximate or inferred.
- SYMBOL, LOCATION AND DIMENSIONAL INFORMATION OF SYMBOL  
○ Overburden thickness (ft)  
○ Sand/gravel resource thickness (ft)  
○ Gravel and flow spacing at resource, 2 ft to 1/2 mile distance  
○ Significant amount of fines (spacing 100 to 1000 ft, or 0.15 to 0.25 mi)  
○ Significant amount of calcareous nodules  
○ Significant amount of decomposed or weak rock  
○ In symbol denotes property abstracted or unknown property  
○ "W" in symbol denotes property abstracted or uncompleted

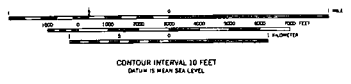


■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Bjorklund, L.J., and Brown, R.P., 1957. Geology and ground-water resources of the lower South Platte River valley between Gardiner, Colorado, and Faxon, Nebraska; U. S. Geol. Survey Water-Supply Paper 1378, pl. 1.

Mapped by: Phillip C. Wicklen  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



ROAD CLASSIFICATION  
Heavy-duty \_\_\_\_\_ Light-duty \_\_\_\_\_  
Medium-duty \_\_\_\_\_ Unimproved dirt \_\_\_\_\_  
○ U.S. Route ○ State Route

BARNESVILLE, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE

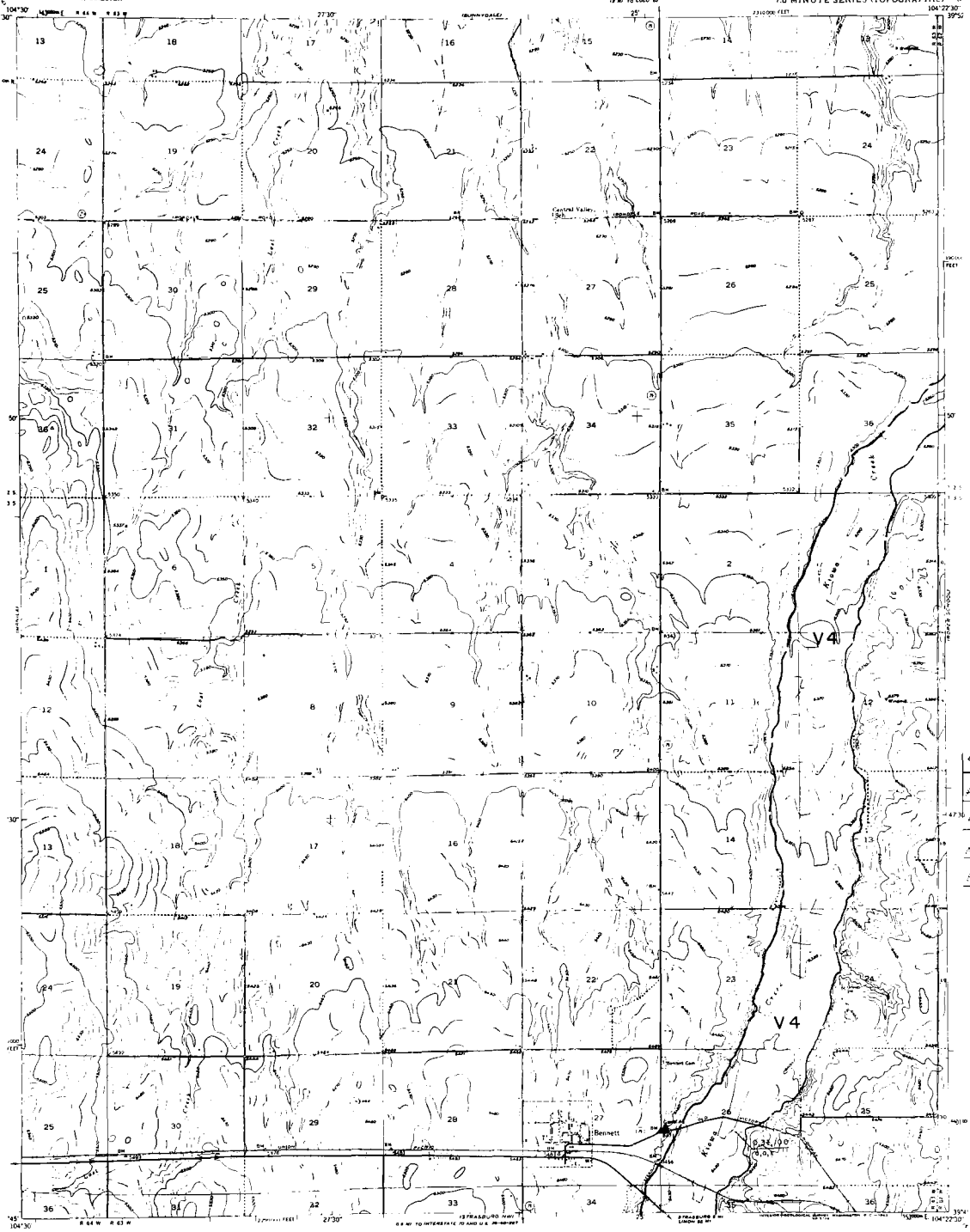
BENNETT QUADRANGLE

RESOURCES MAP

COLORADO-ADAMS CO.

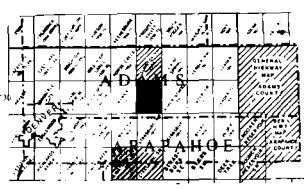
7.6 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Legend:**
  - Landform unit
  - Quadrangle classification
- RESOURCE CLASSIFICATION:**
  - Gravel Deposits:**
    - 1 Gravel, relatively clean and well sorted
    - 2 Gravel, significant fines, decomposed rock, tuffaceous material
  - Other Deposits:**
    - 3 Sand
    - 4 Possible aggregate resource
- MAP SYMBOLS:**
  - A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Potential quarry aggregate resource area
  - F Selected well or drilled location with over-burden thickness (ft) and sand/gravel resource thickness (ft)
  - G "Indicative gravel" (ft) thickness sand
  - H "In gravel" resource availability or volume property
  - I "Gravel" resource availability or volume property
  - J "Sand" resource availability or volume property
  - K Landform boundary, well shown or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF BORINGS:**
  - 10151 (Borehole elevation ft)
  - 10152 (Borehole elevation ft)
  - 10153 (Borehole elevation ft)
  - 10154 (Borehole elevation ft)
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  - 10348 (Borehole elevation ft)
  - 10349 (Borehole elevation ft)
  - 10350 (Borehole elevation ft)



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



ROAD CLASSIFICATION  
Heavy-duty Light-duty  
Unimproved Rd. (Gravel)

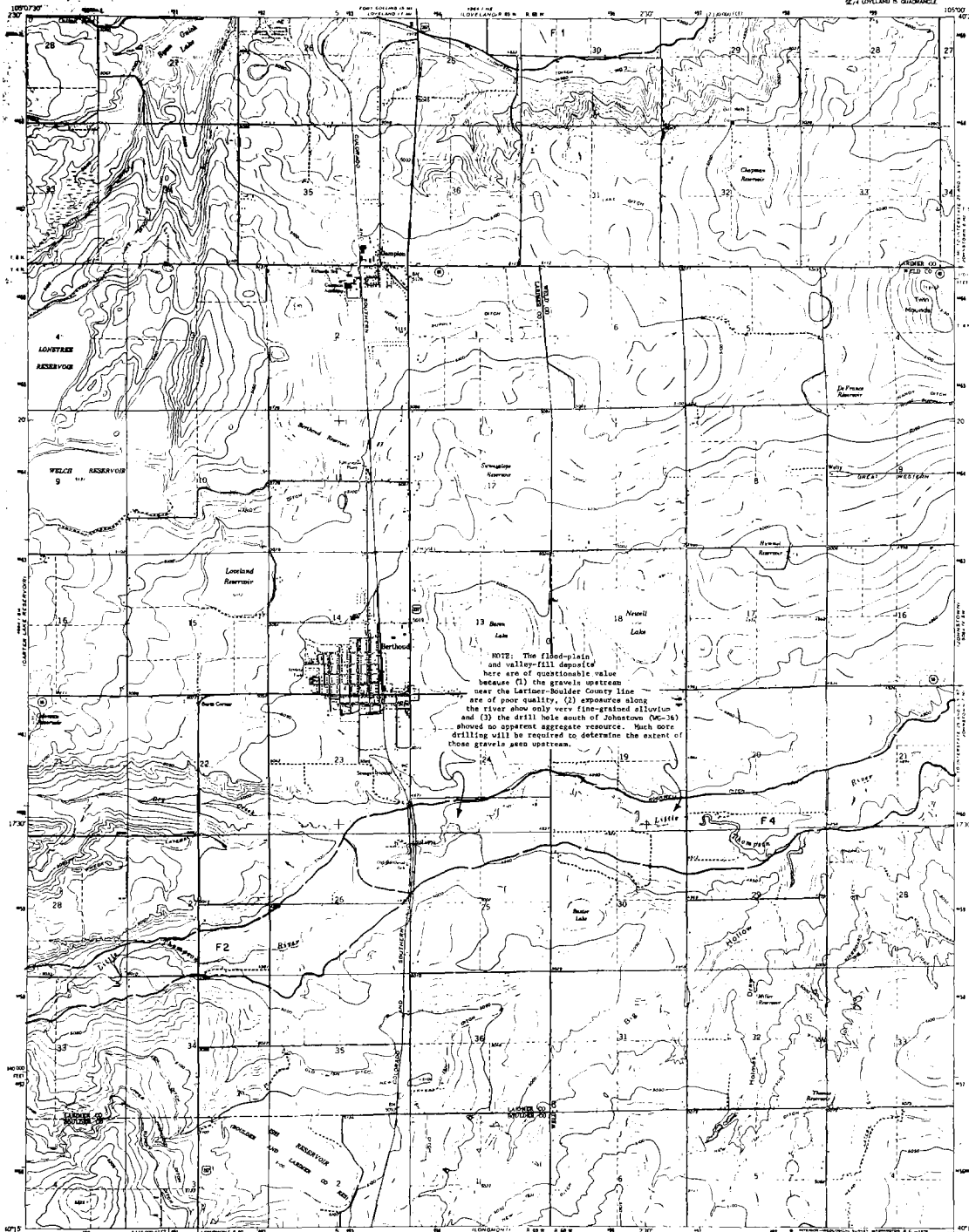
BENNETT, COLO.

Mapped by: Phillip C. Wicklen  
Date: June 30, 1974

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

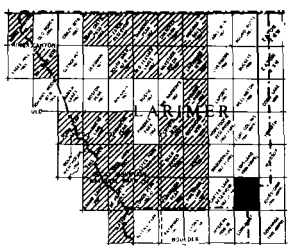
BERTHOUD QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
SCALE UNLEVEL 1:50,000

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



## EXPLANATION

- Geologic units**  
 Name of stratum  
 Name of stratum
- LANDFORMS**  
 F Flood-plain deposit  
 T Trench terrace deposit  
 W Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Man-made deposits (fills, dikes, etc.)
- RESOURCE CLASSIFICATION**  
 1 Gravel: calcareous, clean and sound  
 2 Gravel: significant fines, decomposed rock, salt-like calcareous  
 3 Sand  
 4 Probable aggregate resources
- MAP SYMBOLS**  
 Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Selected well of drill-hole location with open-bottom thickness (ft) over underlying resource thickness (ft), obtained from well logs  
 \* indicates gravel, \* indicates sand  
 \* is symbol denotes investigated or unknown property  
 \* denotes Colorado Geological Survey Well-log and Gravel project drill well  
 Landform boundary, well where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF WELLS**  
 Well name  
 Well number  
 Well depth  
 Well diameter  
 Well completion  
 Well status  
 Well location  
 Well description

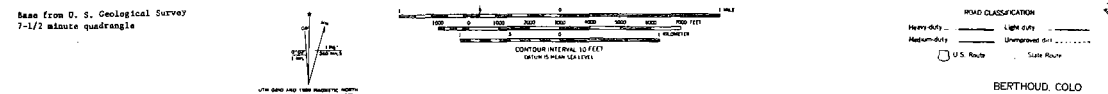


- QUADRANGLE LOCATION**  
 Non-resource or vitriol area

Geology modified after: Colton, R.R., and Mitch, R.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fore Collins-Crkeley Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-553 D.

Map by: Stephen D. Schwoch  
 Date: June 30, 1974

Prepared in cooperation with the  
 U. S. Geological Survey

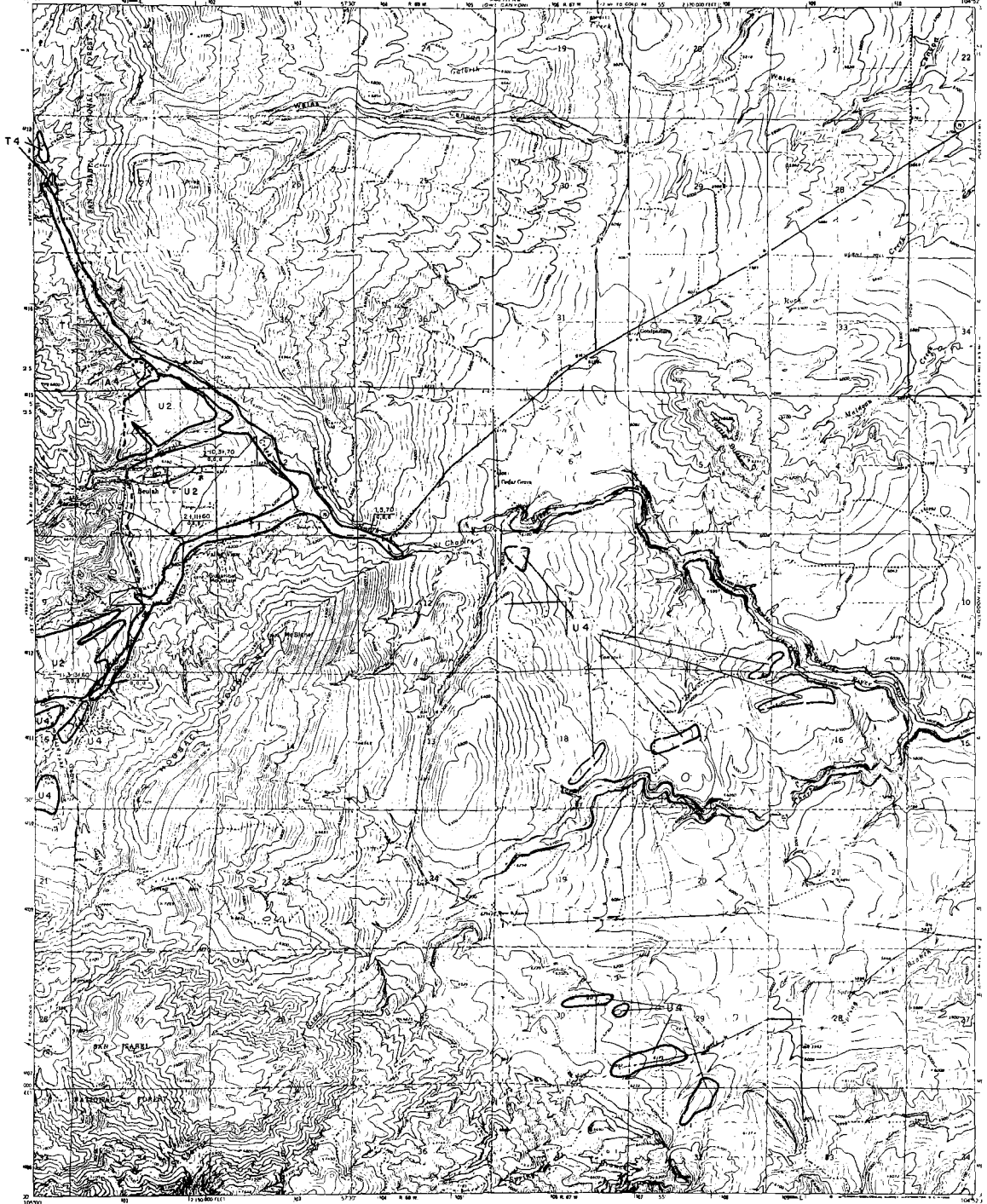


BERTHOUD, COLO

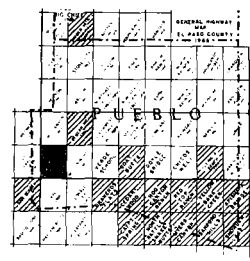
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

BEULAH QUADRANGLE  
COLORADO-PUEBLO CO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



- MAPPER'S KEY**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - W Wind-deposited sand (alluvial)
  - M Man-made deposits (slag, tailings, spoil, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 50% retained on #4 screen, or small aggregate)
- 1 Gravel - relatively clean and sound
  - 2 Gravel - significant fines, decomposed rock calcium carbonate
- Fine Aggregate**  
(passing #20, retaining #40 screen, 40% retained on #100 screen, visual estimation)
- 3 Sand
  - 4 Probable aggregate resource
- MIN. QUANT.**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with over-burden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "I" indicator gravel; "S" indicates sand
  - "\*" in symbol denotes unclassified or unknown property
  - "W" denotes Colorado Geological Survey boundary (see also Coresheet symbols)
  - Landform boundary, solid where known or inferred; dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATIONAL DESCRIPTION OF DEPOSIT**
- Coordinates (elevation (ft))
  - Longitude and true (bearing (°))
  - Area (sq. ft., sq. mi., visual estimation)
  - Significant amount of fines (passing #200 screen, 0.075 in. or 3/16 in.)
  - Significant amount of decomposed or weak rock
  - Significant amount of siliceous calcareous material
  - "\*" in symbol denotes unclassified or unknown property
  - "S" in symbol denotes properly sorted or well-sorted

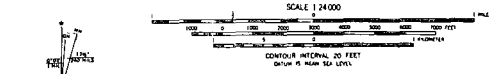


■ QUADRANGLE LOCATION  
▨ MIN-RESOURCE OR VETERINARY AREA

Geology modified after Scott, G. R., and Taylor, R. S., 1973, U. S. Geological Survey, Map 100-311.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Medium duty ..... Light duty .....

Unimproved dirt .....

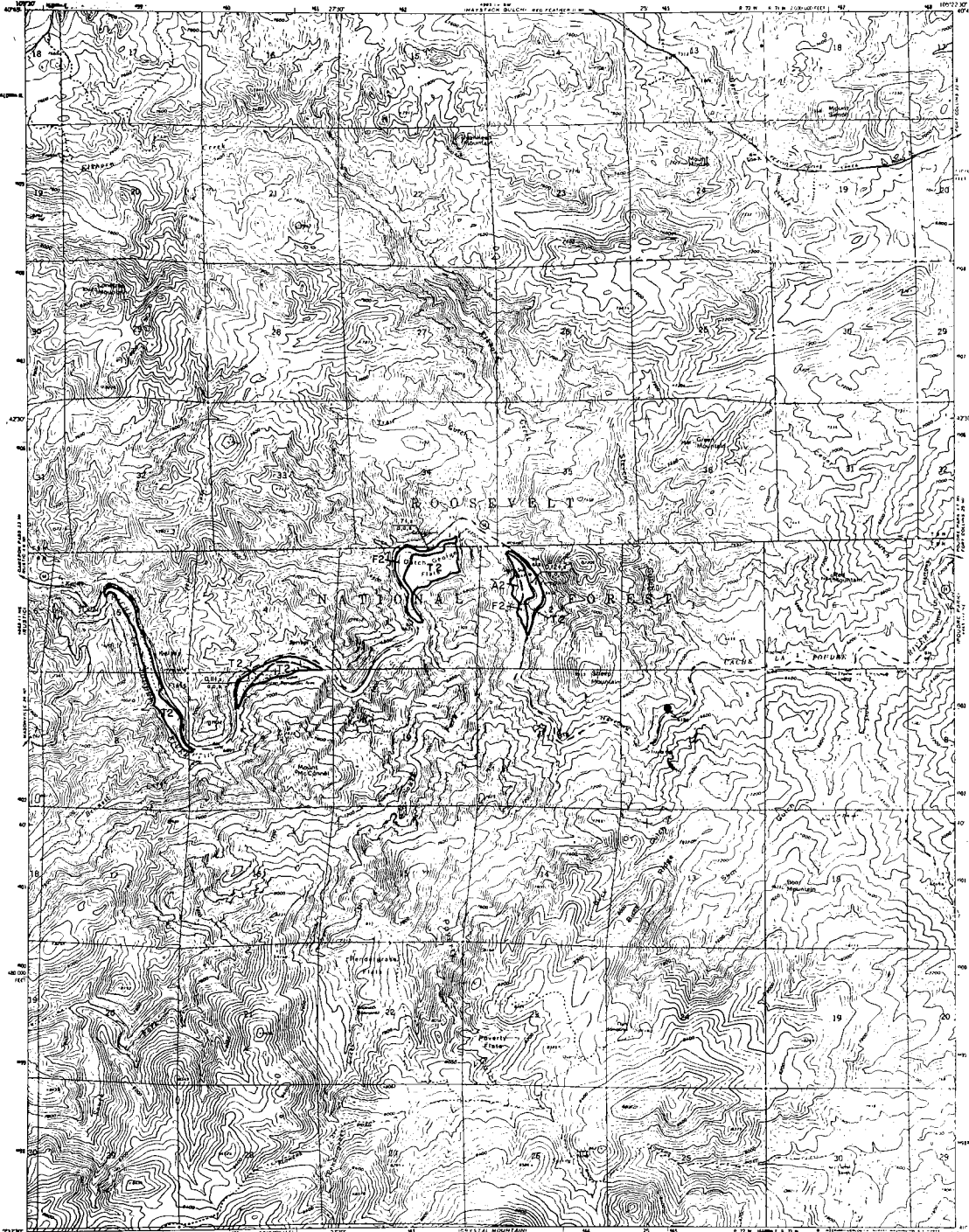
State Route

BEULAH, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

BIG NARROWS QUADRANGLE  
COLORADO-LARIMER CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

Longitude unit  
Elevation classification

### LANDFORM TYPES

- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Man-deposited sand (natural)
- M Man-made deposits (slag, tailings, spoils, ...)

### RESOURCE CLASSIFICATION

- Coarse Sand/Gravel**  
(at least 20% retained on #4 screen, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significantly fines, decomposed rock, surface calcareous

- Fine Sand/Gravel**  
(finer than #20 passing #40 screen, 80% retained on #100 screen, visual estimation)
- 3 Sand

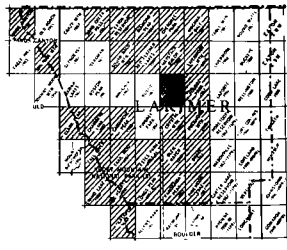
- Unutilized Resource**
- 4 Probable aggregate resource

### MAP SYMBOLS

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Reclaimed quarry aggregate resource area
- Selected well or drill-hole location with overburden thickness (fill over road/gravel resource thickness (ft), shaded from well logs, "n" indicates gravel, "m" indicates sand)
- "n" in symbol denotes unutilized or unknown property
- "m" denotes Colorado Geological Survey "Discontinued and Canceled Projects"
- Well
- Landform boundary, solid where known or observed, dashed where approximate or inferred

### STATION, LOCATION AND GEOLOGICAL CORRELATION OF DEPOSIT

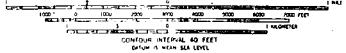
- overburden thickness (ft)
- undisturbed resource thickness (ft)
- percent sand and fines (passing #4 screen, 0.25 in., visual estimation)
- significant amount of fines (passing #100 screen, 0.0075 in. or 0.300 mm.)
- significant amount of decomposed or weak rock
- significant amount of surface calcareous material
- "n" in symbol denotes unutilized or unknown property
- "m" in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR VETERAN AREA

Mapped by: Stephen D. Schwechow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



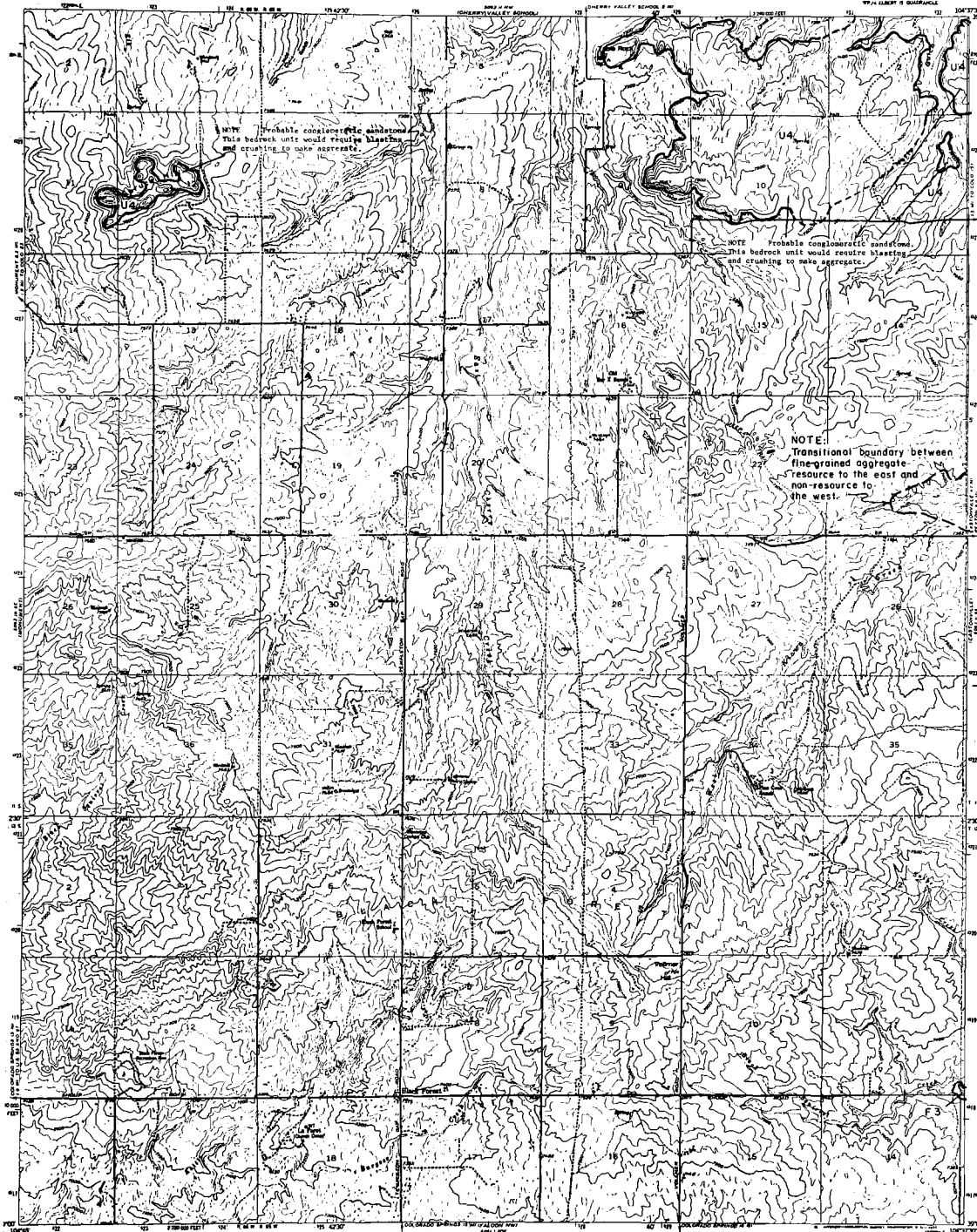
ROAD CLASSIFICATION  
Medium duty      Light duty  
Unimproved dirt      Stone Road

BIG NARROWS, COLO

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

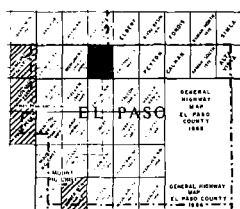
BLACK FOREST QUADRANGLE  
COLORADO-EL PASO QD  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
U.S. GEOLOGICAL SURVEY

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



## EXPLANATION

- Legend**
- LAPORAL UNITS**
- F Fluvial deposit
  - T Tertiary terrace deposit
  - V Valley fill (E & T)
  - U Unclay deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Hummock deposits (slag, tailings, spillover...)
- AGGREGATE CLASSIFICATION**
- Coarse aggregate**  
1st class: 100% retained on #4 screen, visual estimation
- 1 Gravel: Relatively clean and sound
  - 2 Gravel: Slightly finer, decomposed rock, calcium carbonate
- Fine aggregate**  
1st class: 100% passing #4 screen, 20% retained on #20 screen, visual estimation
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Indicated quarry aggregate resource area
  - Indicated quarry aggregate resource area with overburden thickness (ft) over sand/gravel resource thickness (ft) obtained from well logs
  - "u" indicates gravel; "s" indicates sand
  - "\*" is symbol denoting unvested or unknown property
  - "m" denotes Colorado Geological Survey withdrawal and gravel practice drill hole
  - Landowner boundary, solid where known or reported; dashed where approximate or inferred
- SYMBOLS, UNITS AND CONVERSIONS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - gravel and sand flow (cubic ft per second, 0.32 cu ft, visual estimation)
  - significant amount of flow (passing #20 screen, 2,000 cu ft or 0.25 cu ft)
  - significant amount of deposit or used rock
  - "u" or symbol denotes unvested or unknown property
  - "\*" is symbol denoting property status or length/flow

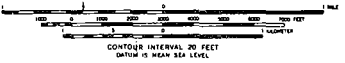


- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
Trimble, D.E., and Fitch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-857 A.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 20 FEET  
DATUM IS MEAN SEA LEVEL

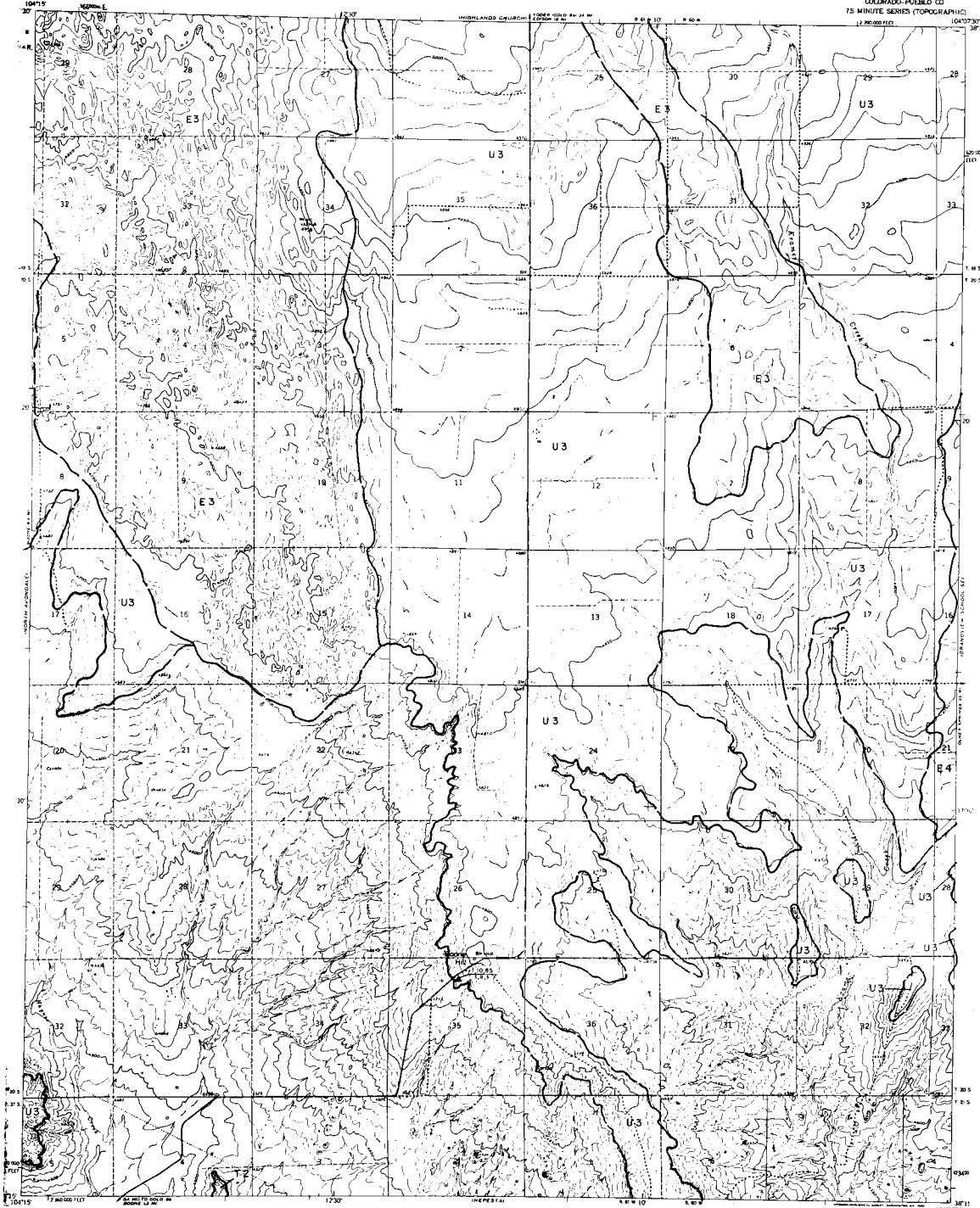
ROAD CLASSIFICATION  
Light duty ————— Unimproved dirt .....

BLACK FOREST, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

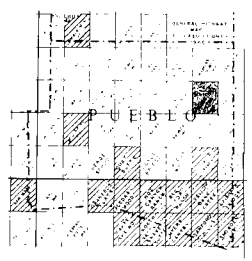
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLZ, DIRECTOR

BOONE HILL QUADRANGLE  
COLORADO-PUEBLO CO  
15 MINUTE SERIES (TOPOGRAPHIC)  
1:250,000



## EXPLANATION

- Contour Interval  
 Resource Classification
- RESOURCE CLASSIFICATION**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated sand
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (beach, dune, etc.)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, solution cavities
  - 3 Sand
  - 4 Probable aggregate resource
- USE SYMBOLS**
  - \* Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Potential well or well-like location with water
  - Potential sand and gravel resource
  - Potential gravel, "m" indicates sand
  - In symbol: resource unclassified or unknown property
  - "m" indicates Colorado Geological Survey resource and gravel projects' title held
  - Landform boundary, solid lines show or contour, dashed lines approximate or inferred
- STATION LOCATION AND CHARACTERISTICS OF BORINGS**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Corrected sand and fines opening at screen, 0.25 (in.), 0.25 (mm)
  - Significant amount of fines (opening 1/16 screen, 0.003 in. or 0.075 mm)
  - Significant amount of decomposed or weak rock
  - Significant amount of calcium hydroxide (rich)
  - "m" symbol denotes mineralized or unknown property
  - "m" symbol denotes property absent or unreported



- QUADRANGLE LOCATION
- NON-RESOURCE OR WILDERNESS AREA

Maped by: Stephen D. Schwochow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



ROAD CLASSIFICATION  
Medium duty \_\_\_\_\_  
Light duty \_\_\_\_\_  
Unimproved dirt \_\_\_\_\_

BOONE HILL, COLO.

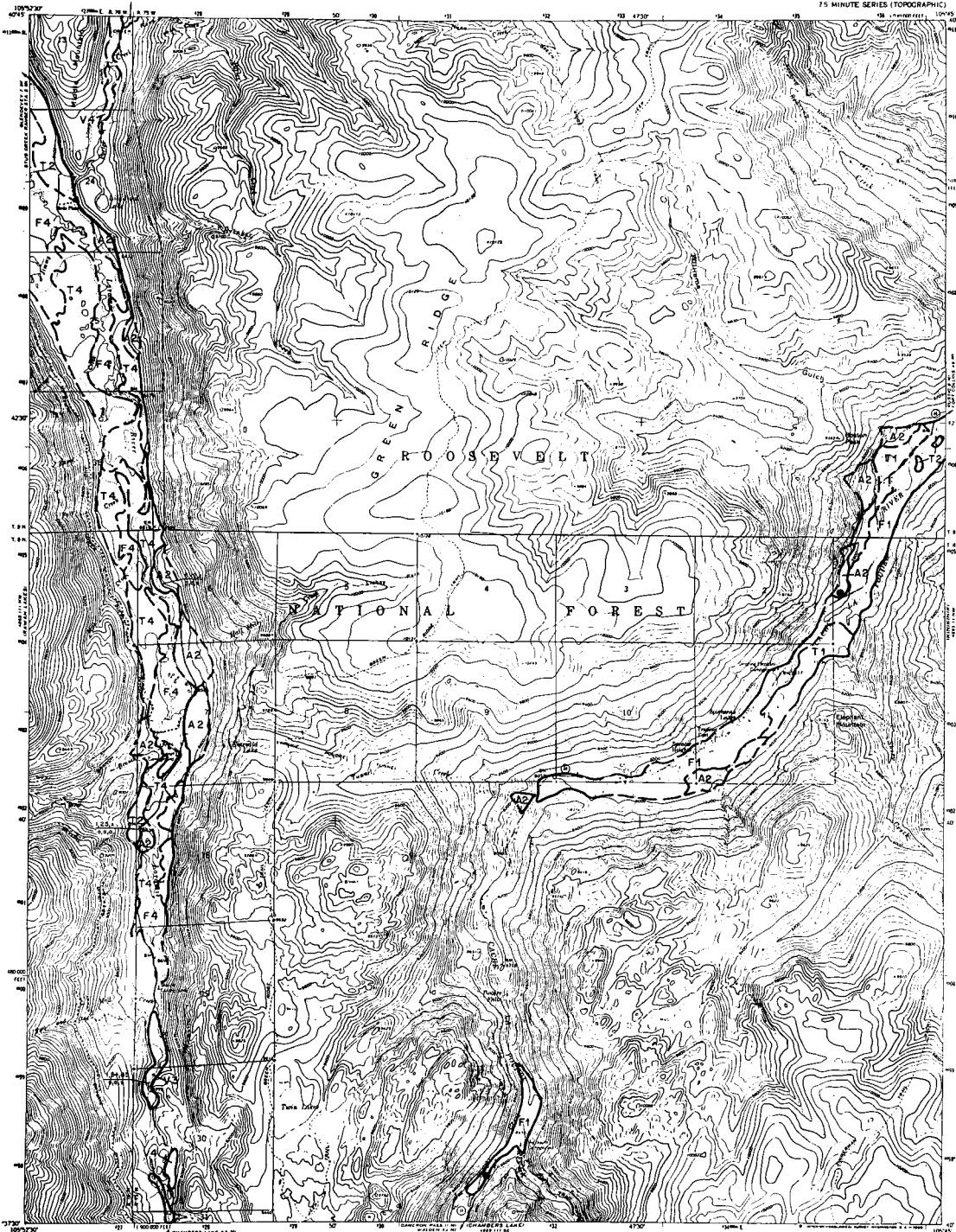
APPROXIMATE MEAN  
DECLINATION, 1980



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

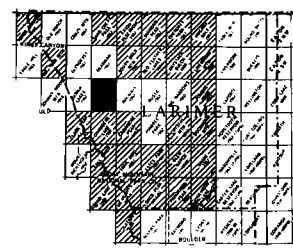
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLS, DIRECTOR  
T 4

BOSTON PEAK QUADRANGLE  
COLORADO-LARIMER CO.  
75 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

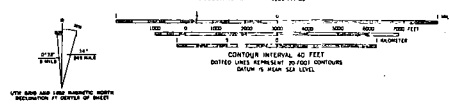
- Contour unit  
 Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mounds deposit (dunes, mounds, spits, ...)
- MINORITY CLASSIFICATION**
- Gravel Aggregate**  
 (as shown on the map) (see note on the map)  
 1 Gravel: relative class and sound  
 2 Gravel: significant fines, decomposed rock, calcitic carbonate
- Sand Aggregate**  
 (as shown on the map) (see note on the map)  
 3 Sand
- Quarry Aggregate**
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area (shaded with 1/2 inch dots) location with overburden thickness (1) over sand/gravel resource thickness (2), obtained from well logs.
  - "1" indicates gravel; "2" indicates sand
  - "1" in symbol denotes unventilated or otherwise property.
  - "2" denotes Colorado Geological Survey (sand/gravel and gravel project) drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred.
- STATION, LOCATION AND CORRELATION INDICATION OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - potential sand and fines (spacing of contour, 1:1, 1:1, 1:1, 1:1, 1:1)
  - significant amount of fines (spacing of contour, 1:1, 1:1, 1:1, 1:1, 1:1)
  - significant amount of decomposed or calc rock.
  - significant amount of relative abundance indicator
  - "1" or symbol denotes unventilated or otherwise property
  - "2" or symbol denotes property absent or unexplored



QUADRANGLE LOCATION  
 NON-RESOURCE OR VITREOUS AREA

Mapped by: Stephen D. Schwoh  
 Date: June 30, 1978

Revised from U. S. Geological Survey  
 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

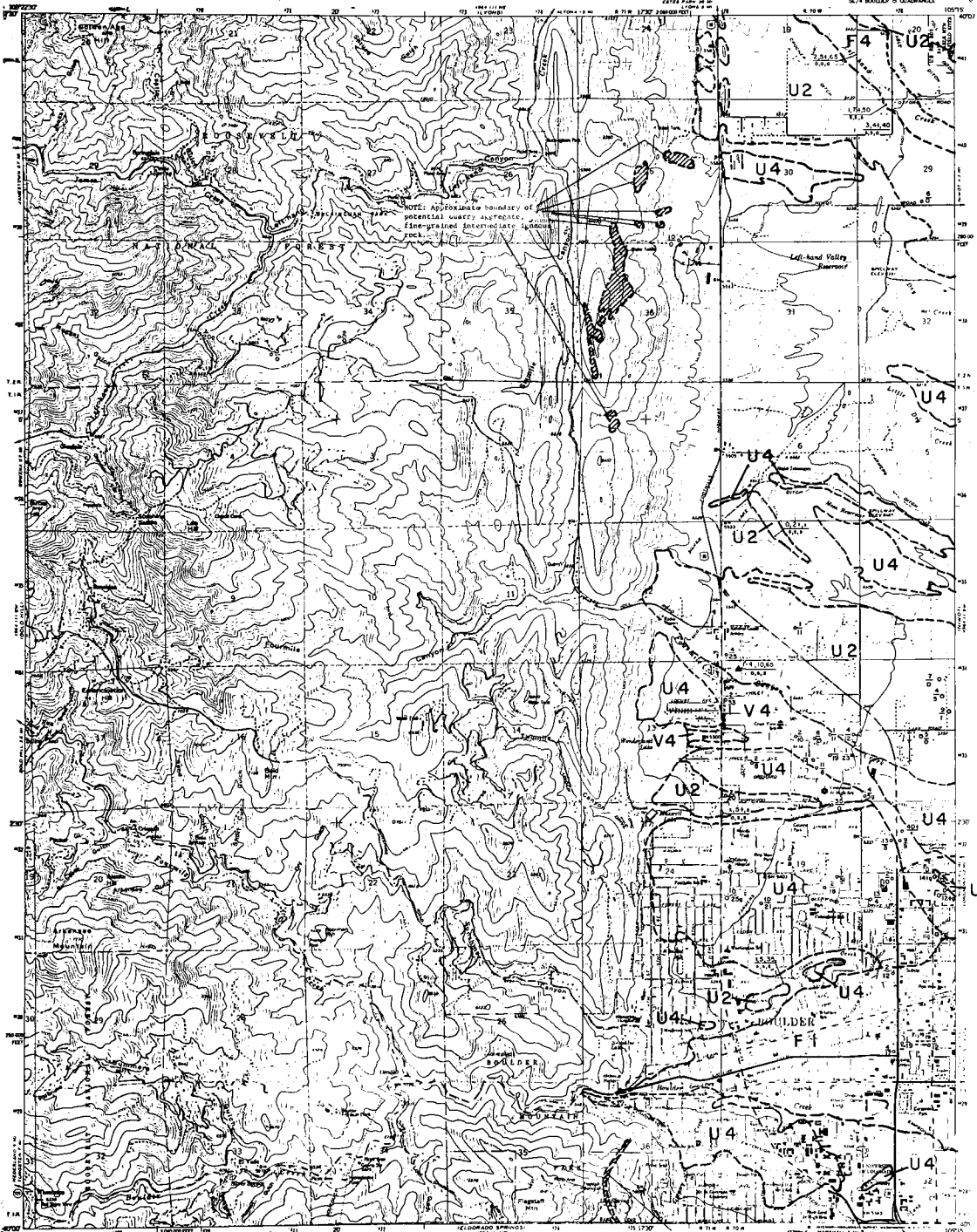
Light-duty Unimproved dirt  
 State Road

BOSTON PEAK, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

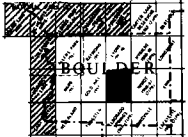
BOULDER QUADRANGLE  
COLORADO—BOULDER CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
SECTION BOULDER 9 QUADRANGLE

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



## EXPLANATION

- CONTOUR LINES**  
 - Contour lines  
 - Resource classification
- RESOURCE CODES**  
 F Fluvial deposit  
 T Tertiary terrace deposit  
 V Valley fill (F & T)  
 U Unsorted deposits  
 A Alluvial fan  
 M Wind-deposited sand (colluvial)  
 M Manganese deposits (slag, tailings, waste...)
- RESOURCE CLASSIFICATION**
- COARSE AGGREGATE**  
 (at least 20% passing #4 screen, 60% retained on #20 screen)  
 1 Gravel: relatively clean and sound  
 2 Gravel: significant fines, decomposed rock, talus, cobbles
- FINE AGGREGATE**  
 (greater than 75% passing #4 screen, 65% retained on #20 screen, 100% retained on #100 screen)  
 3 Sand  
 4 Probable aggregate resource
- MAP SYMBOLS**  
 \* Operating gravel and/or sand pit  
 \* Abandoned gravel and/or sand pit  
 \* Operating stone quarry  
 \* Abandoned stone quarry  
 \* Potential quarry aggregate resource area  
 \* Selected well or drill-hole location with associated thickness (ft) of sand/gravel resource  
 \* "S" indicates sand  
 \* "G" indicates gravel  
 \* "U" in symbol denotes unvaluated or unknown resource  
 \* "M" denotes Colorado Geological Survey "Manganese and gravel projects" drill hole  
 - Contour boundary, solid when shown or dashed when shown otherwise as inferred
- POSITION, LOCATION AND ORIENTATIONAL INFORMATION OF SYMBOLS**  
 - Overburden thickness (ft)  
 - Sand/gravel resource thickness (ft)  
 - Gravel and sand (ft) (passing #4 screen, 0.85 (4.75) percent retention)  
 - Significant amount of fines (passing 100 screen, 0.002 (20) or 0.075 (3) mm)  
 - Significant amount of decomposed or weak rock  
 \* "U" symbol denotes unvaluated or unknown property  
 \* "M" symbol denotes property absent or unprofitable



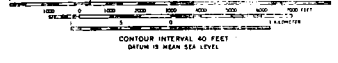
- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
 Colton, R.B., and Fitch, W.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Freeley Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-855 D.  
 Gardner, W.R., 1968. Engineering Geologic Map of the Boulder Quadrangle, Boulder County, Colorado: U. S. Geol. Survey Open-File Report.

Mapped by: Ralph B. Shroba  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.

NOTE: Approximate boundary of potential quarry aggregates, fine-grained intermediate igneous rock.

- ROAD CLASSIFICATION**  
 - Heavy-duty  
 - Medium-duty  
 - Light-duty  
 - Unimproved dirt  
 - U.S. Road  
 - State Road



Base from U. S. Geological Survey 7-1/2 minute quadrangle

8 1/2" x 11" AND 11" x 17" REPRODUCTION OF CENTER OF SHEET

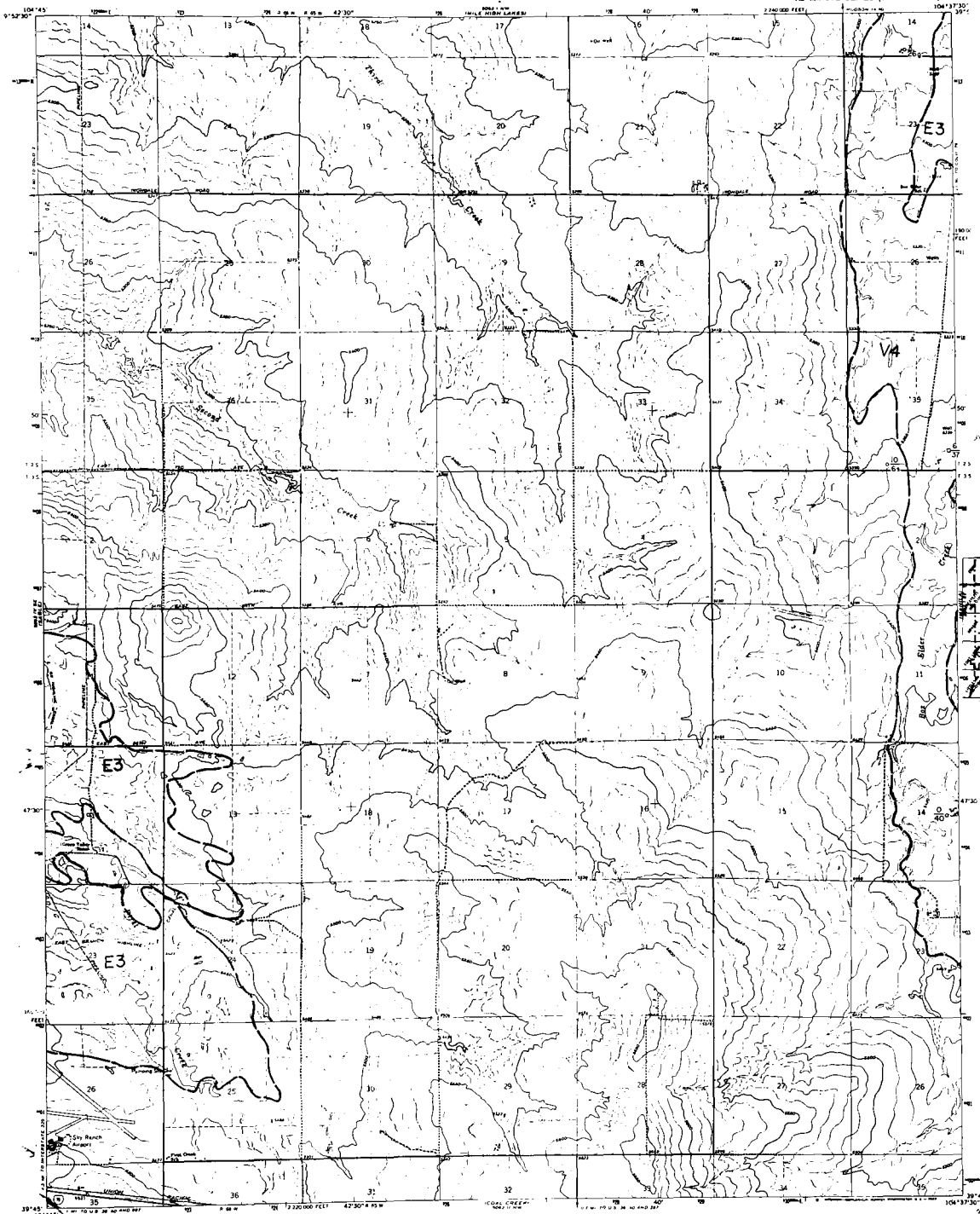
BOULDER COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

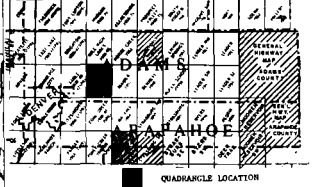
BOX ELDER SCHOOL QUADRANGLE  
COLORADO, ADAMS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

## EXPLANATION



- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-road deposits (telecommunications, etc.)
- RESOURCE CLASSIFICATION**
- Gravel resources**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Sand resources**
- 3 Sand
  - 4 Probable aggregate resource
- QUARRIES**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
- Potential quarry aggregate resource area**
- Gravel: well or millstone location with quarry
  - Gravel: (G) over sand/gravel resource
  - Gravel: (G) located from well logs
  - "G" indicates gravel; "S" indicates sand
  - "G" in small letters unclassified or unknown quantity
  - "G" denotes Colorado Geological Survey classification and gravel projects
  - Fill hole
  - Landform boundary, solid lines known or observed, dashed more approximate or inferred
- STATION, LOCATION AND ORIENTAL DESCRIPTION OF ROAD**
- Intersecting distances (ft)
  - and gravel resource (kilometers) (ft)
  - distance and flow direction
  - Station, 2.5 ft (0.762 m) station
  - Significant amount of flow (approx. 1000 cu ft)
  - Significant amount of decomposed or weak rock
  - Significant amount of siliceous metamorphic facies
  - or unknown property
  - "G" in small letters property absent or insignificant



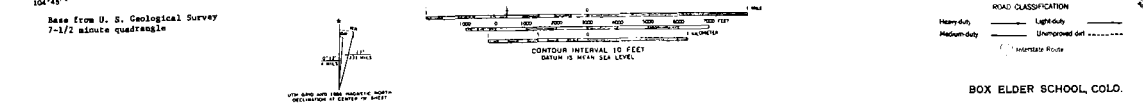
**References:**

Chase, C.H., and McCambray, J.A., 1972. Generalized surficial geologic map of the Denver area, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-731.

Smith, R.D., Schneider, P.A., Jr., and Petri, L.R., 1966. Ground-water resources of the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: U.S. Geol. Survey Water-Supply Paper 1656, pl. 1.

Trumble, D.E., and Fitch, R.S., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U.S. Geol. Survey Misc. Geol. Inv. Map I-856-A.

Mapped by: Stephen D. Schowchow  
Date: June 30, 1976  
Prepared in cooperation with the U. S. Geological Survey.



**ROAD CLASSIFICATION**

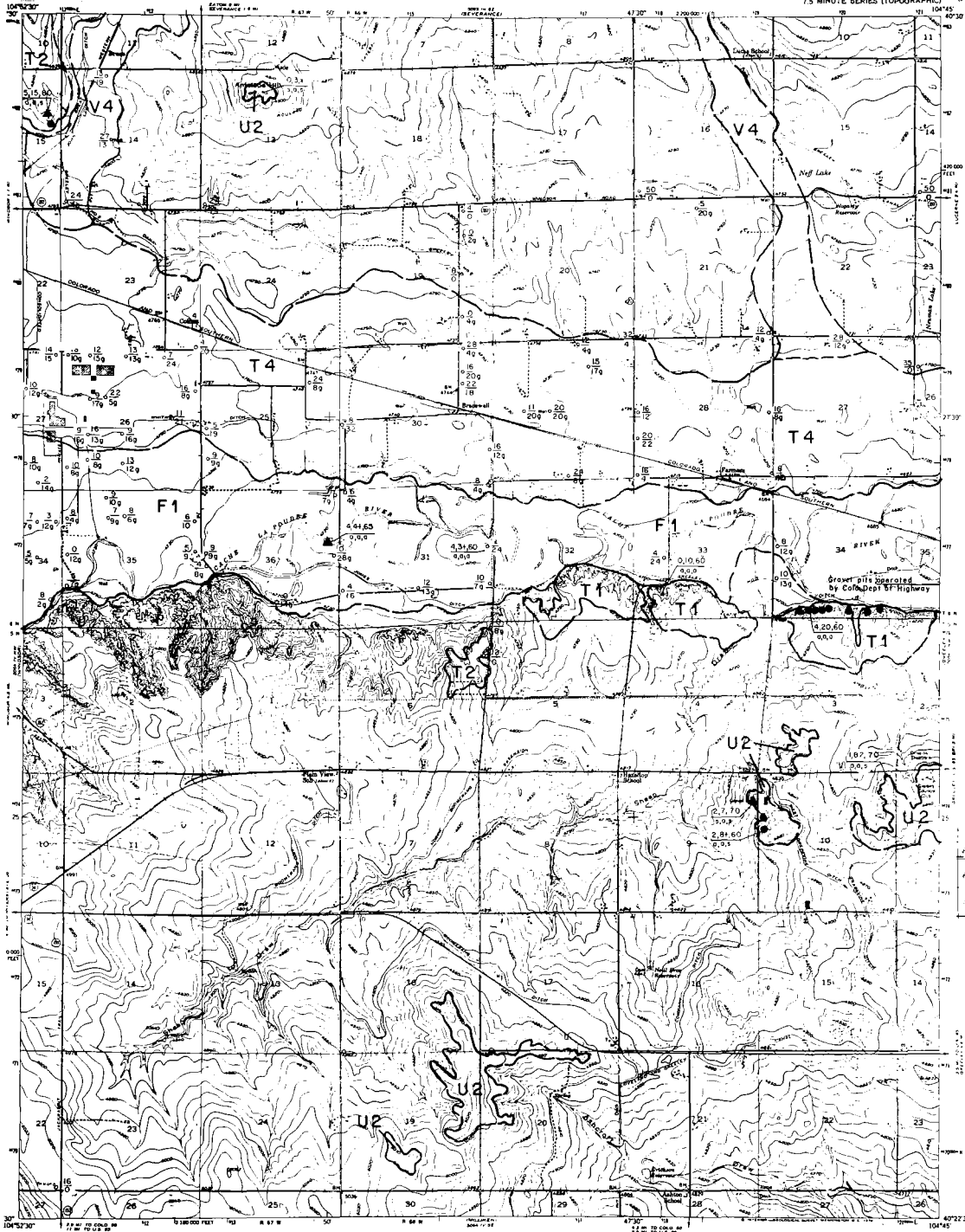
- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved Off
- Horseshoe Road

BOX ELDER SCHOOL, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

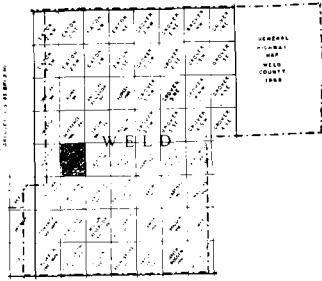
BRACEWELL QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- MAPPER'S KEY**
- T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eolian-deposited sand (limited)
  - M Non-mine deposits (e.g., talus, colluvium, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine ash matrix
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Abandoned stone quarry
  - Revealed quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), indicated from well logs: " " indicates gravel; " " indicates sand
  - " " in symbol denotes unmineralized or unknown property
  - " " denotes Colorado Geological Survey Mineral/Plant and Grass Project (fill hole)
  - Land-use boundary, solid where known or observed; dashed where approximate or inferred
- STATION LOCATION AND ORIENTATION**
- DESCRIPTION OF SYMBOLS**
- Overburden thickness (ft)
  - Significant amount of fines (percent fines and fines (percent of coarse), 0.25 in., #60 sieve)
  - Significant amount of fines (percent fines)
  - Significant amount of decomposed or weak rock
  - Significant amount of mineral carbonate material
  - " " in symbol denotes unmineralized or unknown property
  - " " in symbol denotes unmineralized or unknown property



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Shaw, F. H., III, 1972, Map of surficial geology of the Bracewell quadrangle; Reconnaissance mapping for Colorado Geol. Survey Window Environmental Geology Project, open-file map.

Berebey, L.A., and Schneider, P.A., Jr., 1972, Geologic map of the lower Cache La Poudre River basin, north-central Colorado; U. S. Geol. Survey Misc. Geol. Inv. Map 1-887.

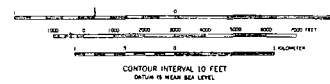
Shelton, D.C., 1974, personal communication.

Ching, P.W., 1972, Economic gravel deposits of the lower Cache La Poudre River; Colorado State Univ. Unpub. Master Sci. Thesis.

**Geology modified after:**  
Colton, R.B., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Dresley Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map 1-855-D.

Mapped by: Stephen D. Schwuchow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7.5-minute quadrangle



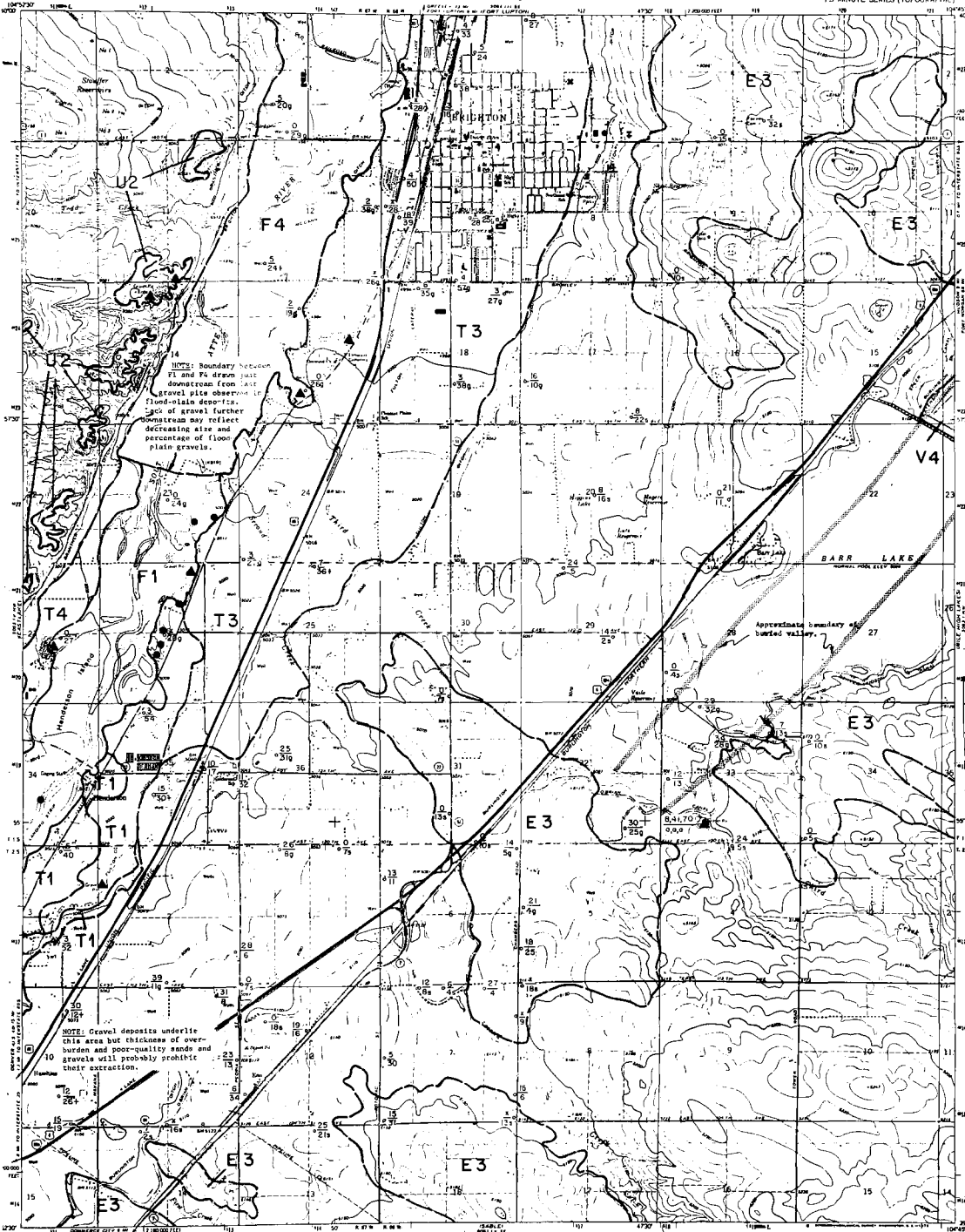
- ROAD CLASSIFICATION**
- Mainly
  - Lightly
  - Unimproved
  - U.S. Route
  - State Route

BRACEWELL, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

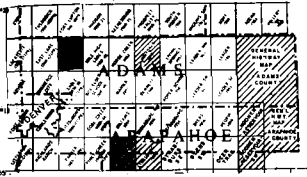
BRIGHTON QUADRANGLE  
COLORADO-ADAMS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Location well
  - Reservoir side function
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (milline)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- CLASS 1  
Gravel relatively clean and sound
- CLASS 2  
Gravel significant fines, decomposed rock, calcine overburden
- CLASS 3  
Sand
- CLASS 4  
Probable aggregate resource
- MAP SYMBOLS**
- Open circle: Operating gravel surface and pit
  - Shaded circle: Abandoned gravel surface and pit
  - Square: Operating stone quarry
  - Shaded square: Abandoned stone quarry
  - Circle with dot: Potential quarry aggregate resource area
  - Circle with cross: Selected well or drill-hole location with overburden thickness (ft.) and gravel resource quantity (cubic yds.)
  - Circle with asterisk: "m" indicates sand
  - Circle with diagonal lines: "s" indicates siltstone or schist
  - Circle with horizontal lines: "g" indicates granite
  - Circle with vertical lines: "l" indicates limestone
  - Circle with wavy lines: "m" indicates man-made deposits
- STATION LOCATION AND GEOLOGICAL ASSOCIATION OF DEPOSIT**
- Overburden thickness (ft.)
  - Percent sand and fines (percent %)
  - Percent sand and fines (percent %)
  - Percent sand and fines (percent %)
- \* In symbol, degree uncorrected or uncorrected
- \* In symbol, degree uncorrected or uncorrected
- \* In symbol, degree uncorrected or uncorrected



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR VETERAN AREA

**References:**  
 De Wit, L.M., 1928, Geology of the city of Boulder, Colorado. Colorado School of Mines Quarterly, v. 65, no. 1, p. 2, 3.

Harrison, G.L., and Owen, W.H., 1972, Geologic aspects, origin and utilization of the Boulder area, Colorado. U.S. Geol. Survey Water-Supply Paper 1638, p. 1.

Chase, G.H., and MacGregor, S.A., 1971, Geologic map of the Boulder area, Colorado. U.S. Geol. Survey Water-Supply Paper 1638, p. 1.

Smith, R.C., Schneider, P.A., Jr., and Ford, L.R., 1974, Ground-water resources of the South Platte River basin in western Adams and southeastern Weld Counties, Colorado. U.S. Geol. Survey Water-Supply Paper 1638, p. 1.

Inter-County Regional Planning Commission, 1961, Strategic course plan for the Denver region - Part I, Sand and gravel resources. Denver, Colo., Inter-County Reg. Plan. Comm., p. 2.

Triebel, D.H., and Petch, R.H., 1974, Map showing potential source of gravel and sandstone aggregate in the Grand Dunes Area, Grand Range Urban Corridor, Colo. U.S. Geol. Survey Misc. Geol. Map G-689-A.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

Scale: 1 inch = 1 mile

CONTOUR INTERVAL, 10 FEET  
(SHOW A FEW SEA LEVEL)

U.S. GEOLOGICAL SURVEY

**ROAD CLASSIFICATION**

- Heavy-duty
- Light-duty
- Interstate Route
- U.S. Route
- State Route

Mapped by: Stephen D. Schwabach  
Date: June 30, 1974

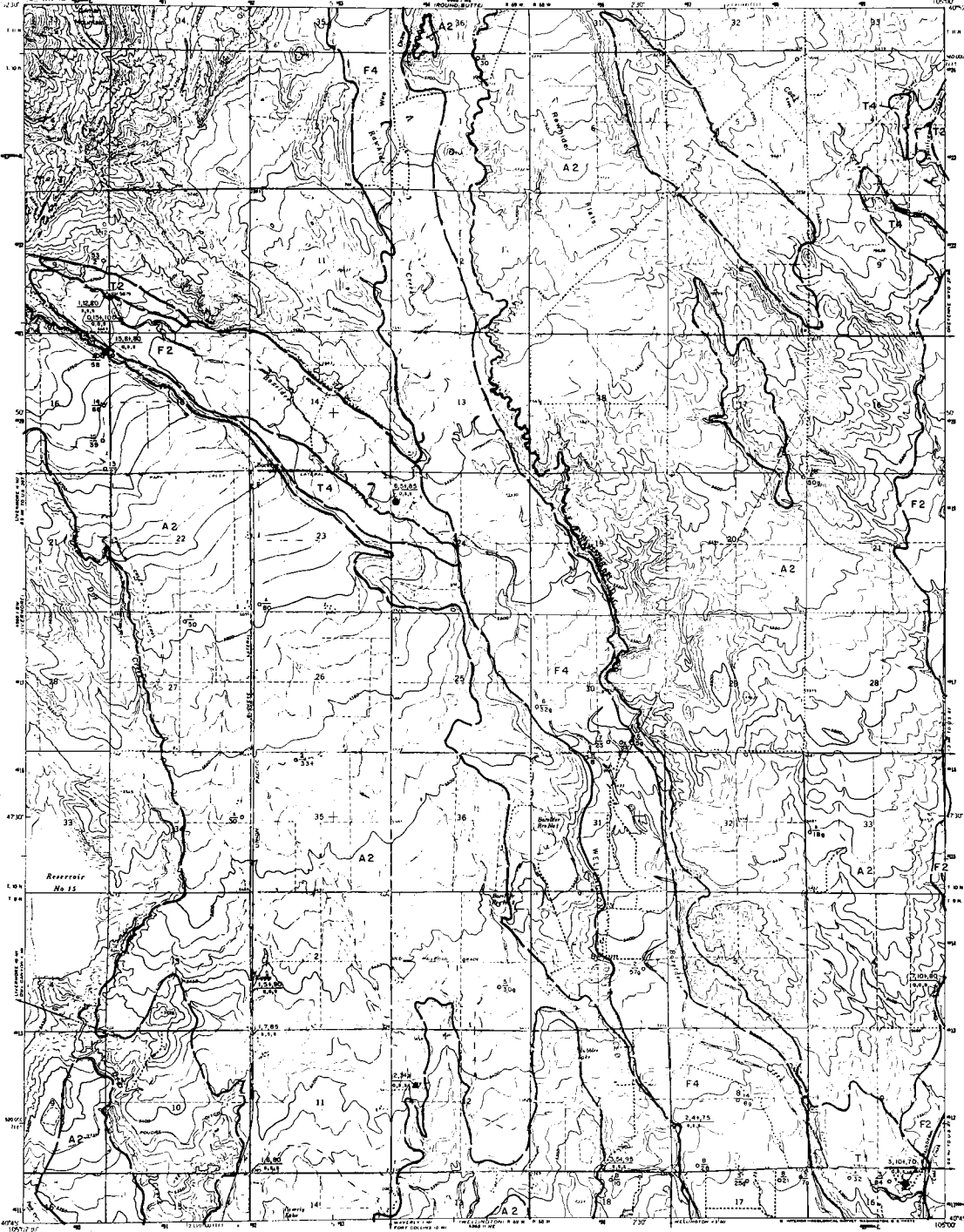
Prepared in cooperation with the  
U. S. Geological Survey.

BRIGHTON, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

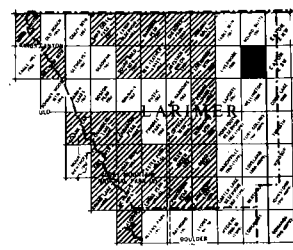
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN G. HOLS, DIRECTOR

BUCKEYE QUADRANGLE  
COLORADO-LARIMER CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- LANDFORMS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Erosion-deposited sand (talus)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 10% retained on #4 screen, official estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, sodium sulfate
- Fine Aggregate**  
(greater than 75 passing #4 screen, 475 retained on #200 screen, official estimation)
- 3 Sand
  - 4 Probable aggregate resource
- QUARRY SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "s" indicates gravel; "m" indicates sand
  - "\*" to denote areas unmineralized or unknown properties
  - "u" denotes Colorado Geological Survey "Unmineralized and Strata Protected" (USL) area
  - Leafline boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF EXPOSIT**
- overburden thickness (ft)
  - unmineralized resource thickness (ft)
  - percent sand and fines (percent of screen, 0.25 in., official estimation)
  - significant amount of fines (greater than 200 screen, 0.075 in. or 2.974 mm.)
  - significant amount of decomposed or weak rock
  - significant amount of sodium sulfate (indicator)
  - "u" in symbol denotes unmineralized or unknown
  - "\*" in symbol denotes property absent or incomplete



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Hartley, T.A., and Schofield, P.A., Jr., 1972,  
Geologic map of the Inner Cache La Poudre River  
basin, north-central Colorado: U. S. Geol. Survey  
Misc. Geol. Inv. Map I-587.

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

Data from U. S. Geological Survey  
7.5-minute quadrangle



ROAD CLASSIFICATION  
Medium duty ——— Light duty ———  
Unimproved dirt - - - - -

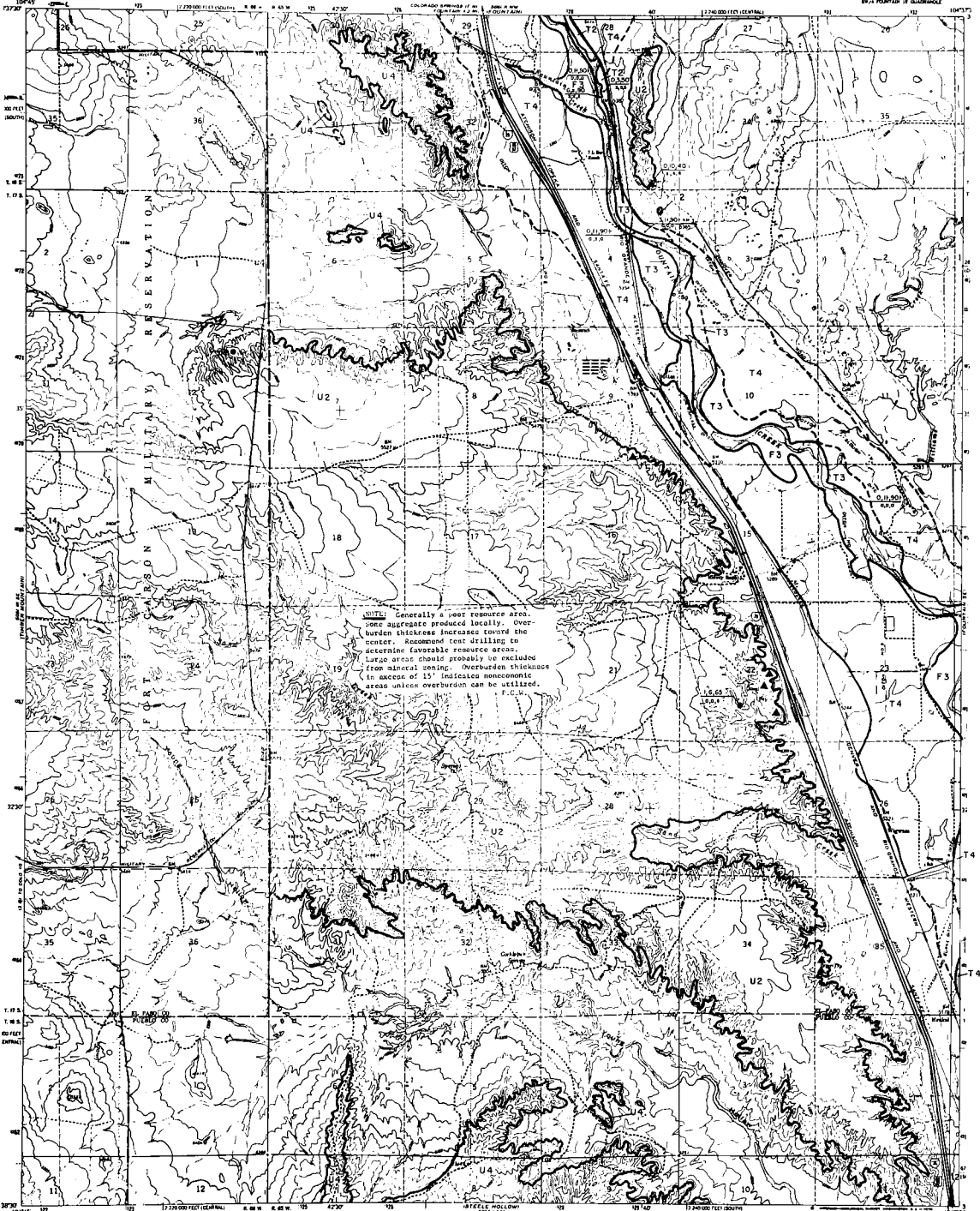
BUCKEYE COLO  
NAD45-W1900775  
1960  
AIR 4941 1 64-82008 7577



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

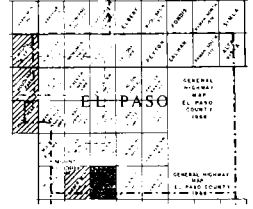
BUTTES QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
BY A POINT IN QUADRANGLE

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



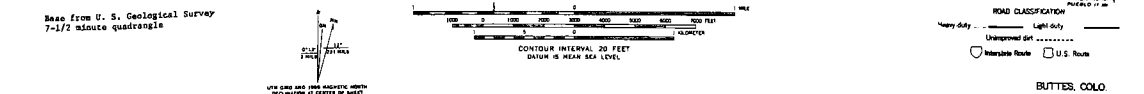
## EXPLANATION

- CONTOUR LINE**  
 Contour classification
- LANDFORM DEPOSIT**  
 F Floodplain deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Upland deposits  
 A Alluvial fan  
 E Unconsolidated sand (colluv.)  
 M Man-made deposits (embankment, spoil, etc.)
- RESOURCE CLASSIFICATION**  
 (See Class. 100, page 10 of 44 sheets, visual explanation)  
 1 Gravel: relatively clean and sand  
 2 Gravel: significant fines, decomposed rock, calcium carbonate.  
**FINE GRAVELS**  
 (Greater than 100 spacing 44 sheets, 428 retained on 4200 screen, visual estimation)  
 3 Sand  
 4 Probable aggregate resource
- MAP SYMBOLS**  
  
 Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.  
 \* indicates gravel; \*\* indicates sand  
 \* or \*\* in symbol denotes overburden or unknown property.  
 \* or \*\* denotes Colorado Geological Survey Water/Fossil and Gevel projects drill hole  
 Location boundary, well where known or reported; actual where approximate or inferred.
- STATION, LOCATION AND ORIENTATIONAL CHARACTERISTICS OF QUARRIES**  
  
 Contourline thickness (ft)  
 and/or gravel resource thickness (ft)  
 percent sand and fines (spacing as follows: 10, 15, 20, visual estimation)  
 Significant amount of fines (spacing 4200 screen, 2,250 in. or 0.075 mm.)  
 Significant amount of decomposed or sand rock.  
 Significant amount of calcium carbonate (calcite)  
 \* or \*\* in symbol denotes unutilized or unknown property  
 \* or \*\* in symbol denotes property absent or insufficient



QUADRANGLE LOCATION  
  
 NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wickliffe  
 Date: June 30, 1974



Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

UTM GRID AND UTM AGGREGATE UNIT  
 REGULATION IS OBSERVED BY SHEET

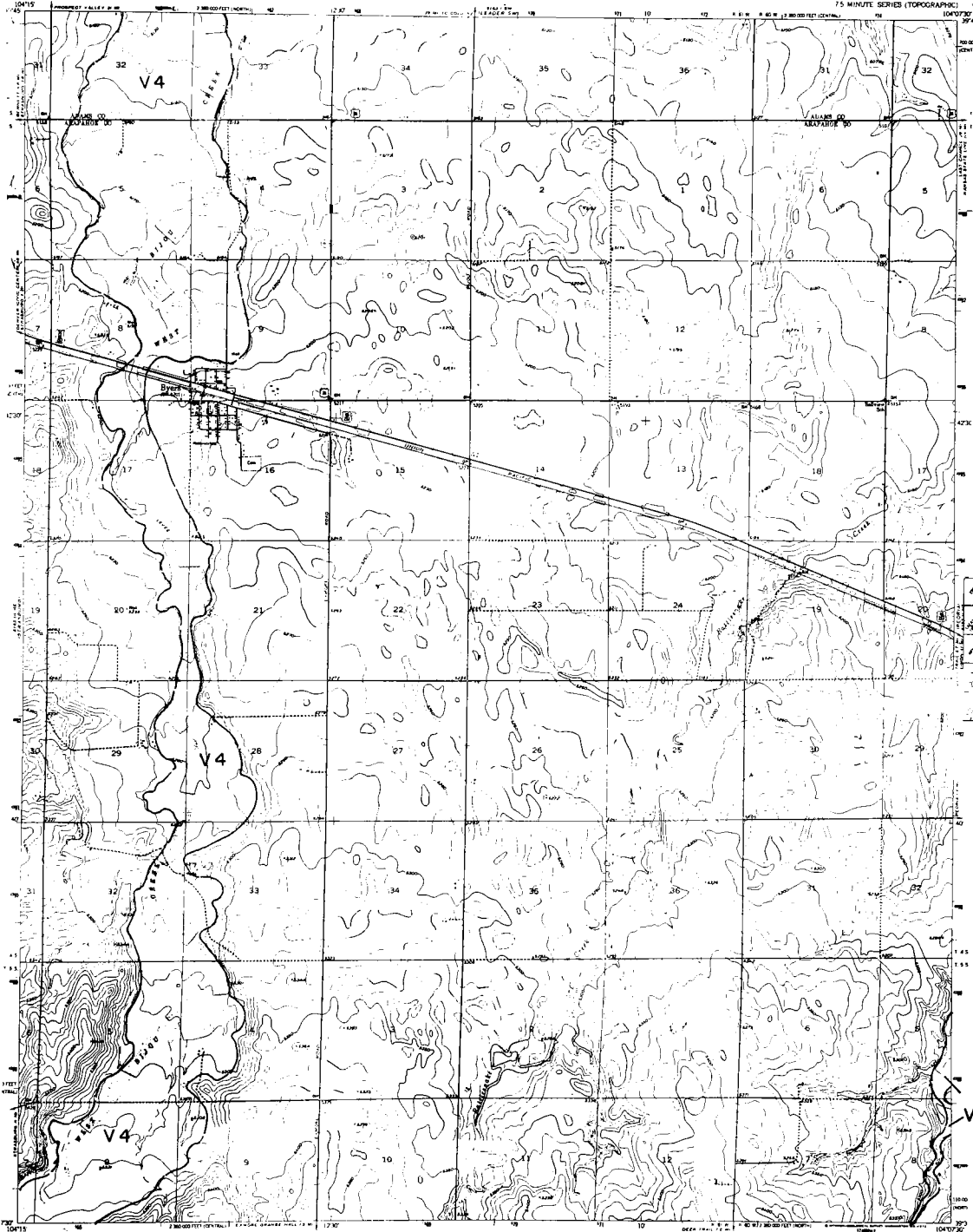
BUTTES, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

BYERS QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

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

EXPLANATION



- LANDFORM UNITS**
- F Floodplain deposit
  - T Tread terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Erosion-deposited sand (terrestrial)
  - M Marine deposits (sand, silt, shale, ...)
- RESOURCE QUALIFICATION**
- GRAVEL RESOURCES**
- 1 Gravel: substantial class and amount
  - 2 Gravel: significant class, decreased fac. calc. carbonate
- SAND RESOURCES**
- 3 Sand
  - 4 Potential aggregate resource
- NON-ROADS**
- A Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with water-bearing thickness (ft) over sand/gravel; resource thickness (ft), obtained from well logs
  - "G" indicates gravel, "S" indicates sand
  - "\*" in symbol denotes unutilized or unknown property
  - "L" in symbol denotes Geological Survey Window (Sand and Gravel) project
  - "X" in symbol denotes unutilized or unknown property
  - "B" in symbol denotes property shared or unutilized
- STATION, LOCATION AND GEOLOGICAL INFORMATION OF SYMBOLS**
- 1/4 section thickness (ft)
  - 1/2 section thickness (ft)
  - 1/2 section thickness (ft) (including 1/4 section, 1/2 in 1/4 section)
  - Significant amount of sand (depth 1000 ft or more, 1/2 in 1/4 section)
  - Significant amount of gravel (depth 1000 ft or more, 1/2 in 1/4 section)
  - "\*" in symbol denotes unutilized or unknown property
  - "B" in symbol denotes property shared or unutilized

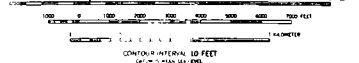
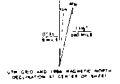


- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OF VITRIFIED AREA

Reference:  
Shadil, S.A., 1971. The Bijou Creek Damites and Reservoirs of Adams and Arapahoe Counties Colorado. Colo. Sch. Mines: EK-137

Mapped by: Phillip C. Wickless  
Date: June 30, 1974

See from U. S. Geological Survey  
7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Heavy duty
  - Light duty
  - Medium duty
  - Unimproved dirt
  - U.S. Road



BYERS COLO  
N7975-W10407.5/7.5  
1956

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

BYERS SW QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

## EXPLANATION

**LEGEND**

**LOCATIONAL UNITS**

- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Man-made deposits (slag, tailings, spoils, ...)

**RESOURCE CLASSIFICATION**

**COARSE SANDS**  
(at least 75% sand on # 20 screen, round particles)

- 1 Gravel: relatively clean and well-sorted
- 2 Gravel: significant fines, decomposed rock, calcian carbonate

**FINE SANDS**  
(greater than 75% passing # 20 screen, 4/5 retained on # 200 screen, round particles)

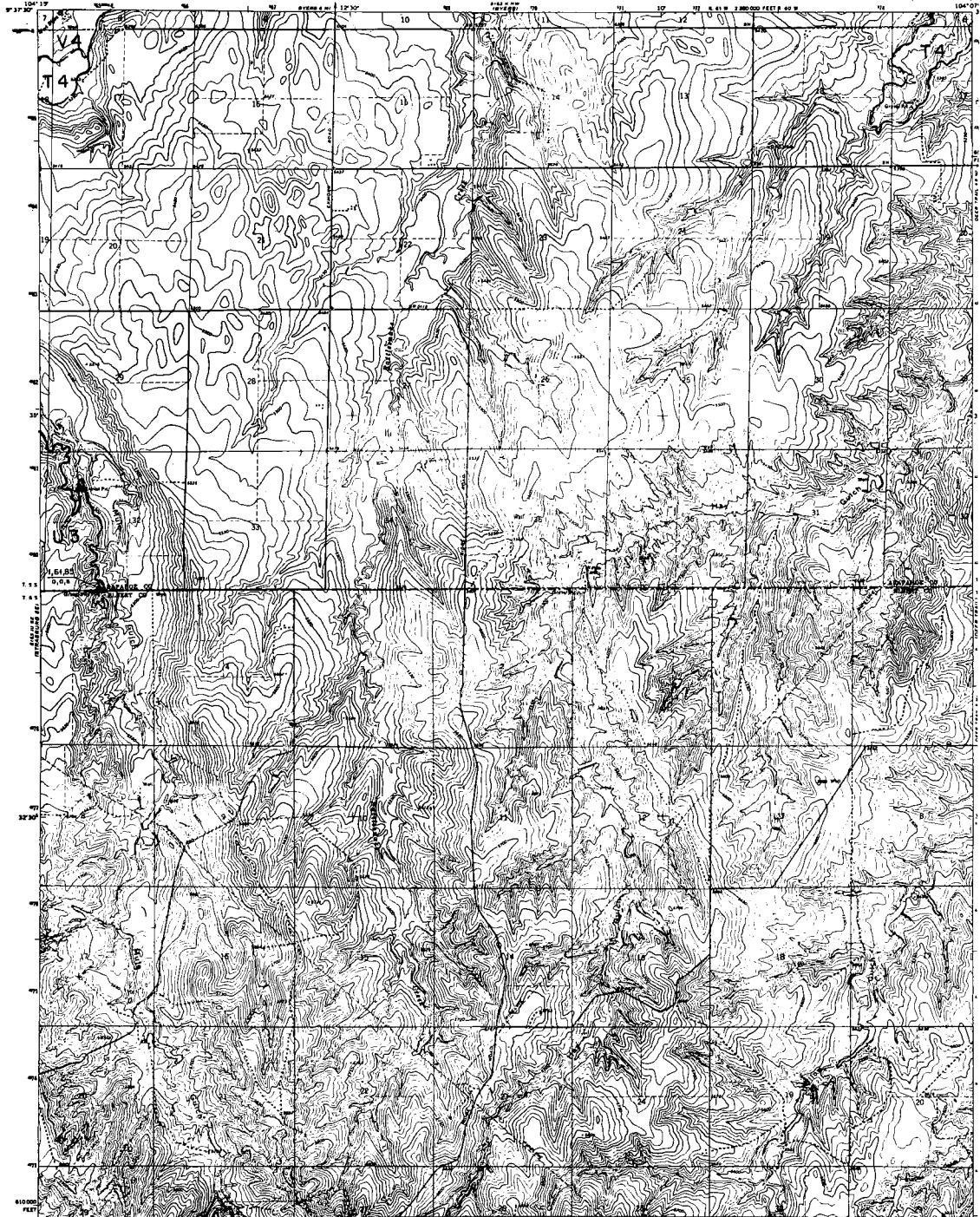
- 3 Sand
- 4 Probable aggregate resource

**NON-UNITS**

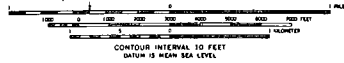
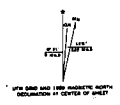
- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected unit or units in location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs:
  - "g" indicates gravel; "s" indicates sand
  - "\*" in symbol indicates unconsolidated or unknown property
  - "M" denotes Colorado Geological Survey boundary and Great Divide
  - "L" indicates landowner boundary, hold where known or unknown; dashed where approximate or inferred.

**STATON, LOCATION AND GEOLOGICAL DESCRIPTION OF RESOURCES**

- number (1000s ft)
- and gravel resource thickness (ft)
- gravel sand and fines (passing # 20 screen, 4/5 retained on # 200 screen)
- significant amount of fines (passing # 200 screen, 4/5 retained on # 200 screen)
- significant amount of decomposed or weak rock
- significant amount of minimum carbonate (calcian)
- "\*" in symbol denotes unconsolidated or unknown property
- "M" in symbol denotes property owner or landowner



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
OUTLINE IS MEAN SEA LEVEL

**ROAD CLASSIFICATION**

Primary highway: hard surface ———— lightly-maint. hard or improved surface ————

Secondary highway: hard surface ———— unimproved road - - - - -

Interstate Route U S Route State Route

Mapped by: Phillip C. Wickless  
Date: June 30, 1974

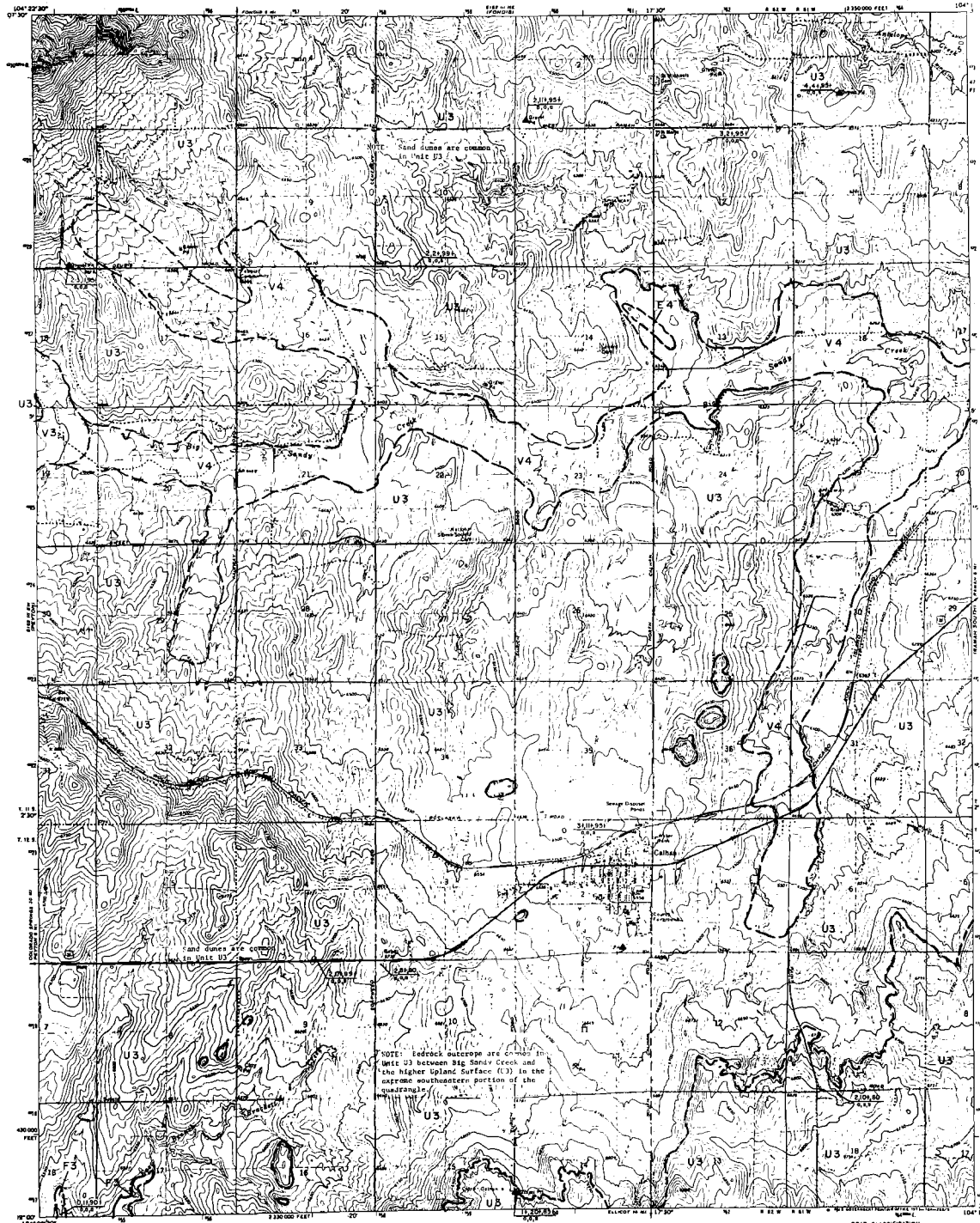
BYERS SW, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

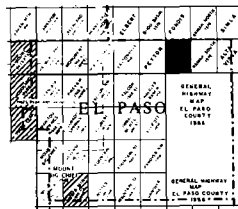
CALHAN QUADRANGLE  
 COLORADO-EL PASO CO.  
 7.5 MINUTE SERIES (TOPOGRAPHIC)

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



### EXPLANATION

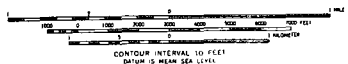
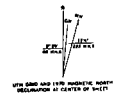
- Landform unit  
 Resource classification
- LANDFORM UNIT**
- F Floodplain deposit
  - T River terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposition sand (eolian)
  - M Marine deposits (glacial, alluvial, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (at least 30% passing 48 screen, 100% retained on 200 screen, except otherwise)
- 1 Gravel: (relatively clean and sound)
  - 2 Gravel: significant fines, decomposed rock, calcian carbonates.
- Fine Aggregate**  
 (greater than 75% passing 48 screen, 60% retained on 200 screen, except otherwise)
- 3 Sand
- Unutilized Resource**
- 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Indicated well or drill-hole location with screen bottom thickness (ft) over sand/gravel resource thickness (ft), indicated from well logs:
    - " " indicates gravel; " " indicates sand
    - " " in symbol denotes unutilized or unknown property
    - " " denotes Colorado Geological Survey (unutilized and gravel) project
    - " " still live
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION LOCATION AND COORDINATE SPECIFICATION OF SYMBOL**
- Coordinate thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Screen sand and flow (passing 48 screen, 0.84 ft), cited indication
  - " " significant amount of fines (passing 100 screen, 0.84 ft, or 2.00 mm)
  - " " significant amount of decomposed or weak rock
  - " " significant amount of calcian carbonate (calcite)
  - " " or unutilized resource unutilized or unknown property
  - " " in symbol denotes property absent or unutilized



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph B. Shroba  
 Date: June 20, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



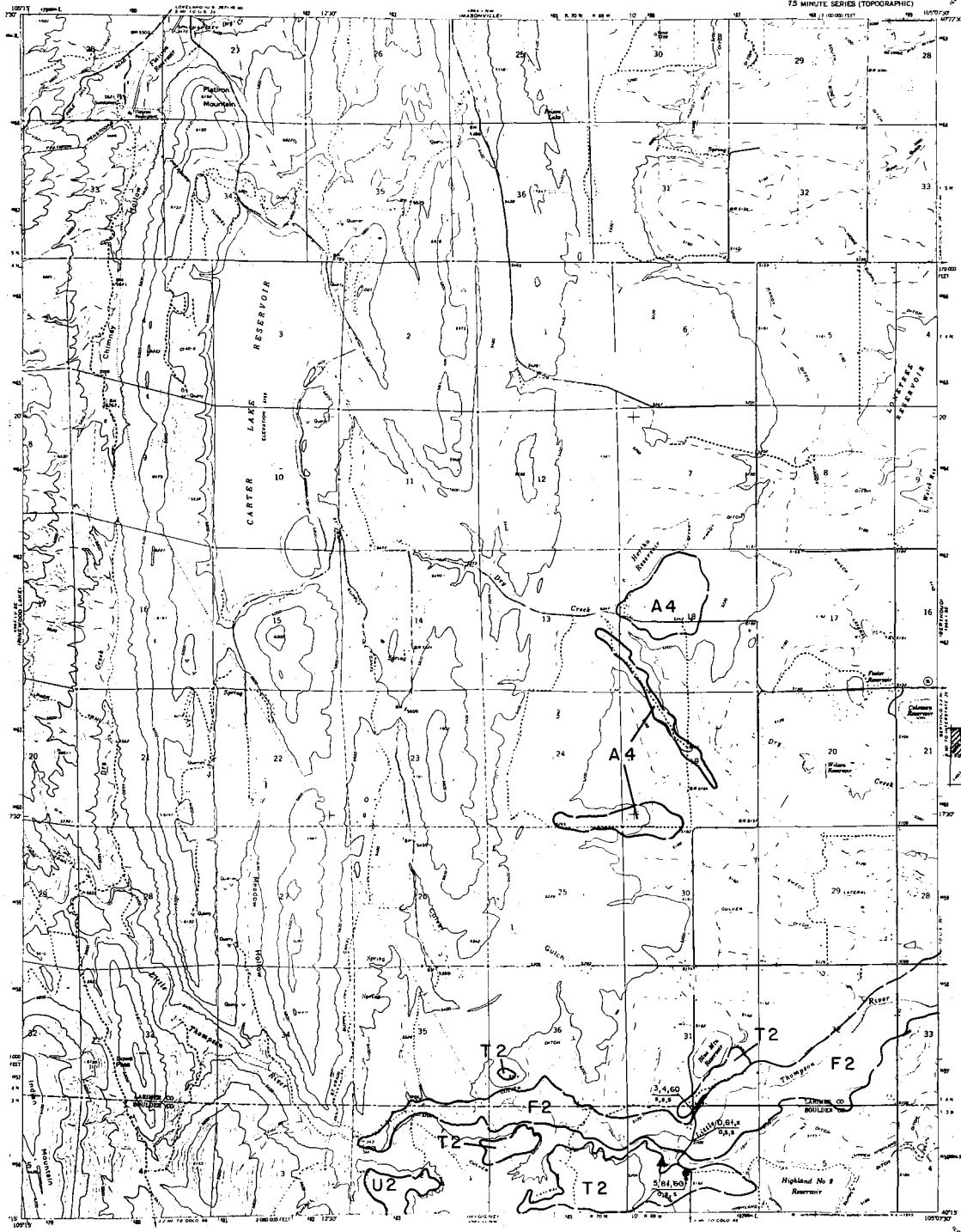
- ROAD CLASSIFICATION**
- Primary highway: Light-duty road, hard or hard surface
  - Secondary highway: Improved surface
  - Unimproved road: Hard surface
  - Interstate Route: U S Route
  - State Route: State Route

CALHAN, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

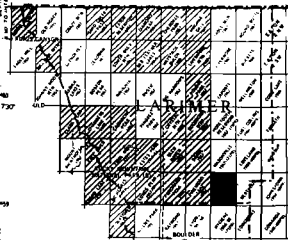
CARTER LAKE RESERVOIR  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Landform unit  
Resource Classification
- LANDFORM UNIT**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eolian-deposited sand (dunes)
  - M Man-made deposits (fill, talus, spalls, ...)
- RESOURCE CLASSIFICATION**
- GRAVEL SANDS**
- 1 Gravel: relatively even and smooth
  - 2 Gravel: significant fines, decomposed rock, saltine calcareous
- SAND SANDS**
- 3 Sand: (specimen size 1/16 inch to 4.75 mm, visual estimation)
  - 4 Potential aggregate resource
- NON-RESOURCE**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or grill-hole location with maximum thickness (ft) over assigned resource thickness (ft), obtained from well logs
  - "N" indicates level; "D" indicates sand
  - "\*" in symbol denotes unvestigated or unknown property
  - "\*\*" means Colorado Geological Survey (Sand and Gravel project) well logs
  - Landform boundary, solid where known or inferred; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL CHARACTERISTICS OF BOWLING**
- maximum thickness (ft)
  - sand/gravel resource thickness (ft)
  - gravel sand and fines (based on screen, 2.5 in.), visual estimation
  - significant amount of decomposed or salt rock
  - significant amount of fines (based on 200 screen, 0.075 in. or 0.094 mm.)
  - significant amount of gilson aggregate (silica)
  - "\*" in symbol denotes unvestigated or unknown property
  - "\*" in symbol denotes property absent or negligible

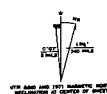


- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR VETTERLAND AREA

Geology modified after: Cairns, R.B., and Pritch, N.S., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Deerley Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map I-835 D.

Mapped by: Stephen D. Schochow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL (FOOT FEET)  
BOLDED ITALIC NUMBERS AT 20 FOOT INTERVALS  
OTHERWISE AS USUAL

ROAD CLASSIFICATION  
Major duty Light duty  
Unimproved dirt  
State Road

CARTER LAKE RESERVOIR, COLO.



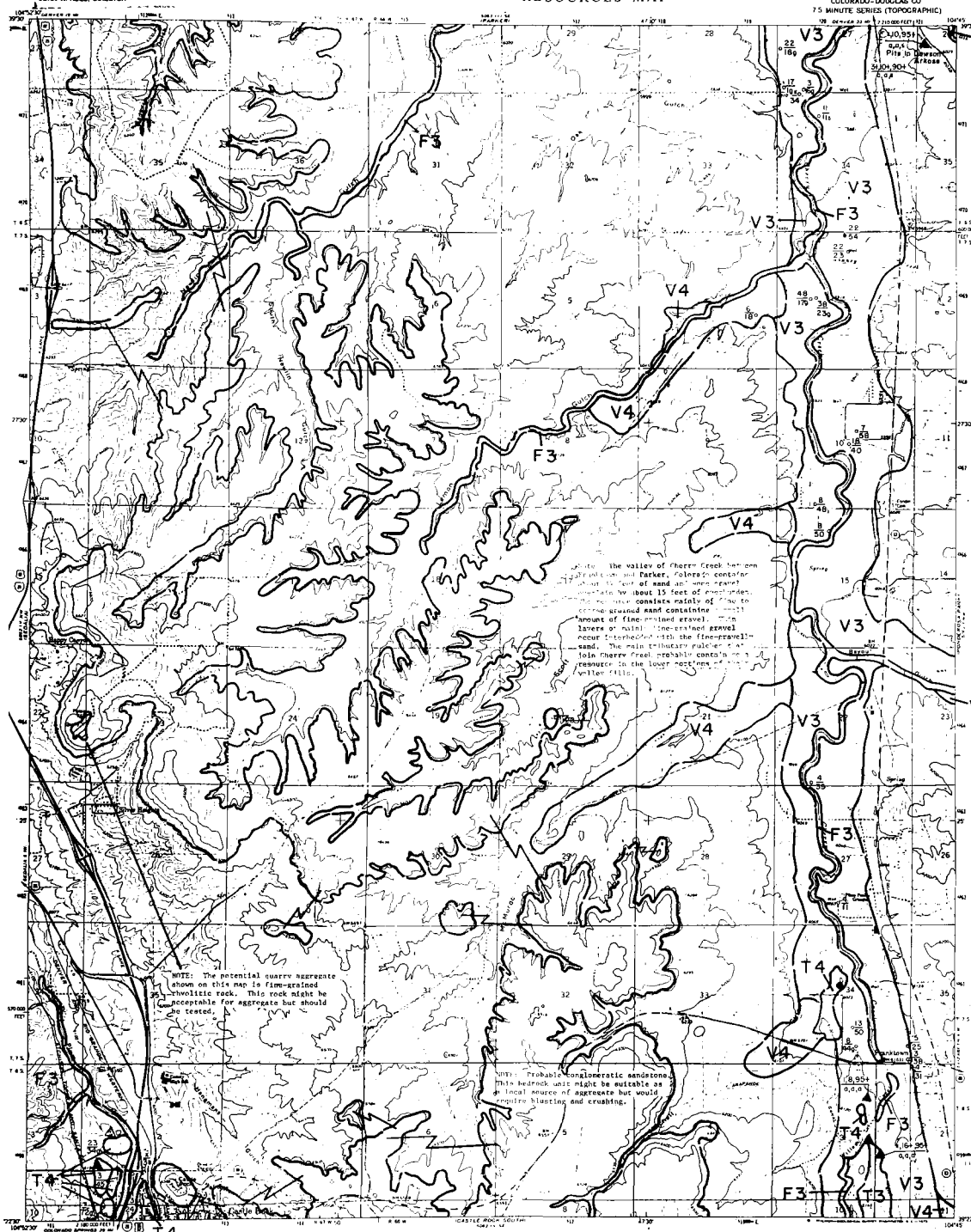




SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

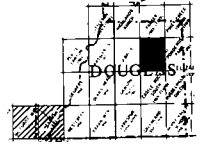
CASTLE ROCK NORTH QUADRANGLE  
COLORADO-DOUGLAS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Legend for EXPLANATION:
- Resource Unit
  - Resource Class/Function
  - MAP SYMBOLS
    - F Fine-grained sandstone
    - T Tephrite terraces deposit
    - V Valley fill (F & T)
    - U Unconsolidated deposits
    - A Alluvial fan
    - E Eolian-deposited sand (colluvium)
    - M Metamorphic deposits (gneiss, schist, etc.)
  - RESOURCE CLASSIFICATION
    - 1 Class: relatively clean and sound
    - 2 Class: significant fines, decomposed rock, additional treatments
    - 3 Class: ...
    - 4 Probable aggregate resource
  - MAP SYMBOLS
    - Operating gravel and/or sand pit
    - Abandoned gravel and/or sand pit
    - Operating stone quarry
    - Abandoned stone quarry
    - Abandoned quarry aggregate resource area
    - Selected well or suitable location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
    - "n" indicates gravel; "s" indicates sand
    - "L" indicates location unutilized or unknown property
    - "m" denotes Colorado Geological Survey Mineral Land and Geology project
    - Drill hole
    - Location boundary, solid where known or observed; dashed where approximate or inferred
  - SECTION LOCATION AND GEOLOGICAL DESCRIPTION OF SECTION
    - Overburden thickness (ft)
    - Sand/gravel resource thickness (ft)
    - Percent sand and fines (percent of screen; 0.075 in.)
    - Class estimation
    - Significant amount of fines (percent)
    - Significant amount of decomposed or weak rock
    - Significant amount of soluble carbonate facies
    - Unsuitable because unutilized or unknown property
    - Not in suitable property amount



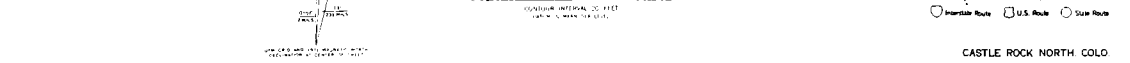
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
Tribble, D.E., and Fitch, U.S., 1974, *Map showing potential sources of gravel and crushed rock aggregate in the Oyster Dunes Area, Front Range Urban Corridor, Colo.*, U.S. Geol. Survey Misc. Geol. Inv. Map 3-836-A.

References:  
Chase, G.O., and McCaughey, J.L., 1973, *Generalized surficial geologic map of the Dunes area, Colorado*, U.S. Geol. Survey Misc. Geol. Inv. Map 1-731.

Mapped by: Ralph E. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey

Based from U. S. Geological Survey 7-1/2 minute quadrangle



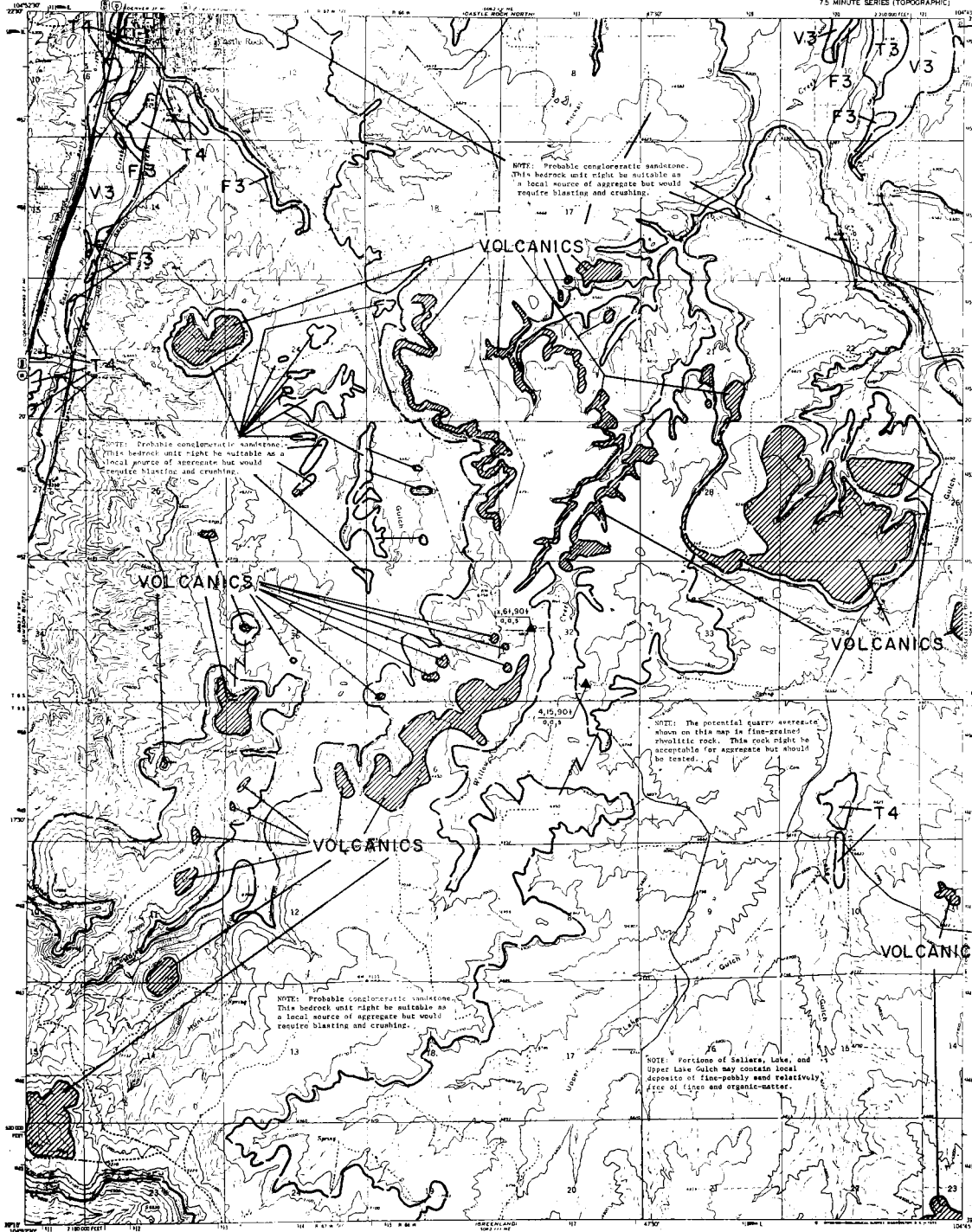
- ROAD CLASSIFICATION
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved dirt
  - Interstate Route
  - U.S. Route
  - State Route

CASTLE ROCK NORTH COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

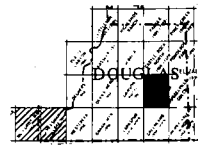
CASTLE ROCK SOUTH QUADRANGLE  
COLORADO-DOUGLAS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - W Wind-deposited sand (aeolian)
  - M Man-made deposits (fills, collars, spoils, ...)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**
- Gravel: retentive class and sand
  - Gravel: significant fines, decomposed rock, calcine calcareous
- Fine Aggregate**
- Gravel: finer than #20 passing #4 screen, 40% retained on #20 screen, gravel equivalent
  - Sand
- Unutilized Resources**
- Probable aggregate resource
- QUARRY STATUS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
- NOTES:**
- Selected well or test-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "a" indicates gravel; "s" indicates sand
  - "a" in symbol denotes unutilized or unknown property
  - "s" in symbol denotes Geological Survey Material/Lead and Gravel project/Drill site
  - Location boundary, well where known or observed, shown where appropriate or inferred
- STATUS, LOCATION AND CHRONOLOGICAL SIGNIFICANCE OF DEPOSIT**
- non-quantitative thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing #4 screen, 0.425 in.), visual estimation
  - significant amount of fines (passing #20 screen, 0.0075 in. or 0.075 mm)
  - significant amount of decomposed or soft rock
  - significant amount of calcine calcareous (calcite)
  - "a" in symbol denotes unutilized or unknown property
  - "s" in symbol denotes property absent or Geologic/Lead



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Chase, G.H., and McCaughey, J.A., 1992. Overview of surficial geologic map of the Denver area, Colorado. U.S. Geol. Survey Misc. Geol. Map T-931.

**Geology and/or Topography:**

Winkler, D.L., and Fitch, H.B., 1978. Map showing potential sources of gravel and crushed-stone aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado. U.S. Geol. Survey Map T-857 A.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U.S. Geological Survey.

**ROAD CLASSIFICATION**

- Highway
- Major-Div.
- Interstate Route
- U.S. Route
- State Route
- Unimproved rd.
- Other

CASTLE ROCK SOUTH, COLO.

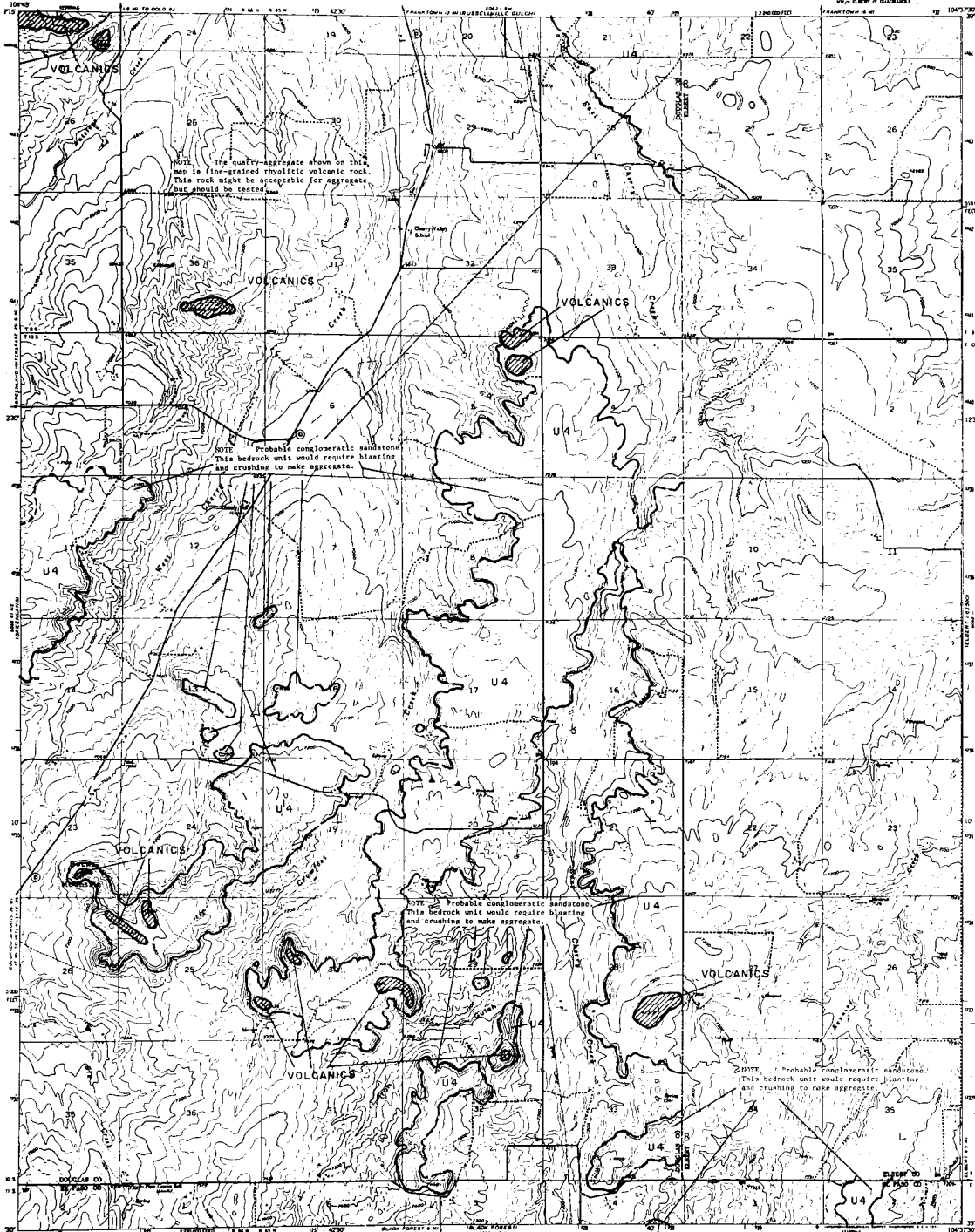
Base from U.S. Geological Survey  
7-1/2 minute quadrangle

CONTOUR INTERVAL, 20 FEET  
1000 900 800 700 600 500 400 300 200 100

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

CHERRY VALLEY SCHOOL QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
U.S. GEOLOGICAL SURVEY

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



NOTE: The quarry aggregate shown on this map is fine-grained rhyolitic volcanic rock. This rock might be acceptable for aggregate, but should be tested.

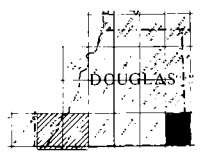
NOTE: Probable conglomeratic sandstone. This bedrock unit would require blasting and crushing to make aggregate.

NOTE: Probable conglomeratic sandstone. This bedrock unit would require blasting and crushing to make aggregate.

NOTE: Probable conglomeratic sandstone. This bedrock unit would require blasting and crushing to make aggregate.

## EXPLANATION

- Landform unit:  
Resource classification
- LANDFORM UNIT**
- F Floodplain deposit
  - F Stream terrace deposit
  - V Valley fill (F & V)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposit (see classification, etc.)
- RESOURCE CLASSIFICATION**
- GRAVEL**  
for largest size material on its screen, based on texture
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, shallow occurrence
- FINE SANDS**  
greater than 20 mesh (passing # 80 screen, 20 mesh retained on # 100 screen, based on texture)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Estimated width of drill-hole location with overburden thickness (ft) and gravel resource thickness (ft) obtained from well logs
  - "x" indicates gravel; "s" indicates sand
  - "\*" in symbol denotes unmineralized or unknown prospect
  - "M" denotes Colorado Geological Survey shallow sand and gravel projects' drill hole
  - Landform boundary, solid short lines or dashed; dashed lines approximate or inferred
- STATION LOCATION AND GEOLOGICAL IDENTIFICATION OF SYMBOLS**
- overburden thickness (ft)
  - rock/gravel resource thickness (ft)
  - screened gravel and fine (passing # 20 screen, # 20 to # 100) (ft)
  - significant amount of fine (passing # 20 screen, # 20 to # 100) m.
  - significant amount of decomposed or sand rock
  - significant amount of material unmineralized or unknown prospect
  - "x" in symbol denotes unmineralized or unknown prospect
  - "s" in symbol denotes unmineralized or unknown prospect



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:

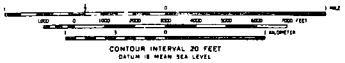
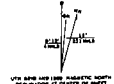
Trotter, D.F., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map 1-857 A.

REFERENCE: Trimble, Donald, 1974, U.S.G.S.; Personal Communication

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Based on U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 20 FEET  
ELEVATION IN FEET SEA LEVEL

- ROAD CLASSIFICATION**
- Major Road
  - Light Road
  - Unimproved or
  - Salt Road

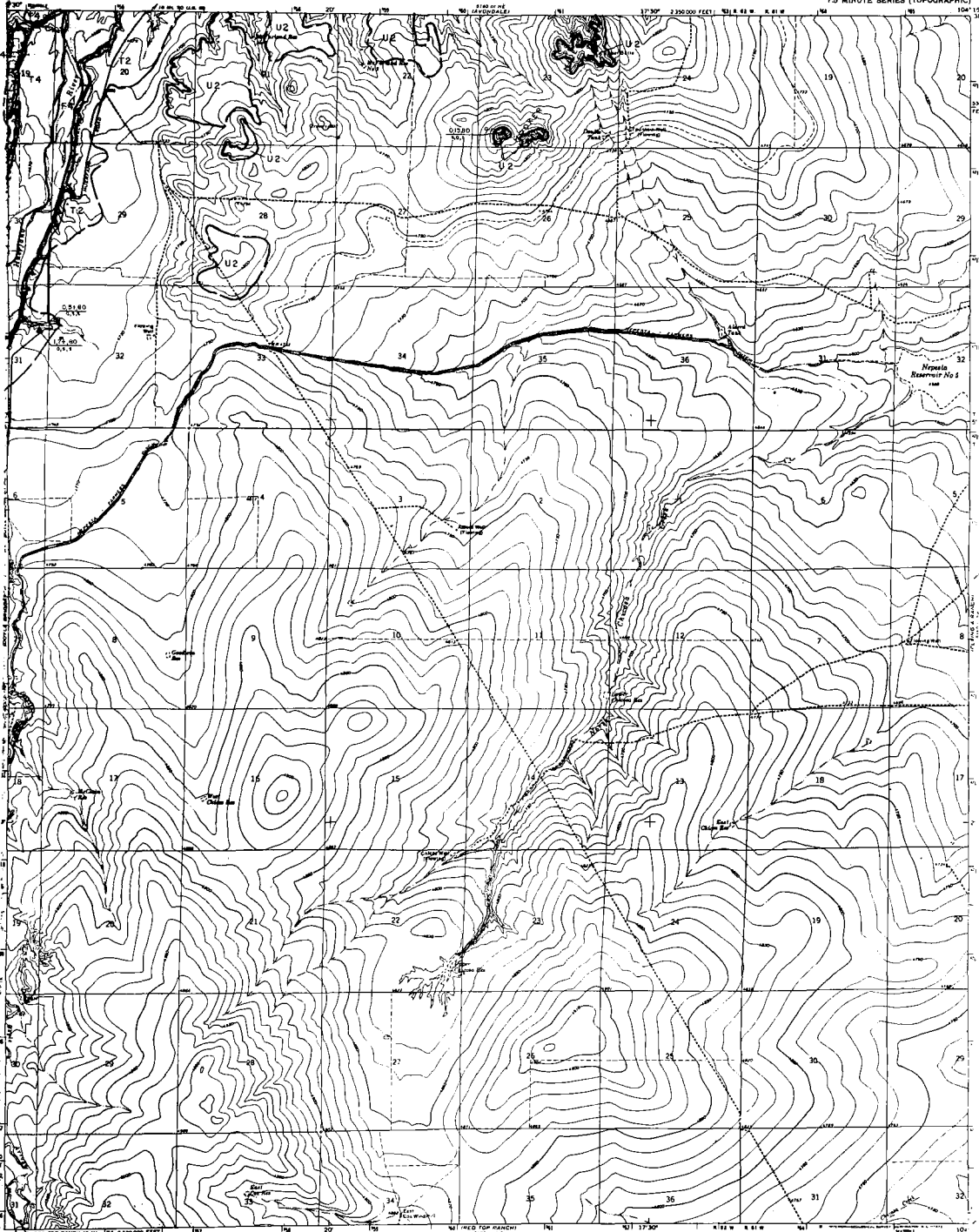
CHERRY VALLEY SCHOOL COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

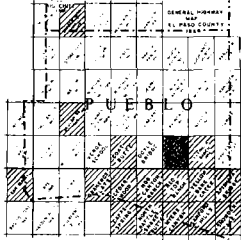
CHICOS WELL QUADRANGLE  
COLORADO—PUEBLO CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

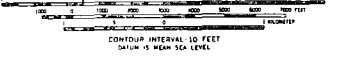
- CONTOUR LINES**  
 ———— Contour lines  
 - - - - - Contour lines (interpolated)
- MAP SYMBOLS**  
 F Floodplain deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Non-sand deposit (slag, caliche, spalls, etc.)
- RESOURCE CLASSIFICATION**  
**CLASS 1: GRAVEL**  
 (at least 20% passing #4 screen, visual estimation)  
 1 Gravel: relatively clean and sound  
 2 Gravel: agricultural waste, decomposed rock, caliche carbonate  
**CLASS 2: SAND**  
 (more than 50% passing #4 screen, 40% retained on #20 screen, visual estimation)  
 3 Sand  
**Classified Resource**  
 4 Potential aggregate resource
- MAP SYMBOLS**  
 Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Selected well or drill hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs  
 "M" indicates gravel; "S" indicates sand  
 "U" in symbol denotes unmineralized or unknown property  
 "W" denotes Colorado Geological Survey "Watershed and Gravel" project #1111  
 "L" in symbol denotes unmineralized or unknown property  
 "S" in symbol denotes property absent or insignificant
- STATUS, LOCATION AND GEOLOGICAL DESCRIPTION OF SANDS**  
 ———— Sand/gravel thickness (ft)  
 ———— Gravel resource thickness (ft)  
 ———— Sand and fines (passing #4 screen, 40% retained on #20 screen, visual estimation)  
 ———— Significant amount of fines (passing #20 screen, 80% on #100 mesh)  
 ———— Significant amount of eolian carbonate material  
 "M" in symbol denotes unmineralized or unknown property  
 "S" in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WETLAND AREA

Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**  
 Primary highway: ————  
 Hard surface: ————  
 Secondary highway: ————  
 Hard surface: ————  
 Unimproved road: - - - - -  
 Interstate Route: ○  
 U. S. Route: □  
 State Route: ○

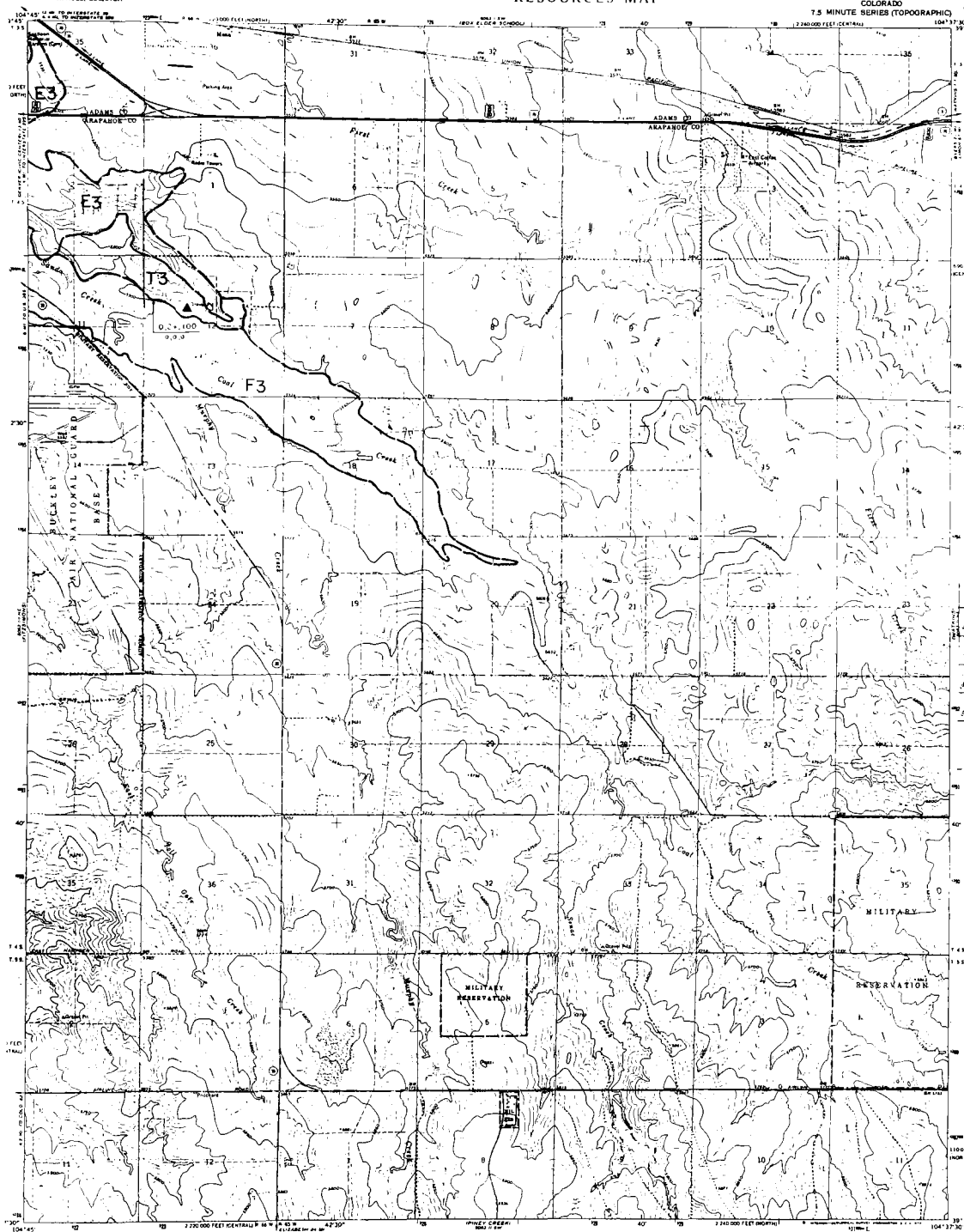
CHICOS WELL, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

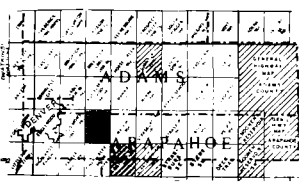
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLL, DIRECTOR

COAL CREEK QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION



- LANDFORMS**
- P Floodplain deposit
  - T Trench surface deposit
  - V Valley fill (F & T)
  - U Upland alluvium
  - A Alluvial fan
  - E Wind-deposited sand (dunes)
  - M Man-made levee (dike, dike, dam, etc.)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**
- 1 Gravel: rippled, clean and round
  - 2 Gravel: rippled and flint, decomposed rock
- Sand Aggregate**
- 3 Sand
- Unutilized Aggregate**
- 4 Potential aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Area not used in this study (potential quarry area)
  - Quarry aggregate (see map legend for details)
  - Gravel aggregate (see map legend for details)
  - Sand aggregate (see map legend for details)
  - Unutilized aggregate (see map legend for details)
  - See also Colorado Geological Survey Miscellaneous and Quaternary Projects' 1971 Map
  - Local boundary, solid lines shown or dashed, show where appropriate or inferred
- STATION, LOCATION AND GEOLOGICAL EXPLANATION OF SYMBOLS**
- 1. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 2. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 3. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 4. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 5. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 6. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 7. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 8. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 9. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 10. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 11. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 12. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 13. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 14. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 15. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 16. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 17. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 18. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 19. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 20. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 21. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 22. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 23. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 24. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 25. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 26. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 27. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 28. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 29. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 30. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 31. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 32. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 33. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 34. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 35. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 36. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 37. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 38. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 39. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 40. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 41. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 42. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 43. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 44. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 45. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 46. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 47. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 48. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 49. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.
  - 50. Station located on section 17E, T33N, R10W, S. 100m x 100m grid.



- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved road
  - Interstate Road
  - U.S. Route
  - State Road
- QUADRANGLE LOCATION**
- NON-RESOURCE OR WITHDRAWN AREA**

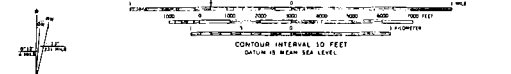
**Reference:**

Chase, C.H., and McConogy, J.A., 1972. Generalized surficial geologic map of the Denver area, Colorado. U.S. Geol. Survey Misc. Geol. Inv. Map 1-731.

Trumble, D.E., and Petch, R.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U.S. Geol. Survey Misc. Geol. Inv. Map 1-856-A.

Mapped by: Stephen D. Schowchow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved road
  - Interstate Road
  - U.S. Route
  - State Road

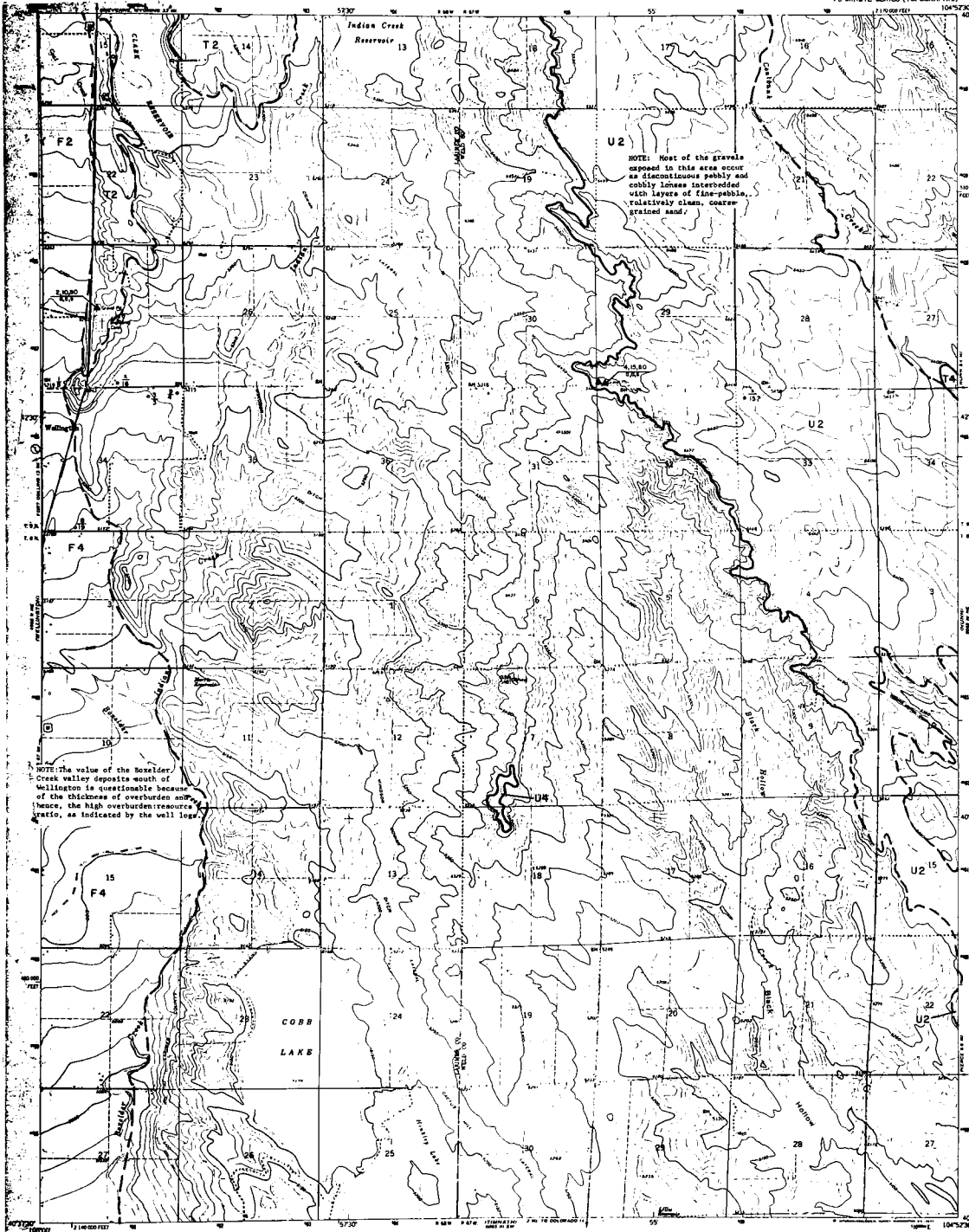
COAL CREEK, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

COBB LAKE QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



NOTE: The value of the Boxelder Creek valley deposits south of Wellington is questionable because of the thickness of overburden and hence, the high overburden/resource ratio, as indicated by the well logs.

NOTE: Most of the gravels exposed in this area occur as discontinuous pebbly and cobbly lenses interbedded with layers of fine-sand, relatively clean, coarse-grained sand.

EXPLANATION

Landform unit  
Resource class/quantity

RESOURCE UNITS

- F Floodplain deposit
- T Terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Marine deposits (slag, tailings, spalls...)

RESOURCE CLASSIFICATION

- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock, calcitic cementation
- 3 Sand
- 4 Probable aggregate resource

WELL SYMBOLS

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Estimated quarry aggregate resource area
- Estimated well or pit-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
- "G" indicates gravel; "S" indicates sand
- "L" in symbol denotes unventilated or unknown property
- "M" denotes Colorado Geological Survey Method A and C well symbols
- drill hole
- Landform boundary, solid where known or observed; dashed where approximate or inferred.

SYMBOL, LOCATION AND ORIGIN OF DESCRIPTION OF SYMBOL

- overburden thickness (ft)
- and/or gravel resource thickness (ft)
- ground level and floor (spacing of screen, 2.5 ft), slant indication
- significant amount of fines (spacing 1000 screen, 2.5 ft, or 10 ft)
- significant amount of decomposed or unit rock
- significant amount of calcitic cementation (in situ)
- "L" in symbol denotes unventilated or unknown property
- "M" in symbol denotes property status or Landform/Class

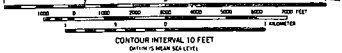


QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Marshek, L.A., and Schuster, P.A., Jr., 1973. Geologic map of the lower Cache la Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-687.

Mapped by: Stephen B. Schwabow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
(OTHER THAN 50-150)

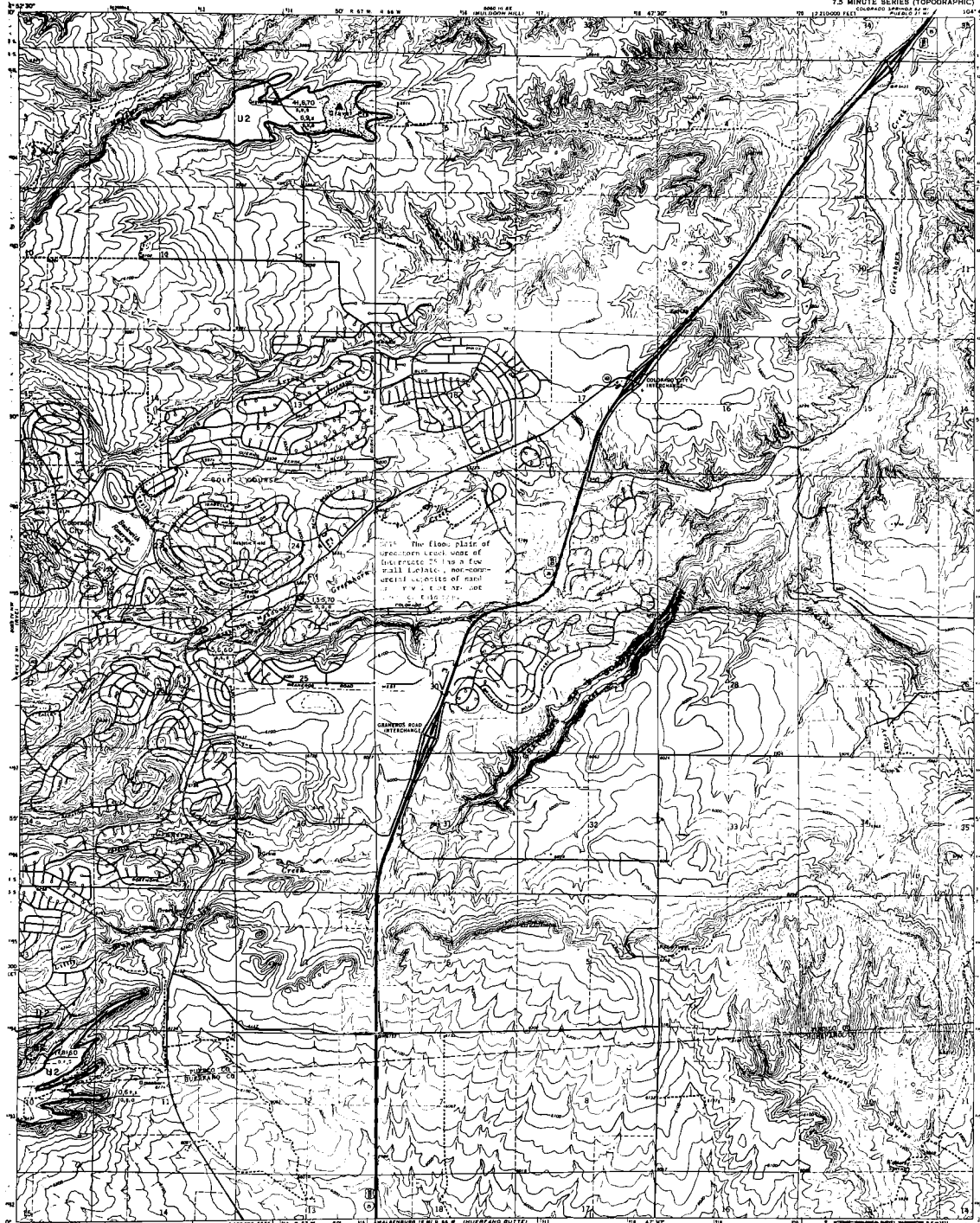
ROAD CLASSIFICATION  
Medium duty Light duty  
Unimproved dirt  
U.S. Route State Route

COBB LAKE, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

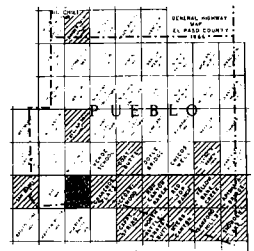
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLA, DIRECTOR

COLORADO CITY QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Symbol on map*  
*Symbol on map*
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - Vs Wind-transported sand (colluvial)
  - M Non-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**
- Gravel Resources**  
1 Gravel: relatively clean and sound  
2 Gravel: significant fines, decomposed rock, certain cements
- Sand Resources**  
3 Sand  
4 Probable aggregate resource
- NOT SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log.
  - "T" indicates gravel; "S" indicates sand
  - "C" in symbol denotes unconsolidated or unknown property.
  - "M" denotes Colorado Geological Survey Visual/Field and Gravel projects drill hole.
  - Landform boundary, well where known or inferred. Label where appropriate or inferred.
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF SECTIONS**
- Section 3301: 100' x 200' (approx.)  
Section 3302: 100' x 200' (approx.)  
Section 3303: 100' x 200' (approx.)  
Section 3304: 100' x 200' (approx.)  
Section 3305: 100' x 200' (approx.)  
Section 3306: 100' x 200' (approx.)  
Section 3307: 100' x 200' (approx.)  
Section 3308: 100' x 200' (approx.)  
Section 3309: 100' x 200' (approx.)  
Section 3310: 100' x 200' (approx.)



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Blanco, Stephen, 1971. Geologic Map of the Rio-Colorado City Area, Pueblo and Huerfano Counties, Colorado; Colorado School of Mines, M.S. Thesis T 1360, Plate 1.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL 20 FEET  
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

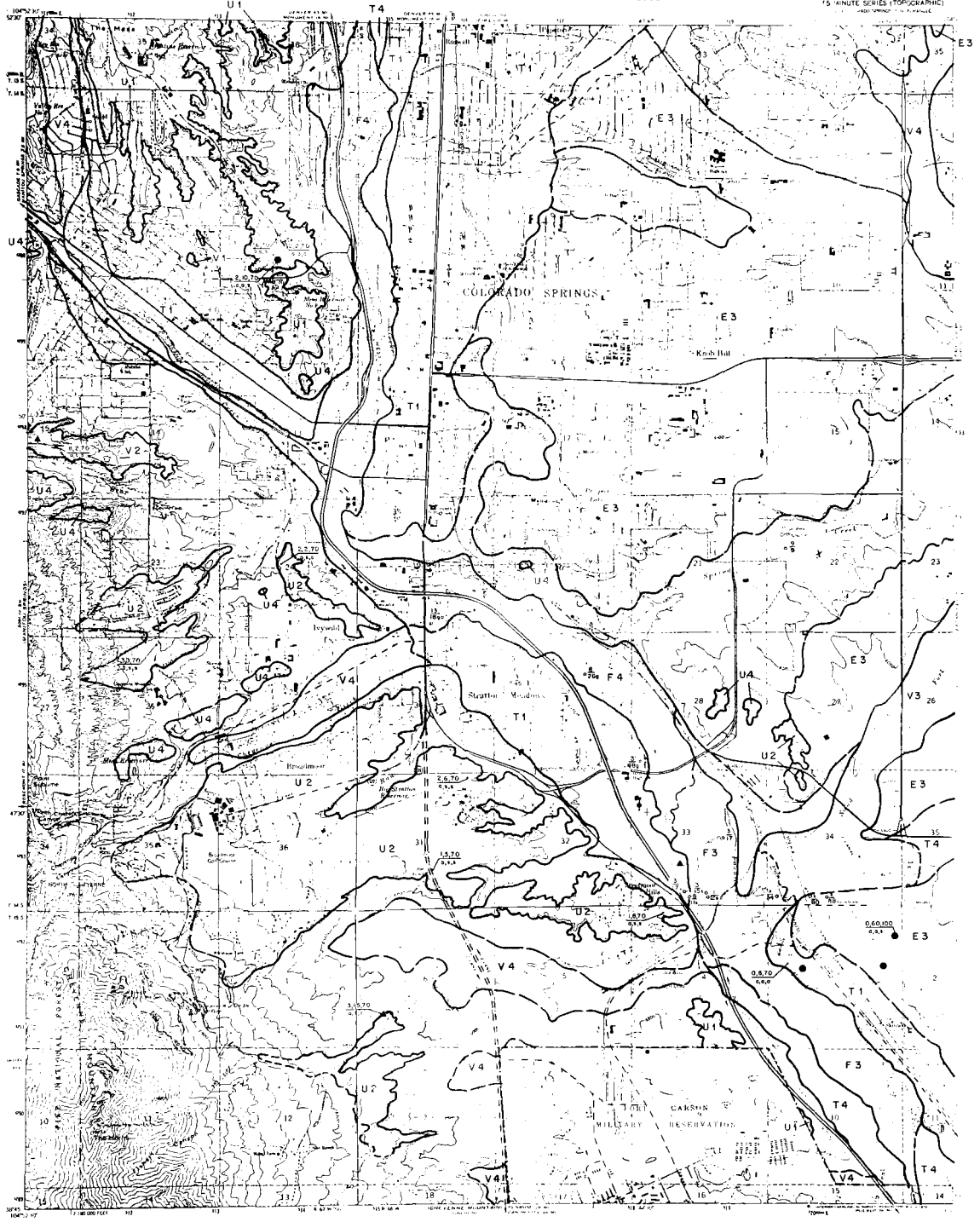
Primary highway	Light duty road, hard or unpaved surface
Hard surface	Secondary highway
Secondary highway	Unimproved road
Hard surface	U S Route
Interstate Route	State Route

COLORADO CITY, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

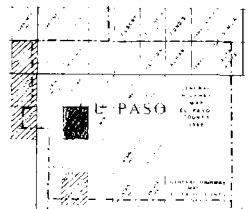
COLORADO SPRINGS QUADRANGLE  
COLORADO-EL PASO CO.  
15 MINUTE SERIES (TOPOGRAPHIC)  
SCALE 1:62,500

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



## EXPLANATION

- SYMBOLS**
- QUARRY
  - SAND
  - GRAVEL
  - CRUSHED ROCK
- LITHOLOGIC UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Manmade deposits (log, tailings, spoil, ...)
- RESOURCE CLASSIFICATION**
- CLASS 1 - SAND**
- 1 Coarse, well-sorted sand and gravel
  - 2 Coarse, slightly to finely decomposed rock, siliceous substance
- CLASS 2 - GRAVEL**
- 3 Sand
- Classified Resource**
- 4 Potential aggregate resource
- NOT SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Quarrying stone quarry
  - Manmade stone quarry
  - Quarried waste disposal
  - Quarried waste disposal location with overburden
  - Quarried waste disposal location with overburden (not quarried from well log)
  - "G" indicates gravel; "S" indicates sand
  - "M" in sand denotes manmade or unknown property
  - "U" denotes Colorado Geological Survey "Unclassified and Crowned" project
  - "U" in sand denotes unclassified or unknown property
  - "U" in gravel denotes unclassified or unknown property
  - "U" in crushed rock denotes unclassified or unknown property
  - "U" in aggregate denotes unclassified or unknown property
- STATUS, LOCATION AND ORIGIN OF CLASSIFICATION OF DEPOSIT**
- (Symbol) (Resource) (Class) (Date)
  - (Symbol) (Resource) (Class) (Date) (Property)
  - (Symbol) (Resource) (Class) (Date) (Property) (Unclassified)
  - (Symbol) (Resource) (Class) (Date) (Property) (Unclassified) (Unclassified)
  - (Symbol) (Resource) (Class) (Date) (Property) (Unclassified) (Unclassified) (Unclassified)
  - (Symbol) (Resource) (Class) (Date) (Property) (Unclassified) (Unclassified) (Unclassified) (Unclassified)



**QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

Geology modified after Scott, G.R., & Moberg, R. A. 1973, Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map 10-482.

**REFERENCES**

Trumble, D.E., and Fitch, R.S., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-857 A.

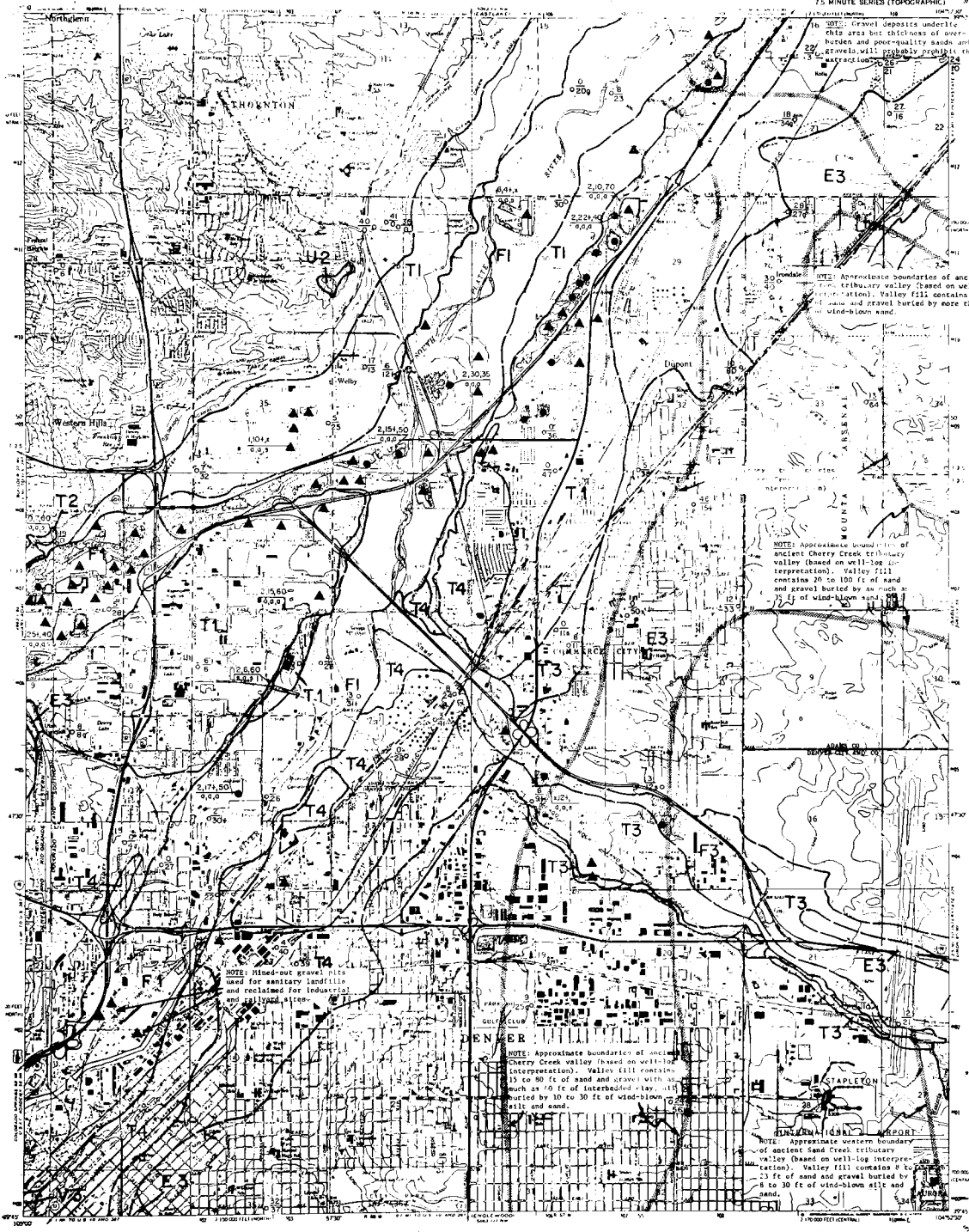
Mapped by: Phillip C. Wicklein  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Scale 1:62,500  
1 inch = 1 mile  
CONTOUR INTERVAL 20 FEET  
DATE OF SURVEY 1974  
ROAD CLASSIFICATION  
Main Road Light Duty  
Minor Road Unimproved Bit.  
Unimproved Road U.S. Road City Road  
COLORADO SPRINGS, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

COMMERCE CITY QUADRANGLE  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
COLORADO



## EXPLANATION

- CONTOUR LINE**  
 - Elevation  
 - Reservoir classification
- LANDFORM UNIT**  
 F Fluvial deposit  
 T Tertiary terrace deposit  
 W Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Man-made deposit (cultural debris, etc.)
- RESOURCE CLASSIFICATION**  
 1 Green: relatively clean and good  
 2 Green: significant fines, unconsolidated, calcium carbonate  
 3 Yellow: moderate fines, unconsolidated, calcium carbonate  
 4 Red: high fines, unconsolidated, calcium carbonate  
 5 Red: high fines, unconsolidated, calcium carbonate, and other deleterious materials
- ROAD CLASSIFICATION**  
 - Interstate Road  
 - U.S. Road  
 - State Road
- NOTE:** Approximate boundaries of ancient Cherry Creek tributary valley (based on well-log interpretation). Valley fill contains about 23 ft of sand and gravel buried by more than 25 ft of wind-blown sand.
- NOTE:** Approximate boundaries of ancient Cherry Creek tributary valley (based on well-log interpretation). Valley fill contains 20 to 100 ft of sand and gravel buried by an average of 75 ft of wind-blown sand.
- NOTE:** Approximate western boundary of ancient Sand Creek tributary valley (based on well-log interpretation). Valley fill contains 8 to 23 ft of sand and gravel buried by 8 to 30 ft of wind-blown silt and sand.
- NOTE:** Allow-not gravel: this sand for sanitary landfill and reclaimed for industrial and railroad sites.

Symbol	Description
Circle with dot	Quadrangle location
Circle with cross-hatch	Non-resource or withdrawn area
Circle with diagonal lines	Quarry aggregate resource area
Circle with horizontal lines	Allow-not gravel
Circle with vertical lines	Green resource
Circle with wavy lines	Yellow resource
Circle with solid fill	Red resource

Base from U. S. Geological Survey  
7-172 minute quadrangle



**ROAD CLASSIFICATION**  
 - Interstate Road  
 - U.S. Road  
 - State Road

COMMERCE CITY COLO

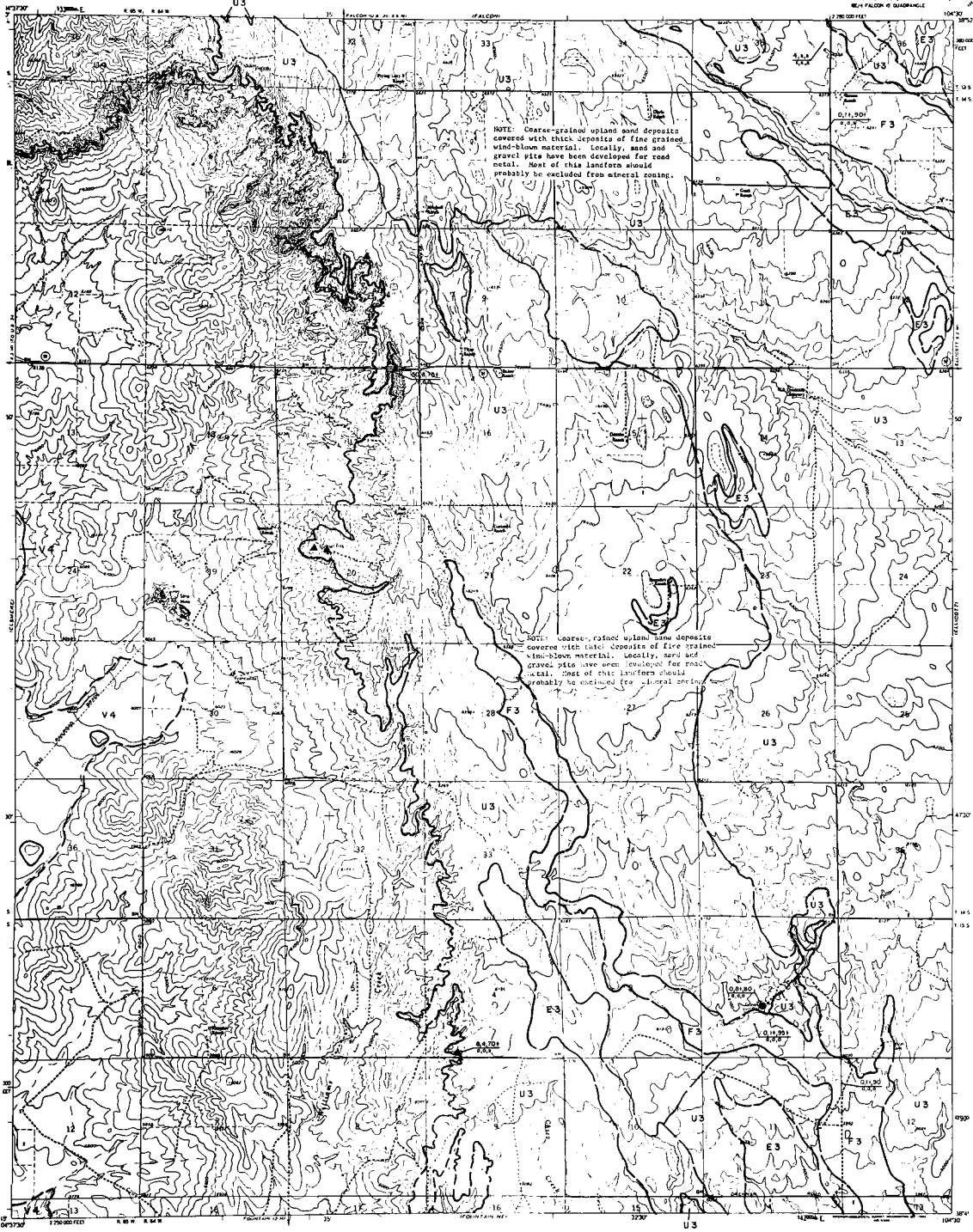
- Geology modified after**  
 Hunt, C.B., 1954. Pleistocene and Recent deposits in the Denver area, Colorado. U.S. Geol. Survey Bull. 795-C, pl. 2.  
 and  
 DeWitt, R.H., 1968. Quaternary history of Rocky Mountain Arsenal and surrounding Adams County, Colorado. Colorado School Mines Quart., v. 63, no. 1, p. 1.
- References:**  
 Tenthredon Regional Planning Commission, 1961. Drainage course plan for the Denver region - Part 1, sand and gravel resources: Denver, Colo., Inter-County Reg. Plan. Comm., 91, 1.  
 Hamilton, J.L., and Owen, M.G., 1972. Geologic aspects, soils and related foundation problems, Denver metropolitan area, Colorado. Colorado Geol. Survey Environmental Geol. Rept. 1, p. 2.  
 Chase, G.H., and McConaghy, J.A., 1972. Generalized surficial geologic map of the Denver area, Colorado. U.S. Geol. Survey Misc. Geol. Inv. Map T-731.  
 Smith R.O., Schneider, P.A., Jr. and Perci, L.L., 1964. Ground-water resources in the South Platte River basin in western Adams and southeastern Weld Counties, Colorado. U.S. Geol. Survey Water-Supply Paper 1658, pl. 1.  
 Trimble, D.E., and Pihon, H.R., 1974. Map showing potential resources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor. Colo. U. S. Geol. Survey Misc. Geol. Inv. Map T-816-A.

Prepared in cooperation with the U. S. Geological Survey.  
 Mapped by: Stephen D. Schwechow  
 Date: June 30, 1974

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

CORRAL BLUFFS QUADRANGLE  
COLORADO, EL PASO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
M-1 FALCON 6 QUADRANGLE

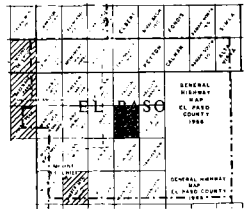


NOTE: Coarse-grained upland sand deposits covered with thick deposits of fine grained wind-blown material. Locally, sand and gravel pits have been developed for road metal. Most of this landform should probably be excluded from mineral zoning.

NOTE: Coarse, rippled upland sand deposits covered with thick deposits of fine grained wind-blown material. Locally, sand and gravel pits have been developed for road metal. Most of this landform should probably be excluded from mineral zoning.

## EXPLANATION

- LANDFORMS**  
 - Contour lines  
 - Elevation classification
- AGGREGATE UNITS**  
 F Floodplain deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Upland deposits  
 A Alluvial fan  
 E Mid-deposited sand (colluvial)  
 M Man-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**  
 1 **Gravel** - relatively clean and round  
 2 **Gravels** - significant fines, decomposed rock, calcian carbonate  
 3 **Gravel**  
 4 **Probable aggregate resource**
- ROAD CLASSIFICATION**  
 - Operating gravel and/or sand pit  
 - Abandoned gravel and/or sand pit  
 - Operating stone quarry  
 - Abandoned stone quarry  
 - Potential quarry aggregate resource area  
 - Selected well or fill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); obtained from well logs  
 - "S" indicates gravel; "M" indicates sand  
 - "u" in symbol denotes unutilized or unknown property  
 - "m" denotes Colorado Geological Survey Mineral Land and Gravel project  
 - "M" note  
 - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND DIMENSIONAL COMPARISON OF PROSIT**  
 - Sand/gravel thickness (ft)  
 - Sand/gravel resource thickness (ft)  
 - Percent sand and fines (passing #20 screen, 0.075 in.), visual estimation  
 - Significant amount of fines (passing #20 screen, 0.075 in. or 0.075 mm.)  
 - Significant amount of decomposed or weak rock  
 - Significant amount of calcian carbonate facies  
 - "u" in symbol denotes unutilized or unknown property  
 - "m" in symbol denotes property absent or indesignified

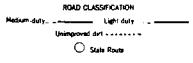
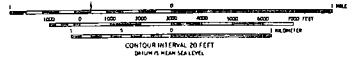


- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Slatner, P. E., 1968, U. S. Geological Survey, Map GQ-783.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

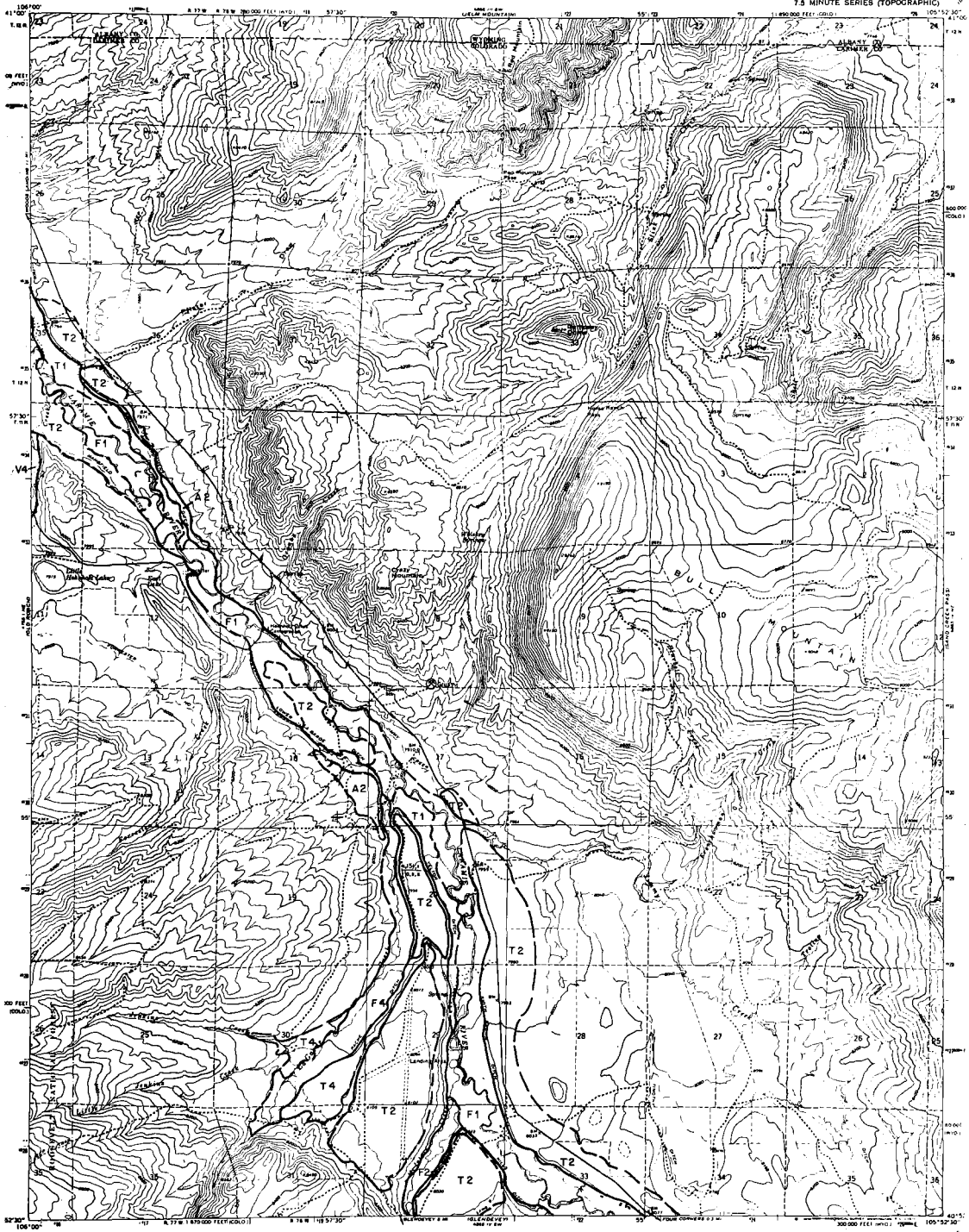


CORRAL BLUFFS, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

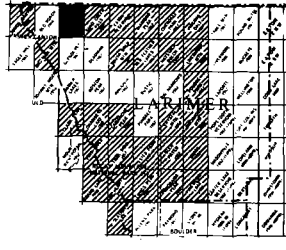
CRAZY MOUNTAIN QUADRANGLE  
COLORADO - WYOMING  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



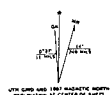
## EXPLANATION

- Landform unit
- Resource status/location
- LITHOLOGIC UNIT**
  - F Fluvial deposit
  - T Tertiary terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposit
  - A Alluvial fan
  - E Eolian deposit and (colluvium)
  - M Mesozoic deposits (slag, tailings, spalls, etc.)
- ROAD CLASSIFICATION**
  - 1 Openly graded or 40 ft across, paved or asphalt
  - 2 Gravel, relatively clean and sound
  - 3 Gravel, significant fines, dimensional rock, calcium carbide
  - 4 Fine aggregate (grades from 20 passing 60 screen, 100 retained on 200 screen, 100% retained on 425 screen, 100% retained on 600 screen)
  - 5 Low
  - 6 Ungraded aggregate resource
- RF SYMBOLS**
  - A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Potential quarry aggregate resource area
  - F Related well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - G "G" indicates gravel; "S" indicates sand
  - H "H" in symbol denotes unconsolidated or unknown property
  - I "I" in symbol denotes Geological Survey Standard Sand and Gravel project
  - J Well
  - K Landform boundary, solid where known or inferred, dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATION**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (based on 40 screen, 2.5 in.), visual estimation
  - Significant amount of fines (passing 200 screen, 0.075 in. or 0.075 mm.)
  - Significant amount of decomposed or sand rock
  - Significant amount of surface carbonate (caliche)
  - "u" in symbol denotes unconsolidated or unknown property
  - "i" in symbol denotes property shared or inferred



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WETLANDS AREA

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 40 FEET  
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION  
Light duty ————— Unimproved dirt

CRAZY MOUNTAIN, COLO. - WYO.

Mapped by: Stephen D. Schochow  
Date: June 30, 1974

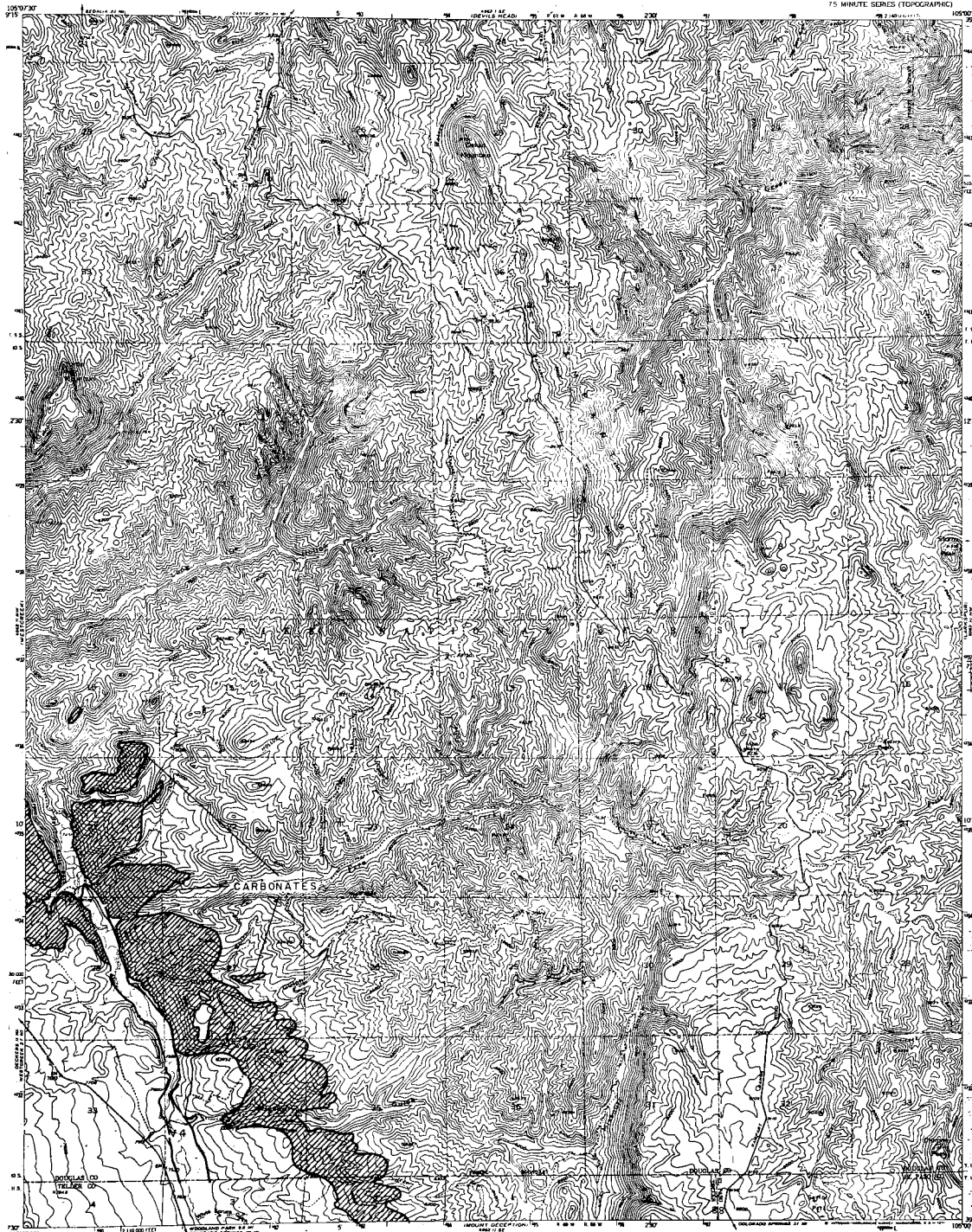


SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

DAKAN MOUNTAIN QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

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



- LANDFORMS**
- F Floodplain deposit
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-igneous deposits (slag-tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 1/4 inch on 48 screen, mixed distribution)
- 1 Gravel: selectively clean and smooth
  - 2 Gravel: significant fines, decomposed rock, calcareous carbonate
- Fine Aggregate**  
(greater than 208 passing 48 screen, 60% retained on 420 screen, mixed distribution)
- 3 Sand
  - 4 Probable aggregate resource
- NOT SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
- Indicated with an outline: location with minimum thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
- "g" indicates gravel; "s" indicates sand
  - "u" in symbol denotes unevaluated or unknown property
  - "u" in symbol denotes unevaluated or unknown property
  - "u" in symbol denotes property absent or in doubt
- STATION, LOCATION AND ORIENTATIONAL INDICATION OF SPIRES**
- Overhead (thickness ft)
  - Side/gravel resource thickness (ft)
  - Gravel and sand (line spacing ft)
  - Gravel: 2-25 ft; mixed distribution
  - Significant amount of fines (passing 208 screen, 2.0% or 0.075 mm)
  - Significant amount of decomposed or weak rock
  - Significant amount of relation to surface fault
  - "u" in symbol denotes unevaluated or unknown property
  - "u" in symbol denotes property absent or in doubt

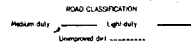
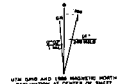


- QUADRANGLE LOCATION
- NON-RESOURCE OR MINERAL AREA

Geology Modified after:  
Harris, J.C., 1951, Structural geology of the eastern flank of the southern Front Range, Colorado: University of Colorado Ph.D. Thesis, 121 p., 3 pls.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Based from U. S. Geological Survey  
7-1/2 minute quadrangle

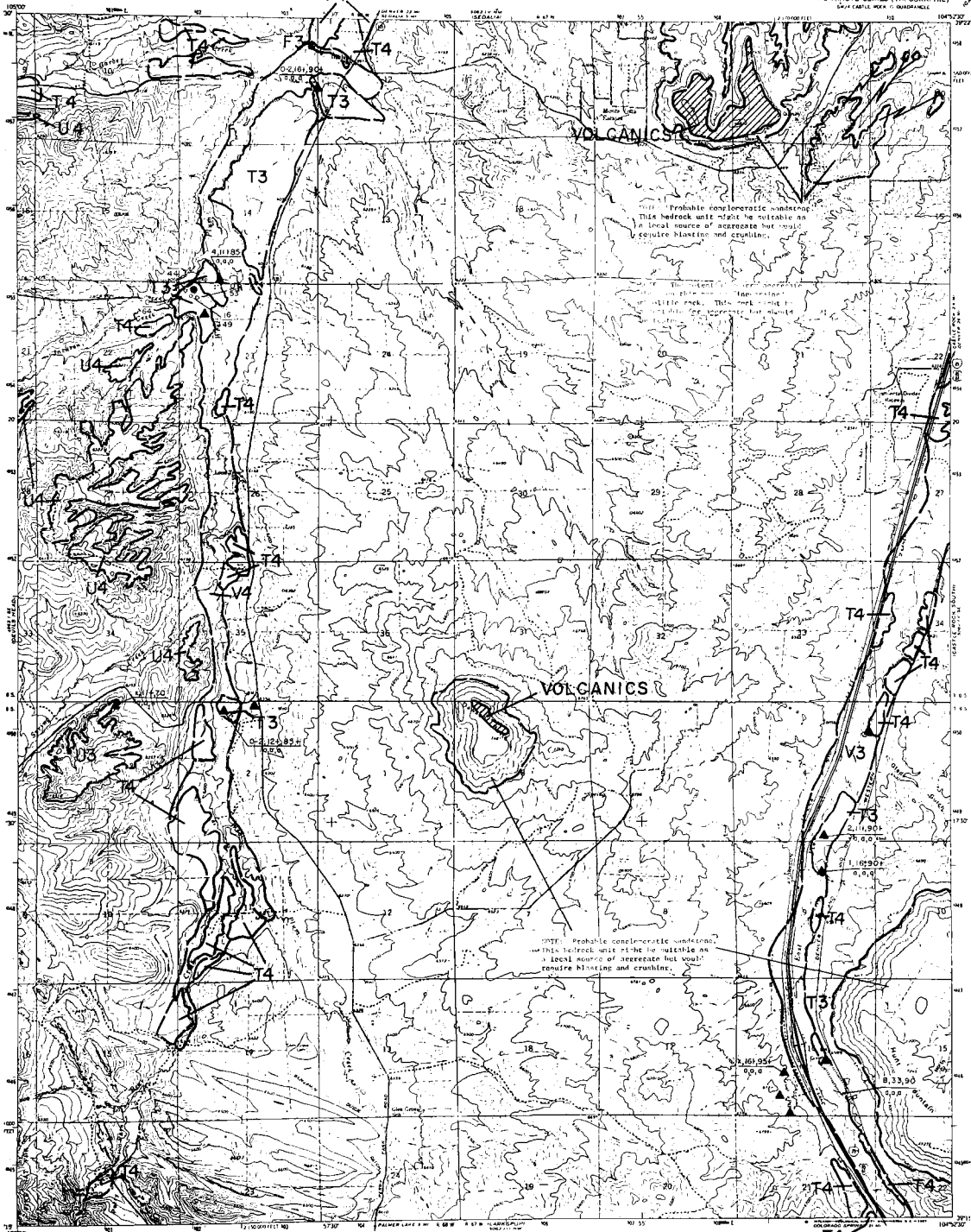


DAKAN MOUNTAIN COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

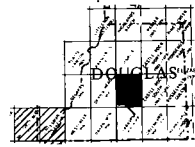
DAWSON BUTTE QUADRANGLE  
COLORADO - DOUGLAS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
6.4-CABLE, BOX 9 QUADRANGLE

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



EXPLANATION

- Landform unit
- Resource classification
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spalls, ...)
- RESOURCE CLASSIFICATION**
  - Gravel**
    - 1 Gravel: relatively clean and smooth
    - 2 Gravel: significant fines, decomposed rock, calcium carbonate.
  - Sand**
    - 3 Sand
    - 4 Probable aggregate resource
- ROAD SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "C" indicates gravel; "S" indicates sand
  - "u" symbol denotes unmineralized or unknown property
  - "M" denotes Colorado Geological Survey Material and Gravel projects
  - "S" is symbol denoting unmineralized or unknown property
  - Low-flow boundary, mild where shown or otherwise, based where appropriate on inference
- STATION, LOCATION AND GEOLOGICAL SIGNIFICANCE OF SPILLS**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Personnel and fines (spills) at stream, 0.25 in. to 0.5, actual extraction
  - Significant amount of fines (spills) 1000 ft<sup>2</sup> area, 0.002 in. or 0.074 mm
  - Significant amount of decomposed or weak rock
  - Significant amount of calcium carbonate (includes)
  - "u" or symbol denotes unmineralized or unknown property
  - "M" or symbol denotes property claims or designations



QUADRANGLE LOCATION  
NON-RESOURCE OR VETERINARY AREA

Geology Modified after:  
Tschuba, D.E., and Pitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U.S. Geol. Survey Map T-557-A.

Reference:  
Chase, C.H., and McCook, J.A., 1973, Generalized surficial geologic map of the Denver area, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map T-733.

Mapped by: Ralph B. Shroba,  
Date: June 30, 1974

Prepared in cooperation with the  
U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

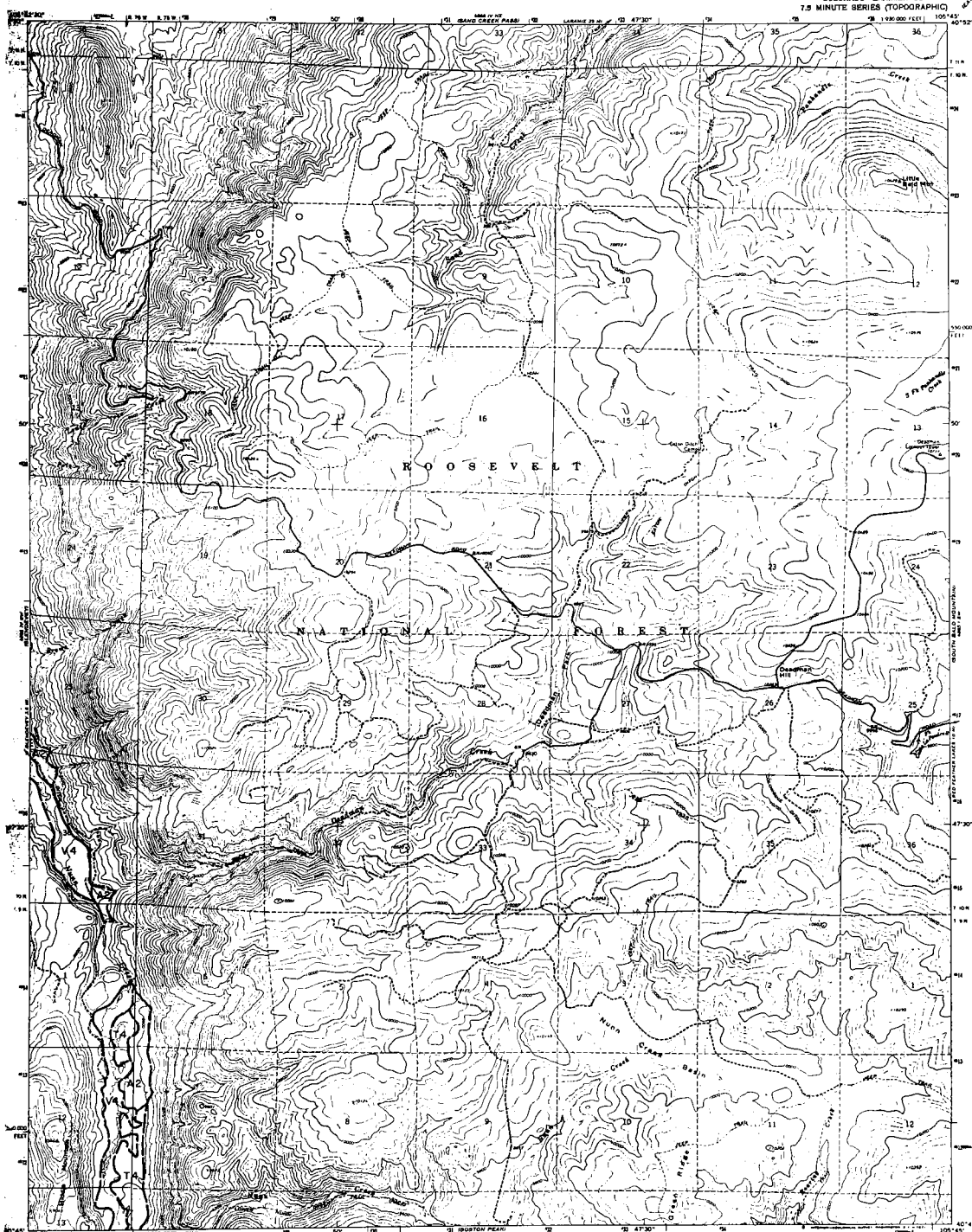
Heavy-duty	Light-duty
Medium-duty	Unimproved dirt
Interstate Route	U.S. Route
	State Route

DAWSON BUTTE, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

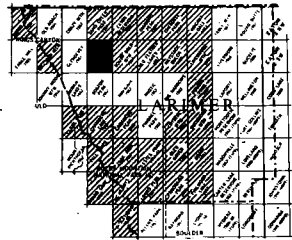
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLLA, DIRECTOR

DEADMAN QUADRANGLE  
COLORADO-LARIMER CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Landform Unit**  
Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Marine deposits (slag, ballast, spoils, etc.)
- RESOURCE CLASSIFICATION**
- CONCRETE AGGREGATE**  
(at least 10% retained on #4 screen, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcian calciferous
- FINE AGGREGATE**  
(greater than 75% passing #4 screen, visual estimation)
- 3 Sand
  - 4 Probable aggregate resources
- MAP SYMBOLS**
- A Operating gravel surface and pit
  - ⊖ Abandoned gravel surface and pit
  - ⊙ Operating stone quarry
  - ⊖ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Related well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "m" Indicated gravel; "m" indicates sand
  - "r" is symbol denotes unconsolidated or unknown property.
  - "m" denotes Colorado Geological Survey classified sand and gravel product
  - Landform boundary, solid where known or observed; dashed where approximated or inferred.
- STATION, LOCATION AND ORIENTATIONAL INFORMATION OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing #4 screen, 7.5 in., visual estimation)
  - significant amount of fines (passing 100 screen, 0.004 in., or 0.075 mm.)
  - significant amount of decomposed or weak rock.
  - significant amount of incision overburden material.
  - "u" to symbol denotes unconsolidated or unknown property.
  - "p" to symbol denotes property absent or completely owned.



■ QUADRANGLE LOCATOR  
▨ NON-RESOURCES OR WITHDRAWN AREA

Mapped by: Stephen D. Schuchow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL, 40 FEET  
DOTTED LINES REPRESENT 20-FOOT CONTOURS  
DATUM IS MEAN SEA LEVEL

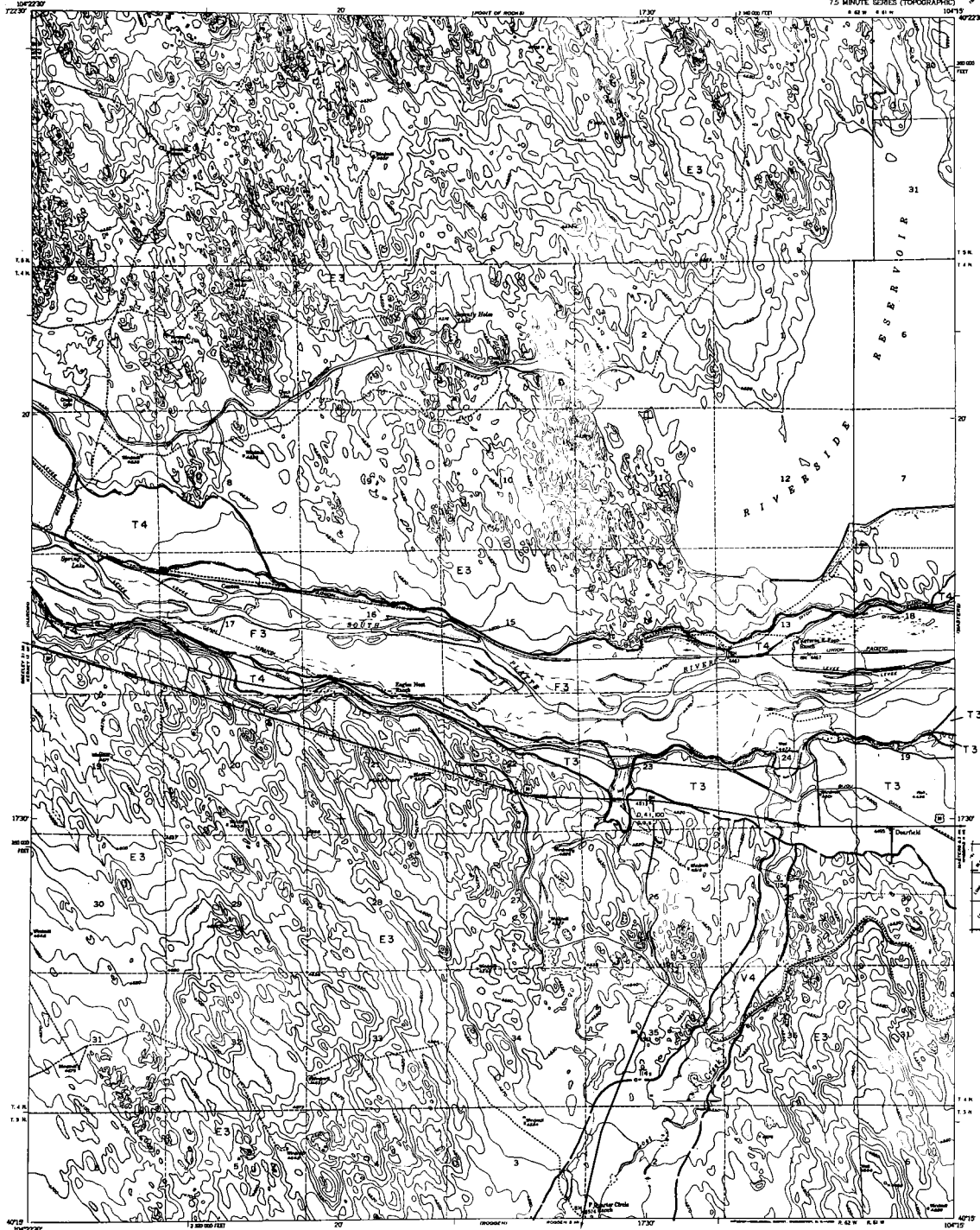
ROAD CLASSIFICATION  
Light-duty — Unimproved det.

DEADMAN, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

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

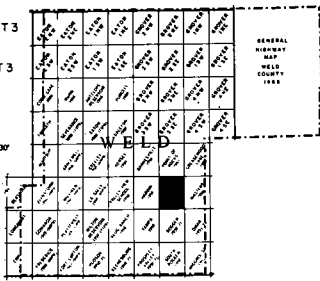
DEARFIELD QUADRANGLE  
COLORADO-WELD CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- LANDFORMS**
- Contour interval
  - Resource classification
- LITHOLOGIC UNIT**
- F Fluvialite deposit
  - S Recent terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-sand deposit (sandstone, siltstone...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
(at least 20% gravel on 40 screen, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous nodules
- Sand Aggregate**  
(finer than 20 mesh passing 40 screen, 40% retained on 100 screen, visual estimation)
- Sand**
- 4 Probable aggregate resource
- QUARRY SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
- POTENTIAL QUARRY AGGREGATE RESOURCE AREA**  
(indicated with 10' contour interval with overburden thickness (ft) over sand/gravel resource thickness (ft) indicated from well logs. "s" indicates gravel, "m" indicates sand. "u" in symbol denotes unmineralized or unknown property. "m" denotes Colorado Geological Survey "Mineral Boundary and Gravel Prospect" well hole. Random boundary, solid black shows no observed sandstone there approximately or laterally.)

- STATION, LOCATION AND GEOLOGICAL CHARACTERISTICS OF BORINGS**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (passing 40 screen, 1:30 to 1:1, visual estimation)
  - 1:10 to 1:20
  - Significant amount of fines (passing 100 screen, 0.075 to 0.0075 mm)
  - Significant amount of decomposed or weak rock
  - Significant amount of soluble carbonate facies
  - "u" in symbol denotes unmineralized or unknown property
  - "m" in symbol denotes property above or indeterminate

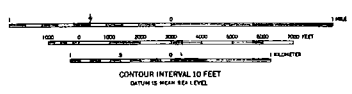


■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WINDY/RAIN AREA

REFERENCE: Bjorklund, L.J., and Brown, R.F., 1957, Geology and ground-water resources of the lower South Platte River valley between Hardin, Colorado, and Fenton, Nebraska: U. S. Geol. Survey Water-Supply Paper 1378, pl. 1.

Mapped by: Phillip C. Ucklein  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy-duty ROAD & LAKE Light-duty
- Medium-duty CANALS & DITCHES Unimproved dirt
- U.S. Route State Route

DEARFIELD, COLO.



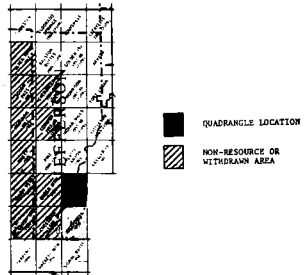
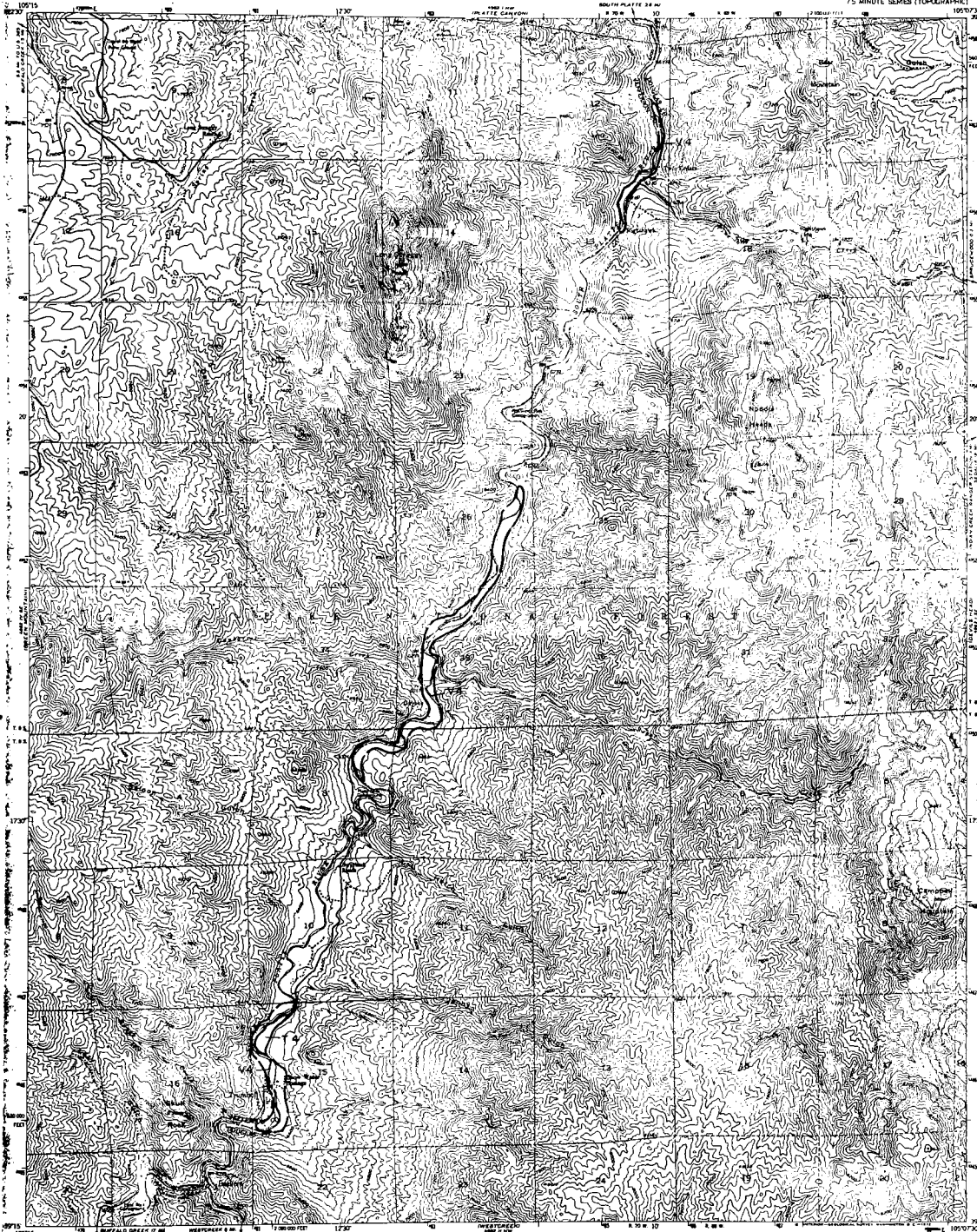
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

DECKERS QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

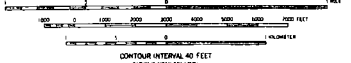
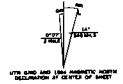
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. RYAN, DIRECTOR

## EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Non-mine deposits (sand, silt, clay, pebbles, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 20% retained on #4 screen, 0.75" retention)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous carbonates
- Fine Aggregate**  
(greater than 75% passing #4 screen, 80% retained on #20 screen, visual estimation)
- 3 Sand
  - 4 Probable aggregate resources
- NO MINES**
- \* Operating gravel and/or sand pit
  - ⊗ Abandoned gravel and/or sand pit
  - ⊙ Abandoned stone quarry
  - ⊕ Potential quarry aggregate resource sites
  - ⊖ Potential well or drill-hole location with associated thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs. "r" indicates gravel; "s" indicates sand. "r" in symbol denotes unretained or unknown property.
  - "w" denotes Colorado Geological Survey "Water/Lean and Gravel" projects' drill hole.
  - Landform boundary, solid where known or inferred; dashed where approximate or inferred.
- STATION LOCATION AND IDEOLOGICAL INDICATION OF RESULTS**
- resource thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing #4 screen, 0.75 in.), visual estimation
  - significant amount of fines (passing #20 screen, 0.850 in. or 0.075 mm)
  - significant amount of decomposed or weak sand
  - significant amount of calcareous carbonate (colluvial)
  - "r" in symbol denotes unretained or unknown property.
  - "s" in symbol denotes property where data



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Medium-duty      Light-duty

Unimproved dirt      .....

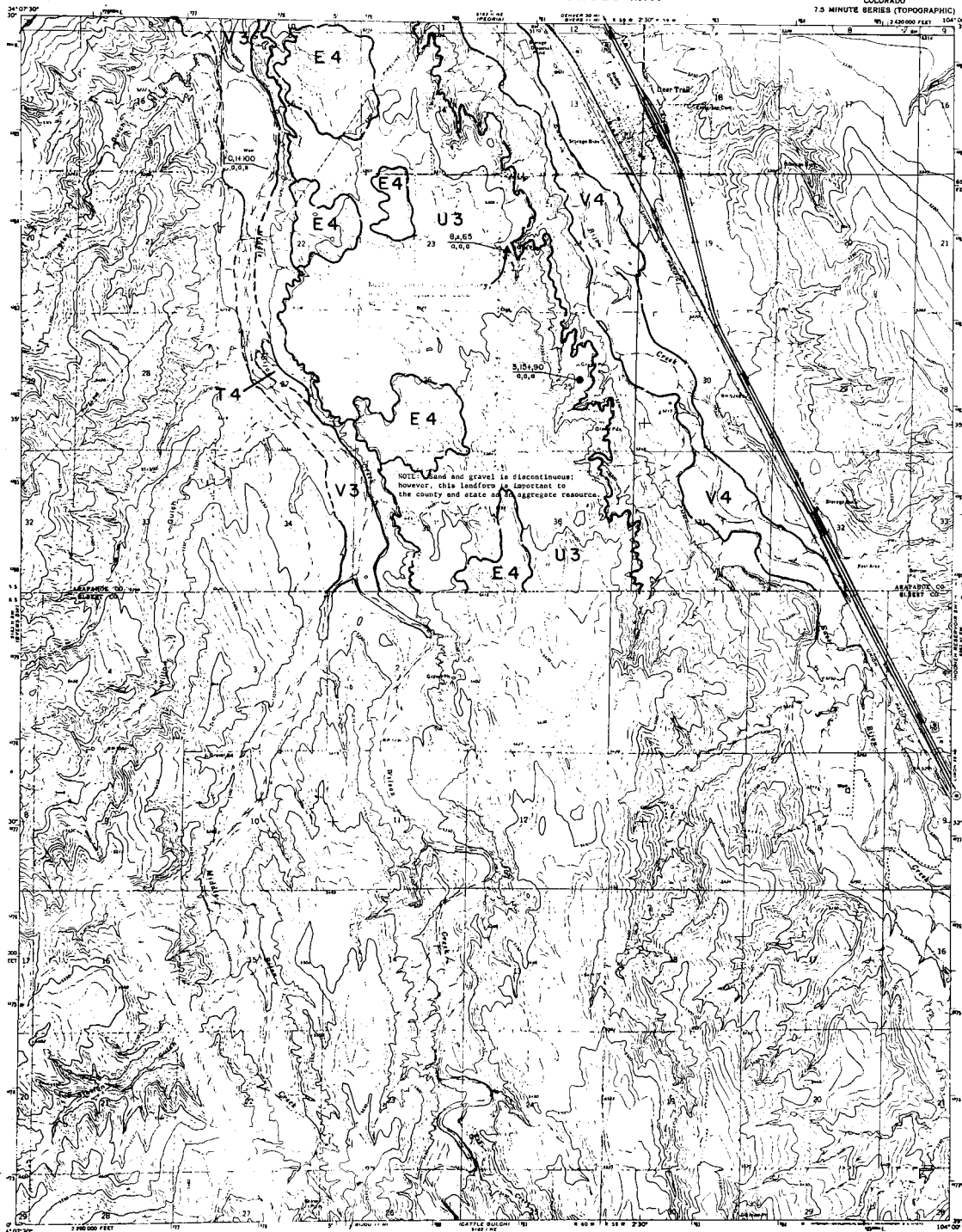
Maped by: Phillip C. Wicklein  
Date: June 30, 1974

DECKERS, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

DEER-TRAIL QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - S Stream terrace deposit
  - V Valley fill (E & T)
  - U Upland alluvium
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (like ballgame, apron, ...)

- MINING CLASSIFICATION**
- CLAYE AGGREGATE**  
(a) (200' to 250' contour) - 84 acres,  
(b) (200' to 250' contour) - 84 acres
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine subbase
- FINE SANDS**  
(200' to 250' contour) - 84 acres, 675  
residual on 400' contour, visual estimation
- 3 Sand
  - 4 Probable aggregate resource

- MIN SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Residual sand and gravel location (see resources (U3), (E4) over sand/gravel resource
  - Shaded (E4), shaded from well logs: "s" (eolian sand); "m" (eolian sand)
  - "s" in symbol denotes unconsolidated or column property
  - "m" denotes Colorado Geological Survey Wind-blown Sand and Gravel project
  - 1955 hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred.

- SYMBOL, LOCATION AND SYMBOLICAL REPRESENTATION OF AGGREGATE**
- unconsolidated (shaded) (U3)
  - sand/gravel resource (shaded) (E4)
  - residual sand and gravel (shaded) (E4, U3) (see well logs)
  - significant amount of fines (appearing 100' contour, 0.005' (s) or 0.01' (m))
  - significant amount of decomposed or rock rock
  - significant amount of calcine (inclined) (inclined)
  - "s" in symbol denotes unconsolidated or column property
  - "m" in symbol denotes properly shown



DEER TRAIL, COLO.  
N3830-W10400/7.5  
1969  
AUG 1110 © 68 - SERIES 7077

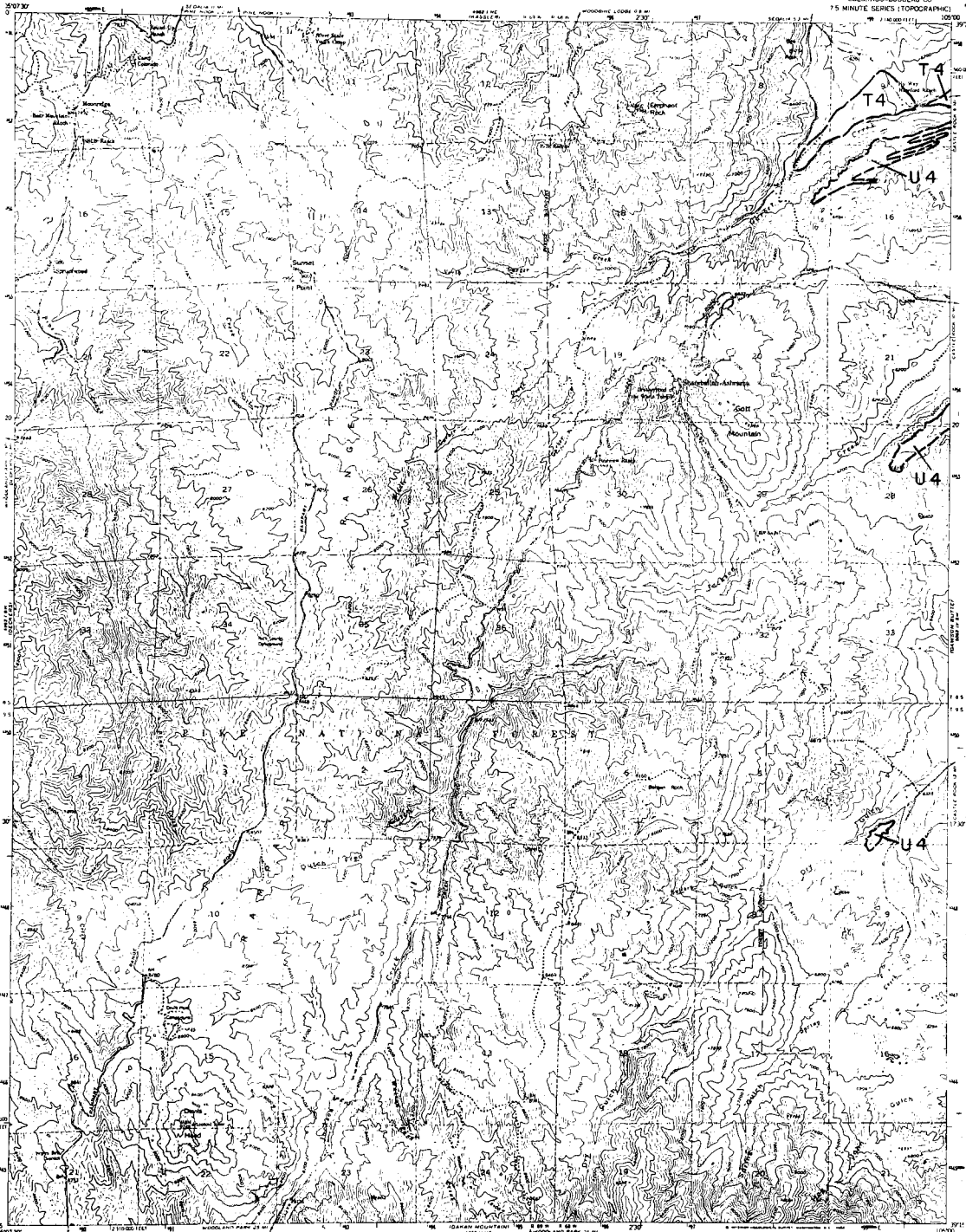
Mapped by: Phillip C. Wickham  
Date: June 30, 1974



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

DEVILS HEAD QUADRANGLE  
COLORADO-DOUGLAS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

### LANDFORMS

- F Floodplain deposit
- T Trench (erosion channel)
- V Valley fill (F & T)
- U Upland deposit
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Non-road materials (slag/tailings, opoka...)

### RESOURCE CLASSIFICATION

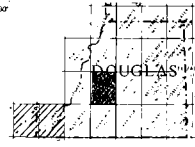
- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock, carbonates
- 3 Sand
- 4 Potential aggregate resource

### MAP SYMBOLS

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Indicates unit or deposit location with overburden thickness (ft) over underlying resource thickness (ft), obtained from well logs
- "G" indicates gravel, "S" indicates sand
- "X" in symbol denotes nonvalued or unknown resource
- "M" denotes Colorado Geological Survey Material and Gravel product drill hole
- Landform boundary, solid where known or observed, dashed where approximate or inferred.

### STATION, LOCATION AND CHRONOLOGICAL SIGNIFICANCE OF SYMBOLS

- overburden thickness (ft)
- and gravel resource thickness (ft)
- resource and overburden (spacing of arrows, 0.15 in., usual definition)
- Significant amount of fines (spacing of 100 arrows, 0.05 in. or 0.075 in.)
- Significant amount of decomposed or unit rock
- "X" in symbol denotes nonvalued or unknown resource
- "M" in symbol denotes properly observed or inferred

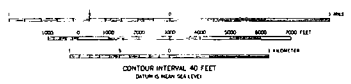
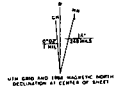


- 7 QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Tribble, D.E., and Hitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map I-857 A.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



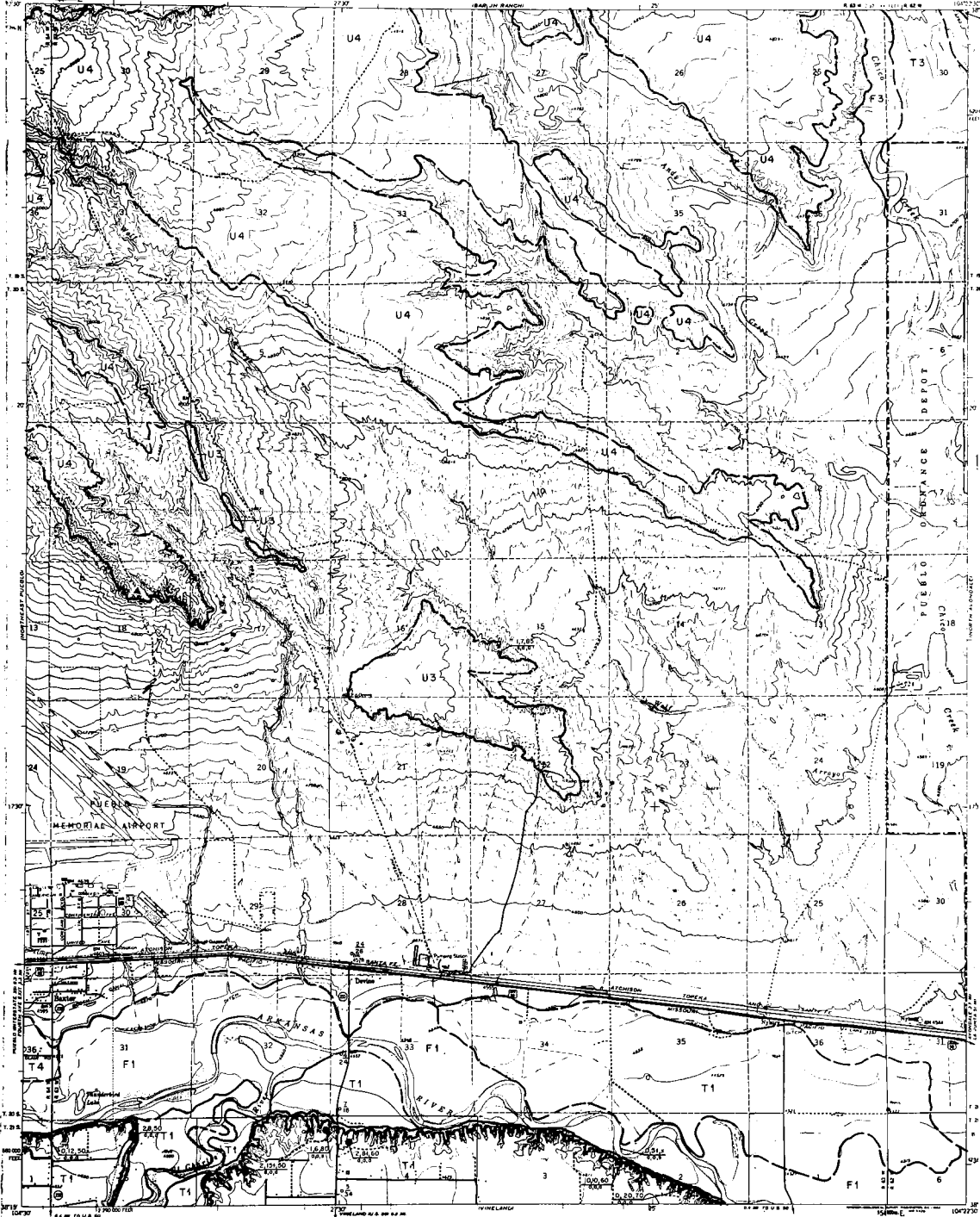
ROAD CLASSIFICATION  
Lightly Unimproved dirt

DEVILS HEAD, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

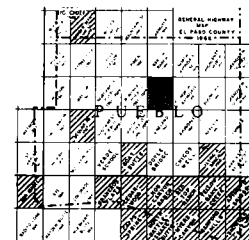
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. MOSE, DIRECTOR

DEVINE QUADRANGLE  
COCONA-PUEBLO CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



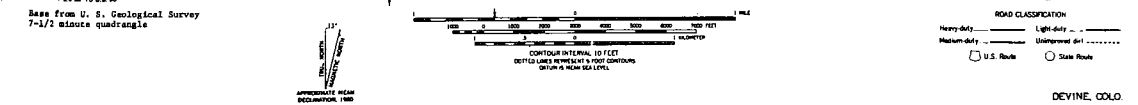
EXPLANATION

- Landform unit
- Resource classification
- LITHOLOGICAL UNIT**
  - F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Erosion-resistant sand (colluv.)
  - W Hard-rock deposits (slag, talus, spalls, etc.)
- RESOURCE CLASSIFICATION**
  - GRAVEL (AGGREGATE)**  
(see foot-note regarding use of survey, special restrictions)
    - 1 Gravel: relatively clean and sound
    - 2 Gravel: significant fines, unconsolidated, calcareous carbonate
  - SAND**
    - 3 Sand
  - PROBABLE AGGREGATE RESOURCES**
    - 4 Probable aggregate resources
- AGGREGATE**
  - 5 Operative gravel and/or sand pit
  - 6 Abandoned gravel and/or sand pit
  - 7 Operative stone quarry
  - 8 Abandoned stone quarry
  - 9 Potential quarry aggregate resource area
- WELL**
  - Selected well or drill-hole location with estimated thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "s" indicates gravel; "s" indicates sand.
  - "c" in symbol denotes unconsolidated or unknown property.
  - "w" denotes Colorado Geological Survey Water/Fuel and Gravel projects well logs.
  - Landform boundary, well where known or shown; shaded where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
  - Numbered thickness (ft)
  - Estimated resource thickness (ft)
  - Percent sand and fines (approx. 66 percent, 0-20 in., visual estimation)
  - Approximate amount of fines (approx. 1000 screen, 0.075 in. or 2.074 mm)
  - Approximate amount of unconsolidated or sand rock.
  - Approximate amount of calcareous carbonate (caliche)
  - "s" in symbol denotes unconsolidated or unknown property.
  - "c" in symbol denotes property absent or unconsolidated.



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schewchow  
Date: June 30, 1974



APPROXIMATE MEAN ELEVATION, 1980

CONTOUR INTERVAL, 10 FEET  
DETT LINE REPRESENTS FOOT CONTOURS  
DOTTED LINE SHOWS SEA LEVEL

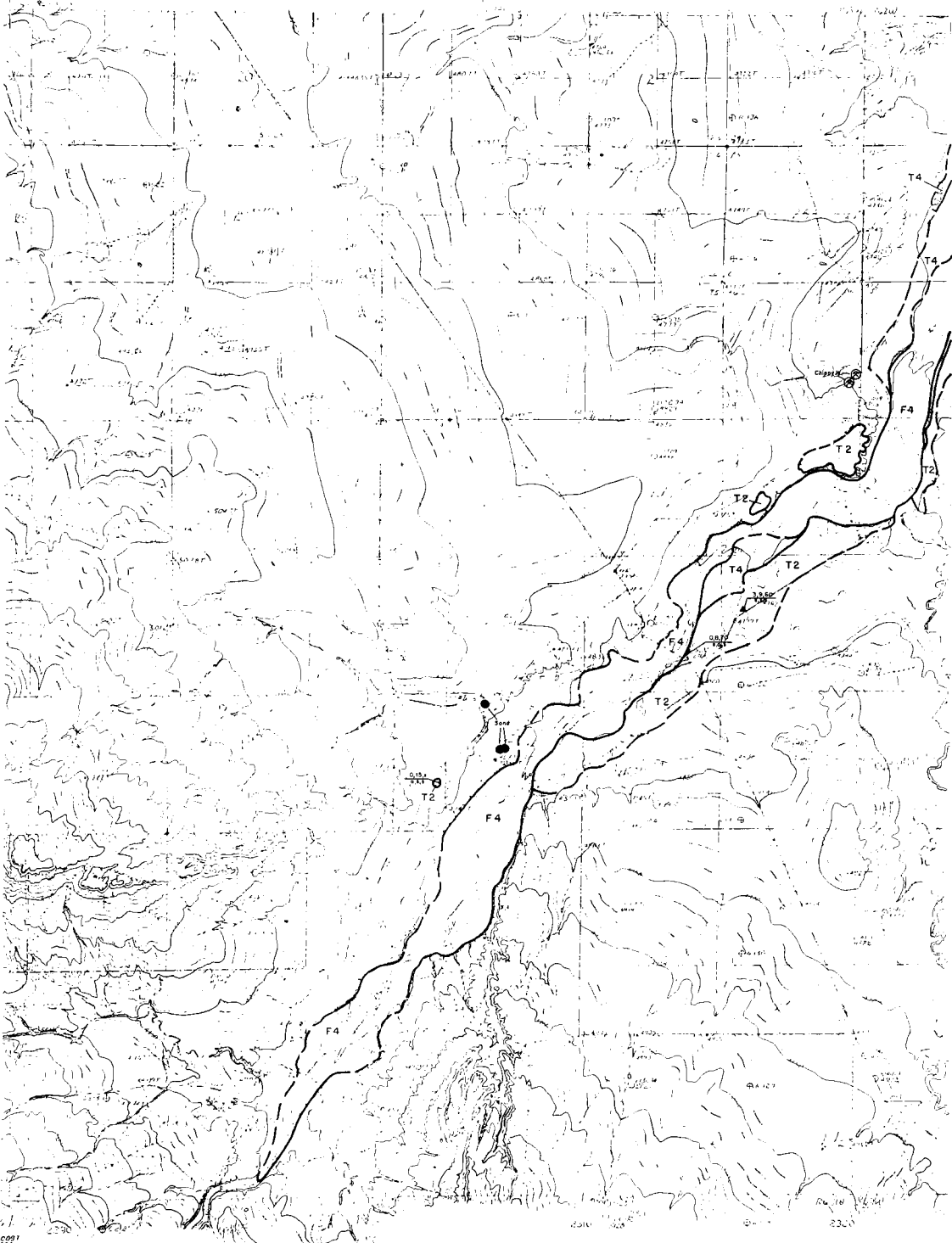
ROAD CLASSIFICATION  
Heavy-duty \_\_\_\_\_ Light-duty \_\_\_\_\_  
Medium-duty \_\_\_\_\_ Unimproved dirt \_\_\_\_\_  
U.S. Route \_\_\_\_\_ State Route \_\_\_\_\_

DEVIENE, COLO.



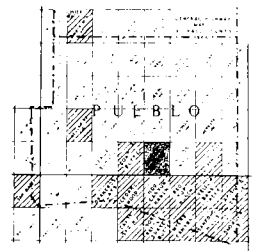
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

DOYLE BRIDGE QUADRANGLE



EXPLANATION

- Resource Classification
- AGGREGATE TYPES**
- F Fluvialite deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (highways, embankments)
- RESOURCE CLASSIFICATION**
- Grade Aggregate**  
 as listed in the legend on the screen, actual percentages
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, section unknown
- Fill Aggregate**  
 as listed in the legend on the screen, actual percentages
- 3 Sand
  - 4 Probable aggregate resource
- IMP. SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Section with no significant resources
  - Section with some but not significant resources
  - Section with significant resources
  - "S" indicates gravel; "M" indicates sand
  - "X" symbol denotes unclassified or unknown resource
  - "U" denotes Colorado Geological Survey unclassified and gravel projects still in the
  - Section boundary, actual where shown or observed, dashed where approximate or inferred
- STATION, LOCATION AND ORIGIN:**
- SECTION OF MAP:**
- Section boundary (dashed line)
  - Section boundary (solid line)
  - Section boundary (dotted line)
  - Section boundary (dash-dot line)
  - Section boundary (long-dash line)
  - Section boundary (short-dash line)
  - Section boundary (dash-dot-dot line)
  - Section boundary (long-short-dash line)
  - Section boundary (short-long-dash line)
  - Section boundary (dash-dot-dot-dot line)
  - Section boundary (long-short-short-dash line)
  - Section boundary (short-long-short-dash line)
  - Section boundary (dash-dot-dot-dot-dot line)
  - Section boundary (long-short-short-short-dash line)
  - Section boundary (short-long-short-short-dash line)
  - Section boundary (dash-dot-dot-dot-dot-dot line)
  - Section boundary (long-short-short-short-short-dash line)
  - Section boundary (short-long-short-short-short-dash line)
  - Section boundary (dash-dot-dot-dot-dot-dot-dot line)
  - Section boundary (long-short-short-short-short-short-dash line)
  - Section boundary (short-long-short-short-short-short-dash line)



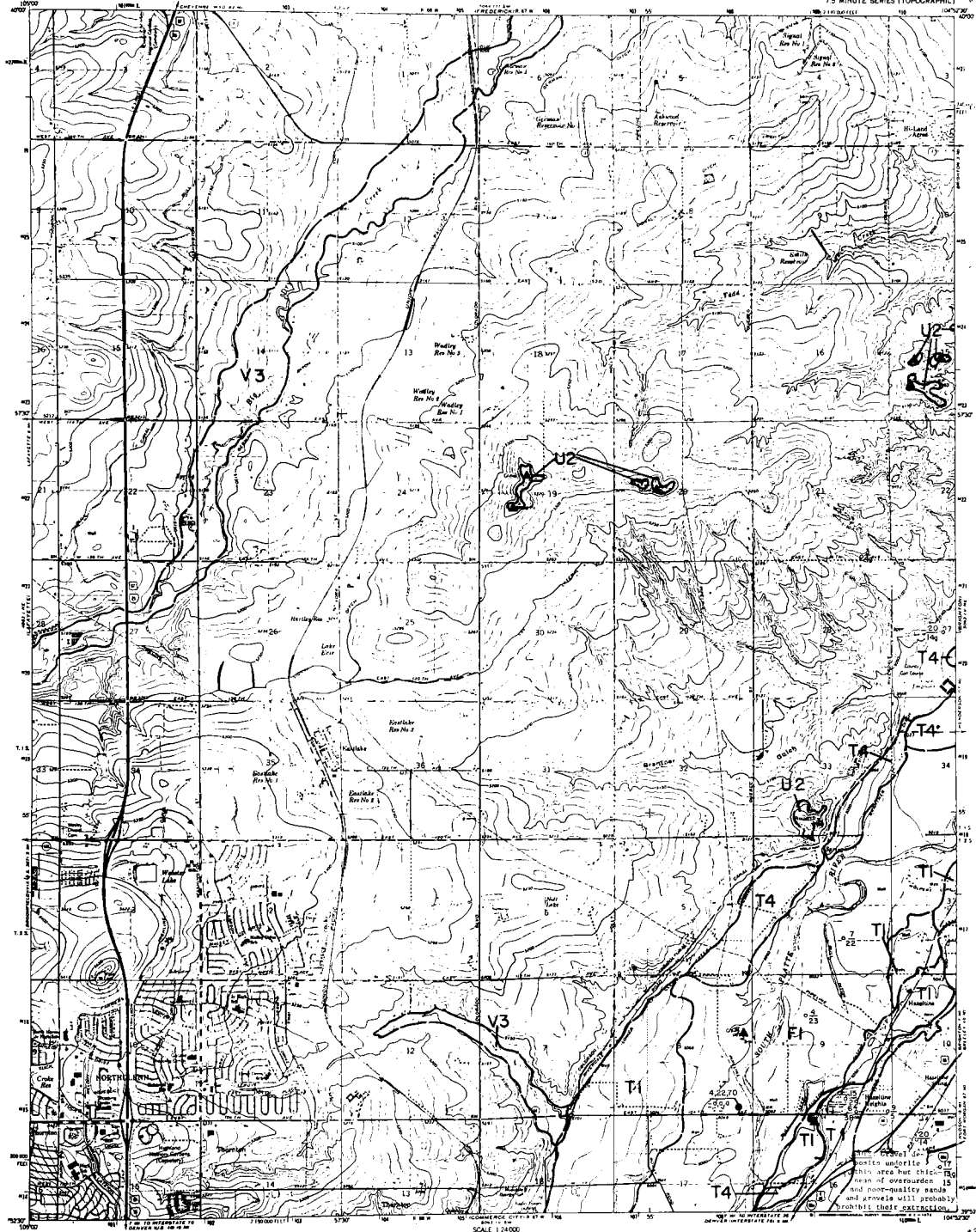
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwabow  
 Date: June 30, 1974

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

EASTLAKE QUADRANGLE  
COLORADO-ADAMS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LANDFORM UNIT**  
 - Landform unit  
 - Contour class/location
- LANDFORM UNITS**  
 F Floodplain deposit  
 T Stream terrace deposit  
 W Valley fill (F & T)  
 U Upland deposits  
 A Alluvial fan  
 E Wind-deposited sand (colluv.)  
 M Man-made deposits (landfill, spoil, etc.)
- ROAD CLASSIFICATION**  
 - Unimproved dirt road  
 - Unimproved gravel road  
 - U.S. Route  
 - State Route
- ROAD SYMBOLS**  
 - Operating gravel and/or sand pit  
 - Abandoned gravel and/or sand pit  
 - Operating stone quarry  
 - Abandoned stone quarry  
 - Potential quarry aggregate resource area  
 - Selected well or drill-hole location with average thickness (ft) of sand/gravel resource thickness (ft), obtained from well logs.  
 - "U" indicates gravel; "S" indicates sand.  
 - "U" in symbol denotes unventilated or unknown property.  
 - "S" denotes Colorado Geological Survey (Water/Soil and Gevel projects) drill hole.  
 - Landform boundary, solid where known or observed; dashed where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL ANALYSIS OF SANDS**  
 - sand/gravel resource thickness (ft)  
 - sand/gravel resource thickness (ft)  
 - percent sand and fines (passing #10 screen, 0.25 in.), usual notation.  
 - Significant amount of fines (passing #200 screen, 0.0075 in. or 0.19 mm.)  
 - Significant amount of silt and clay content.  
 - Significant amount of silt/clay content (includes "U" in symbol denotes unventilated or unknown property.  
 - "S" in symbol denotes property status or ownership.

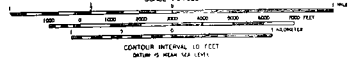
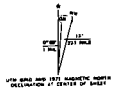


QUADRANGLE LOCATION  
 NON-RESOURCE OR METERED AREA

**References:**  
 Schuchow, S.D., 1972. Surficial geology of the Eastlake quadrangle, Adams County, Colorado. Colorado School Mines Quarterly, Master Sci. Thesis 1-1965, p. 1.  
 De Vito, E.H., 1968. Quaternary history of Rocky Mountain Arsenal and environs, Adams County, Colorado. Colorado School Mines Quarterly, v. 63, no. 1, p. 1.  
 Hamilton, J.L., and Owen, W.C., 1972. Sewage treatment, solids and related foundation problems, Denver metropolitan area, Colorado. Colorado Geol. Survey Environmental Sciences Report 1, p. 1.  
 Inter-County Regional Planning Commission, 1961. Drainage source plan for the Denver region - Part 1, Sand and gravel resources; Denver, Colo., Inter-County Reg. Plan. Comm., p. 1.  
 Chase, C.H., and McLaughlin, S.M., 1972. Generalized surficial geologic map of the Denver area, Colorado. U.S. Geol. Survey Misc. Geol. Inv. Map 1-731.  
 Smith, R.O., Schneider, P.A., Jr., and Patz, L.H., 1964. Ground-water resources of the San Platte River basin in western Adams and southwestern Weld Counties, Colorado. U.S. Geol. Survey Water-Supply Paper 1618, p. 1.  
 Trimble, D.E., and Pritch, H.L., 1974. Map showing potential sources of gravel and sand aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo. U.S. Geol. Survey Misc. Geol. Inv. Map 1-858A.

Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



ROAD CLASSIFICATION  
 - Unimproved dirt road  
 - Unimproved gravel road  
 - U.S. Route  
 - State Route

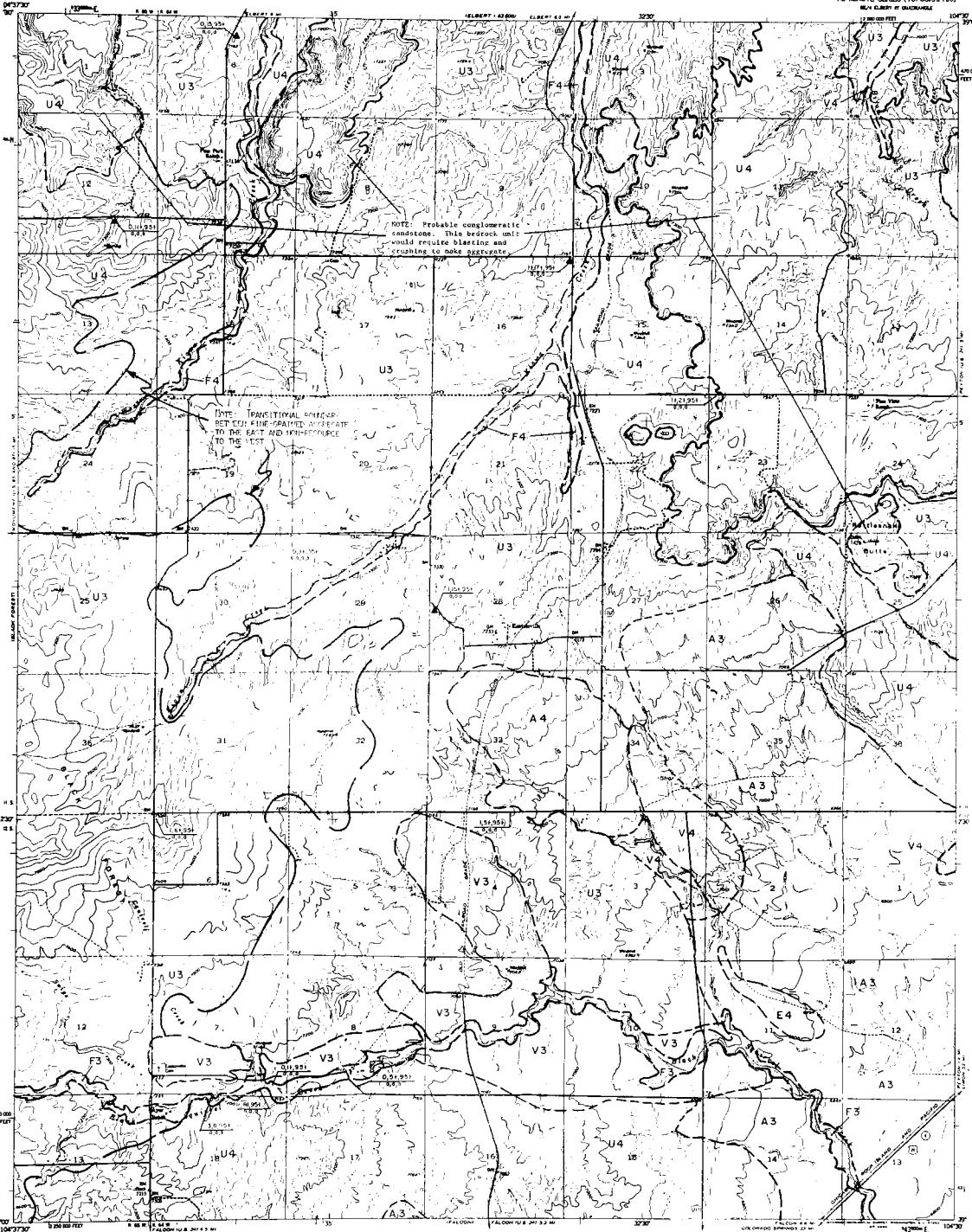
EASTLAKE, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

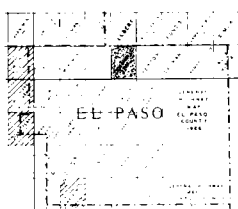
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HALL, DIRECTOR

EASTONVILLE QUADRANGLE  
COLORADO-EL PASO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
BASE MAP OF 1960



## EXPLANATION

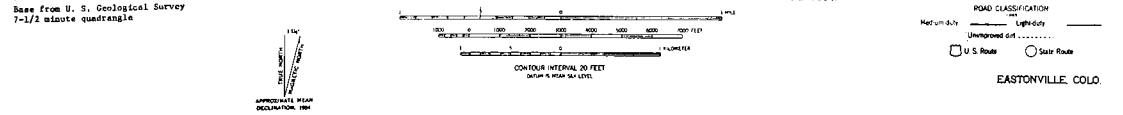
- SYMBOLS**
- Contour interval
  - Stream
  - Road
  - Boundary
- AGGREGATE QUANTITIES**
- 1. 100,000 cu yd
  - 2. 50,000 cu yd
  - 3. 25,000 cu yd
  - 4. 10,000 cu yd
  - 5. 5,000 cu yd
  - 6. 2,500 cu yd
  - 7. 1,000 cu yd
  - 8. 500 cu yd
  - 9. 250 cu yd
  - 10. 100 cu yd
  - 11. 50 cu yd
  - 12. 25 cu yd
  - 13. 10 cu yd
  - 14. 5 cu yd
  - 15. 2.5 cu yd
  - 16. 1 cu yd
  - 17. 0.5 cu yd
  - 18. 0.25 cu yd
  - 19. 0.1 cu yd
  - 20. 0.05 cu yd
  - 21. 0.025 cu yd
  - 22. 0.01 cu yd
  - 23. 0.005 cu yd
  - 24. 0.0025 cu yd
  - 25. 0.001 cu yd
- AGGREGATE QUALITY**
- 1. Good
  - 2. Fair
  - 3. Poor
  - 4. Marginal
  - 5. Unusable
- AGGREGATE TYPE**
- 1. Sand
  - 2. Gravel
  - 3. Sand and gravel
  - 4. Sand, gravel and crushed rock
  - 5. Sand, gravel and crushed rock with aggregate
  - 6. Sand, gravel and crushed rock with aggregate and cement
  - 7. Sand, gravel and crushed rock with aggregate and cement and aggregate
  - 8. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate
  - 9. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate
  - 10. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate
  - 11. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate
  - 12. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 13. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 14. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 15. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 16. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 17. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 18. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 19. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 20. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 21. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 22. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 23. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 24. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate
  - 25. Sand, gravel and crushed rock with aggregate and cement and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate and aggregate



**QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

Mapped by: Ralph S. Shroba  
Date: June 30, 1974

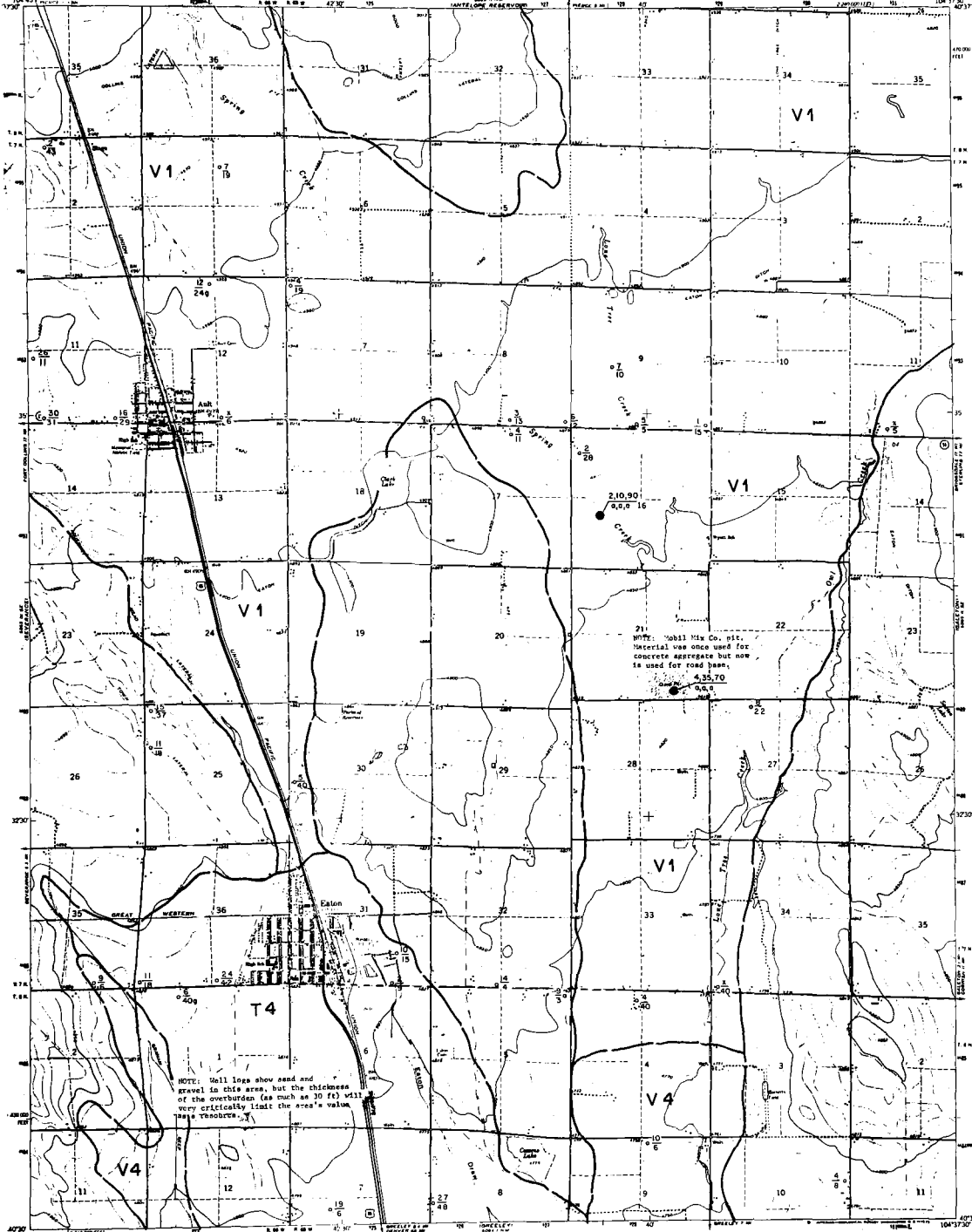


SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

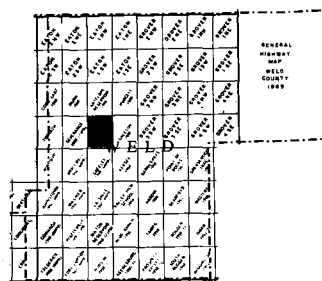
EATON QUADRANGLE  
 COLORADO-WELD CO.  
 7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Contour lines
- Resource class/amount
- RESOURCE CLASS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eol wind-deposited sand (outcrop)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and smooth
  - 2 Gravel: significant fines, decomposed rock, calcareous concretions
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft); overburden resource thickness (ft); obtained from well logs
  - "T" indicates areas of talus and debris
  - "L" in symbol denotes unincorporated or unknown property
  - "W" denotes Colorado Geological Survey Water/land and Gravel projects
  - "C" in symbol denotes Colorado Geological Survey Water/land and Gravel projects
  - Landform boundary, solid where known or dashed where approximated or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
  - overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (spacing 80 screen, 0.10 U.S. visual estimation)
  - percent amount of fines (spacing 200 screen, 0.0075 in. or 0.20 mm.)
  - significant amount of decomposed or sand rock
  - significant amount of calcareous concretions (outcrop)
  - "L" in symbol denotes unincorporated or unknown property
  - "W" in symbol denotes property shared or leased/owned



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
 Herodot, L.A., and Schneider, F.A., Jr., 1972, Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 7-687.

Wm. R. S., III, 1982, Map of surficial geology of some of the Eaton quadrangle: Resource mapping for Colorado Geol. Survey Watershed Environmental Geology Project, open-file map.

Shelton, D.C., 1994, personal communication.  
 Geology modified after: Colton, R.B., and Pritch, H.H., 1976, Map showing potential sources of gravel and crushed-rock aggregates in the Boulder-Fort Collins-Orealey Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 7-693-D.

Mapped by: Stephen B. Schochov  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7.5-minute quadrangle

CONTOUR INTERVAL 10 FEET

ROAD CLASSIFICATION  
 Heavy-duty ————— Light-duty —————  
 Medium-duty ————— Unimproved Rd. —————  
 ○ U.S. Road ○ State Road

EATON, COLO.

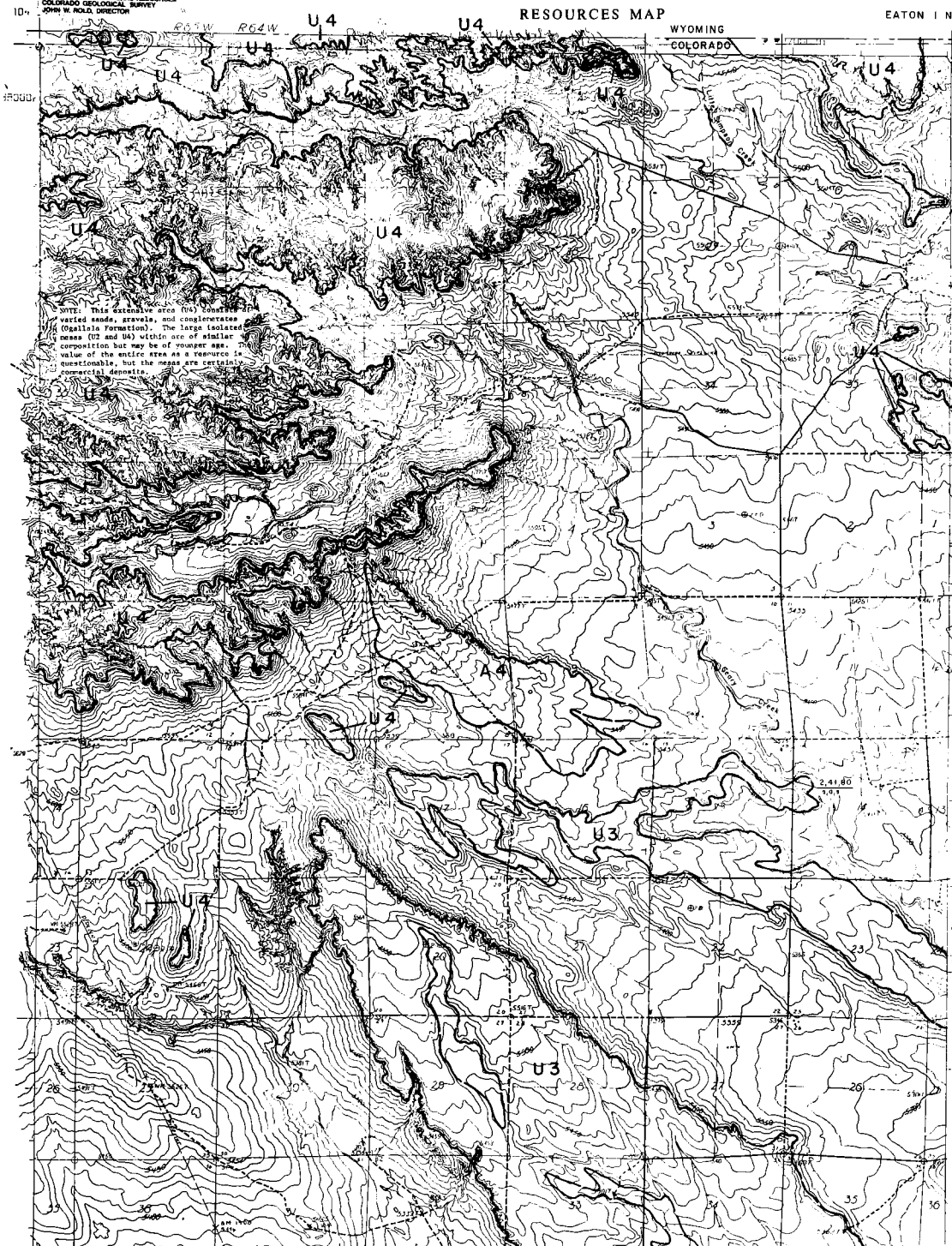


SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

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

EATON 1 NE



EXPLANATION

- Landform
- Resource classification
- AGGREGATE TYPES**
  - T Sandstone deposit
  - V Valley fill (F.A.T.)
  - U Unsorted deposits
  - A Alluvial fan
  - E High-velocity sand (medium)
  - M Marine deposits (silt, calcilug, opalite...)
- RESOURCE CLASSIFICATION**
  - Coarse Aggregate** (as listed on schedule on 24 screen, visual estimation)
    - 1 Gravel: relatively clean and sound
    - 2 Gravel: significant fines, decomposed rock, calcite nodules
  - Fine Aggregate** (screened from 24 screen, 20 screen, 100 retained on 100 screen, visual estimation)
    - 3 Sand
  - 4 Possible aggregate resource
- NOT SYMBOLS**
  - Operating sand and/or sand pit
  - Abandoned stone and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Residual quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log.
  - "m" indicates gravel; "u" indicates sand
  - "s" indicates unconsolidated or untested
  - "w" denotes Colorado Geological Survey hydrographical and cross-section (drill) hole
  - Leaching boundary, solid where known or dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (based on screen, 0.075 in., visual estimation)
  - Significant amount of fines (based on 100 screen, 0.075 in. or 0.075 mm.)
  - Significant amount of decomposed or weak rock
  - Significant amount of siliceous materials (silica)
  - "u" in symbol denotes unconsolidated or untested
  - "s" in symbol denotes properly sorted or calcified



QUADRANGLE LOCATION

NON-RESOURCE OR WITHDRAWN AREA

- REFERENCE:
- Lover, H.E., and Crist, W.A., 1967, Geology and ground-water resources of Larimer County, Wyoming; U.S. Geol. Survey Water-Supply Paper 1834, pl. 1.
  - Mat, W.C., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgwick, and Weld Counties, Colo.; U.S. Geol. Survey Water-Supply Paper 1809-A, pl. 1.
  - Denson, H.M., 1974, personal communication.
- Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle R63W R64W 11

- ROAD CLASSIFICATION
- Primary highways: Light-duty road, hard or hard surface
  - Secondary highways: Improved surface
  - Unimproved road
  - Private Route
  - U.S. Route
  - State Route

FOUR INTERVAL 10 FEET

SAND, GRAVEL AND QUARRY AGGREGATE

EATON 1 NW

104

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

R 66 W R 65 N

RESOURCES MAP  
 WYOMING  
 COLORADO



NOTE: This extensive area (U4) consists of varied sands, gravels, and conglomerates (Ogallala Formation). The large isolated mesas (U2 and U4) within are of similar composition but may be of younger age. The value of the entire area as a resource is questionable, but the mesas are certainly commercial deposits.

EXPLANATION

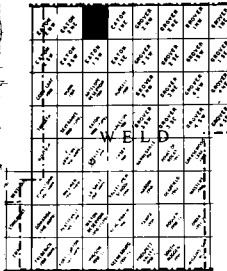
Landform units  
 Resource class/location

- LANDFORM UNITS**
- F Fluvial/terrace deposit
  - T Stream terrace deposit
  - V Valley fills (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mesquite deposits (sage, tallgrass, spolia, ...)

- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
 (at least 20% retained on #4 screen, 100% retention)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, tabular carbonate
- Fill Aggregate**  
 (greater than 75% passing #4 screen, 100% retained on #10 screen, usual definition)
- 3 Sand
  - 4 Probable aggregate resource

- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable quarry aggregate resource area
  - Selected well or drilled hole location with water
  - Water thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - " " indicates gravel; " " indicates sand
  - " " in symbol denotes unconsolidated or unknown gravel
  - " " denotes Colorado Geological Survey Water/Water and Ground Samples drill hole
  - Landform boundary, solid where known or dashed where approximate or inferred

- SYMBOL, LANDFORM AND GEOLOGICAL CLASSIFICATION OF DEPOSITS**
- overburden thickness (ft)
  - underground resource thickness (ft)
  - gravel and fines (passing #4 screen, # 20 to 1), usual definition
  - significant amount of fines (passing #10 screen, # 20 to 1, or # 100 mesh)
  - significant amount of decomposed or weak rock
  - " " in symbol denotes unconsolidated or unknown gravel
  - " " in symbol denotes property subject to litigation



QUADRANGLE LOCATION  
 NON-RESOURCE OR WYTHDRAWN AREA

**REFERENCE:**

Lowry, H.E., and Crist, H.A., 1967, Geology and ground-water resources of Larimer County, Wyoming; U. S. Geol. Survey Water-Supply Paper 1834, pl. 1.

Denagy, H.W., 1974, personal communication.

Wiest, W.G., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colo.; U. S. Geol. Survey Water-Supply Paper 1809-L, pl. 1.

Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974

- ROAD CLASSIFICATION**
- Primary highway: hard surface
  - Secondary highway: hard surface
  - Light-duty road: hard or improved surface
  - Unimproved road
  - Interstate Route
  - U. S. Route
  - State Route

CONTOUR INTERVAL 10 FEET

27100001  
 Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

EATON 1 NW (03) (01)

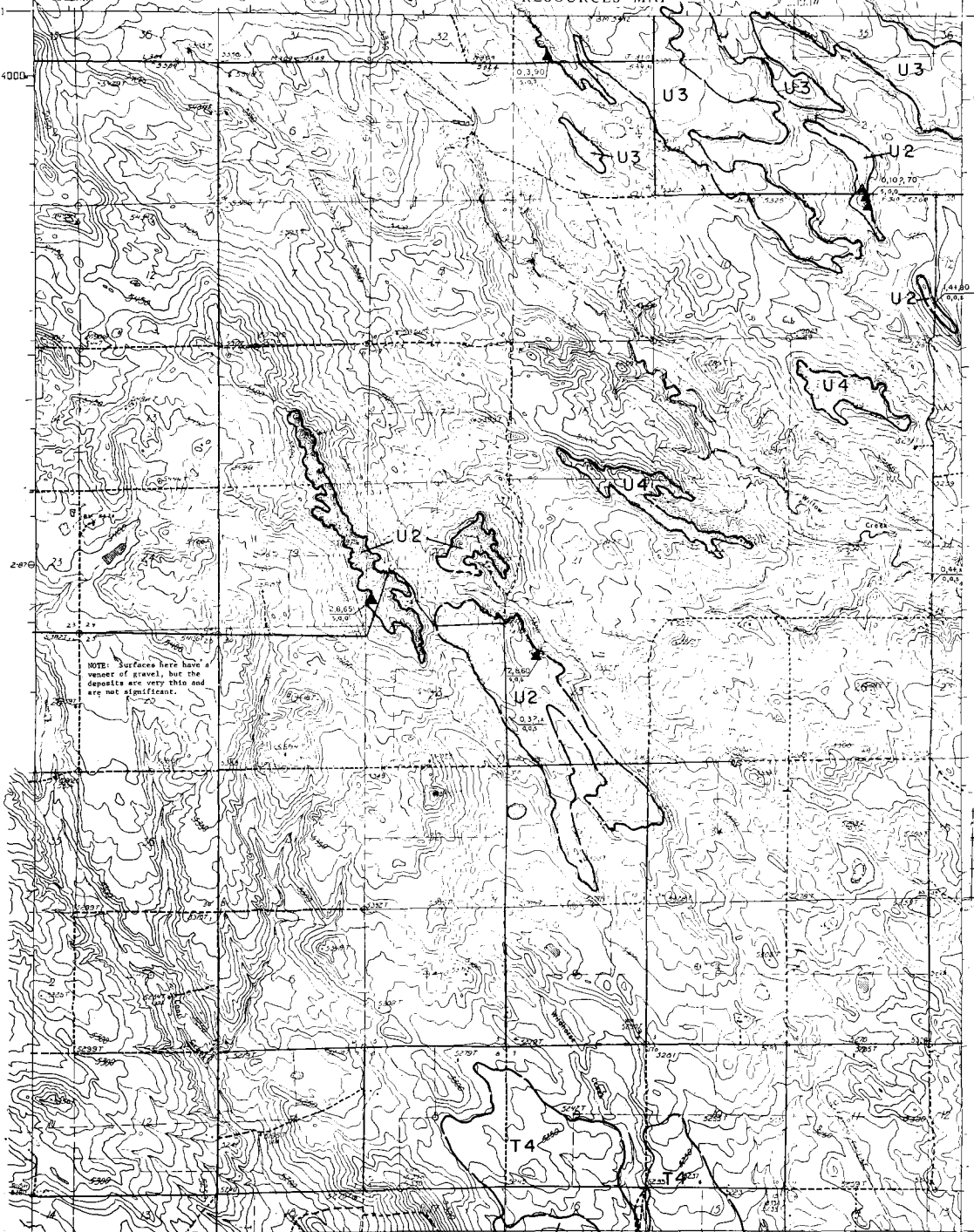


SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

EATON 15E

104

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



EXPLANATION

- Contour interval
- Elevation/Spot Elevation
- LITHOLOGIC UNIT**

  - F Fluvialite deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eolian deposits and facies
  - M Non-igneous deposits (slag, tailings, opella...)

- RESOURCE CLASSIFICATION**

  - 1 **Class 1**: relatively clean and sound
  - 2 **Class 2**: impure/finer, decomposed rock, calcitic carbonate
  - Class 3**: low
  - 4 **Class 4**: Probable aggregate resource

- MAP SYMBOLS**

  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with measured thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "\*" indicates gravel; "o" indicates sand
  - "?" is spot where overlain or unknown property
  - "N" indicates geological survey, hydrological and gravel projects
  - "S" is spot where overlain or unknown property
  - Location boundary, solid where known or inferred
  - Shaded where approximate or inferred

- STATUS, LOCATION AND GEOLOGICAL DESCRIPTION OF RESOURCES**

  - resource thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (using de Smet's, 0.25 in., 1/2 inch sub-sieve)
  - Significant amount of fines (using 180 mesh, 0.0025 in. or 0.075 mm.)
  - Significant amount of decomposed or soft rock
  - Significant amount of calcitic carbonate facies
  - "\*" is spot where overlain or unknown property
  - "o" is spot where overlain or unknown property
  - "N" is spot where overlain or unknown property
  - "S" is spot where overlain or unknown property

15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20
15E-1	15E-2	15E-3	15E-4	15E-5	15E-6	15E-7	15E-8	15E-9	15E-10	15E-11	15E-12	15E-13	15E-14	15E-15	15E-16	15E-17	15E-18	15E-19	15E-20

■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwechow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

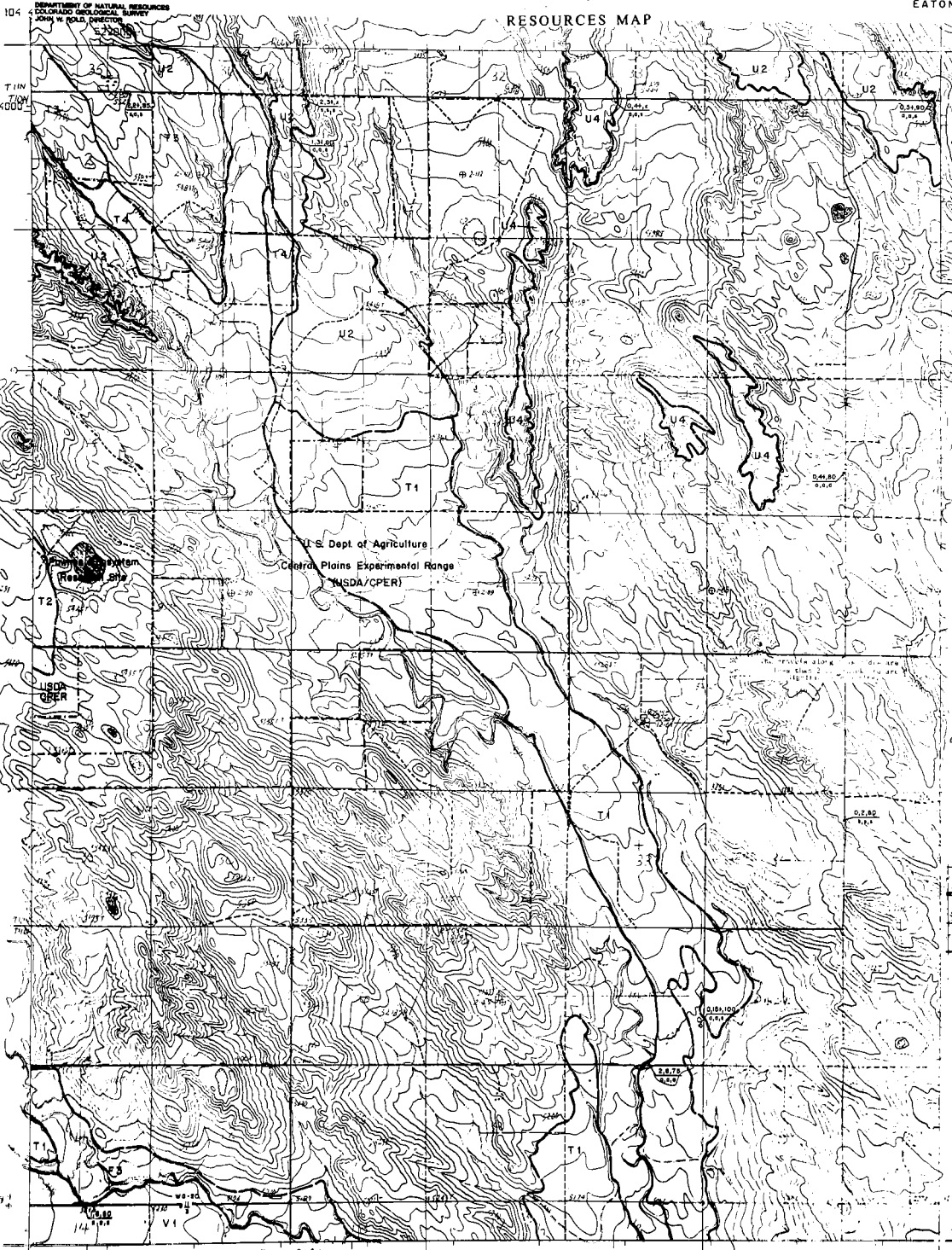
**ROAD CLASSIFICATION**

- Primary highway
- Hard surface
- Secondary highway
- Hard surface
- Unimproved road
- Interstate Route
- U. S. Route
- State Route
- Light-duty road, hard or improved surface
- Unimproved road
- U. S. Route
- State Route

EATON 15E (08) COLO

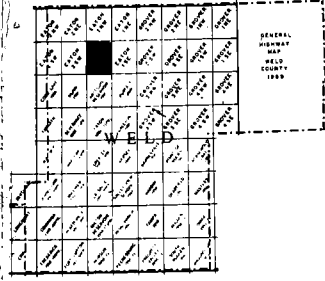
SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

EATON 1 SW



EXPLANATION

- LANDFORMS**
- # Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Erosional land (alluvial)
  - M Marine deposits (e.g., caliche, spalls...)
- ROCK CLASSIFICATION**
- Gravel deposits**  
(as defined by Federal on 49 acres, Federal acquisition)
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, matrix of sandstone
- Fine aggregate**  
(as defined by Federal on 49 acres, 100 percent on 150 acres, Federal acquisition)
- 3 Sand
  - 4 Probable aggregate resource
- UNCLASSIFIED RESOURCE**
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Remnant quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "I" indicates gravel; "S" indicates sand
  - "\* in symbol denotes unclassified or unknown property
  - "\* denotes Colorado Geological Survey (Colorado State and Great projects) drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- EXTENT, LOCATION AND ORIGIN OF ACQUISITION OF RIGHTS**
- overburden thickness (ft)
  - unclassified resource thickness (ft)
  - percent sand and fines (percent of)
  - percent, 0.25 to 0.50 ft, Federal acquisition
  - unclassified amount of fines (percent)
  - 100 percent, 0.25 to 0.50 ft, Federal acquisition
  - significant amount of decomposed or weak rock
  - significant amount of alluvium (matrix) (matrix)
  - "\* in symbol denotes unclassified or unknown property
  - "\* in symbol denotes property about or insignificant



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**  
Bavly, L.A., and Schneider, F.A., Jr., 1972, Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Inv. Map T-487.

U.S.D.A., Patuxent Site  
Ecosystem Research Headquarters, Map

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7 1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET

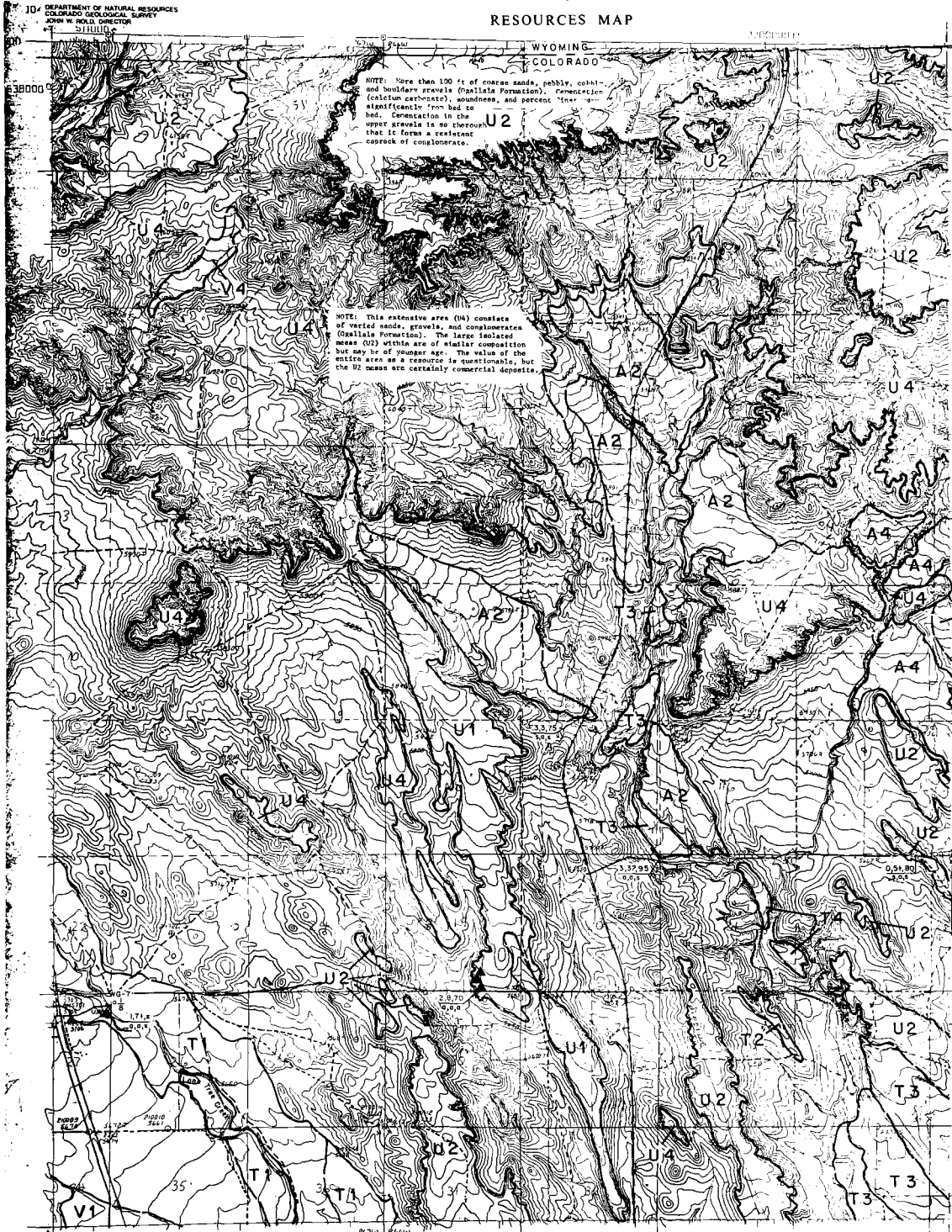
- ROAD CLASSIFICATION**
- Primary highway, hard surface
  - Light duty road, hard or improved surface
  - Secondary highway, hard surface
  - Unimproved road
  - Interstate Route
  - U. S. Route
  - State Route

EATON 1 SW 10/1



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

EATON 2 NE



EXPLANATION

- LEGEND**
- U2 U2
  - U4 U4
  - A2 A2
  - A4 A4
  - T3 T3
  - T2 T2
  - T1 T1
  - V1 V1
- ROAD CLASSIFICATION**
- Primary highway: light gray road, hard or improved surface
  - Secondary highway: dark gray road, hard surface
  - Unimproved road: dotted line
  - Interstate Route: shield symbol
  - U.S. Route: square symbol
  - State Route: circle symbol
- ROADWAY**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quality aggregate resource area
  - Selected well or drill-hole location with maximum thickness (ft) over sand/gravel resource
  - Thickness (ft), obtained from well logs
  - "U" indicates property of unknown owner
  - "S" in symbol denotes unmineralized or unknown property
  - "M" in symbol denotes mineralized and known property
  - "W" in symbol denotes mineralized and known property
  - "A" in symbol denotes property absent or insignificant
- QUADRANGLE LOCATION**
- GENERAL QUADRANGLE
  - WELD COUNTY
  - NEED
- REFERENCE:**
- Lewis, R. E., and Crist, H. A., 1967, Geology and ground-water resources of Larimer County, Wyoming. U. S. Geol. Survey Water-Supply Paper 1834, pl. 1.
  - Damon, H. M., 1974, personal communication.
  - Weist, U. G., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedwick, and Weld Counties, Colo.; U. S. Geol. Survey Water-Supply Paper 1809-1, pl. 1.
- Mapped by: Stephen D. Schwachow  
Date: June 30, 1974



Base from U. S. Geological Survey 7-1/2 minute quadrangle 2160000 11

CONTOUR INTERVAL 10 FEET

EATON 2NE 104 COLO

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

EATON 2 NW

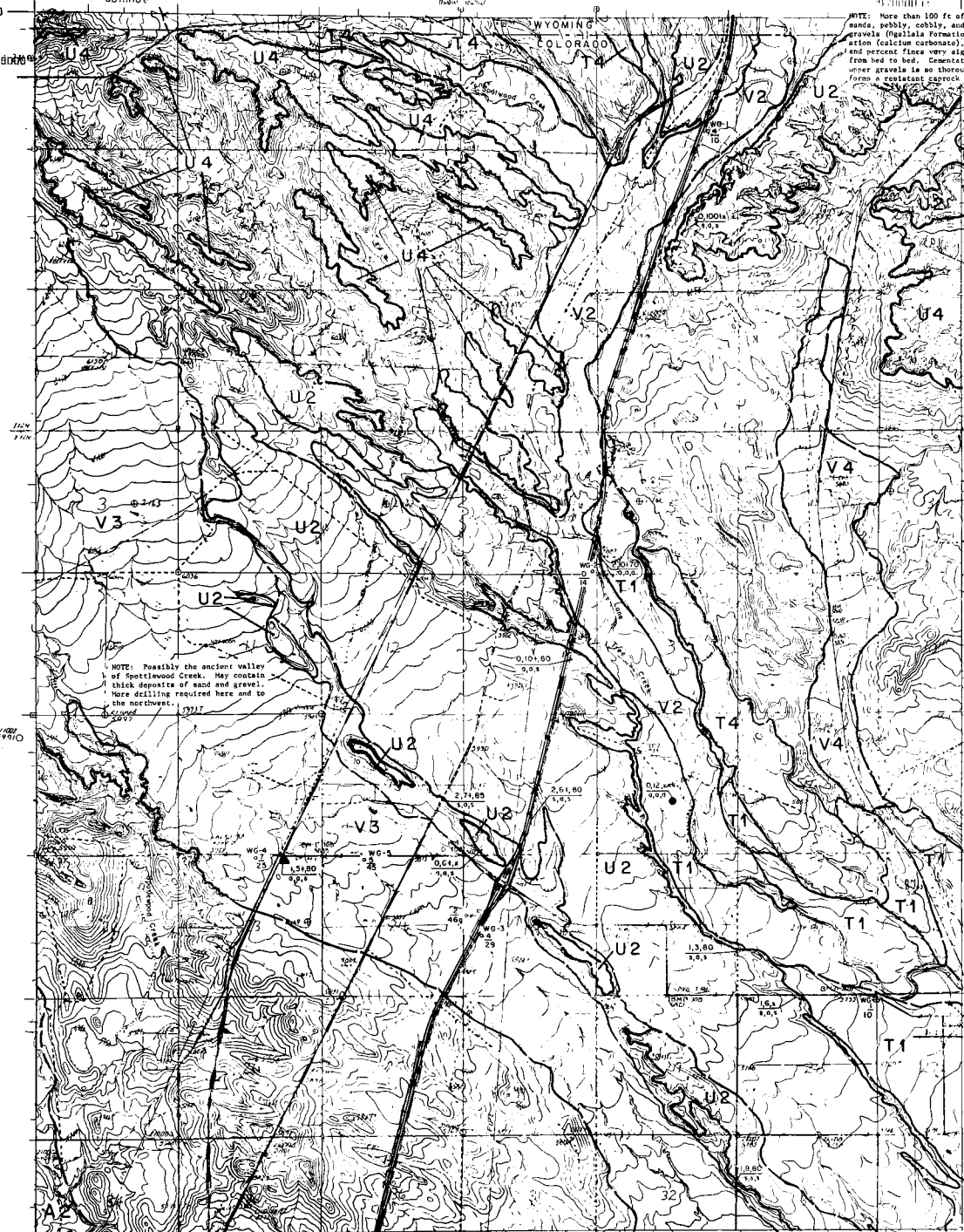
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLD, DIRECTOR

NOTE: More than 100 ft of coarse sand, pebbly, tabby, and bouldery gravels (Fgallala Formation), cementation (calcium carbonate), roundness, and percent fines vary significantly from bed to bed. Cementation in the upper gravels is so thorough that it forms a resistant caprock of conglomerate.

EXPLANATION

- Floodplain deposit
  - Stream terrace deposit
  - Valley fill (F & T)
  - Alluvial deposit
  - Wind-deposited sand (terracel)
  - Non-sand deposits (shale, siltstone, etc.)
- RESOURCE CLASSIFICATION**
- CLASS 1** (100% to 75% sand)
  - CLASS 2** (75% to 50% sand)
  - CLASS 3** (50% to 25% sand)
  - CLASS 4** (25% to 0% sand)
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating quarry
  - Abandoned quarry
  - Potential quarry aggregate resource area
- STATION, LOCATION AND GEOLOGICAL THICKNESS OF SANDS**
- Sand thickness 100 to 200 ft
  - Sand thickness 200 to 300 ft
  - Sand thickness 300 to 400 ft
  - Sand thickness 400 to 500 ft
  - Sand thickness 500 to 600 ft
  - Sand thickness 600 to 700 ft
  - Sand thickness 700 to 800 ft
  - Sand thickness 800 to 900 ft
  - Sand thickness 900 to 1000 ft
  - Sand thickness 1000 to 1100 ft
  - Sand thickness 1100 to 1200 ft
  - Sand thickness 1200 to 1300 ft
  - Sand thickness 1300 to 1400 ft
  - Sand thickness 1400 to 1500 ft
  - Sand thickness 1500 to 1600 ft
  - Sand thickness 1600 to 1700 ft
  - Sand thickness 1700 to 1800 ft
  - Sand thickness 1800 to 1900 ft
  - Sand thickness 1900 to 2000 ft
  - Sand thickness 2000 to 2100 ft
  - Sand thickness 2100 to 2200 ft
  - Sand thickness 2200 to 2300 ft
  - Sand thickness 2300 to 2400 ft
  - Sand thickness 2400 to 2500 ft
  - Sand thickness 2500 to 2600 ft
  - Sand thickness 2600 to 2700 ft
  - Sand thickness 2700 to 2800 ft
  - Sand thickness 2800 to 2900 ft
  - Sand thickness 2900 to 3000 ft
  - Sand thickness 3000 to 3100 ft
  - Sand thickness 3100 to 3200 ft
  - Sand thickness 3200 to 3300 ft
  - Sand thickness 3300 to 3400 ft
  - Sand thickness 3400 to 3500 ft
  - Sand thickness 3500 to 3600 ft
  - Sand thickness 3600 to 3700 ft
  - Sand thickness 3700 to 3800 ft
  - Sand thickness 3800 to 3900 ft
  - Sand thickness 3900 to 4000 ft
  - Sand thickness 4000 to 4100 ft
  - Sand thickness 4100 to 4200 ft
  - Sand thickness 4200 to 4300 ft
  - Sand thickness 4300 to 4400 ft
  - Sand thickness 4400 to 4500 ft
  - Sand thickness 4500 to 4600 ft
  - Sand thickness 4600 to 4700 ft
  - Sand thickness 4700 to 4800 ft
  - Sand thickness 4800 to 4900 ft
  - Sand thickness 4900 to 5000 ft

NOTE: Possibly the ancient valley of Spottedwood Creek. May contain thick deposits of sand and gravel. More drilling required here and to the northwest.



QUADRANGLE	RESOURCES	WELLS	GENERAL
U4	U4	U4	GENERAL
U3	U3	U3	GENERAL
U2	U2	U2	GENERAL
U1	U1	U1	GENERAL
V4	V4	V4	GENERAL
V3	V3	V3	GENERAL
V2	V2	V2	GENERAL
V1	V1	V1	GENERAL
T4	T4	T4	GENERAL
T3	T3	T3	GENERAL
T2	T2	T2	GENERAL
T1	T1	T1	GENERAL

QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Lowy, M.E., and Crist, M.A., 1967, Geology and ground-water resources of Larimer County, Wyoming; U. S. Geol. Survey Water-Supply Paper 1834, pl. 1.

Noore, P.B., 1959, Geographic evolution of the east flank of the Larimer Range, Colorado and Wyoming; Univ. Wyoming Pub. Ph.D. Thesis, pl. 4.

Denson, H.M., 1974, personal communication.  
Weist, H.C., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedwick, and Weld Counties, Colo.; U. S. Geol. Survey Water-Supply Paper 1809-1, pl. 1.

Maped by: Stephen D. Schochow  
Date: June 30, 1974

ROAD CLASSIFICATION  
Primary highway, hard surface  
Secondary highway, hard surface  
Unimproved road  
Interstate Route  
U.S. Route  
State Route

EATON 2NW (04) COLO.

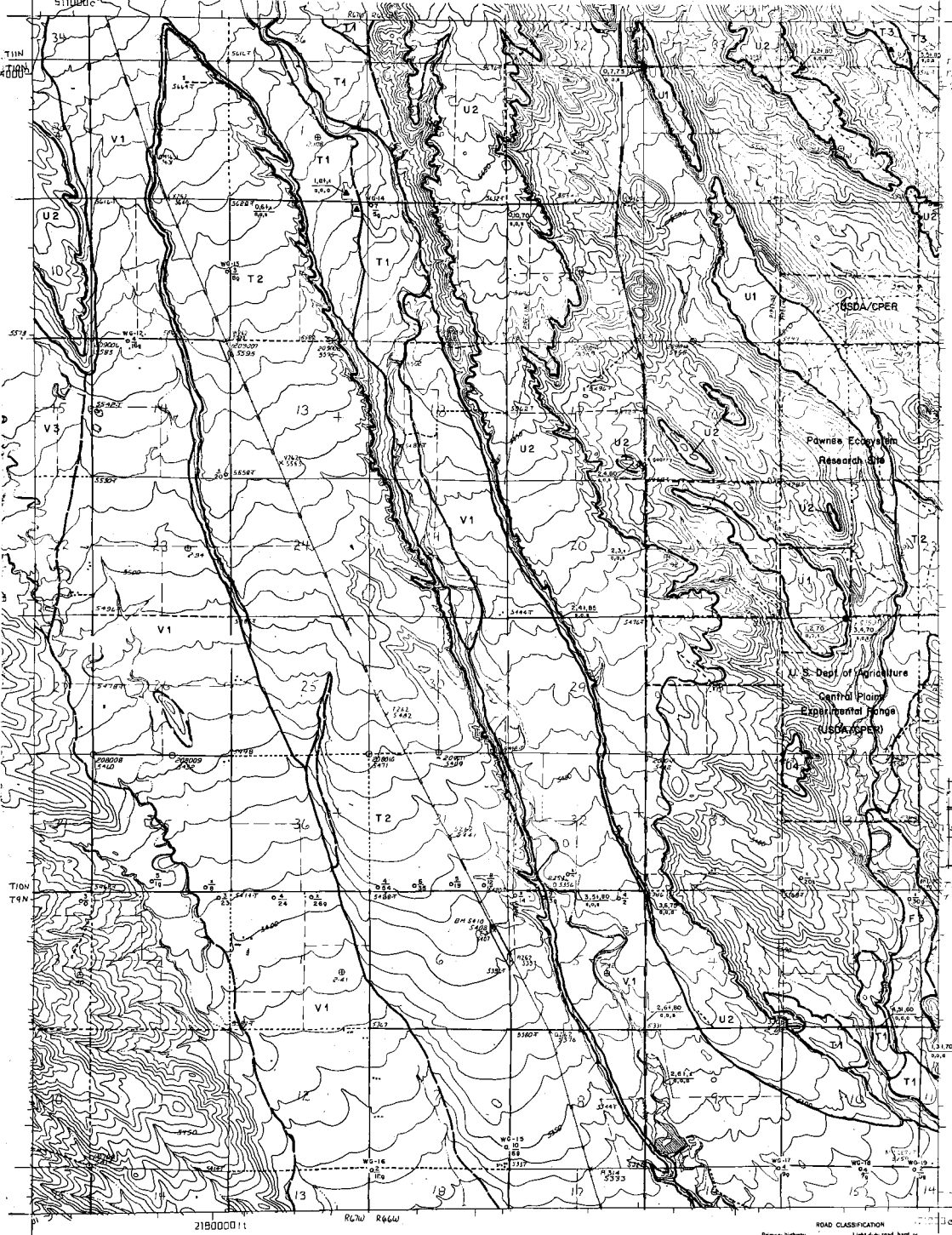
CONTOUR INTERVAL 10 FEET

714,000 ft  
Based from U. S. Geological Survey  
7-1/2 minute quadrangle

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

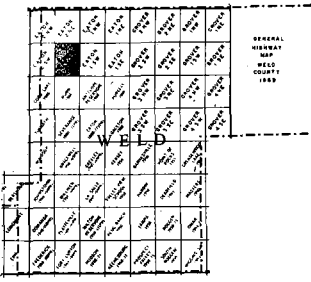
EATON 2 SE

DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HALL, DIRECTOR  
5110BDC



EXPLANATION

- Legend for symbols:
  - Sandstone salt
  - Resource classification
- LEGEND**
  - F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E High-discharge sand (veins)
  - M Man-made deposits (Culverts, ditches, etc.)
- RESOURCE CLASSIFICATION**
  - Gravel Aggregate**
    - (1) Cont. 50% material on 48 screen, visual estimation
    - 1 Gravel: relatively clean and sound
    - 2 Gravel: significant fines, decomposed rock, calcine admixture.
  - Sand Aggregate**
    - (1) Cont. 100% material on 48 screen, 100 retained on 200 screen, visual estimation
    - 3 Sand
    - 4 Probable aggregate resource
- OPERATING QUARRIES**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential gravel aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log.
  - "r" indicates gravel; "s" indicates sand
  - "u" in spatial database unutilized or unknown property
  - "w" denotes Colorado Geological Survey Windbreak and Cover project
  - Still hole
  - Land-use boundary, with where known or observed; dashed where approximate or inferred
- STATION LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
  - overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing 48 screen, 2.00 mm, or 0.075 in.)
  - ft/(ft) amount of fines (passing 100 screen, 0.0075 in. or 0.19 mm)
  - ft/(ft) amount of decomposed or well rock
  - significant amount of calcine admixture (wt-%)
  - in spatial database unutilized or unknown property
  - in spatial database property absent or (outcrop/flout)



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**  
 Hershney, L.A., and Schneider, P.A., Jr., 1972. Geologic map of the Lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map T-687.  
 U.S.D.A. Pawnee Site Ecotypes Research Headquarters, Map.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET

- ROAD CLASSIFICATION**
- Primary highway
  - State highway
  - Secondary highway
  - Local highway
  - Light-duty rdg. hwy
  - Improved surface
  - Unimproved road
  - Interstate Route
  - U.S. Route
  - State Route

EATON 2SE (06) COLO

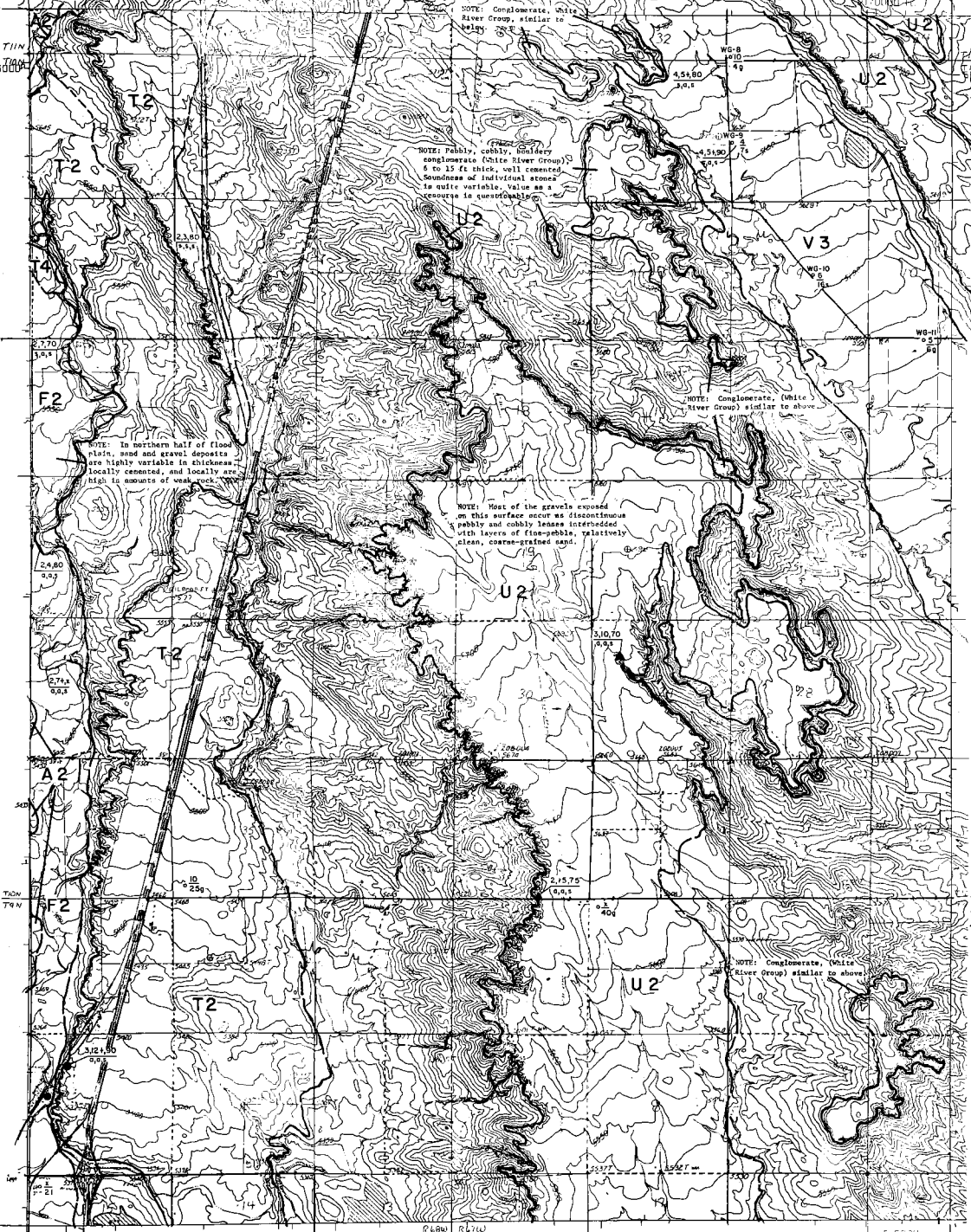
Map by: Stephen D. Schwochow  
Date: June 30, 1974



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

EATON 25W

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



EXPLANATION

- CONTOUR UNIT  
Resource Classification
- LANDFORMS**
- F Floodplain deposit
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M (slag, tailings, spilla...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Fill Deposits**
- 1 "Cover" fill: 75% passing #4 screen, 0% or more on #100 screen, visual estimation
  - 2 Sand
- Overvalued Resource**
- 4 Possible aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or discharge location with overburden thickness (ft) over underlying resource thickness (ft) obtained from well logs
  - "g" indicates gravel; "s" indicates sand
  - "\*" in symbol denotes unvaluated or unknown property
  - "w" denotes Colorado Geological Survey unvaluated and gravel producer's drill hole
  - Landform boundary, with name or elevation (elevation shown approximate or indicated)
- SYMBOL, LOCATION AND GEOLOGICAL DESCRIPTION OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - covered sand and fill (passing #4 screen, 0-25 ft.), visual estimation
  - significant amount of fines (passing #100 screen, 0-200 ft. or 0-100 ft.)
  - significant amount of calcium carbonate (eolian) without property
  - "\*" in symbol denotes property status or Owner/Owner



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Areas of conglomerate outcrop depicted in part from Newberry, L.H., and Schneider, P.J., Jr., 1974, Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-487.

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

ROAD CLASSIFICATION

- Primary highway, hard surface
- Lightly used hard surface
- Secondary highway, hard surface
- Unimproved road
- Interstate Route
- U.S. Route
- State Road

Published by: Colorado Geological Survey  
Base from U. S. Geological Survey  
7 1/2 minute quadrangle

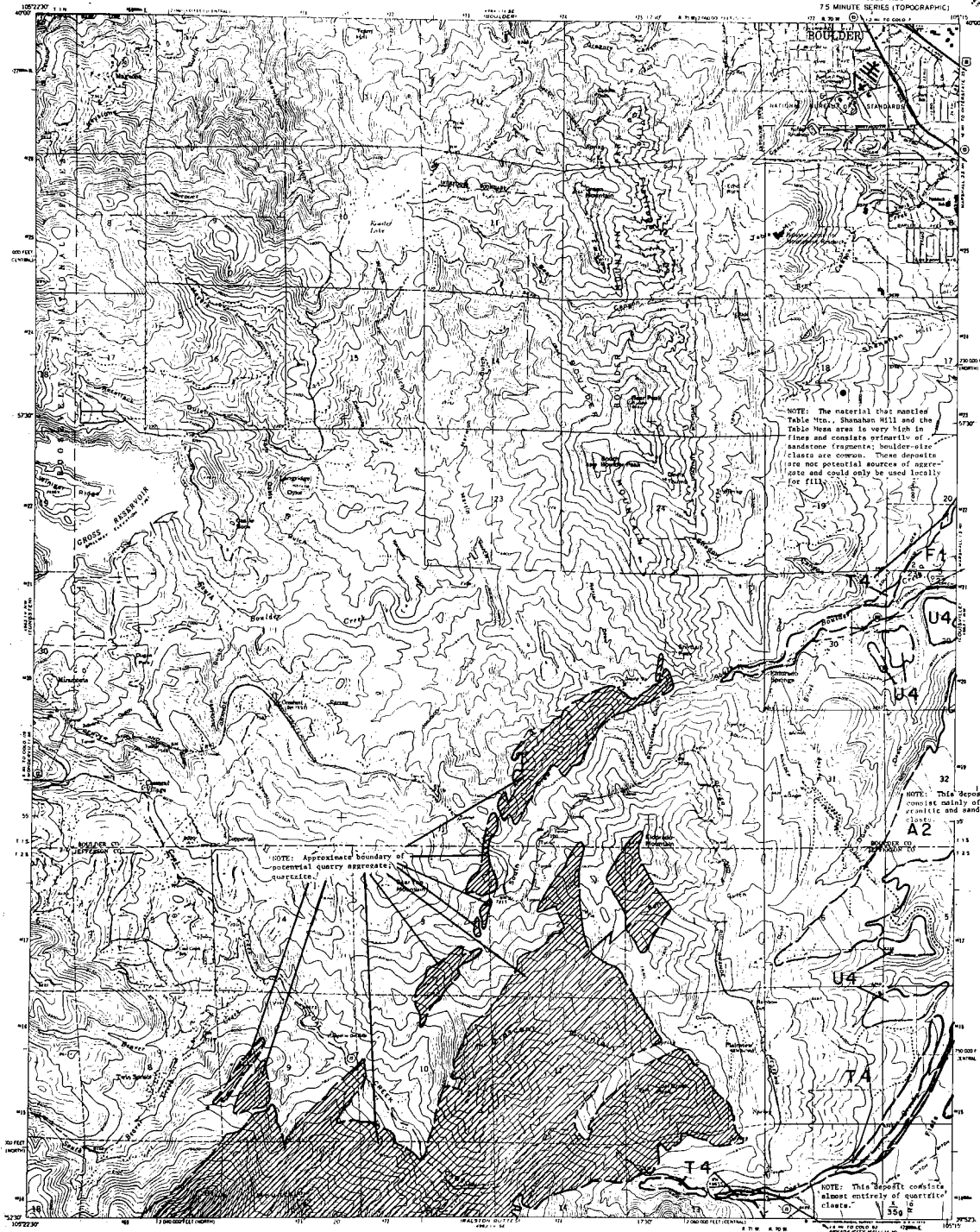
CONTOUR INTERVAL 10 FEET

EATON 25W 1051 COLO

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

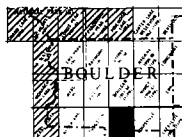
ELDORADO SPRINGS QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
7 1/2 MIN. (30 x 30)

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



## EXPLANATION

- CONTOUR INTERVAL**  
— Contour interval, 40 feet
- LANDFORMS**  
F Floodplain deposit  
T Terrace terrace deposit  
V Valley fill (F & T)  
U Upland deposits  
A Alluvial fan  
E Non-deposited sand (alluvial)  
M Man-made deposits (dams, railings, spurs, etc.)
- AGGREGATE CLASSIFICATION**  
**GRAVEL AGGREGATE**  
(See legend for description of aggregate types)  
1 Gravel: relatively clean and sound  
2 Gravel: significant fines, accompanied sand, calcareous carbonate  
**FINE AGGREGATE**  
3 Sand  
4 Probable aggregate resource
- QUARRY TYPES**  
\* Operating gravel and/or sand pit  
\* Abandoned gravel and/or sand pit  
\* Operating stone quarry  
\* Abandoned stone quarry  
\* Potential quarry aggregate resource area  
\* Material well or well-site location with maximum thickness (ft), maximum from well top.  
\* "X" indicates gravel "X" indicates sand "X" in symbol denotes unclassified or unknown property.  
\* "M" denotes Colorado Geological Survey Material and Gravel projects.  
\* Landform boundary, solid where known or inferred, dashed where approximate or inferred.
- RELATION, LOCATION AND ORIENTATIONAL INFORMATION**  
\* Contour interval (ft)  
\* Aggregate resource thickness (ft)  
\* Gravel and fines (gravel & fines, 0.075 in. to 0.25 in.), overall collection  
\* Significant amount of fines (gravel 0.075 in. to 0.075 in.)  
\* Significant amount of decomposed or weak rock  
\* Significant amount of calcareous sandstone (inches)  
\* "X" in symbol denotes unclassified or unknown property  
\* "M" in symbol denotes property absent or unclassified



■ QUADRANGLE LOCATION  
▨ NON-RESERVE OR WITHDRAWN AREA

**REFERENCES:**  
Cham, C.E., and McGonaghy, J.A., 1972, Generalized surficial geologic map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-721.  
Trumble, D.E., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range-South Colorado, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map 1-756-A.  
Geology modified after:  
Wells, J.D., 1965, Preliminary Geologic Map of the Eldorado Springs Quadrangle, Boulder and Jefferson Counties, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-383.  
Geology modified after:  
Carruth, M.E., 1969, Preliminary report on the engineering geology of the Eldorado Springs Quadrangle, Boulder and Jefferson Counties, Colorado: U. S. Geol. Survey Open-File Report.

Base from U. S. Geological Survey 7 1/2 minute quadrangle

Scale: 1 inch = 1 mile

CONTOUR INTERVAL, 40 FEET  
Scale in miles, 0 to 10

Map made by: \_\_\_\_\_  
Checked by: \_\_\_\_\_  
U.S. Route      State Route

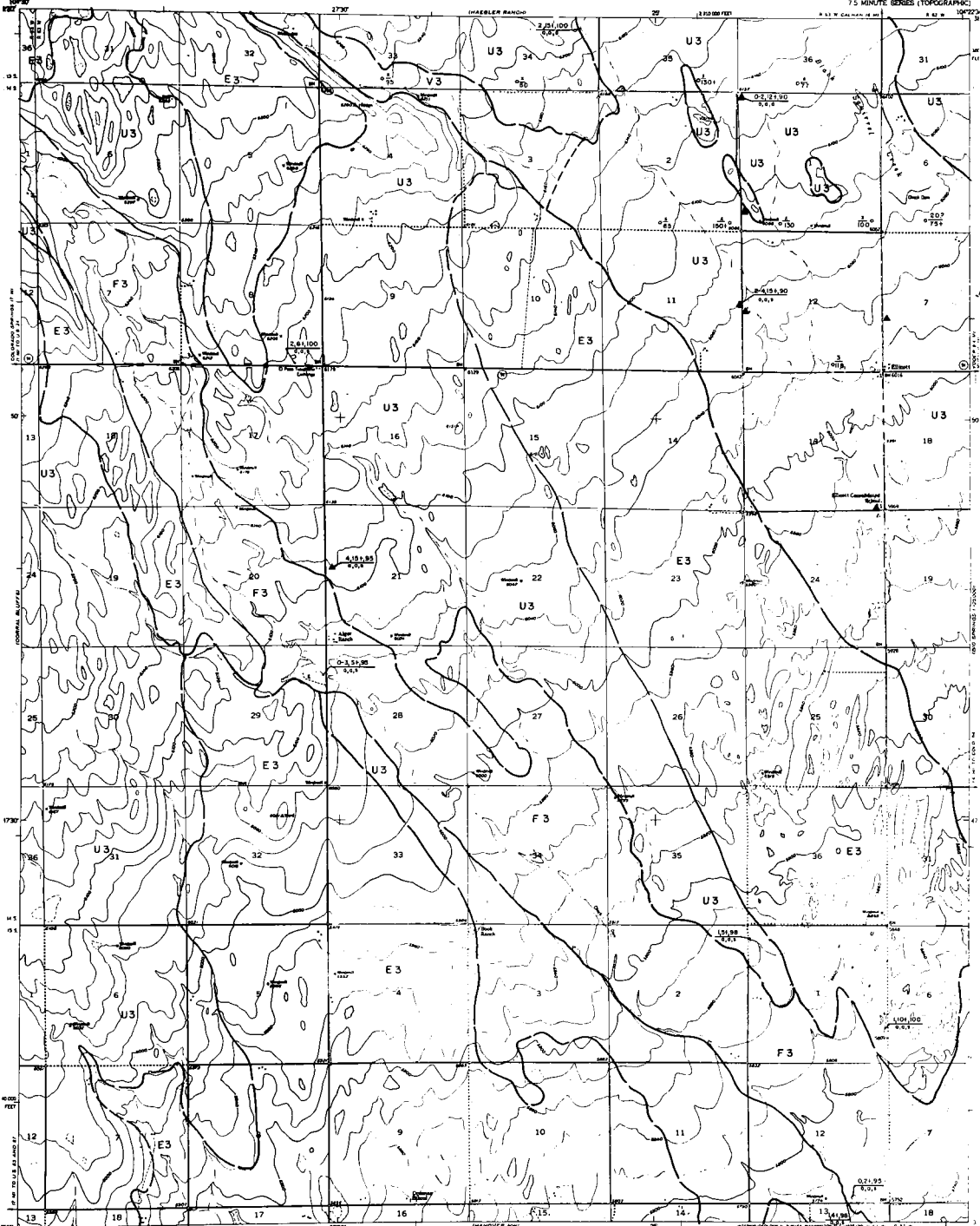
ELDORADO SPRINGS, COLO.

THE BUREAU OF TOPOGRAPHIC SURVEY  
DEPARTMENT OF THE ARMY

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

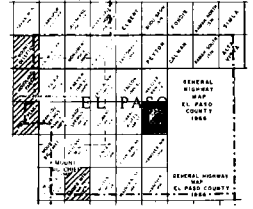
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. FROD, DIRECTOR

ELLIOTT QUADRANGLE  
COLORADO-3, PARD CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
1:50,000



## EXPLANATION

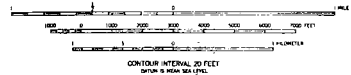
- Landform units**  
Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Area terrace deposit
  - V Valley fill (V & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-swept sand (colluvial)
  - M Non-mine deposits (clay, shales, etc.)
- RESOURCE CLASSIFICATION**
- CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
  - 3 Sand: greater than 75 percent #4 screen, 60% retained on #20 screen, usual application
  - 4 Fractionated materials
  - 5 Probable aggregate reserves
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Revised well or drill-hole location with elevation (feet), obtained from well logs
  - "E" indicates gravel; "S" indicates sand
  - "U" in symbol denotes unconsolidated or unknown property
  - "M" denotes Colorado Geological Survey Water/Load and Crustal Projects drill hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- SYMBOL, LOCATION AND ORIENTATIONAL INFORMATION OF SYMBOLS**
- Symbol: resource thickness (ft)
  - Symbol: amount of fines (percent)
  - Symbol: amount of decomposed or weak rock
  - Symbol: amount of calcium carbonate (percent)
  - "U" in symbol denotes unconsolidated or unknown property
  - "M" in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwochow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



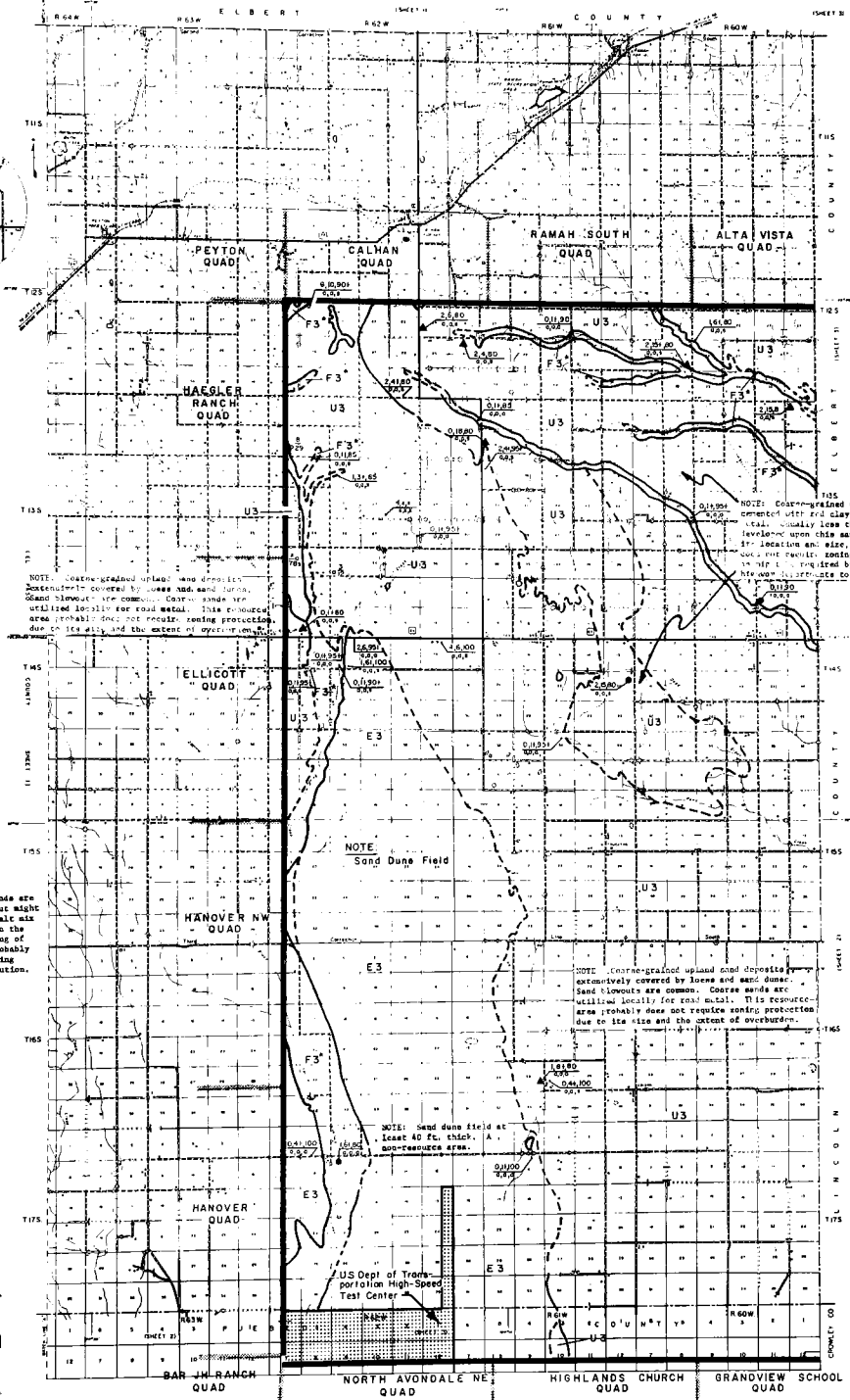
**ROAD CLASSIFICATION**

- Main Road
- Minor Road
- Light Road
- Unimproved road
- U.S. Route
- State Route

ELLIOTT, COLO.

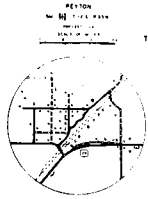


SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP



EXPLANATION

- SYMBOLS**
- Flowline deposit
  - Stream terrace deposit
  - Valley fill (F & T)
  - Upland deposits
  - Alluvial fan
  - Wind-deposited sand (eolian)
  - Non-resource deposits (slag, tailings, spolia, etc.)
- RESOURCE CLASSIFICATION**
- Unassessable resource
  - Probable aggregate resource
- NOTES**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Relative stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drillhole location with associated lithologic logs (see log and/or resource estimates file) obtained from well logs
  - "I" indicates granite; "S" indicates sand
  - "I" in symbol denotes unoperated or unknown structure
  - Whereas Colorado Geological Survey has determined the location of the well or drill hole
  - Location boundaries, solid where known or inferred, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
- Reference to the map file:  
 Station number: 100-100000-100000  
 Location: 100-100000-100000  
 Description: 100-100000-100000
- Important notes of this map:  
 1. This map is not a legal document.  
 2. It is not intended to be used as a basis for any legal action.  
 3. It is not intended to be used as a basis for any legal action.



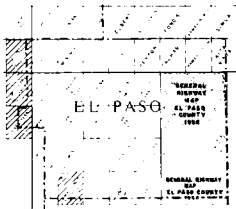
NOTE: Clean coarse sands are not utilized locally but might be a source of asphalt mix for some local roads in the future. Reassessment of the flood plains is probably not necessary considering their size and distribution.

NOTE: Coarse-grained upland sand deposits extensively covered by loess and sand dunes. Sand blowouts are common. Coarse sands are utilized locally for road metal. This resource area probably does not require zoning protection due to its size and the extent of overburden.

NOTE: Coarse-grained upland sand deposits extensively covered by loess and clay. An excellent road metal. Usually less than 2% of soil is available upon this sand with a "blow" of 10-15 lbs. per cubic foot. This sand is not normally used for road metal zoning protection except in the case of construction projects to maintain aggregate pits.

NOTE: Sand dune field at least 40 ft. thick. A non-resource area.

NOTE: Coarse-grained upland sand deposits extensively covered by loess and sand dunes. Sand blowouts are common. Coarse sands are utilized locally for road metal. This resource area probably does not require zoning protection due to its size and the extent of overburden.



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

GENERAL LEGEND

Symbol	Description
[Symbol]	Flowline deposit
[Symbol]	Stream terrace deposit
[Symbol]	Valley fill (F & T)
[Symbol]	Upland deposits
[Symbol]	Alluvial fan
[Symbol]	Wind-deposited sand (eolian)
[Symbol]	Non-resource deposits (slag, tailings, spolia, etc.)
[Symbol]	Unassessable resource
[Symbol]	Probable aggregate resource
[Symbol]	Operating gravel and/or sand pit
[Symbol]	Abandoned gravel and/or sand pit
[Symbol]	Relative stone quarry
[Symbol]	Abandoned stone quarry
[Symbol]	Potential quarry aggregate resource area
[Symbol]	Selected well or drillhole location with associated lithologic logs (see log and/or resource estimates file) obtained from well logs
[Symbol]	"I" indicates granite; "S" indicates sand
[Symbol]	"I" in symbol denotes unoperated or unknown structure
[Symbol]	Whereas Colorado Geological Survey has determined the location of the well or drill hole
[Symbol]	Location boundaries, solid where known or inferred, dashed where approximate or inferred

GENERAL HIGHWAY MAP  
 EL PASO COUNTY  
 COLORADO

PREPARED BY THE  
 STATE DEPARTMENT OF HIGHWAYS  
 DIVISION OF HIGHWAYS-STATE OF COLORADO  
 PLANNING AND RESEARCH DIVISION

U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION

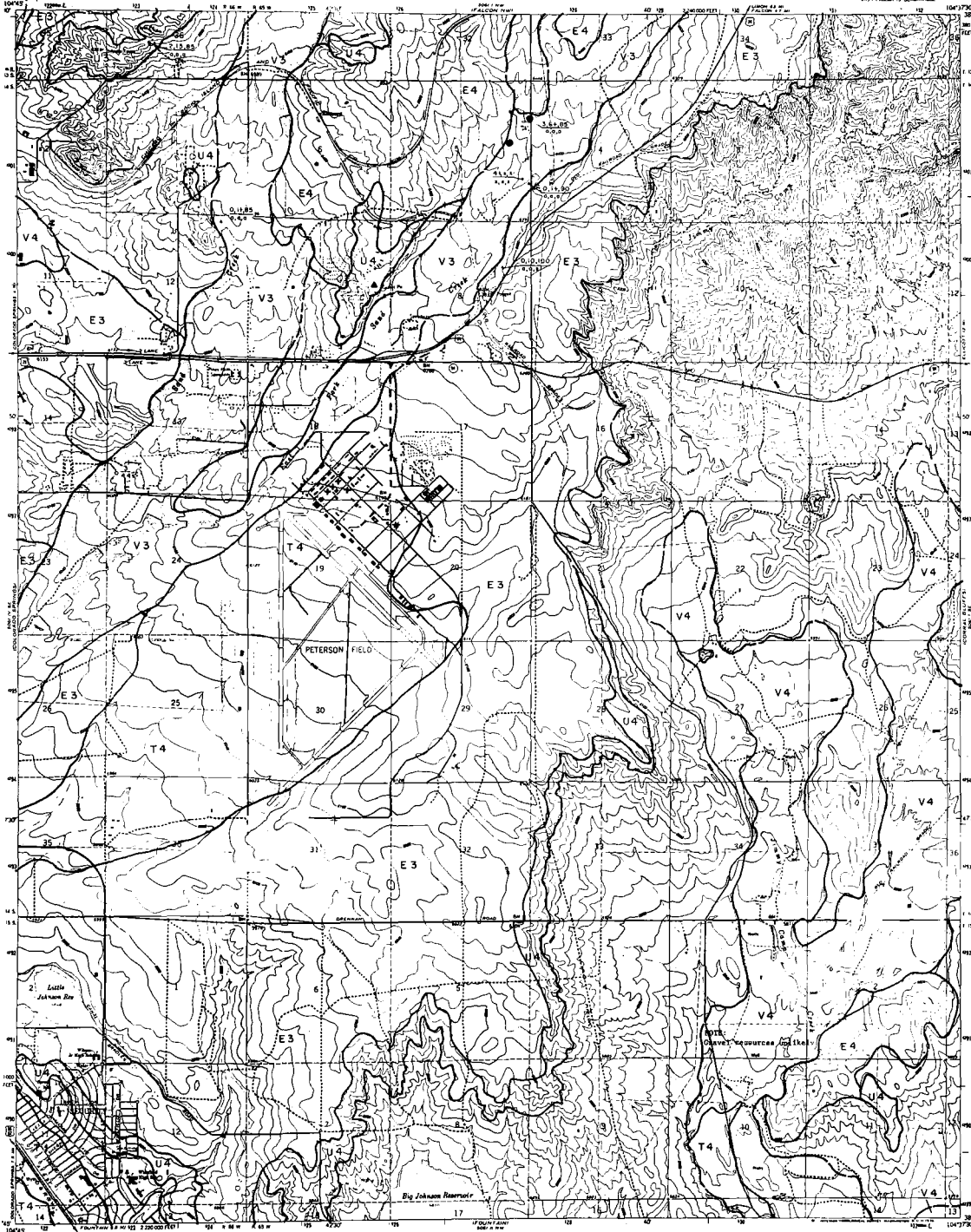
Mapped by: Phillip C. Wicklett  
 Date: June 30, 1974

SCALE OF MILES  
 1956

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

ELSMERE QUADRANGLE  
COLORADO - EL PASO CO.  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)  
80° 1' ALONG 13 QUADRANGLE

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



EXPLANATION

Contour unit  
Resource classification

- LANDFORM UNIT**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Man-made deposits (dike, talus, spill, ...)

**RESOURCE CLASSIFICATION**

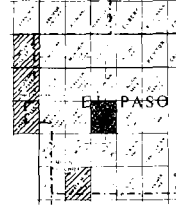
- Gravel resources**  
(at least 300 feet<sup>2</sup> on 44 acres, 1000 feet<sup>2</sup> minimum)
- 1 Gravel: relatively clean and smooth
  - 2 Gravel: significant fines, decomposed rock, surface talusstone
- Stone resources**  
(greater than 750 pounds ft screen, 60% retained on 420 screen, 141 net weight)
- 3 Sand
  - 4 Probable aggregate resource

**MAP SYMBOLS**

- Operated gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Existing stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected well or drill-hole location with measured thickness (100 feet and less) and gravel resource
- Selected well or drill-hole location with measured thickness (100 feet and less) and gravel resource
- "x" indicates gravel, "s" indicates sand
- "x" in symbol denotes unclassified or unknown prospect
- "m" denotes Colorado Geological Survey "Milestone and Core" project
- Well hole
- Landform boundary, solid when known or dashed when approximate or inferred

**STATION, LOCATION AND LITHOLOGICAL CHARACTERIZATION OF BOREHOLE**

- Overburden thickness (ft)
- Sand/gravel resource thickness (ft)
- Gravel and fines spacing (ft screen, 0.25 in., 100 mesh)
- Significant amount of fines (spacing 100 screen, 0.25 in. or 100 mesh)
- Significant amount of decomposed or weak rock
- Significant amount of talus or carbonate facies
- "x" in symbol denotes unclassified or unknown prospect
- "m" in symbol denotes property owned or leased



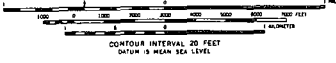
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WETLAND AREA

Geology modified after Scott, G.R., & Uebus, R.A., 1973, Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map, MW-482.

**REFERENCES**  
Tribble, D.E., and Petch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregates in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map E-857 A.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 20 FEET  
Datum is Mean Sea Level

- ROAD CLASSIFICATION**
- Heavy duty
  - Medium duty
  - Light duty
  - Unimproved dirt
  - U.S. Route
  - State Route

ELSMERE, COLO.



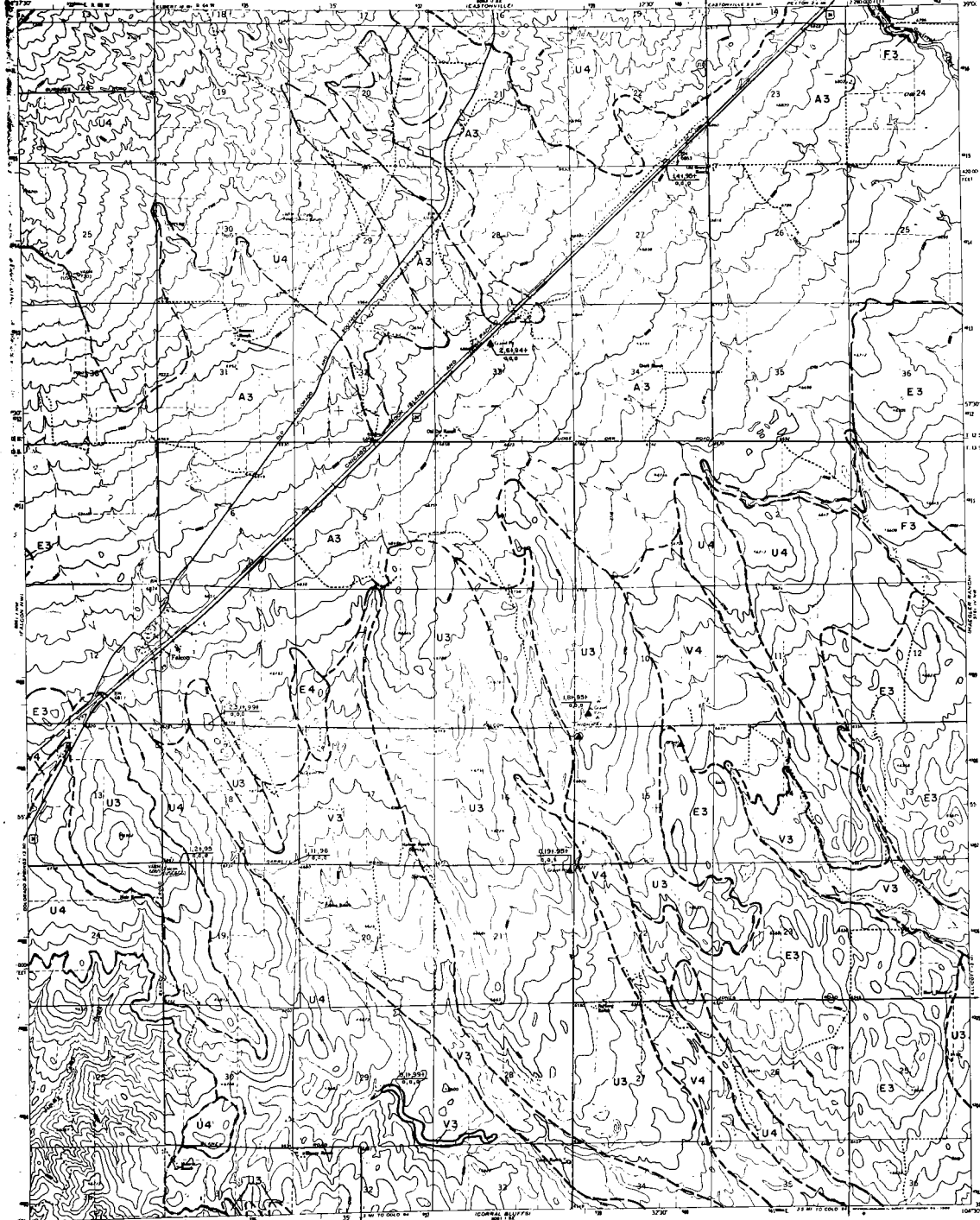




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

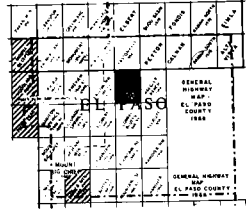
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLLA, DIRECTOR

FALCON QUADRANGLE  
COLORADO—EL PASO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
1:25,000 SCALE QUADRANGLE



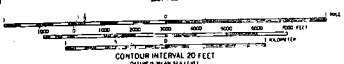
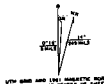
## EXPLANATION

- Resource Classification**
- F Fluvial deposit
  - V Stream terrace deposit
  - U Valley fill (F & V)
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Residual deposits (shales, limestones, etc.)
- AGGREGATE CLASSIFICATION**
- Gravel Deposits**  
(at least 50% retained on #4 screen, 100% on #100 screen)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous
- Sand Deposits**  
(greater than 75% passing #4 screen, 50% retained on #100 screen, natural sediment)
- 3 Sand
- Residual Resources**
- 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with screen thickness (ft), gravel and/or sand percent thickness (ft), obtained from well log
  - "\*" indicates gravel, "s" indicates sand
  - "\*" in symbol denotes unconsolidated or unknown provenance
  - "\*\*" denotes Colorado Geological Survey Well Log and Gravel projects
  - Well
  - Landform boundary, solid where known or observed, dashed where approximation or inferred
- STATION, LOCATION AND GEOLOGICAL INFORMATION SYMBOLS**
- nonuniform thickness (ft)
  - non/gravel resource thickness (ft)
  - percent sand and fines (percent of gravel, 0-100%), direct estimation
  - significant amount of fines (passing 100 mesh, 2.500 in. or 0.075 mm.)
  - significant amount of decomposed or weak rock
  - significant amount of soluble carbonate (calcite)
  - "\*" in symbol denotes unconsolidated or unknown provenance
  - "\*" in symbol denotes properly absent or insignificant



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Heavy duty ——— Light duty ———

Unimproved dirt - - - - -

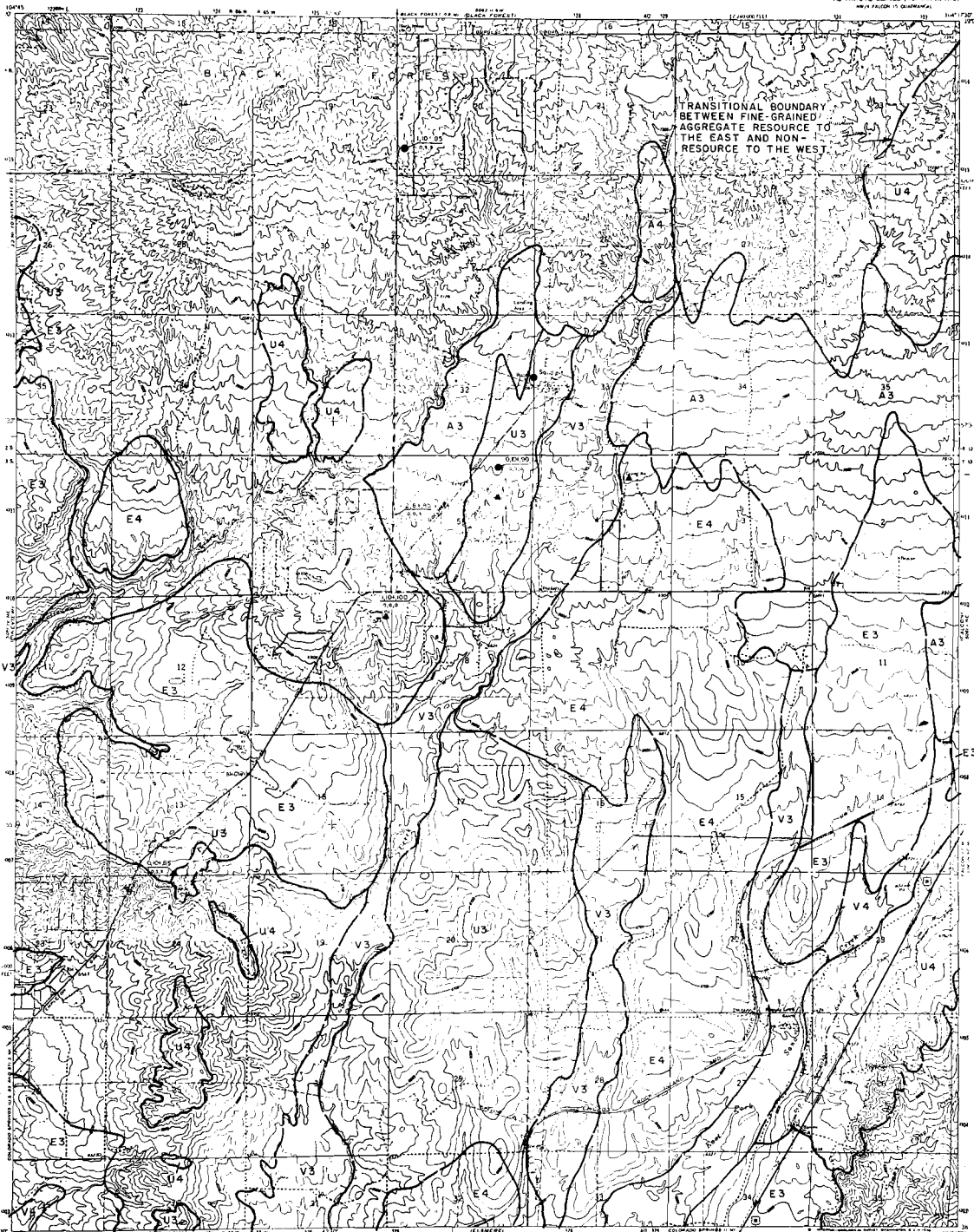
U.S. Route ——— State Route ———

FALCON, COLO.

Mapped by: Ralph E. Shroba  
Date: June 30, 1974

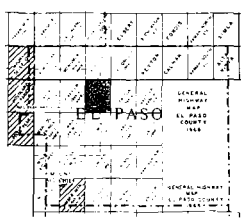
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

FALCON NW QUADRANGLE  
 COLORADO EL PASO CO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)  
 WITH FALCON 15 QUADRANGLE



EXPLANATION

- Landform unit  
 Resource classification
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Trough terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - W Wind-deposited sand (eolian)
  - M Mountain deposits (ice, talus, debris, etc.)
- AGGREGATE CLASSIFICATION**
  - 1 Coarse aggregate (at least 25% retained on 48 screen, actual percentage)
  - 2 Gravel: relatively clean and sound
  - 3 Gravel: significant fines, decomposed rock, certain percentages
  - 4 Fine aggregate (produced by crushing of gravel, 47% retained on 48 screen, actual percentage)
  - 5 Sand
  - 6 Unavailable resource
  - 7 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Quarry well or drift hole location with upper horizon thickness (ft) over sand/gravel resource thickness (ft) indicated from well logs
  - "L" indicates gravel; "S" indicates sand
  - "U" symbol denotes unavailable or unknown properties
  - "W" denotes Colorado Geological Survey (reworked and gravel projects) drill hole
  - Location boundary, well where known or inferred (actual where appropriate or inferred)
- STATION, LOCATION AND GEOLOGICAL IDENTIFICATION OF BOREHOLE**
  - Horizontal thickness (ft)
  - Hand-drawn reference thickness (ft)
  - Vertical axis and line indicate the horizon, (ft) interval of 100 ft
  - Significant amount of fines (greater than 20% on 48 or 60 screen)
  - Significant amount of decomposed or weak rock
  - "U" symbol denotes unavailable or unknown property
  - "W" symbol denotes property absent or unexplored



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, G.R., & Mabus, R. A. 1973, Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map, 1:50,000.

REFERENCE:  
 Tribble, D.E., and Petch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-537 A.

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7.5-minute quadrangle



- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved dirt
  - U.S. Route

FALCON NW, COLO.







SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

FORT LOGAN QUADRANGLE  
 COLORADO  
 MINUTE SERIES (TOPOGRAPHIC)

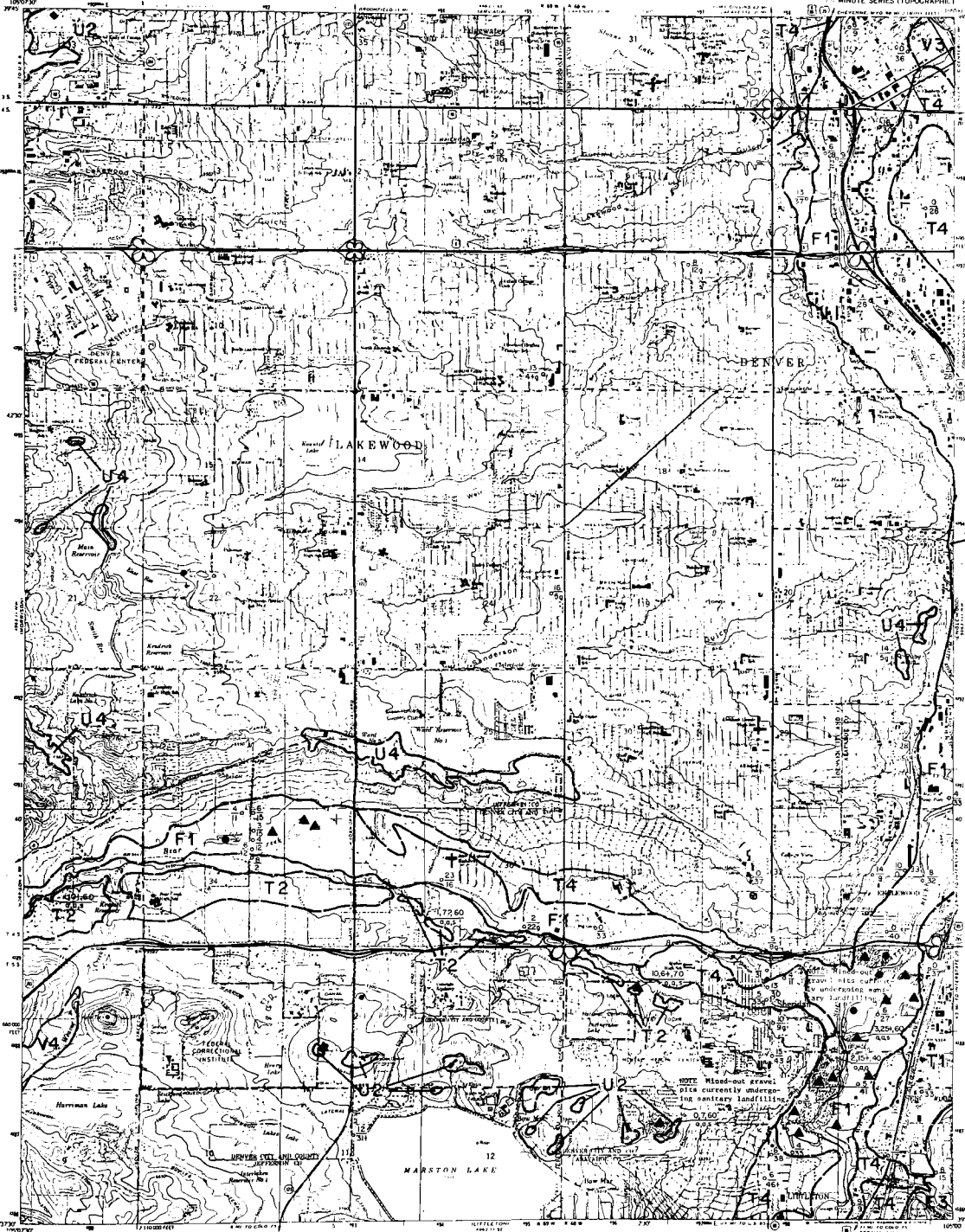
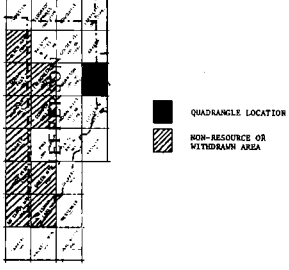
EXPLANATION

- LITHOLOGY**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposit
  - A Alluvial fan
  - E Non-ventilated sand (estuary)
  - M Non-sand deposits (shales, limestones, etc.)

- RESOURCE CLASSIFICATION**
- Gravel*
- 1 Gravel: relatively clean and sound
  - 2 Gravel: argillaceous fines, decomposed rock, calcareous carbonate
- Sand*
- 3 Sand
  - 4 Probable aggregate resource

- MAP SYMBOLS**
- A Operating gravel and/or sand pit
  - AB Abandoned gravel and/or sand pit
  - OS Operating stone quarry
  - AS Abandoned stone quarry
  - PA Potential quarry aggregate resource area
  - W Selected well or drill-hole location with owner's name (if over 100 feet) or name of contractor (if obtained from well log)
  - "s" indicates gravel; "m" indicates sand
  - "\*" in symbol denotes unutilized or unknown storage
  - "G" denotes Colorado Geological Survey ground water and gravel project
  - Landform boundary, solid where known or observed, dashed where approximate or inferred

- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
1. Station number (if available)
2. Location (e.g., 0.218 mi. or 0.274 mi.)
3. Description of deposit (e.g., gravel, sand, etc.)
4. Significant amount of fines (less than 100 mesh, 0.075 mm. or 0.075 mm.)
5. Significant amount of decomposed or weak rock
6. Significant amount of medium to coarse material
7. "s" in symbol denotes unutilized or unknown storage
8. "m" in symbol denotes probable sand or calcareous



base from U. S. Geological Survey 7-1/2 minute quadrangle

ROAD CLASSIFICATION

- Heavy duty
- Light duty
- Medium-duty
- Unimproved dirt
- Interstate Route
- U.S. Route
- State Route

VERTICAL INTERVAL 10 FEET (GRADE IN FEET ON LEVEL)

Scale: 1 inch = 1 mile

Fort Logan, Colo.

Geology modified after Hunt, C.B., 1954, Pleistocene Recent deposits in the Denver area, Colorado; U.S. Geol. Survey Bull. 990-c, pl. 3.

References:  
 Inter-County Regional Planning Commission, 1961, Drainage course plan for the Denver region - Part 1, Sand and gravel resources; Denver Colo., Inter-County Reg. Plan. Comm., pl. 1.  
 Hamilton, J.L., and Omma, W.C., 1972, Geologic aspects, soils and related geomorphic problems, Denver metropolitan area, Colorado; Colorado Geol. Survey Environmental Geology Rept. 1, pl. 1.  
 Chase, C.B., and McCaughey, J.A., 1972, Generalized surficial geologic map of the Denver area, Colorado; U.S. Geol. Survey Misc. Geol. Inv. Map T-731.  
 Trimble, D.E., and Fitch, 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map T-836-A.

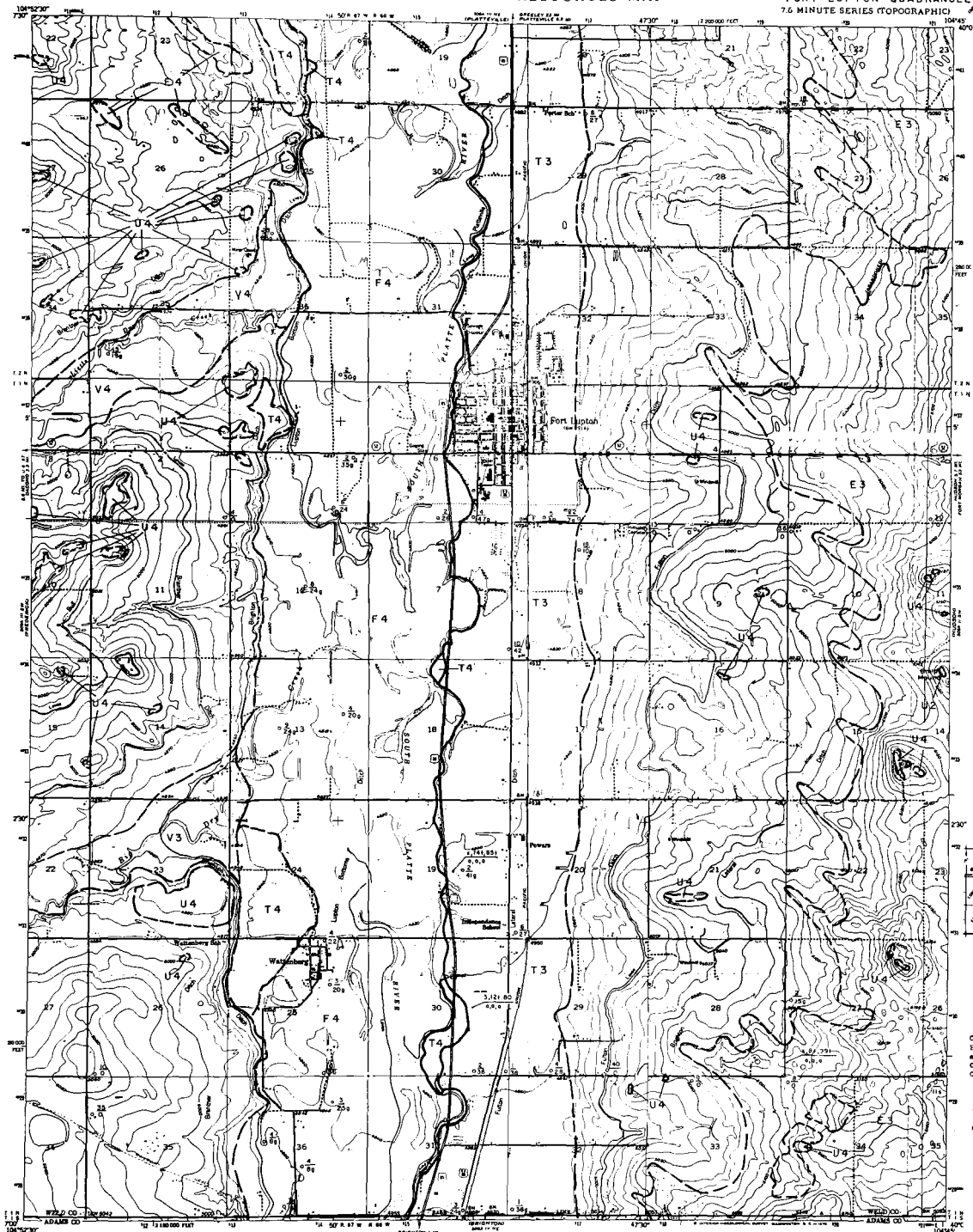
Mapped by: Stephen D. Schwachow  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

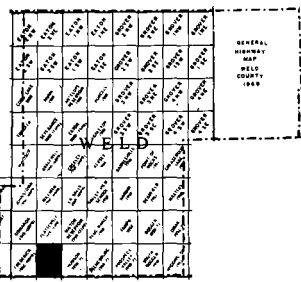
FORT LUPTON QUADRANGLE  
7.6 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Topographic Units**  
 - Contour lines  
 - Stream course deposit  
 - Valley fill (U & T)  
 - Alluvial fan  
 - Wind-deposited sand (initial)  
 - Non-made deposits (slag, tailings, spalls, etc.)
- RESOURCE CLASSIFICATION**
- GROUP 1: GRAVEL**  
 1. Gravel: Well-sorted, clean and round  
 2. Gravel: Significant fines, decomposed rock, calcium carbonate
- GROUP 2: SAND**  
 3. Sand  
 4. Unevaluated Resource  
 5. Probable aggregate resource
- QUARRY TYPES**  
 - Operating gravel and/or sand pit  
 - Abandoned gravel and/or sand pit  
 - Abandoned stone quarry  
 - Potential quarry aggregate resource area  
 - Selected well or drill-hole location with overburden thickness (ft) above sand/gravel resource  
 - Distance (ft) obtained from well logs  
 - "C" indicates gravel, "S" indicates sand  
 - "U" in symbol denotes unevaluated or unknown property  
 - "M" denotes Colorado Geological Survey Window/Field and Gravel products  
 - "G" in symbol denotes property absent or interrupted  
 - Landform boundary, solid where known or inferred  
 - Shaded where appropriate or inferred
- NOTATION, LOCATION AND GEOLOGICAL DESCRIPTION OF SYMBOL**
- overburden thickness (ft)  
 - sand/gravel resource thickness (ft)  
 - gravel and fines (spacing 80 percent and finer (spacing 60 percent, 0.75 in.), visual estimation)  
 - Significant amount of fines (spacing 80 percent, 0.250 in. or 0.075 mm.)  
 - Significant amount of decomposed or soft rock  
 - Significant amount of calcareous materials  
 - "U" in symbol denotes unevaluated or unknown property  
 - "M" in symbol denotes property absent or interrupted



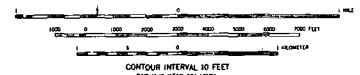
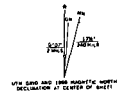
■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WYLDHORN AREA

Geology modified after:  
 Colton, R.B., and Fitch,  
 U.S., 1974, Map showing potential sources of gravel  
 and crushed-rock aggregate in the Boulder-Fort  
 Collins-Greeley Area, Front Range Urban Corridor,  
 Colorado: U. S. Geol. Survey Map T-355 D.

Soister, P. E.,  
 1965, U. S. Geological Survey Geological  
 Quadrangle Top. CG-397.

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974  
 Prepared in cooperation with the  
 U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



ROAD CLASSIFICATION  
 Heavy-duty ——— Light-duty ———  
 Medium-duty ——— Unimproved dirt ———  
 □ U.S. Route ○ State Route

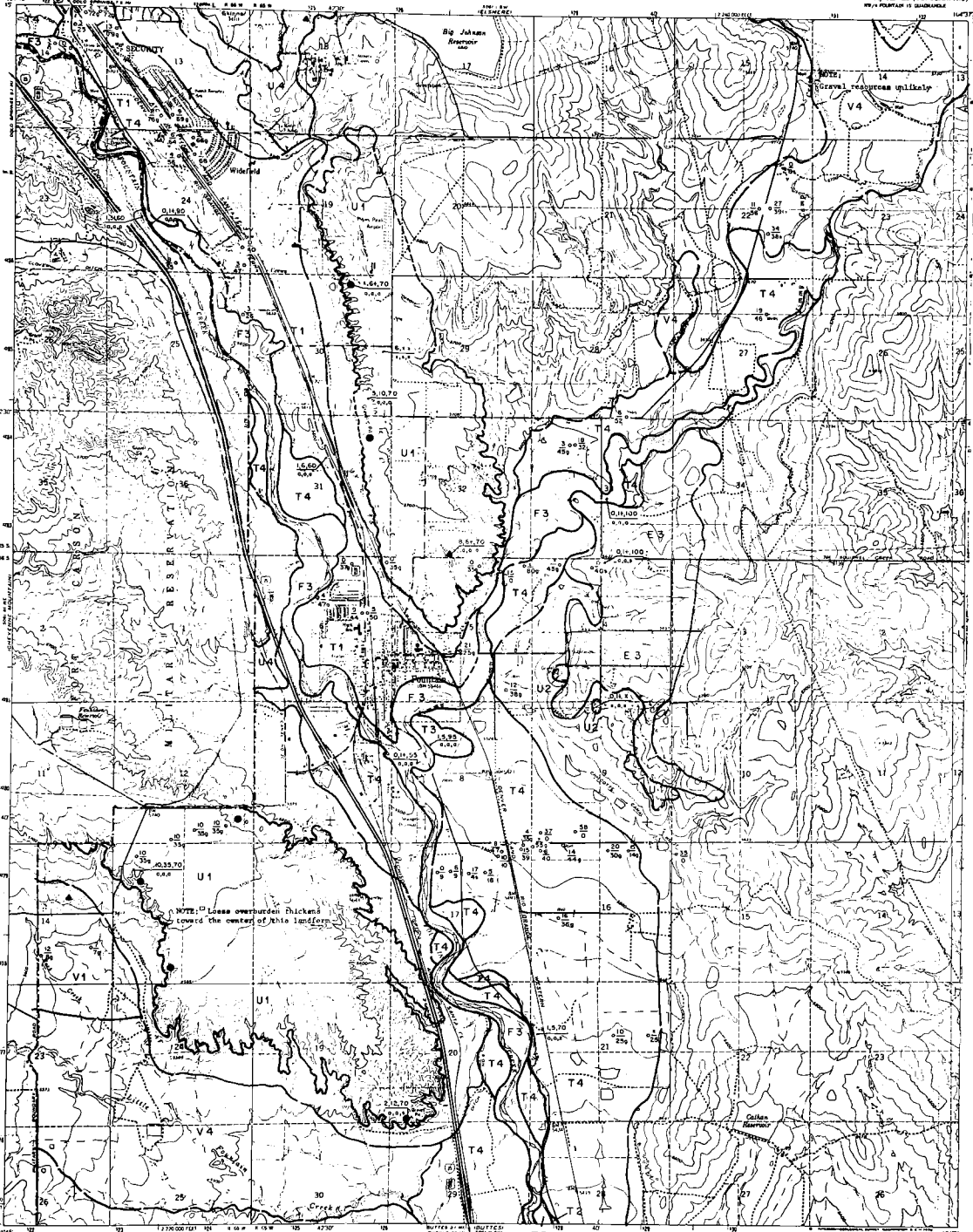
CONTOUR INTERVAL 10 FEET  
 (BASED ON MEAN SEA LEVEL)

FORT LUPTON, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

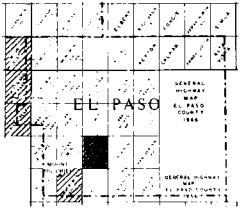
FOUNTAIN QUADRANGLE  
COLORADO-EL PASO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
MAY PLANTING IS QUADRANGLE

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



EXPLANATION

- Location Unit**  
Resource classification
- RESOURCE TYPE**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unfilled deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-sand deposits (slag, tailings, waste, ...)
- RESOURCE CLASSIFICATION**
- GRADE QUALITY**  
(for sand 50 percent or 80 percent, gravel 100 percent)
- 1 Gravel: relatively clean and smooth
  - 2 Gravel: significant fines, unrounded rock, latent carbonates
  - 3 Sand
  - 4 **Unutilized Resource**
  - 5 **Available aggregate resource**
- USE STATUS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft), sand/gravel resource thickness (ft), obtained from well logs
  - Well location symbol: "L" indicates sand; "G" indicates gravel; "U" indicates unutilized or unknown property
  - "M" denotes Colorado Geological Survey "Wider/Lead and Crustal projects" drill hole
  - Landform boundary, wild chase, house or structure, shaded where appropriate or inferred
- STATION, LOCATION AND GEOLOGICAL SIGNIFICANCE OF DEPOSIT**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing #4 screen, 0.075 in.), gravel percentage (%)
  - significant amount of fines (passing #40 screen, 0.0075 in., or 0.075 mm.)
  - significant amount of decomposed or soft mud
  - significant amount of calcium carbonate (carbonate)
  - "U" in symbol denotes unutilized or unknown property
  - "M" in symbol denotes property absent or unapplied



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WET/DRAIN AREA

Geology modified after Scott, G.R., & Hubbs, R.A. 1973. Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map, MP-482.

Triebel, D.E., and Finch, H.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-857 A.

Mapped by: Phillip C. Wickliffe  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



CONTOUR INTERVAL 20 FEET  
ELEVATION IN FEET MEAN SEA LEVEL

- ROAD CLASSIFICATION**
- Heavy-duty
  - Light-duty
  - Medium-duty
  - Unimproved dirt
  - Interstate Route
  - U.S. Route

FOUNTAIN, COLO.

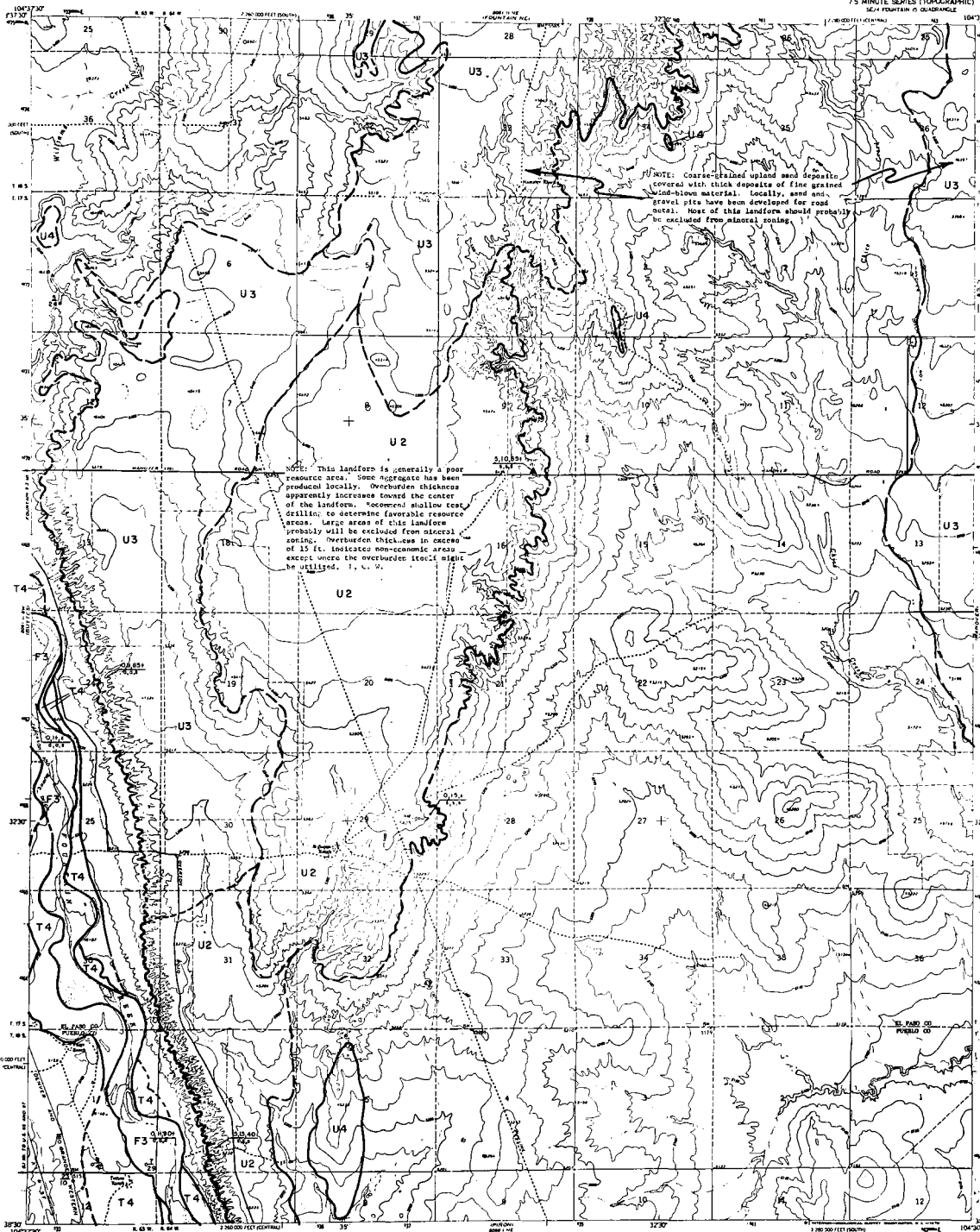




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

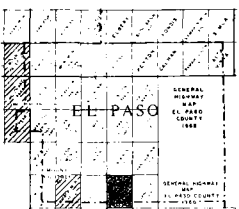
FOUNTAIN SE QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
SCALE: EQUATION OF QUADRANGLE

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



## EXPLANATION

- Legend unit  
Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mudslope deposits (slag-tailings, spalls, ...)
- RESOURCE CLASSIFICATION**
- COARSE GRAVELS**
- 1 Gravel (material) clean and sound
  - 2 Gravel (material) fine, decomposed rock, calcareous carbonate
- FINE GRAVELS**
- 3 Sand
  - 4 Probable aggregate resource
- AGGREGATE**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
- POTENTIAL QUARRY AGGREGATE RESOURCE AREAS**
- Selected well or drill-hole location with overburden thickness (ft.) over sand/gravel resource thickness (ft.) obtained from well logs.
  - "a" indicates gravel, "s" indicates sand
  - "u" in symbol denotes unvaluated or unknown property.
  - "m" indicates Colorado Geological Survey landform number and crest projection 491331616
  - Landform number(s), well where known or observed; shaded where appropriate or indicated.
- RELATION, LOCATION AND ORIENTATION - DESCRIPTION OF SYMBOLS**
- Overburden thickness (ft.)
  - Sand/gravel resource thickness (ft.)
  - Percent sand and fines (spacing of screen, 0.25 in., or 0.075 mm.)
  - Significant amount of fines (spacing 200 mesh, 0.075 in., or 0.075 mm.)
  - Significant amount of decomposed or soft rock.
  - Significant amount of calcareous carbonate (calciferous)
  - "u" in symbol denotes unvaluated or unknown property.
  - "m" in symbol denotes property status or insignificant.



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wickline  
Date: June 30, 1974



ROAD CLASSIFICATION  
Light-duty Unimproved dirt

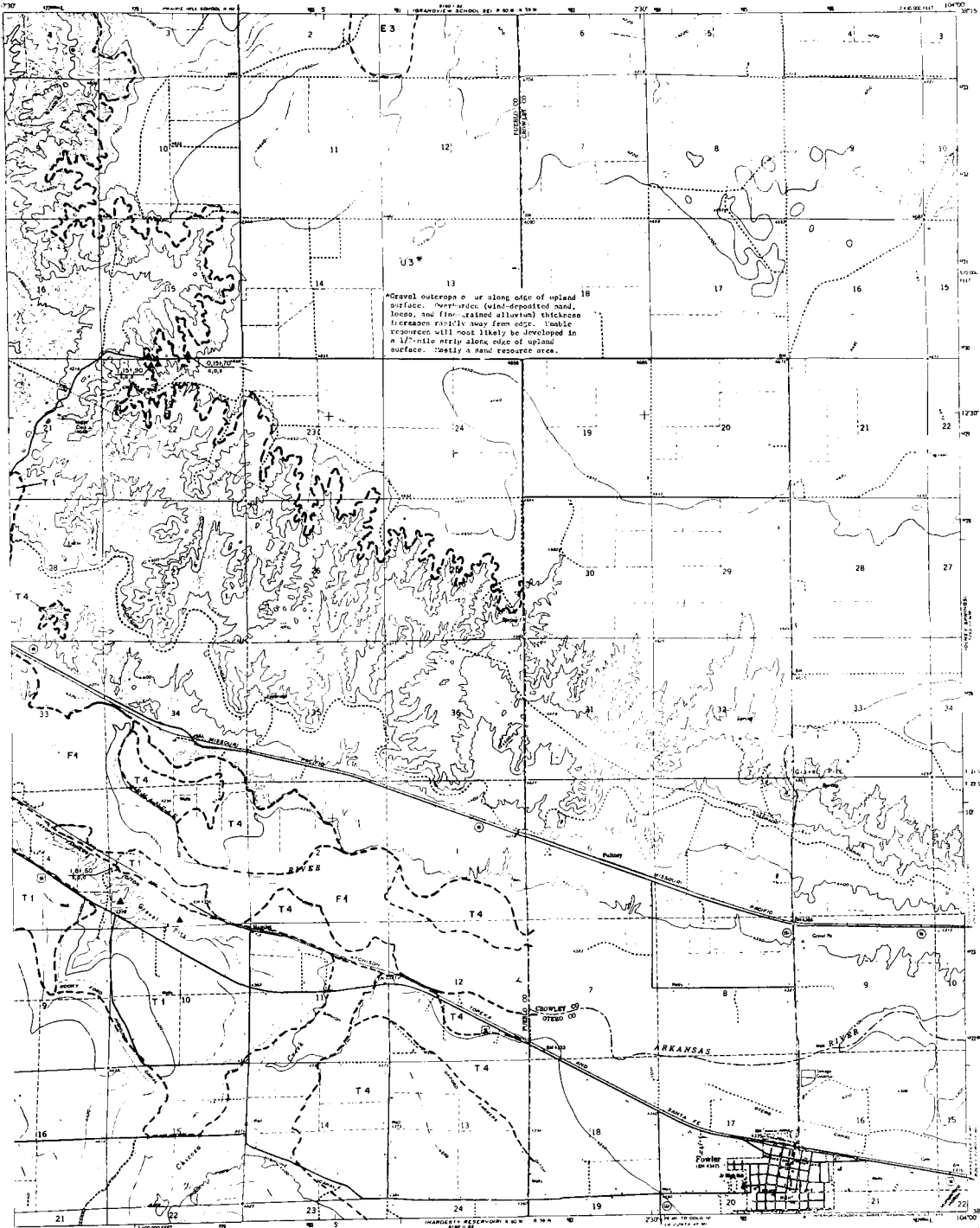
FOUNTAIN SE, COLO.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

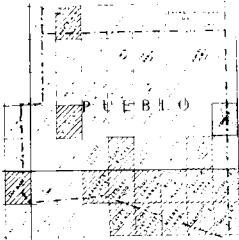
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. FOLD, DIRECTOR

FOWLER QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

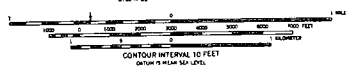
- LANDFORMS**
- T Trench deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (beach, dune, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and sharp
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
  - 3 Sand
  - 4 Probable aggregate resource
- AGGREGATE**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "U" indicates gravel, "M" indicates sand
  - "N" is symbol device denominated or unknown (1967)
  - Water table contours (indicated by dashed lines) show sand and gravel pits in 1972
  - Landform boundary, solid where known or estimated; dashed where approximate or inferred
- STATION, LOCATION AND GEOMORPHIC CHARACTERISTICS OF QUARRY**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Interval and dip from topography to quarry (1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1)
  - Length (ft) of face (spacing 200 ft, 250 ft, 300 ft, 350 ft, 400 ft, 450 ft, 500 ft, 550 ft, 600 ft, 650 ft, 700 ft, 750 ft, 800 ft, 850 ft, 900 ft, 950 ft, 1000 ft)
  - Approximate amount of sand/gravel in sand pit
  - Approximate amount of aggregate resource in quarry
  - "N" is symbol device denominated or unknown (1967)
  - "U" is symbol device denominated or unknown (1967)
  - "M" is symbol device denominated or unknown (1967)
  - "E" is symbol device denominated or unknown (1967)
  - "T" is symbol device denominated or unknown (1967)
  - "V" is symbol device denominated or unknown (1967)
  - "A" is symbol device denominated or unknown (1967)
  - "E" is symbol device denominated or unknown (1967)
  - "M" is symbol device denominated or unknown (1967)



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WETLANDS AREA

Mapped by: Stephen D. Schockewitz  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



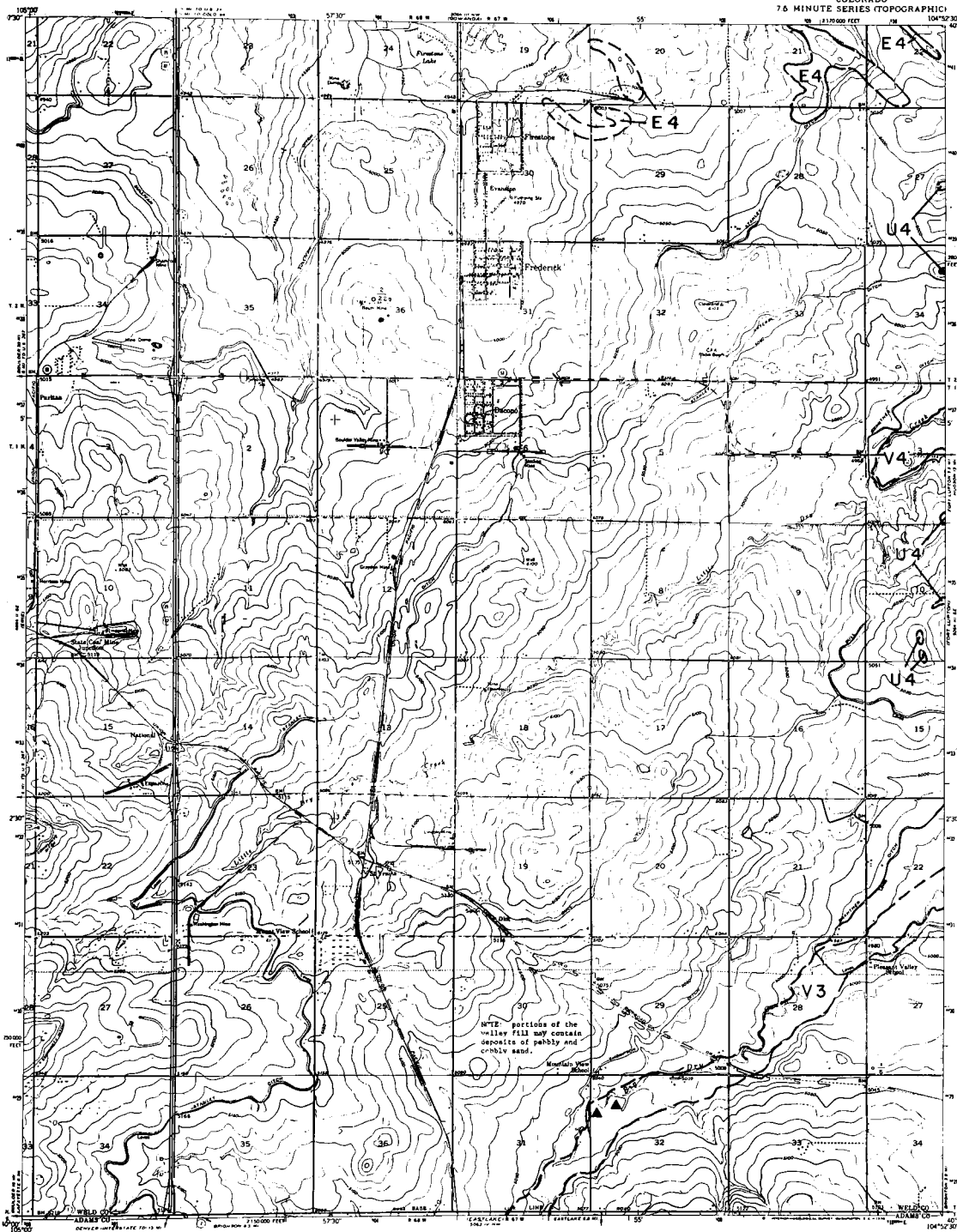
- ROAD CLASSIFICATION**
- Heavy duty
  - Light duty
  - Medium duty
  - Unimproved dirt
  - U.S. Route
  - State Route

FOWLER, COLO

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

FREDERICK QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

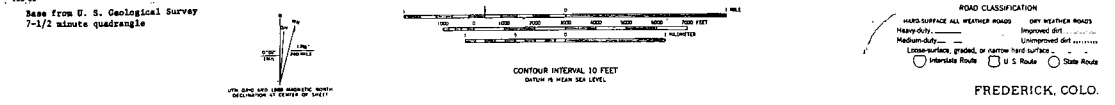
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (U or T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (data available, see...)
- MINERAL CLASSIFICATION**
- GRAVEL**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous
- SAND**
- 3 Sand
- UNDEVELOPED RESOURCES**
- 4 Probable aggregate resource
- MINERALS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Isolated well or drill-hole location with overburden thickness (ft) over sand/gravel resource
  - Isolated well or drill-hole location with overburden thickness (ft) over sand/gravel resource
  - "I" indicates gravel, "S" indicates sand
  - "I" in symbol denotes unventilated or unknown property
  - "W" denotes Colorado Geological Survey well location and gravel producer's drill hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF SYMBOL**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (percent of screen, 0.075 mm, 0.075 mm)
  - significant amount of fines (percent of screen, 0.075 mm, 0.075 mm)
  - significant amount of decomposed or weak rock
  - "W" or symbol denotes unventilated or unknown property
  - "I" is symbol denotes property absent or unexplored



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
Colton, R.H., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Owens area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map 1-55-D.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.



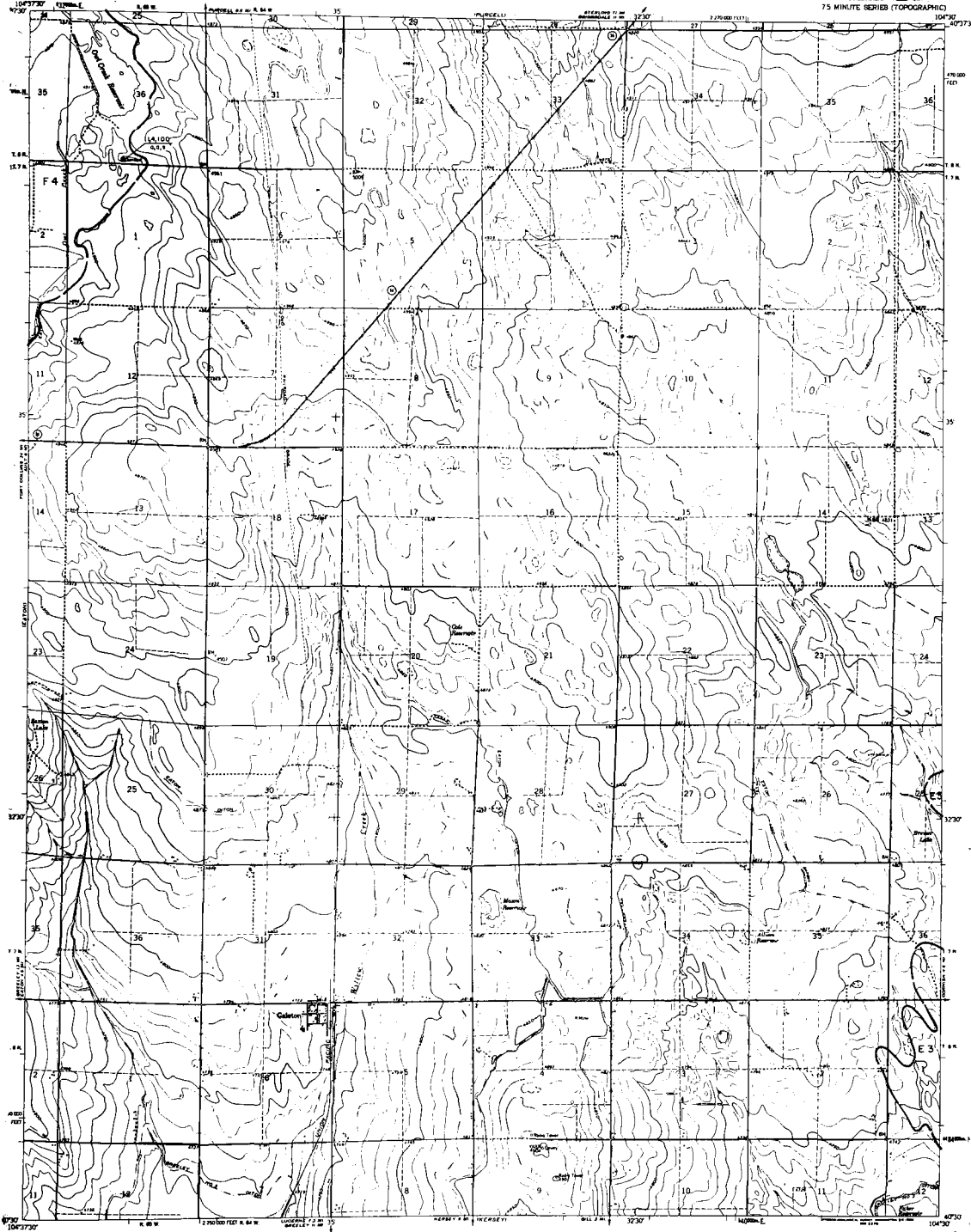
FREDERICK, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

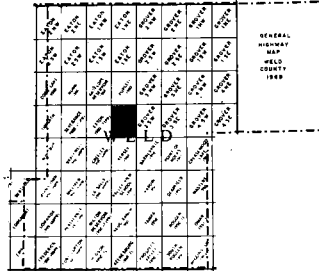
GALETON QUADRANGLE  
COLORADO-WELD CO  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Legend for symbols and line types.
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Man-made deposit (fill, colluvium, spalls, ...)
- RESOURCE CLASSIFICATION**
- Coarse Gravels**  
(at least 20% retained on #8 screen, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous cement
- Fine Gravels**  
(passed #20 passing #40 screen, 40% retained on #200 screen, visual estimation)
- 3 Sand
- Reclassified Resources**
- 4 Possible aggregate resources
- QUIRRY SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Reclassified quarry aggregate resource area
  - Selected well or drill-hole location with proven sand (1) and/or gravel (2) resources
  - Wellness (1): obtained from well logs
  - "g" indicates gravel; "s" indicates sand
  - "\*" in symbol denotes unmineralized or unknown property
  - "W" denotes Colorado Geological Survey (discontinued and gravel prospect)
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL CLASSIFICATION OF DEPOSIT**
- contour thickness (ft)
  - development resource thickness (ft)
  - percent sand and fines (passing #8 screen, 0.25 in.), visual estimation
  - significant amount of fines (passing #200 screen, 0.0075 in. or 0.300 mm.)
  - significant amount of decomposed or weak rock
  - "g" in symbol denotes unmineralized or unknown property
  - "s" in symbol denotes property absent or changed/lost



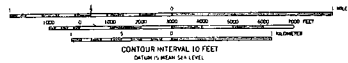
- QUADRANGLE LOCATION**
- NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Swan, R. H., III, 1972, Map of surficial geology of part of the Galeton quadrangle: Recon. mapping for Colorado Geol. Survey Window Environmental Geology Project, open-file map.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

APPROXIMATE MEAN  
DECLINATION, 1980



ROAD CLASSIFICATION

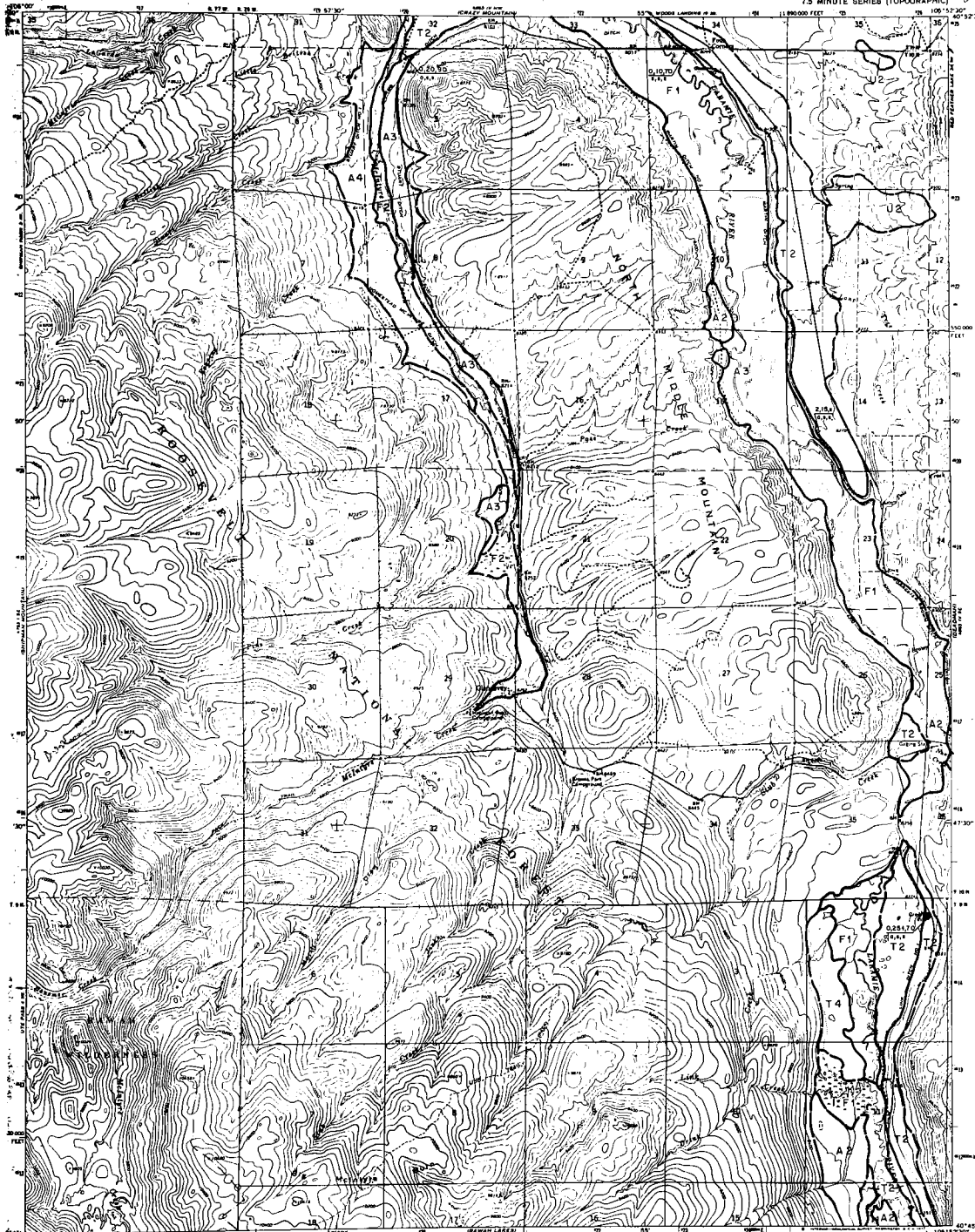
- Medium-duty
- Light-duty
- Unimproved dirt
- State Route

GALETON, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

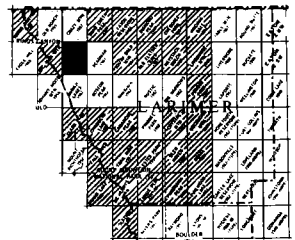
OLENDEVEY QUADRANGLE  
COLORADO - LARIMER CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

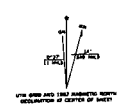
- Land-use units**  
Resource class/function
- LANDFORMS**  
F Fluvial deposits  
T Stream terrace deposit  
V Valley fill (F & T)  
U Upland deposits  
A Alluvial fan  
E Wind-eroded sand (eolian)  
M Hummock deposits (e.g., collins, spalls...)
- RESOURCE CLASSIFICATION**
- COARSE GRAVELS**  
1st class: 20% retained on #4 screen, visual estimation  
2 Gravel: relatively clean and smooth  
3 Gravel: significant fines, decomposed rock, contain concretions
- FINE GRAVELS**  
1st class: 20% passing #4 screen, 60% retained on #20 screen, visual estimation  
2 Sand
- Unutilized Resources**  
4 Probable aggregate resources
- MAP SYMBOLS**
- Operating gravel sand/gravel pit
  - Abandoned gravel sand/gravel pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft.) over sand/gravel resource thickness (ft.), obtained from well logs
  - "u" indicates gravel; "a" indicates sand
  - "u" or "a" symbol denotes unutilized or unknown property
  - "u" denotes Colorado Geological Survey "unutilized and draws projects" drill hole
  - Land-use boundary, solid where known or observed; dashed where approximate or inferred
- SYMBOLS, LOCATION AND CHARACTERISTICS OF SPILLS**
- overburden thickness (ft.)
  - sand/gravel resource thickness (ft.)
  - percent sand and fines (passing #4 screen, 0.75 in.), visual estimation
  - Significant amount of fines (passing #20 screen, 0.850 in. or 0.075 in.)
  - Significant amount of decomposed or weak rock
  - "u" or "a" symbol denotes unutilized or unknown property
  - "u" or "a" symbol denotes property about or changed/changed



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 40 FEET  
DOTTED LINES REPRESENT 50-FOOT CONTOURS  
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION  
Lg+6-0 Unimproved dirt

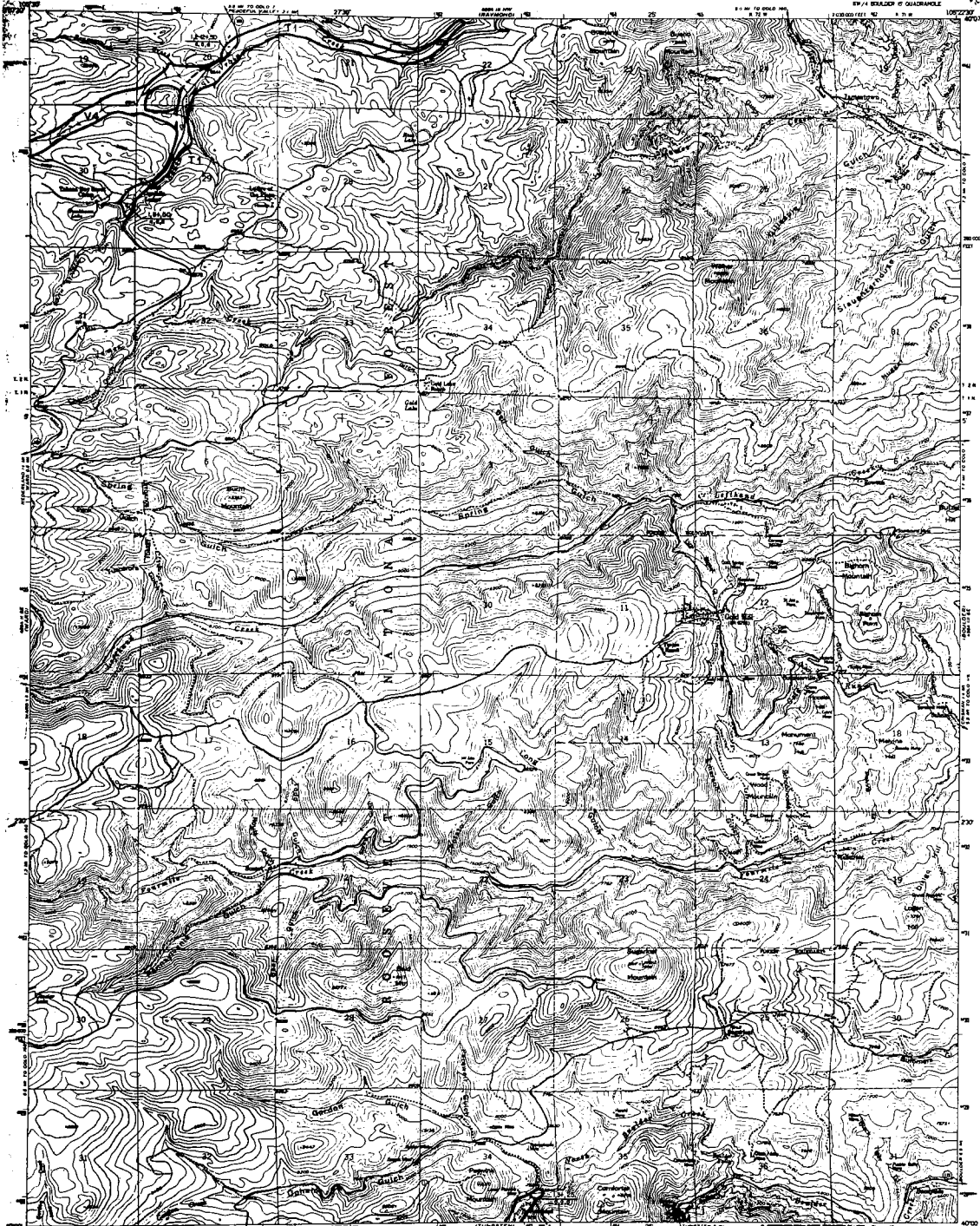
OLENDEVEY, COLO.





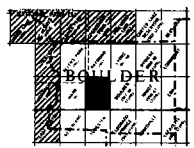
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

GOLD HILL QUADRANGLE  
COLORADO-Boulder CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
BY A. BRADY & QUADRANGLE



## EXPLANATION

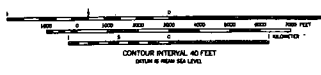
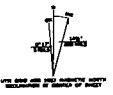
- Landform unit**  
*Reference class/footprint*
- LANDFORM UNIT**
- F Floodplain deposit
  - T Terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Hummock deposits (shag, talus, spalls...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
 Not less than 20% retained on #4 screen, 40% retained on #10 screen.
- 1 Gravel: Relatively clean and sound
  - 2 Gravel: Significant fines, decomposed rock, talus, talusstone.
- Fill Aggregate**  
 (greater than 75% passing #4 screen, 60% retained on #10 screen, ideal gradation)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); shaded from well logs.
  - "s" indicates gravel; "m" indicates sand
  - "a" in symbol denotes unconsolidated or unknown property.
  - "m" denotes Colorado Geological Survey "shaded/red and gravel structure" drill hole
  - Landform boundary, solid where known, wavy otherwise; dashed where approximate or inferred.
- RELATION LOCATION AND OVERBURDEN THICKNESS OF SANDS**
- overburden thickness (ft)
  - non-gravel resource thickness (ft)
  - resource sand and fines (passing #4 screen, 2.5 to 1.0; usual gradation)
  - significant amount of fines (passing #100 screen, 0.075 to 0.015 mm)
  - significant amount of decomposed or weak rock.
  - "a" in symbol denotes unconsolidated or unknown property.
  - "m" in symbol denotes property absent or unapplicable.



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph S. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Multi-lane highway    Light duty  
 Unimproved dirt  
 State Route

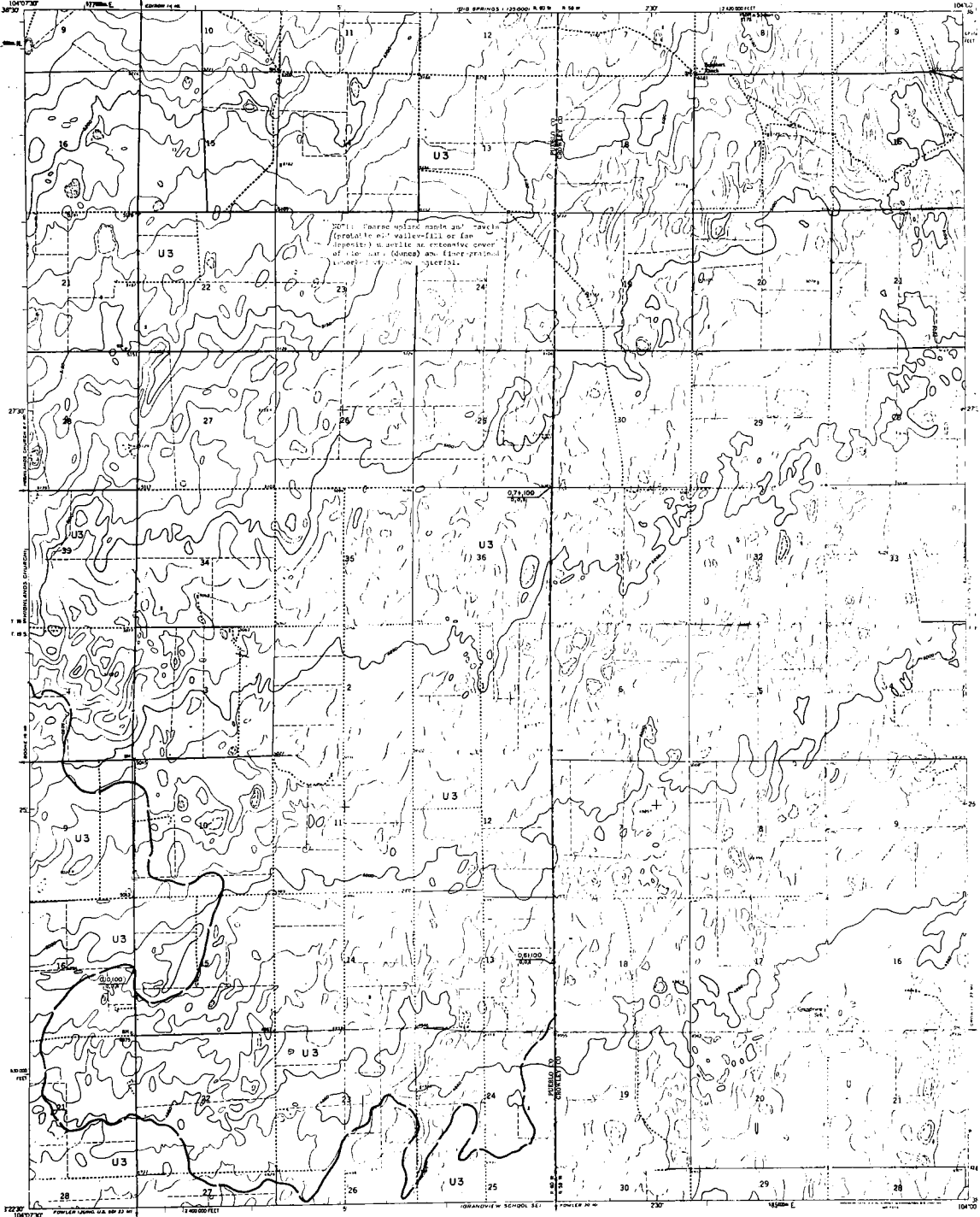
GOLD HILL, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

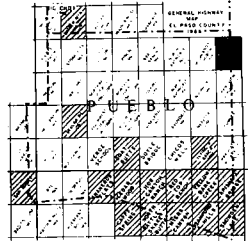
GRANDVIEW SCHOOL QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Landform unit  
Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E High-dissected sand (alluvium)
  - M Mountain deposits (slag, tailings, spalls...)
- RESOURCE CLASSIFICATION**
- CONCRETE AGGREGATE**  
(for 100' and 200' material on 20' contour, if actual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, increased rock, custom aggregate
- FILL MATERIALS**  
(based on 100' spacing of survey, 20' material on 100' spacing, actual estimation)
- 3 Sand
  - 4 Probable aggregate resources
- QUIRY SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs:
    - "0" indicates gravel; "0" indicates sand
    - "0" in symbol denotes unclassified or unknown property
    - "0" denotes Colorado Geological Survey Well-Log and Gravel Project
    - Drill hole
    - Landform boundary, solid where known or observed; dashed where approximate or inferred
- FACTOR LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (spacing 20' screen, 0.25 in., visual estimation)
  - 0-25
  - light/float amount of fines (spacing 100' screen, 0.075 in. or 0.075 mm)
  - 0-100
  - significant amount of indurated carbonate (caliche)
  - "0" in symbol denotes unclassified or unknown property
  - "0" in symbol denotes properly absent or negligible



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

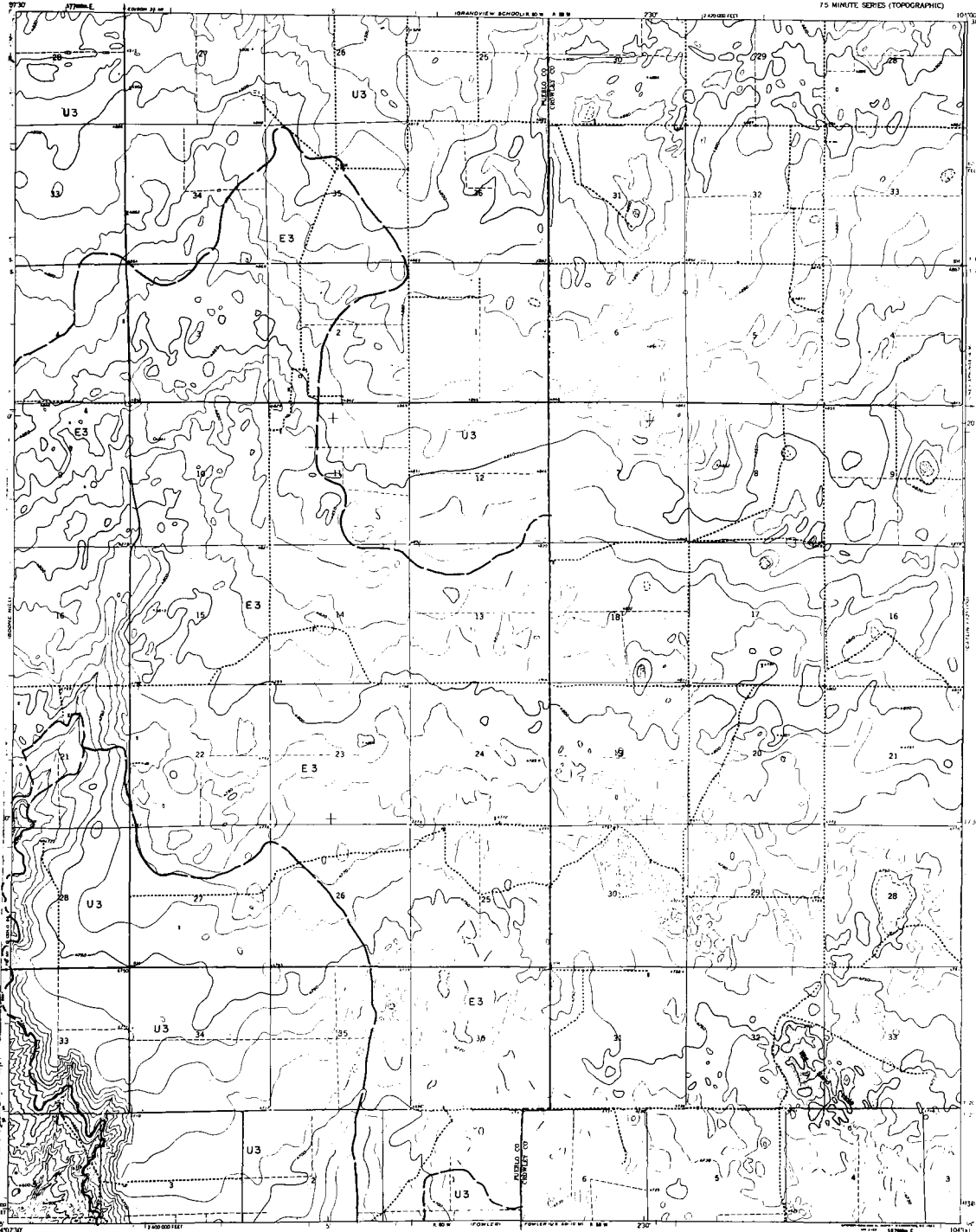
Mapped by: Stephen D. Schwabow  
Date: June 30, 1974





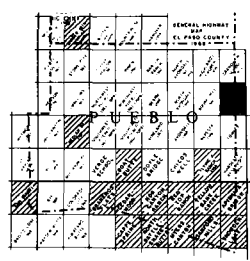
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

GRANDVIEW SCHOOL SE QUADRANGLE  
 COLORADO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- Landform unit
- Resource classification
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (roads, ditches, etc.)
- RESOURCE CLASSIFICATION**
  - Coarse Aggregate**  
 (at least 20% material on #20 screen, visual estimation)
    - 1 Gravel: relatively clean and round
    - 2 Gravel: significant fines, unrounded rock, calcian carbonate
    - Fine Aggregate**  
 (at least 20% passing #20 screen, 80% retained on #100 screen, visual estimation)
      - 3 Sand
      - 4 Unwashed aggregate
      - 5 Probable aggregate resource
  - NOT SYMBOLS**
    - \* Operating gravel and/or sand pit
    - \* Abandoned gravel and/or sand pit
    - \* Operating stone quarry
    - \* Abandoned stone quarry
    - \* Potential quarry aggregate resource area  
 Selected well or drill-hole location with over-burden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs. "C" indicates gravel; "S" indicates sand. "X" in symbol denotes unvested or unknown property.
    - \* American Colorado Geological Survey "Sand/Gravel and Gravel Projects" drill hole
    - Landform boundary, solid where known or observed, dashed where appearance is inferred.
  - STATION LOCATION AND ORIENTATIONAL INDICATION OF SPILL**
    - Overburden thickness (ft)
    - Sand/gravel resource thickness (ft)
    - Percent sand and fines (passing #60 screen, 0.25 in.), visual estimation
    - Significant amount of fines (passing #200 screen, 0.075 in. or 0.075 mm.)
    - Significant amount of dampness or sand rock.
    - Significant amount of inclusion materials (culture)
    - \* In symbol denotes unvested or unknown property.
    - \* In symbol denotes property absent or insignificant.

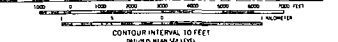


QUADRANGLE LOCATION  
 NON-RESOURCE OR KITTOWAN AREA

Mapped by: Stephen D. Schwechow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

APPROXIMATE MEAN  
 DECLINATION, 1980



ROAD CLASSIFICATION  
 Light duty      Unimproved dirt

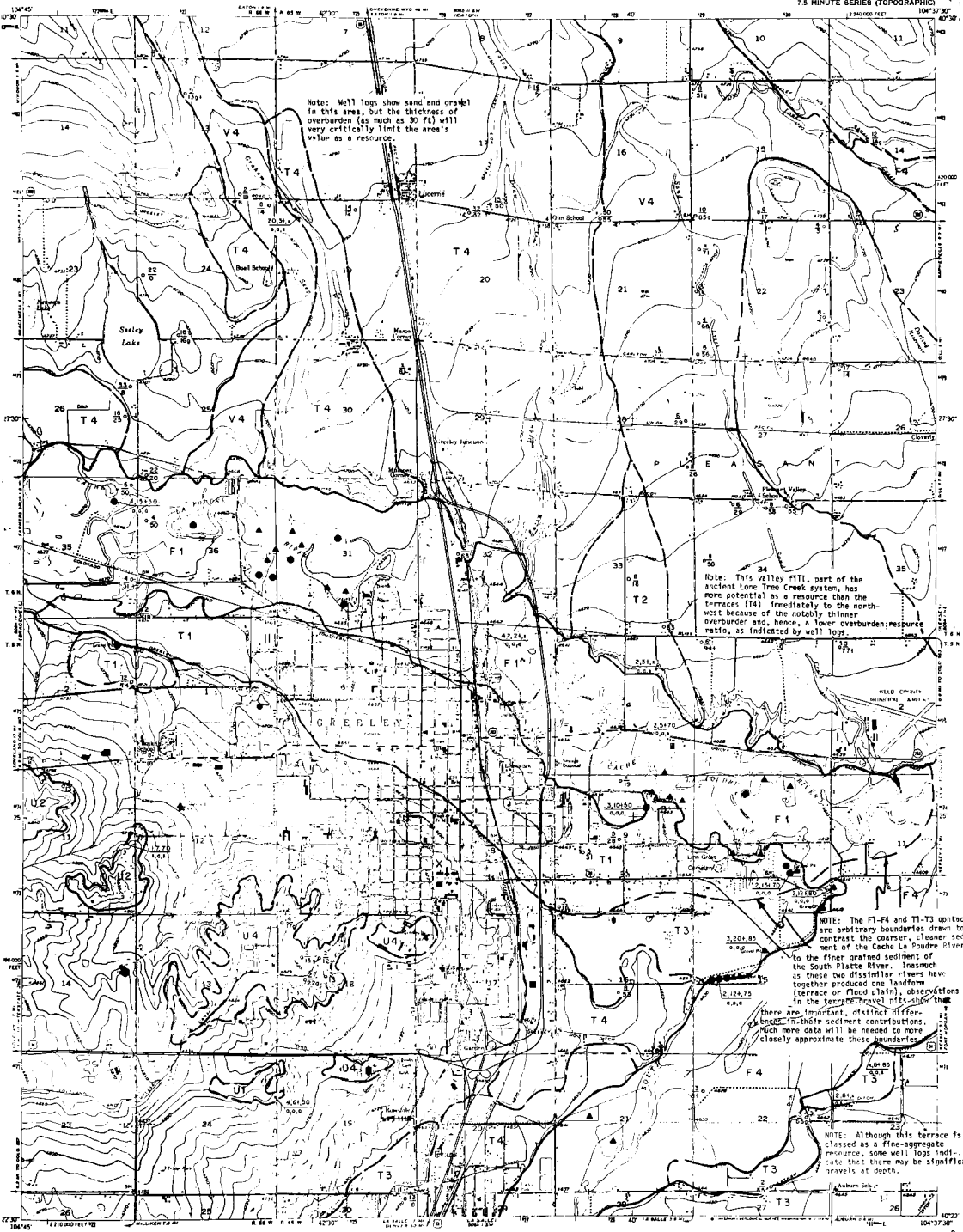
GRANDVIEW SCHOOL SE, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

GREELEY QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
2400000 FEET

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



Note: Well logs show sand and gravel in this area, but the thickness of overburden (as much as 30 ft) will very critically limit the area's value as a resource.

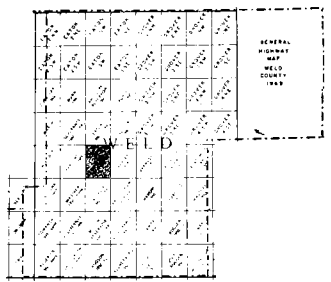
Note: This valley fill, part of the ancient Lone Tree Creek system, has more potential as a resource than the terraces (T4) immediately to the northwest because of the notably thinner overburden and, hence, a lower overburden:resource ratio, as indicated by well logs.

NOTE: The F1-F4 and T1-T3 contacts are arbitrary boundaries drawn to contrast the coarser, cleaner sediment of the Cache La Poudre River to the finer graded sediment of the South Platte River. Inasmuch as these two distasteful rivers have together produced one landform (terrace or flood plain), observations in the terrace/gravel systems there are important, distinct differences in their sediment contributions. Much more data will be needed to more closely approximate these boundaries.

NOTE: Although this terrace is classed as a fine-aggregate resource, some well logs indicate that there may be significant gravels at depth.

EXPLANATION

- SYMBOLS**
- Contour interval
  - Resource classification
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley Fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (dike, tailings, waste, ...)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**
- 1 Coarse aggregate (not less than 100 percent on 48 screen, except as noted)
  - 2 Coarse aggregate (not less than 50 percent on 48 screen, except as noted)
  - 3 Sand
- Fine Aggregate**
- 1 Fine aggregate (not less than 100 percent on #200 screen, except as noted)
  - 2 Fine aggregate (not less than 50 percent on #200 screen, except as noted)
  - 3 Sand
- Overburden Resource**
- 1 Probable aggregate resource
- ROAD SYMBOLS**
- Operating gravel under road pit
  - Abandoned gravel under road pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area (shaded with wavy lines)
  - Shaded (black) areas (1) over underlying resource resources (F), (2) obtained from well logs
  - "F" indicates unrelieved; "T" indicates same "F" in symbol denotes unrelieved or shallow overburden
  - "A" denotes Colorado Geological Survey Boulder/Lead and Great projects (1) (1) (1)
  - Landform boundary, slightly known or observed (dashed lines appropriate or inferred)
- STATION, LOCATION AND GEOLOGICAL SIGNIFICANCE OF DEPOSIT**
- 1 Significant thickness (ft)
  - 2 Significant resource thickness (ft)
  - 3 Percent sand and fines (passing #200 screen, 0.075 in. or 0.003 in.)
  - 4 Significant amount of unrelieved or shallow overburden
  - 5 Significant amount of action (unrelieved or shallow overburden)
  - 6 "F" in symbol denotes unrelieved or shallow overburden
  - 7 "T" in symbol denotes property absent or unrelieved



QUADRANGLE LOCATION

- NON-RESOURCE OR WITHDRAWN AREA

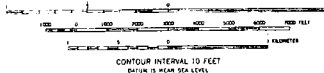
**References:**

- Swan, F. H., III, 1972, Map of surficial geology of the Greeley quadrangle: Recon. Mapping for Colorado Geol. Survey Mendoc Environmental Geology Project, Open-File Map.
- Hershey, L. A., and Schneider, P. R., Jr., 1972, Geologic map of the Lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-587.
- Shelton, D. C., 1974, Personal communication.
- Smith, R. O., Schneider, P. A., Jr., and Peck, L. B., 1964, Ground-water resources of the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: U. S. Geol. Survey Water-Supply Paper 1458, p. 11.
- Geology modified after: Colton, T. B., and Fitch, S. R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Greeley Area, Front Range Urban Corridor Colorado: U. S. Geol. Survey Map I-855-B.

Map by: Stephen D. Schwochow  
Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle  
Prepared in cooperation with the U. S. Geological Survey.

USE THIS AND OTHER APPROPRIATE MAPS TO DETERMINE LOCATION OF QUARRY SITES



**ROAD CLASSIFICATION**

ROADS WITH WEATHER PLANS

- Major duty
- Medium duty
- Loose surface, graded, or narrow hard surface
- U.S. Route
- State Route

OTHER WEATHER ROADS

- Improved dirt
- Unimproved dirt

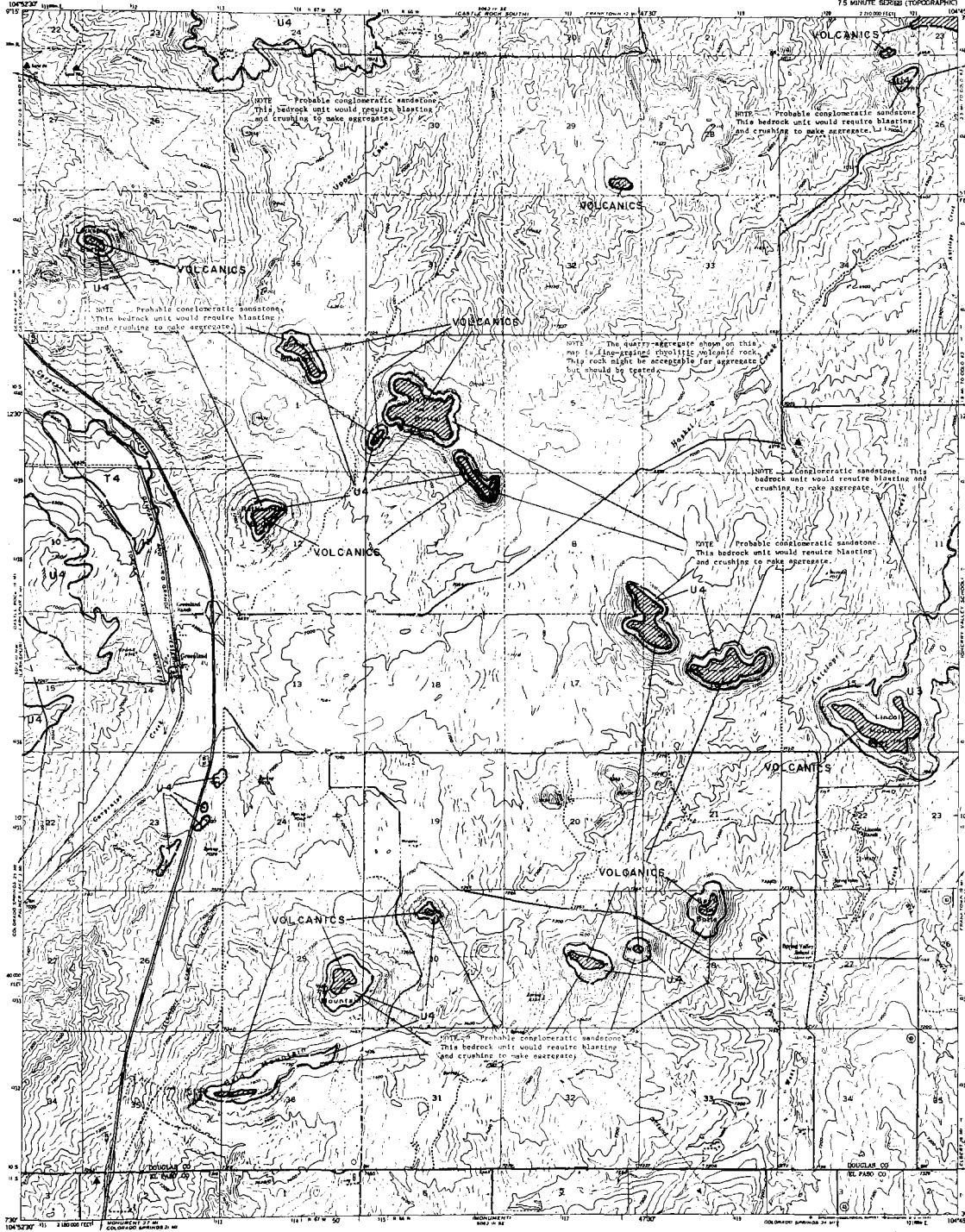
GREELEY, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

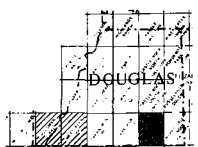
GREENLAND QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Landform unit**  
Resource classification
- LANDFORM UNIT**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - M Man-deposited sand (barren)
  - E Eolian deposit (sand dunes, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 25% retained on #4 screen, visual inspection)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous cementation
- Fine Aggregate**  
(greater than 75% passing #4 screen, not retained on #20 screen, visual inspection)
- 3 Sand
  - 4 Probable aggregate resource
- QUIRRY SYMBOLS**
- \* Operating gravel and/or sand pit
  - A Abandoned gravel and/or sand pit
  - Q Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Indicated with or without location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs: " indicates gravel; "s" indicates sand
  - "s" in symbol denotes unavaliable or unknown property
  - "m" denotes Colorado Geological Survey "Mineral Land and Gravel Project" drill hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATIONAL INDICATION BY SYMBOL**
- overburden thickness (ft) and/or gravel resource thickness (ft)
  - percent sand and fines (percent of screen, 0.075 in., or 0.075 mm.)
  - significant amount of fines (greater than 100 percent, 0.075 in., or 0.075 mm.)
  - significant amount of decomposed or weak rock
  - "s" in symbol denotes unavaliable or unknown property
  - "m" in symbol denotes property about or insignificant



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Trimble, D.E., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-537 A.

Trimble, Donald, 1974, U.S.G.S. Personal Communication

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey



GREENLAND, COLO.

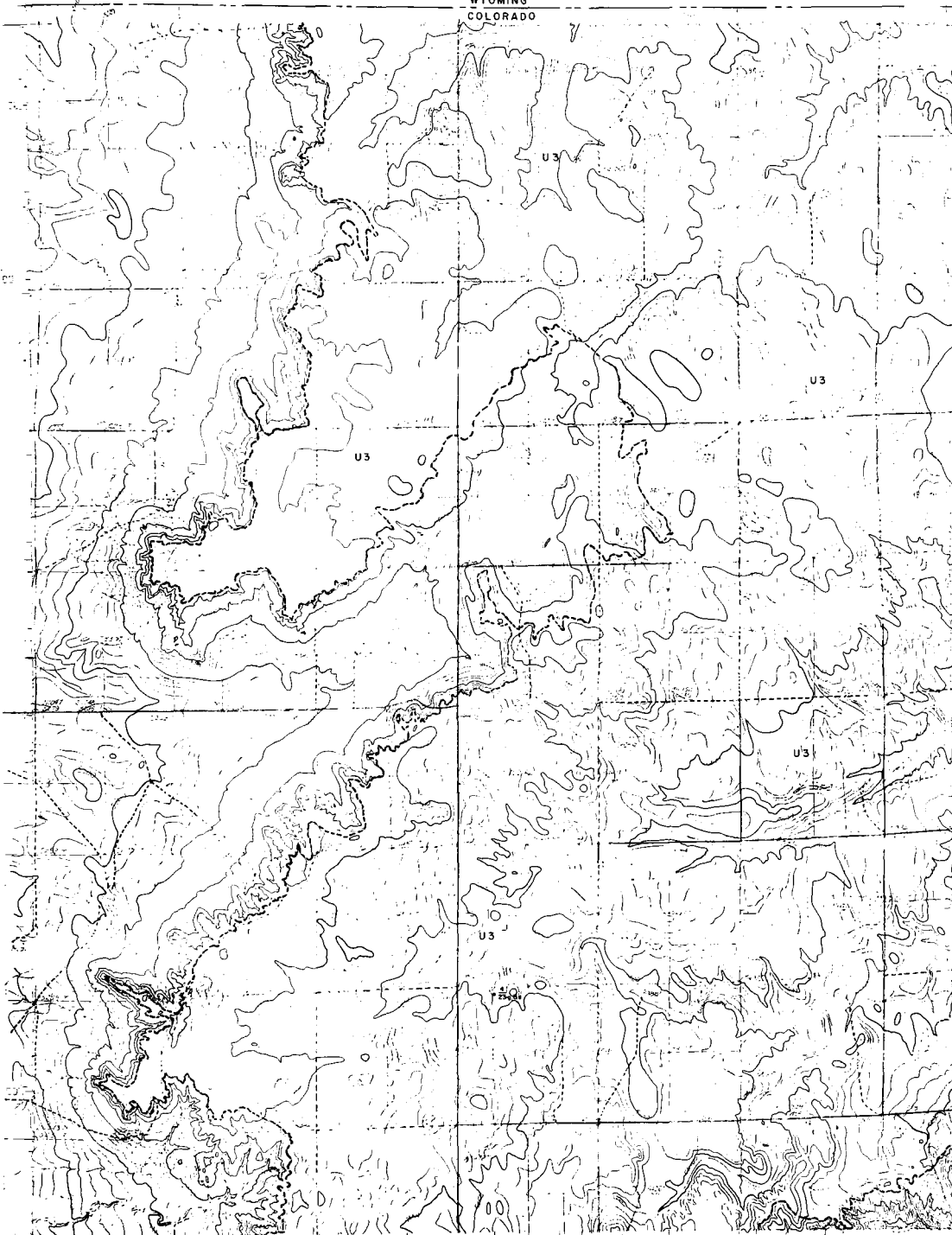
SAND, GRAVEL AND QUARRY AGGREGATE

GROVER INE

RESOURCES MAP

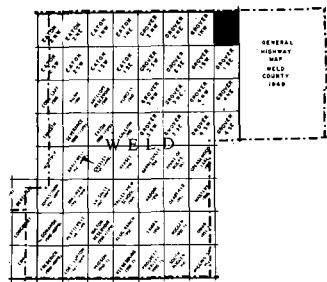
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 COLORADO GEOLOGICAL SURVEY  
 JOHN W. HOLID, DIRECTOR

WYOMING  
 COLORADO



EXPLANATION

- Contour unit
  - Resource classification
- LAYERED UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Non-deposited sand (alluvial)
  - M Non-mine deposit (slag, tailings, waste...)
- RESOURCE CLASSIFICATION**
- CONCRETE AGGREGATE**  
 (at least 20% retained on #8 screen, usual extraction)
- 1 Gravel: relatively clean and good
  - 2 Gravel: significant fines, decomposed rock, surface softness
- PIPE AGGREGATE**  
 (greater than 75% passing #4 screen, 85% retained on #10 screen, usual extraction)
- 3 Sand
- Unutilized Resource**
- 4 Possible aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), attached from well logs
  - "\*" indicates gravel; "m" indicates sand
  - "m" in symbol denotes unutilized or unknown property
  - "m" American Colorado Geological Survey "Method/Date and Screen Project"
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- SECTION, LOCATION AND ORIENTATION**
- REMARKS OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - screen used and from (square ft, screen, 0.75 in.), usual extraction
  - Large/Small amount of fines (square feet)
  - Small/Small amount of fines (square feet)
  - Small/Small amount of material (square feet)
  - "\*" or symbol denotes unutilized or unknown property
  - "m" in symbol denotes property absent or unutilized



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Helzer, G.E., Jr., 1965. Reconnaissance of gravel-sand resources in parts of Teton, Logan, Morgan, Sedgewick, and Weld Counties, Colo.: U. S. Geol. Survey Water-Supply Paper 1609-A, pl. 1.

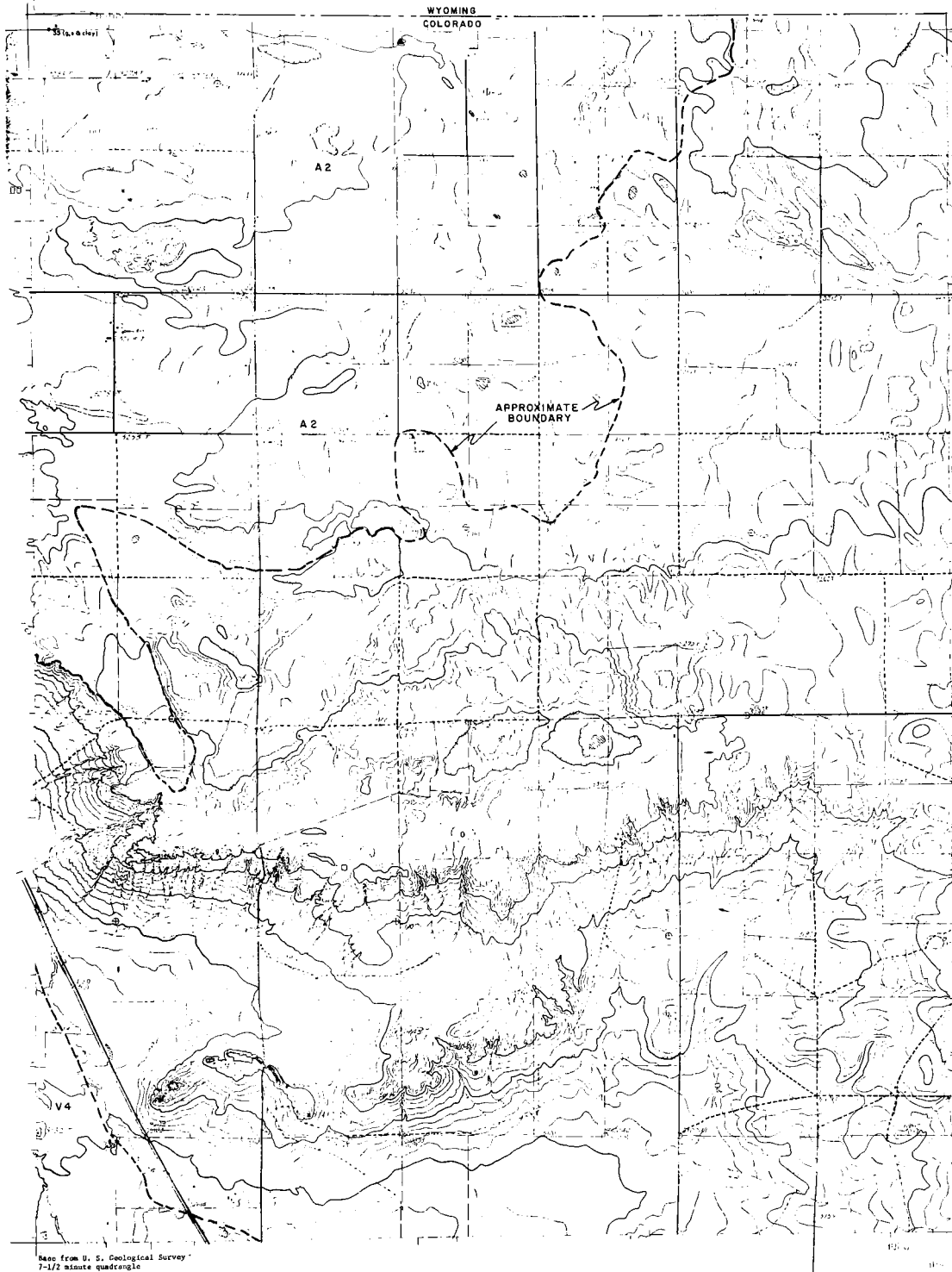
Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

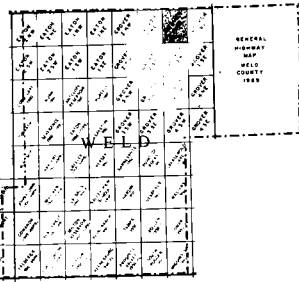
GROVER INW

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



EXPLANATION

- boundary unit
  - boundary classification
- LAYERED UNIT**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconformity
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-mine aggregate (caliche, caliche, silt, ...)
- RESOURCE CLASSIFICATION**
- Quality Indicators**
- 1 Coarse: calcareous clay and sand
  - 2 Coarse: significant fines, decomposed rock, calcareous
  - 3 Sand
- Estimated Resource**
- 4 Probable aggregate resource
- Site Symbols**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Selected well or drill-hole location with overburden thickness (ft) over unconsolidated resource thickness (ft), obtained from well logs
  - ⊙ "u" indicates gravel, "e" indicates sand
  - ⊙ "u" symbol denotes unconsolidated or unknown property
  - ⊙ "m" denotes Colorado Geological Survey Window (sand and gravel) projects
  - ⊙ drill hole
  - ⊙ boundary boundary, solid where known or inferred; dashed where approximate or inferred
- RELATION LOCATION AND SYMBOLS**
- ⊙ overburden thickness (ft)
  - ⊙ unconsolidated resource thickness (ft)
  - ⊙ gravel and fines (spacing in inches, 0.25 in. = 1/4 inch)
  - ⊙ significant amount of fines (spacing in inches, 0.25 in. or 0.075 in.)
  - ⊙ significant amount of decomposed or soft rock
  - ⊙ significant amount of eolian carbonate (caliche)
  - ⊙ "u" symbol denotes unconsolidated or unknown property
  - ⊙ "m" symbol denotes property owned or managed



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Meier, W.G., Jr., 1965. Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgwick, and Weld Counties, Colo.: U. S. Geol. Survey Water-Supply Paper 1809-L, pl. 1.

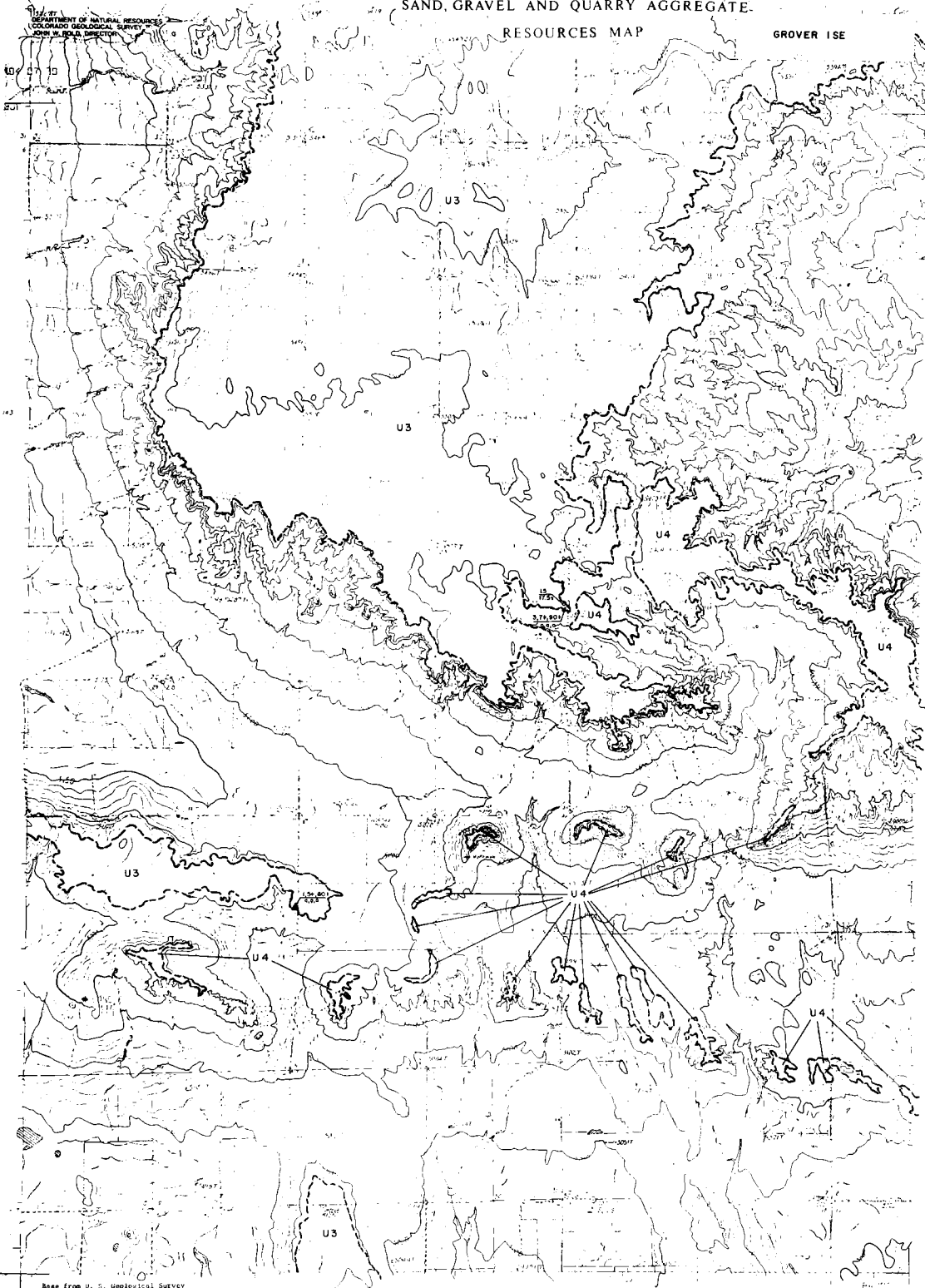
Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



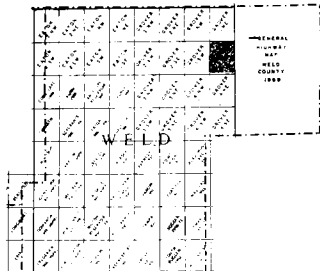
SAND, GRAVEL AND QUARRY AGGREGATE.  
RESOURCES MAP

GROVER USE



EXPLANATION

- (dashed line) well
  - (solid line) resource class/limit
- LANDFORMS**
- F Floodable deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (alluvial)
  - M Man-made deposits (dike, levee, apron, etc.)
- RESOURCE CLASSIFICATION**
- CLASS 1**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, tabular carbonate
- CLASS 2**
- 3 Sand
- CLASS 3**
- 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Related well or drill-hole location with overburden thickness (ft) over sand/gravel resource
  - Thickness (ft) obtained from well logs
  - 1/2" indication gravel; 1/4" indicates sand
  - In symbol denotes unconsolidated or unknown gravity
  - "m" denotes minimum biological survey (water/land and Gross) projects
  - 1/2" line
  - Landform boundary, solid where known or dashed where approximate or inferred
- STATUS, LOCATION AND ORIGIN OF SYMBOLS**
- (dashed line) boundary (ft)
  - (solid line) resource thickness (ft)
  - (dotted line) sand and fines (spacing of symbol, 0.15 to 0.1, actual estimate)
  - (dotted line) amount of fines (spacing 2500 mesh, 0.0075 to 0.075 mm)
  - (dotted line) significant amount of sandstone or sand rock
  - (dotted line) significant amount of siliceous sandstone (include "m" in symbol denotes unconsolidated or unknown gravity)
  - (dotted line) "m" in symbol denotes property absent or unapplicable



REFERENCE: Metcalf, M.C., Jr., 1965. Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colorado. U. S. Geol. Survey Water-Supply Paper 1809-L, pl. 1.

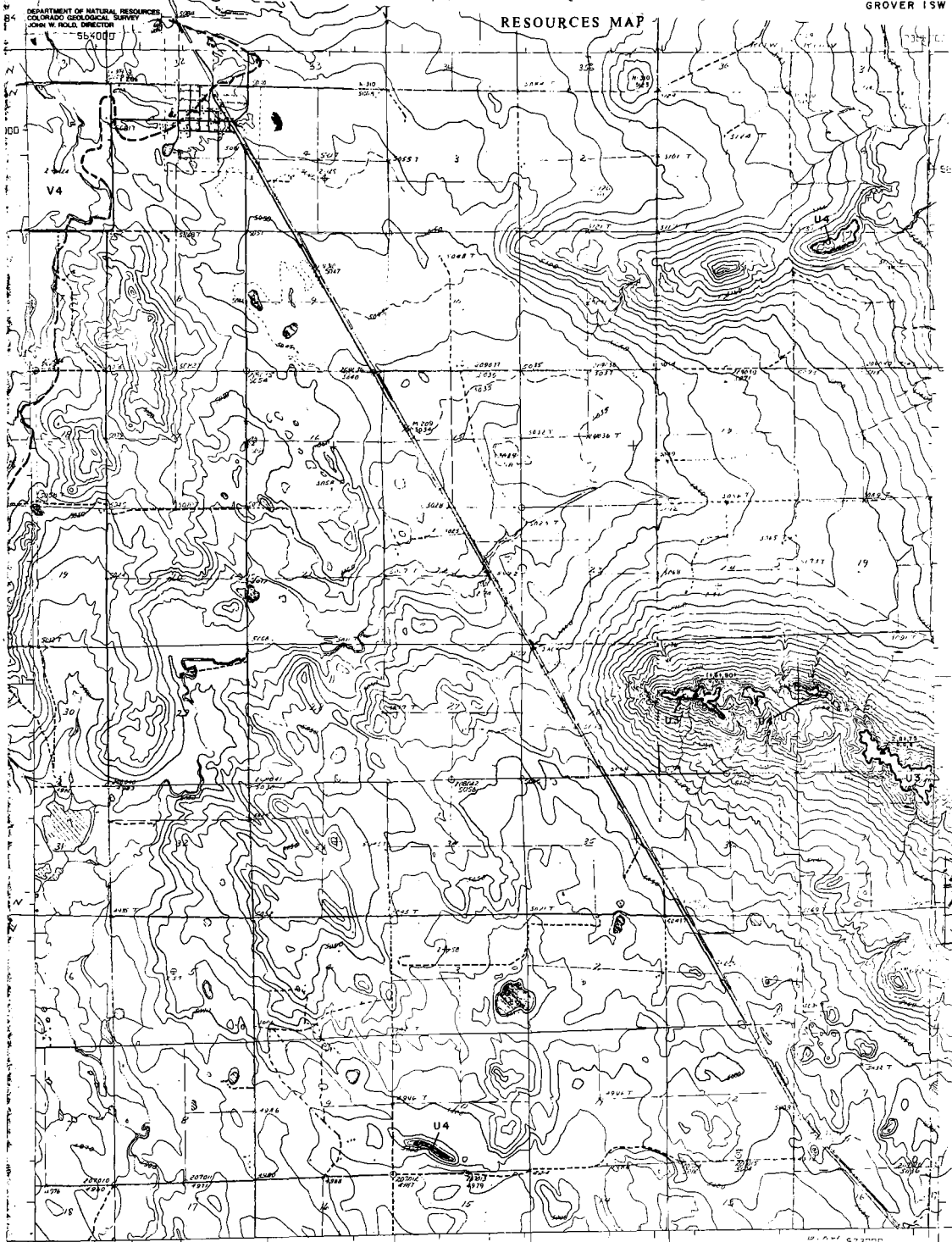
Mapped by: Ralph R. Skroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

# SAND, GRAVEL AND QUARRY AGGREGATE

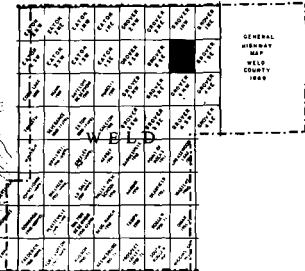
GROVER 15W

## RESOURCES MAP



### EXPLANATION

- Legend: 1/4 inch = 1 mile  
Resource class/function
- AGGREGATE TYPES**
- F Alluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- ROAD CLASSIFICATION**
- CONTOUR INTERVAL**  
All contour lines are based on 40 foot intervals, unless otherwise noted.
- 1** Contour: relatively close and smooth  
**2** Contour: significant lines, decomposed rock, difficult to traverse
- 3** **ROAD CLASSIFICATION**  
1. Interstate Route  
2. U.S. Route  
3. State Route
- 4** **PROBABLE AGGREGATE RESOURCES**
- 5** **OPERATING QUARRY AND/OR SAND PIT**
- 6** **ABANDONED QUARRY**
- 7** **ABANDONED STONE QUARRY**
- 8** **ABANDONED QUARRY OPERATING RESOURCE AREA**  
Selected wall or well-hole location with overburden thickness (ft) over sand/gravel; resource thickness (ft), obtained from well logs.  
"G" indicates gravel; "S" indicates sand.  
"U" in small circles unconsolidated or unknown gravels.  
"M" denotes Colorado Geological Survey Prospected and Capped aggregate fill hole.  
Landmark monument, solid black shown or observed; dashed where approximate or inferred.
- 9** **STATUS, LOCATION AND GEOLOGICAL DESCRIPTION OF SANDPIT**
- overburden thickness (ft)  
sand/gravel resource thickness (ft)  
percent sand and gravel (ignoring 1/2 screen, 0.25 in. or 0.075 mm.)  
significant amount of decomposed or sand road.  
significant amount of solution carbonate (include "C" in symbol circles unconsolidated or unknown gravels.  
"M" in symbol circles properly placed or inferred.



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Meier, U.C., Jr., 1965, Reconsaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colo.: U. S. Geol. Survey Water-Supply Paper 1809-L, pl. 1.

Mapped by: Ralph B. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

- ROAD CLASSIFICATION**
- Light gray road, hard or hard surface
  - Improved surface
  - Secondary highway: hard surface
  - Unimproved road
  - Interstate Route
  - U.S. Route
  - State Route

CONTOUR INTERVAL: 10 FEET

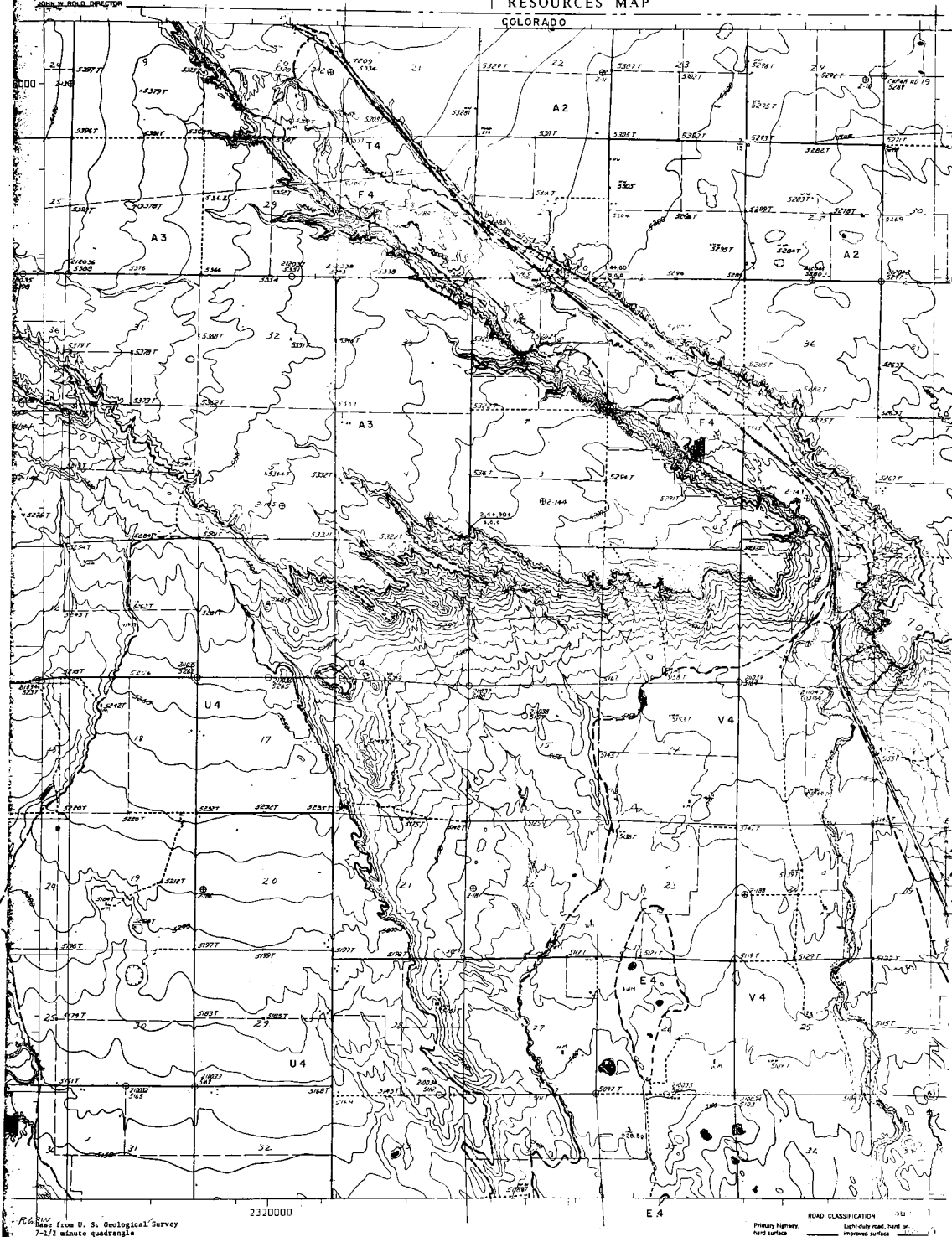
SAND, GRAVEL AND QUARRY AGGREGATE

GROVER 2NE

DEPARTMENT OF NATURAL RESOURCES  
 COLORADO GEOLOGICAL SURVEY  
 JOHN W. BOULDER DIRECTOR

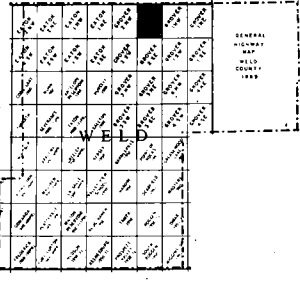
RESOURCES MAP

COLORADO



EXPLANATION

- Landform unit (Resource classification)
- LANDFORM UNIT**
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Erosional deposit (colluvial)
  - M Marine deposits (sand, silt, clay, etc.)
- RESOURCE CLASSIFICATION**
  - 1 **Gravel** (relatively clean and round)
    - 1 Gravelly significant (fine, decomposed rock, siliceous carbonates)
  - 2 **Fine Gravel** (gravel and fine sand)
    - 2 Gravelly significant (fine, decomposed rock, siliceous carbonates)
  - 3 Sand
  - 4 **Probable aggregate resource**
- AGGREGATE RESOURCE**
  - A Operative gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operative stone quarry
  - D Abandoned stone quarry
  - E Potential aggregate resource area
  - F Selected well or drill-hole location with overburden thickness (1) over sand/gravel, numerous testholes (2), obtained from well logs.
    - "s" indicates gravel, "f" indicates sand
    - "r" in upper column unmineralized or unknown property
    - "m" denotes Colorado Geological Survey "Detailed Sand and Gravel Project"
  - G Landform boundary, solid where known or observed, dashed where approximate or inferred
- SECTION LOCATION AND GEOLOGICAL DESCRIPTION OF RESOURCES**
  - Overburden thickness (ft)
  - Overburden thickness (ft)
  - Percent sand and fines (percent of screen, 0.075 in., 20 mesh)
  - Approximate amount of flow (cubic feet per second, 0.016 cu. ft. or 0.454 m<sup>3</sup>)
  - Approximate amount of material available (cubic feet)
  - "s" in upper column unmineralized or unknown property
  - "r" in upper column unmineralized or unknown property



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Weist, W.C., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgwick, and Weld Counties, Colo.; U. S. Geol. Survey Water-Supply Paper 1809-L, pl. 1.

Mapped by: Ralph R. Stroba  
 Date: June 30, 1974

ROAD CLASSIFICATION

- Primary highway, hard surface
- Light duty road, hard or improved surface
- Secondary highway, hard surface
- Unimproved road
- Interstate Route
- U. S. Route
- State Route

CONTOUR INTERVAL 10 FEET

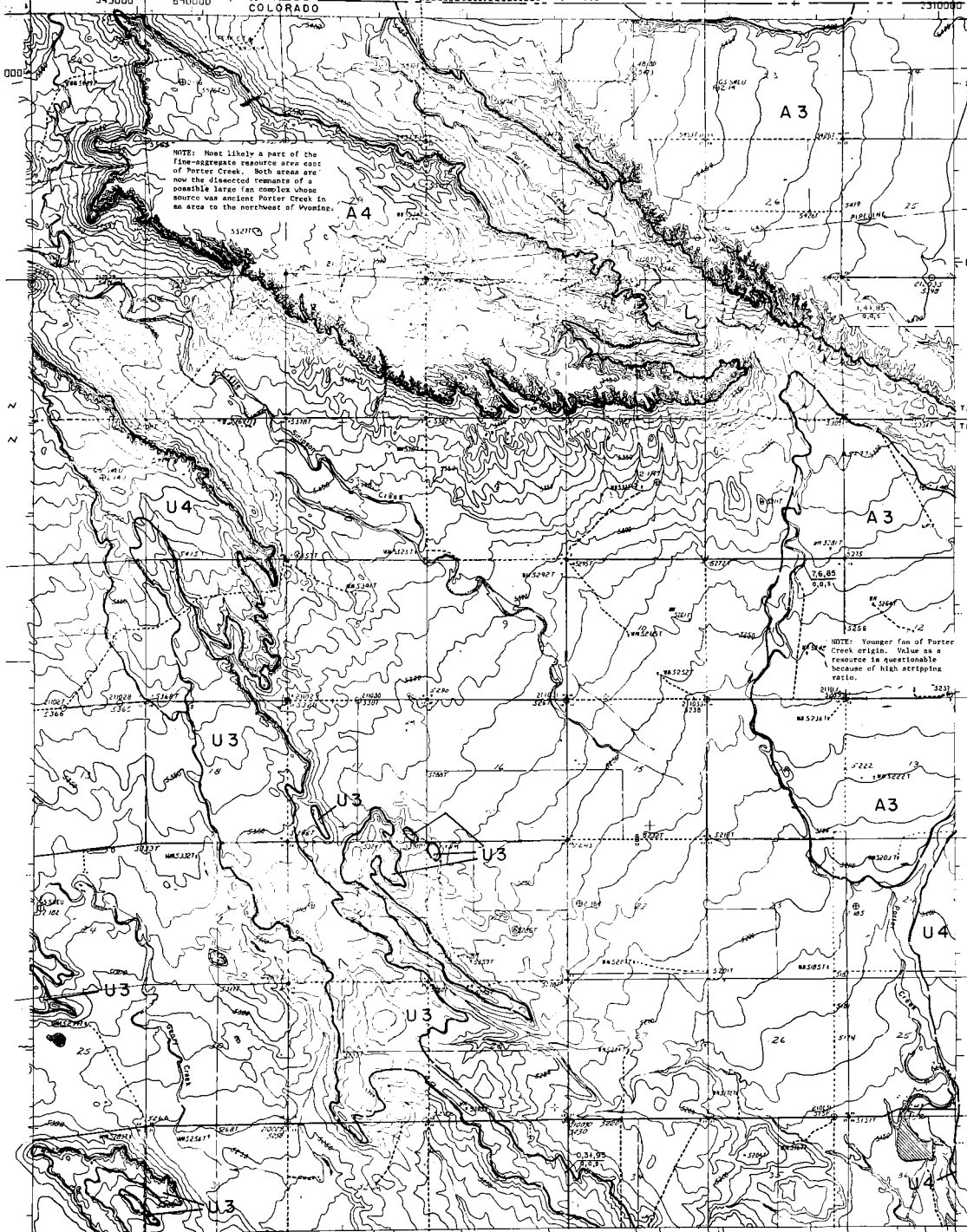


SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

GROVER 2 NW

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

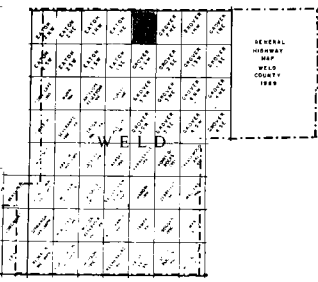


NOTE: Most likely a part of the fine-aggregate resource area east of Porter Creek. Both areas are now the dissected remnants of a possible large fan complex whose source was ancient Porter Creek in an area to the northwest of Wyoming.

NOTE: Number fan of Porter Creek origin. Value as a resource is questionable because of high strip-ratio ratio.

EXPLANATION

- LANDFORMS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - C Wind-deposited sand (alluvial)
  - M Hummock deposits (relating to, etc.)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, occasional rock, medium to coarse
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
  - Operable gravel under sand pit
  - Abandoned gravel under sand pit
  - ⊙ Operable stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Selected well or drill-hole location with open-bottom lithology (if open and/or ground resources unknown (if), selected from well log.
  - " " Indicates gravel. " " indicates sand
  - " " in unopen, unmineralized or unknown prospect
  - " " denotes Colorado Geological Survey Water/Ground and Ground prospect
  - ▭ 100 ft. scale
  - ▭ Land-use boundary, solid white known or observed, dashed where approximate or inferred.
- STATION, LOCATION AND OBSERVATIONAL DESCRIPTION OF DEPOSIT**
  - 100-foot thickness (ft)
  - 100-foot resource thickness (ft)
  - percent sand and fines (spacing of number, 0-100 (%), actual percentage)
  - Significant amount of fines (spacing of 100, 0-100 (%), or 0-25 ft. in.)
  - Significant amount of unopen or small rock
  - Significant amount of medium to coarse (spacing of 100, 0-100 (%), or 0-25 ft. in.)
  - " " in symbol denotes unmineralized or unknown prospect
  - " " in symbol denotes property absent or insignificant



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Meist, W.C., Jr., 1965. Reconnaissance of ground-water resources in part of Larimer, Logan, Morgan, Sedgwick, and Weld Counties, Colo.: U. S. Geol. Survey Water-Supply Paper 1809-B, pl. 1.

Mappea by: Stephen D. Schwachow  
 Date: June 30, 1974

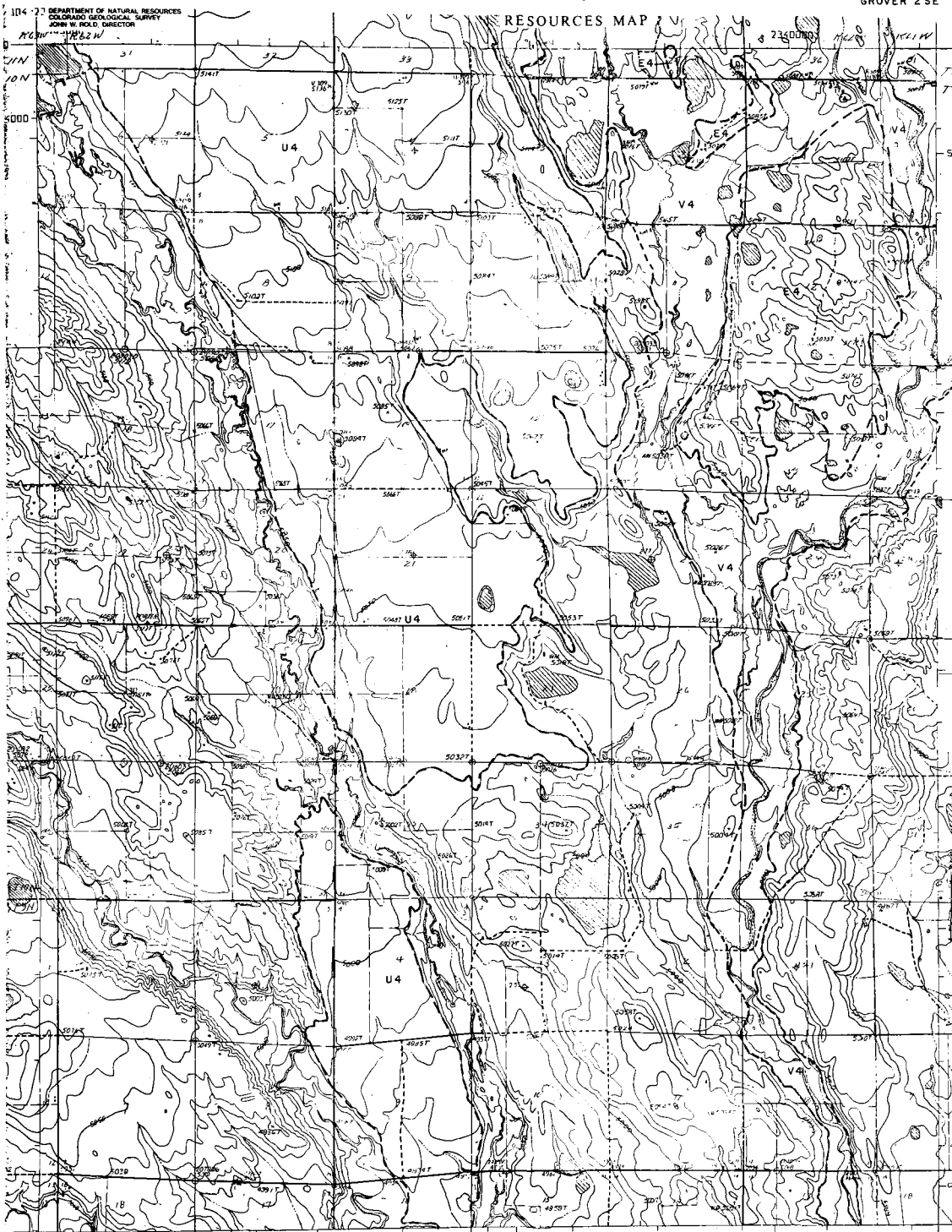
ROAD CLASSIFICATION  
 Primary highway: solid surface  
 Secondary highway: hard surface  
 Light-duty road, hard surface  
 Improved surface  
 Unimproved road  
 Interstate Route  
 U. S. Route  
 State Route

CONTOUR INTERVAL: 10 FEET

GROVER 2 NW (01)  
 75 MINUTE SERIES (TOPOGRAPHIC) A.F.C.

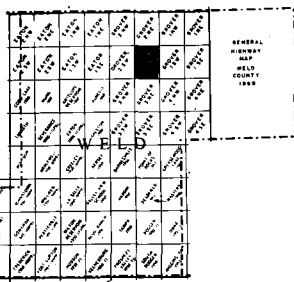
SAND, GRAVEL AND QUARRY AGGREGATE

GROVER 2 SE



EXPLANATION

- Landform unit
- Resource classification
- LANDFORM UNIT**
  - F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (dams, levees, spoil...)
- RESOURCE CLASSIFICATION**
  - Gravel Deposits** (as listed on 25' contour on 64 square, interval estimated)
    - 1 Gravel: relatively clean and small
    - 2 Gravel: significant fines, unrounded rock, calcareous
  - Sand Deposits** (interval on 25' contour on 64 square, interval estimated)
    - 3 Sand
  - Reclaimed Aggregate**
    - 4 Probably aggregate resource
- USE STATUS**
  - \* Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Abandoned stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area (shaded with 40% hatched location with present location (10%); shaded from well logs "X" indicates gravel; "Y" indicates sand "Z" in symbol denotes unclassified or unknown quantity)
  - "\* American Geological Survey (ASGS) Sand and Gravel project" (1971)
  - Landform boundary, solid where known or observed; dashed where approximate in literature
- STATUS, LOCATION AND CATALOGUE INFORMATION**
  - non-resource (classroom) (1)
  - sand/gravel resource (classroom) (2)
  - present sand and flow (contour 40' interval, 0.25 in. 1', interval estimated)
  - significant amount of fines (spacing 1000 square, 0.25 in. on 0.25 in.)
  - significant amount of dumped or wash rock
  - significant amount of calcareous carbonate (caliche)
  - "\* in symbol denotes unclassified or unknown property
  - "\* in symbol denotes property about or under litigation



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

R 62 W 1  
Base from U. S. Geological Survey  
7-1/2 minute quadrangle

232000

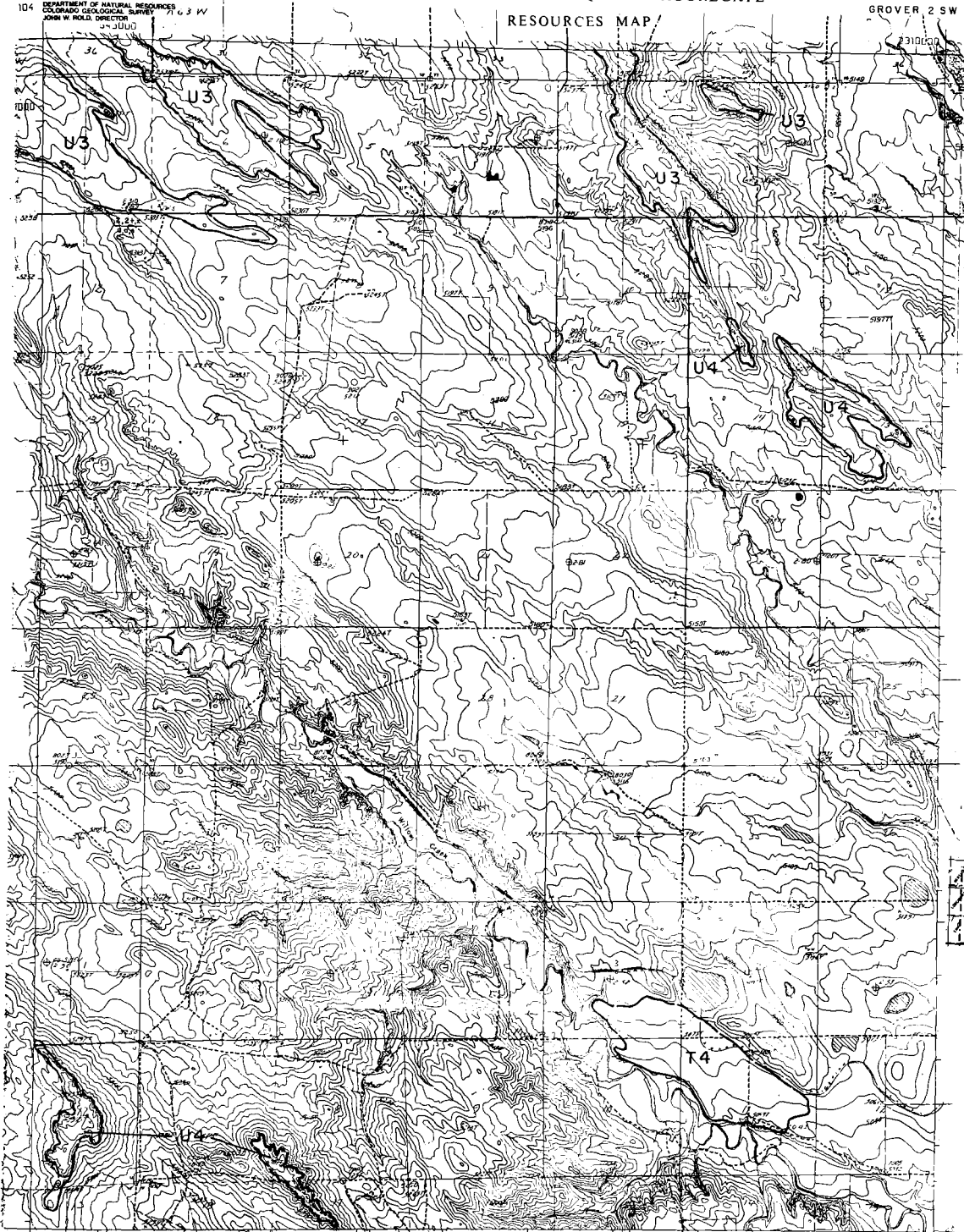
CONTOUR INTERVAL 10 FEET

ROAD CLASSIFICATION 563000  
Primary highway: hard surface  
Secondary highway: hard surface  
Unimproved road  
Interstate Route U S. Route State Route

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

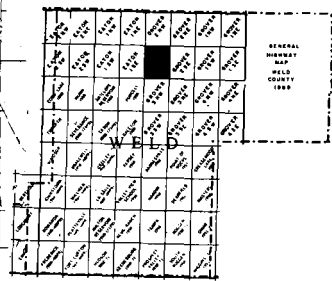
GROVER 2 SW

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



EXPLANATION

- Contour interval  
Reference classification
- LEGEND**
- F Floodplain deposit
  - T Sandstone deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Hummock deposits (slag tailings, etc.)
- RESOURCE CLASSIFICATION**
- CLASS 1**  
Crown aggregate (top 1000 feet) (see page 105 for details)
- 1 Crown: relatively clean and sound
  - 2 Crown: significant fines, decomposed fine section (crustacean)
- CLASS 2**  
Fine aggregate (greater than 100 passing to screen, 65% retained on 20" screen, small amounts)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Collected soil or drill hole location with number
  - Number of thickness (ft) over significant resource
  - Thickness (ft) of sandstone from well logs
  - "u" indicates gravel; "s" indicates sand
  - "u" in symbol denotes unconsolidated or unknown provenance
  - "u" in symbol denotes Geological Survey (Sandstone and Gravel project) drill hole
  - Leaflet boundary, solid where known by otherwise: dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATIONAL**
- SYMBOLS OF RESOURCES**
- Interbedded thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Gravel, sand and fines (passing 60 screen, 20" to 60") mixed sediment
  - Significant amount of fines (passing 200 screen, 2.0 to 60")
  - Significant amount of decomposed or weak rock
  - Significant amount of solution carbonate (calcite)
  - "u" in symbol denotes unconsolidated or unknown provenance
  - "u" in symbol denotes property absent or insufficient



QUADRANGLE LOCATION  
NON-RESOURCE OR VETERAN AREA

Mapped by: Stephen D. Schuchow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

ROAD CLASSIFICATION

- Primary highway: hard surface
- Light duty road, hard improved surface
- Secondary highway: hard surface
- Unimproved road
- Trail
- U. S. Road
- State Route

CONTOUR INTERVAL 10 FEET

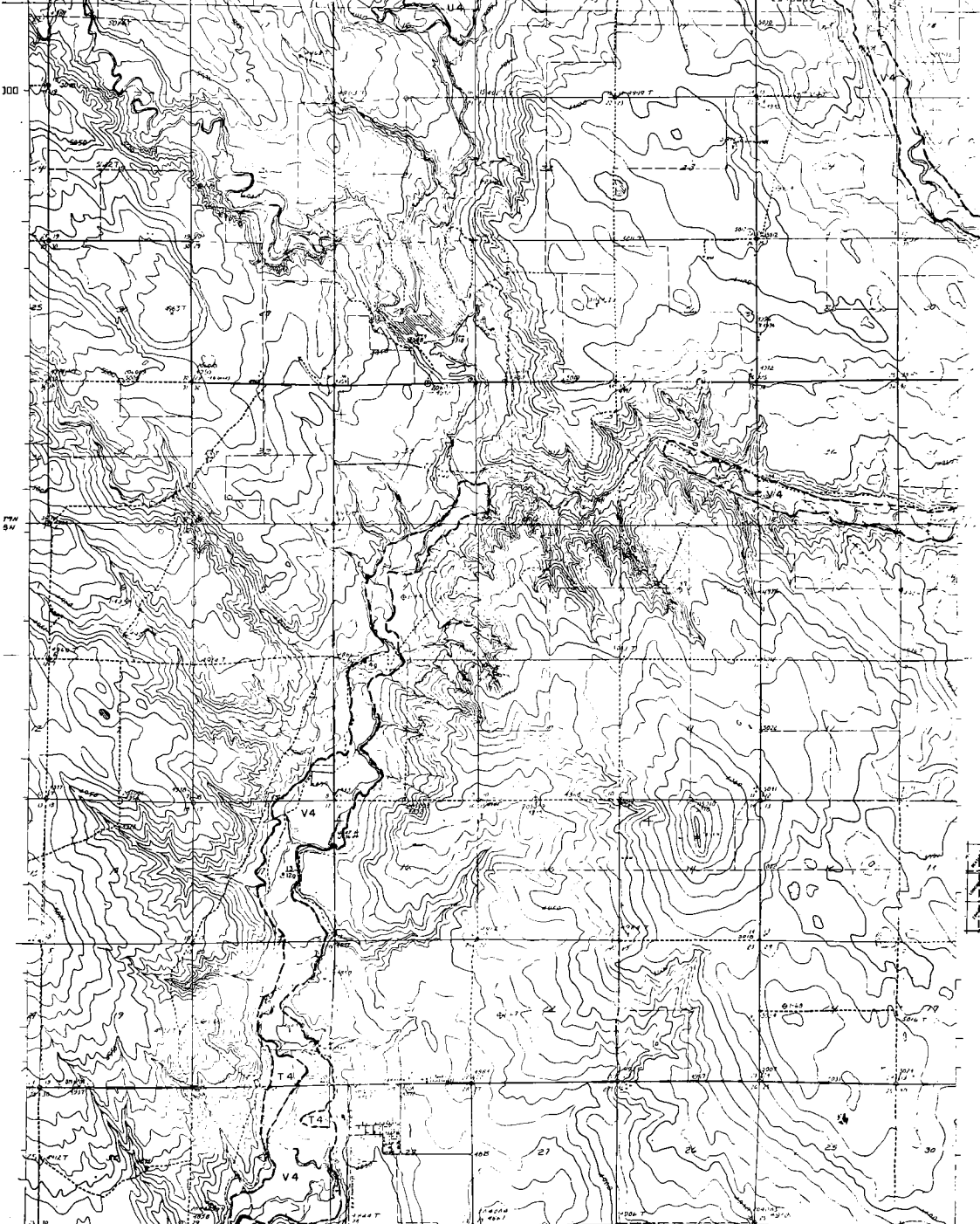


SAND, GRAVEL AND QUARRY AGGREGATE

GROVER 3 NE

RESOURCES MAP

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



EXPLANATION

- Landform units  
 Resource class/Function
- LITHOLOGICAL UNITS**
- F Fluvialite deposit
  - T Tuvaa terrace deposit
  - V Valley fill (F & T)
  - U Unalut deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Nonmarine deposits (slag, tailings, waste, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (at least 20% retained on #4 screen, 40% at least)
- 1 Coarse: relatively clean and sound
  - 2 Coarse: significant fines, decomposed rock, calcium carbonate
- Fine Aggregate**  
 (greater than 75% passing #4 screen, 60% retained on #20 screen, 100% at least)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - ◉ Abandoned gravel and/or sand pit
  - ◉ Operating stone quarry
  - ◉ Abandoned stone quarry
  - ◉ Potential quarry aggregate resource area
  - ◉ Selected well or drill-hole location with overburden thickness (ft) and gravel/gravel resource thickness (ft); shaded from well logs.
  - " " indicates gravel; " " indicates sand
  - " " in symbol denotes unevaluated or unknown property
  - " " denotes Colorado Geological Survey drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- FLUTTER, LOCATION AND ORIENTATION**
- CLASSIFICATION OF DEPOSIT**
- nonburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - gravel sand and fines (passing #4 screen, # 20 in.), gravel restriction
  - significant amount of fines (passing #40 screen, # 20 in. or 0.075 mm.)
  - significant amount of decomposed or weak rock
  - " " in symbol denotes unevaluated or unknown property
  - " " in symbol denotes property absent or Geologic/owner



- ◼ QUADRANGLE LOCATION
- ◼ NON-RESOURCE OR WITHEARN AREA

Mapped by: Ralph S. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle  
 2320000

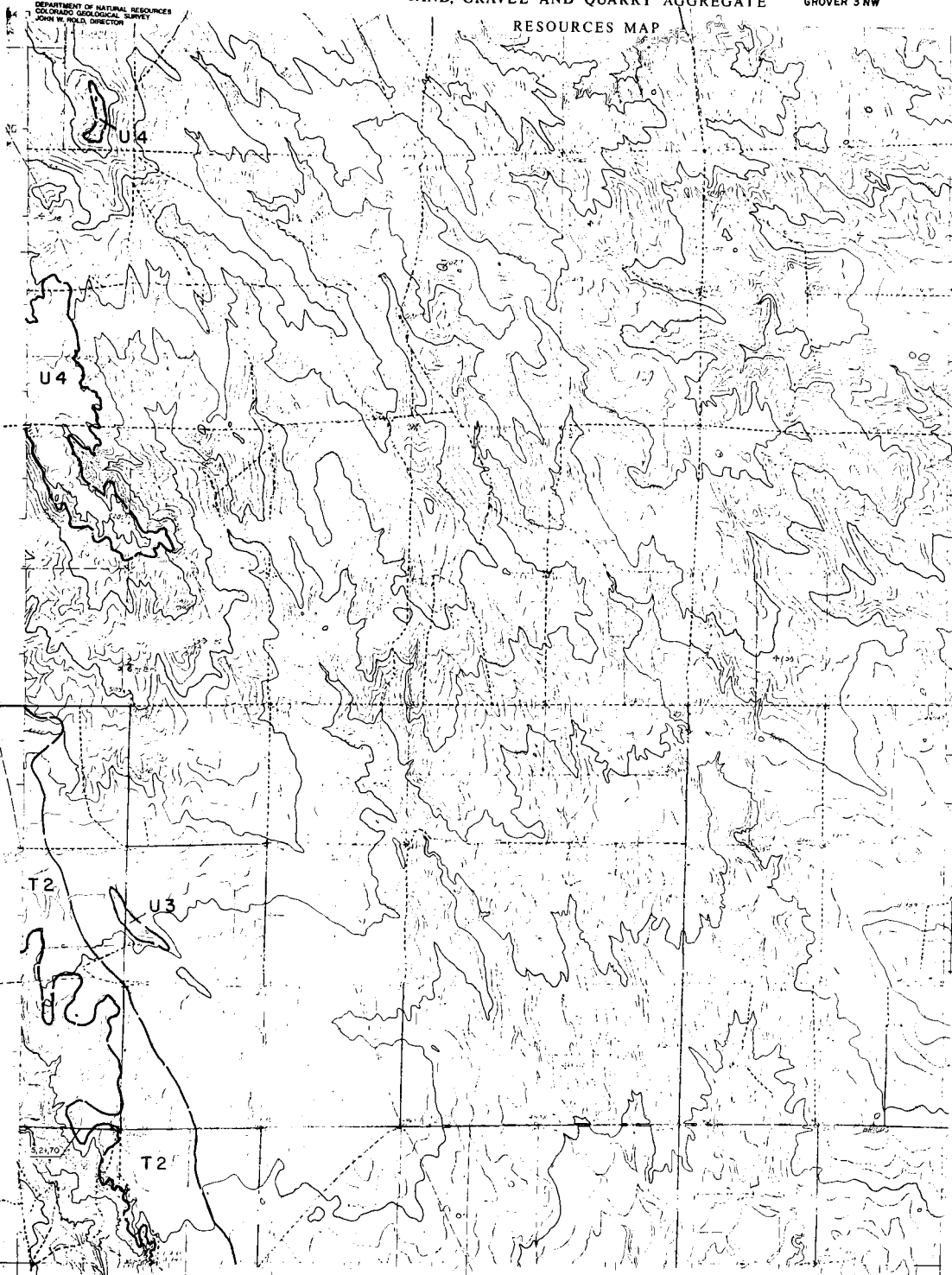
- ROAD CLASSIFICATION**
- Primary highway: hard surface
  - Light duty road: ASP or improved surface
  - Secondary highway: hard surface
  - Unimproved road
  - Interstate Route
  - U. S. Route
  - State Route

CONTOUR INTERVAL: 10 FEET

SAND, GRAVEL AND QUARRY AGGREGATE GROVER 3 NW

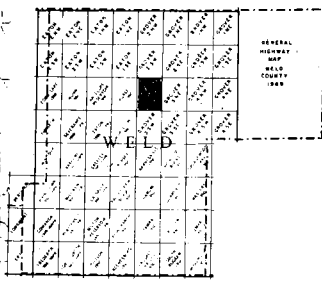
RESOURCES MAP

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



EXPLANATION

- Contour unit
  - Resource classification
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - W Valley fill (F & T)
  - U Upland units
  - A Alluvial fan
  - E Wind-deposited sand (alluvial)
  - M Man-made deposits (levees, dikes, levees, ...)
- RESOURCE CLASSIFICATION**
- Class: SANDS**  
 (as defined by the U.S. Army Corps of Engineers, 1954, p. 100)
- 1 Coarse, relatively clean and round
  - 2 Gravel, significant (50%, decomposed rock, calcium carbonate)
- Class: GRAVELS**  
 (as defined by the U.S. Army Corps of Engineers, 1954, p. 100)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - ▭ Abandoned gravel and/or sand pit
  - ▭ Operating stone quarry
  - ▭ Abandoned stone quarry
  - ▭ Potential quarry aggregate resource area
  - ▭ Selected well or drill-hole location with water-bearing thickness (ft) and sand/gravel resource thickness (ft), obtained from well logs.
  - ▭ "A" indicates gravel; "S" indicates sand
  - "I" in symbol denotes unwatered or shallow property
  - "M" denotes Colorado Geological Survey "Mineral Land and Groundwater" project
  - ▭ Well hole
  - ▭ Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATUS, LOCATOR AND GEOLOGICAL DESCRIPTION OF WELLS**
- water-bearing thickness (ft)
  - sand/gravel resource thickness (ft)
  - ground water and flow (spacing of arrows, 1/2 in. = 1,000 gal/min)
  - Significant amount of fines (spacing 1/2 in. = 1000 lb, or 0.25 cu yd)
  - Significant amount of calcium carbonate (dots)
  - "I" in symbol denotes unwatered or shallow property
  - "M" in symbol denotes property shared or disputed



- ▭ QUARRY/PILE LOCATION
- ▭ NON-RESOURCE OR UTILIZATION AREA

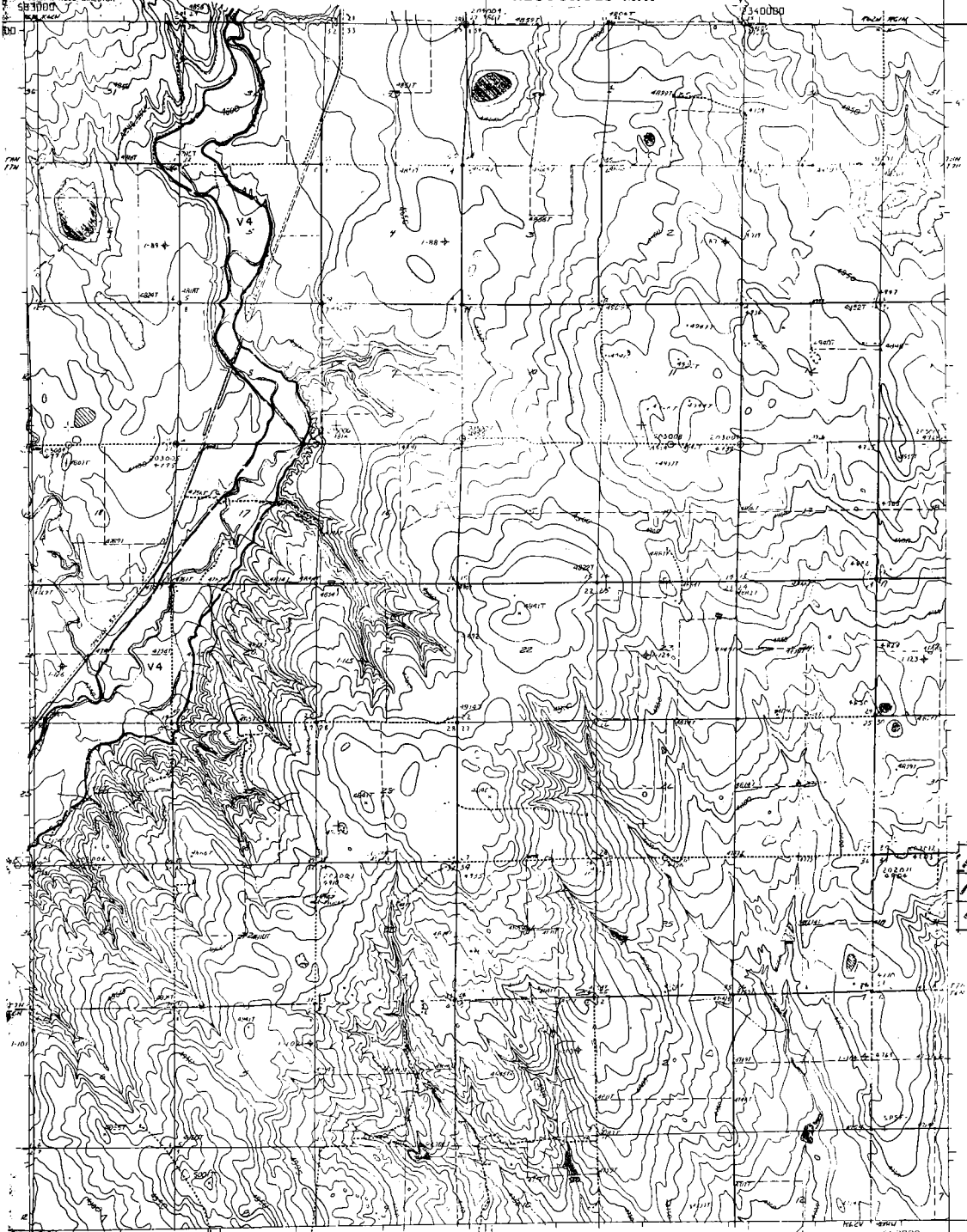
Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

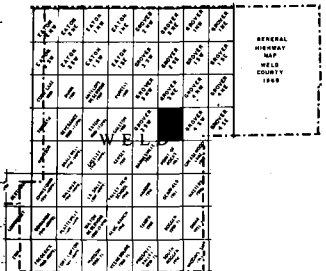
GROVER 3 SE

DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. WELD DIRECTOR



EXPLANATION

- Landform units  
Measure of classification
- LANDFORM UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fills (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Non-depositional land (bedrock)
  - M Man-made deposits (slag, tailings, waste, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
for road use (based on 48 screen, actual estimation)
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, actual estimation
- Fine Aggregate**  
for road use (based on 20 screen, 48 screen, and 100 screen, actual estimation)
- 3 Sand
  - 4 Probable aggregate resource
- QUARRY**
- A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Potential quarry aggregate resource area
  - F Selected well or drill hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - G "Limestone gravel," "L" indicates sand
  - H "L" symbol denotes unutilized or unknown property
  - I "M" denotes Colorado Geological Survey "Master/Lead and Control" status
  - J Drill hole
  - K Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATES, LOCATIONS AND COORDINATE DESIGNATION OF SPOTS**
- contour thickness (ft)  
sand/gravel resource thickness (ft)  
percent sand and fines (percent of screen, 0.75 in.), actual estimation
- light/faint amount of fines (passing 100 screen, 0.075 in. or 0.075 mm.)  
significant amount of decomposed or weak rock.  
light/faint amount of relative carbonate fraction  
unknown property  
"M" in symbol denotes property absent  
"G" in symbol denotes property absent



Mapped by: Phillip C. Wicklets  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

ROAD CLASSIFICATION

Primary highway: hard surfaced  
Lightly road, hard surfaced  
Secondary highway: hard surfaced  
Unimproved road  
Interstate Route  
U.S. Route  
State Route

CONTOUR INTERVAL 10 FEET

GROVER 3 SE 11AFC

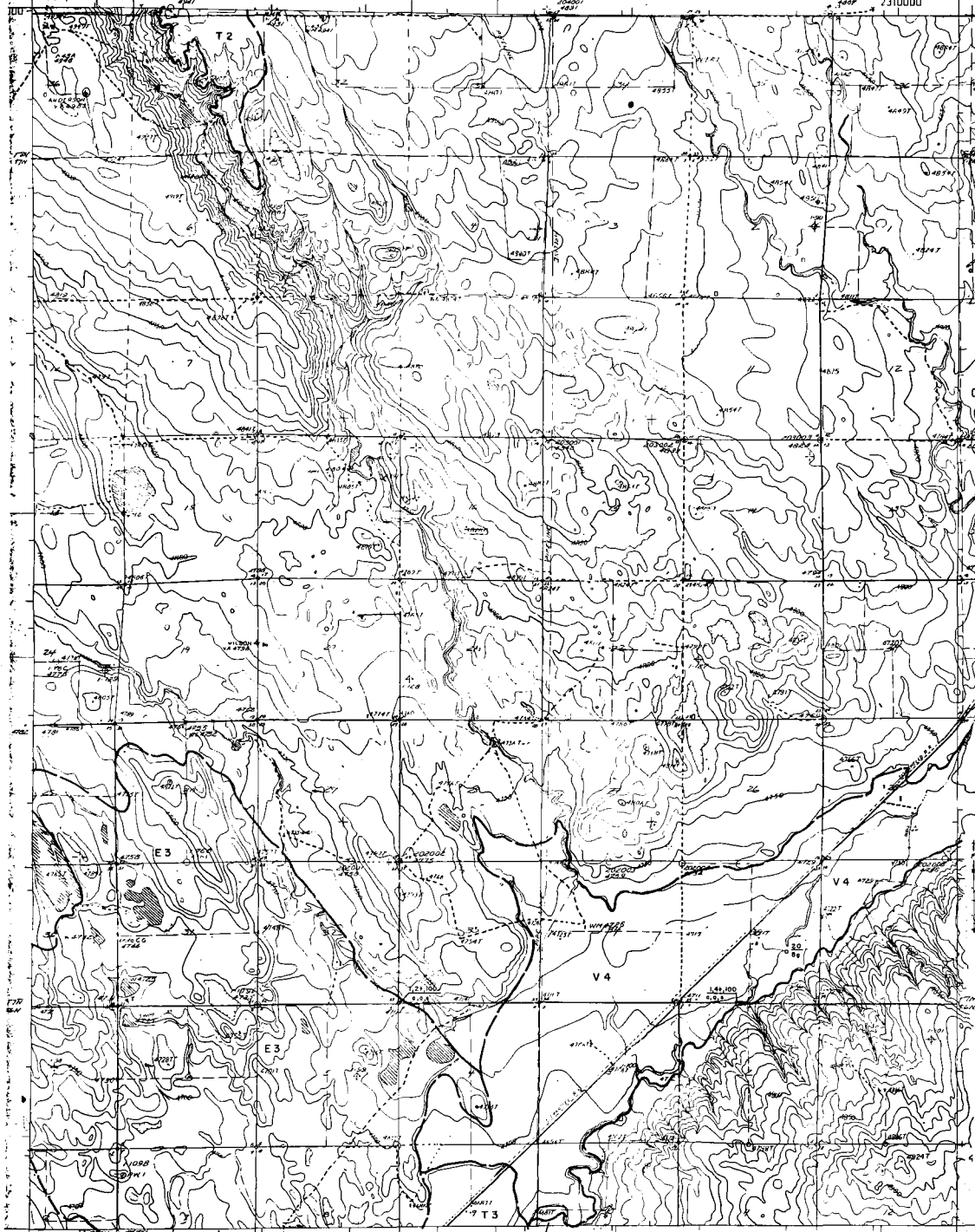


SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

GROVER 3 SW

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



EXPLANATION

Contour interval  
 Resource classification

MAPPING UNIT

- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
- U Unwind deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Non-made deposits (lake, caliche, siltstone...)

RESOURCE CLASSIFICATION

- 1 **COARSE GRAVELS**  
 (at least 50% retained on #4 screen, visual estimation)
- 2 Gravel: relatively clean and smooth
- 3 Gravel: irregularly shaped, decomposed rock calcine carbonate
- 4 **FINE GRAVELS**  
 (greater than 10% passing #4 screen, 60% retained on #20 screen, visual estimation)
- 5 Sand
- 6 **Unutilized Resource**
- 7 Probable aggregate resource

MAP SYMBOLS

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource
- Circle size (ft) obtained from well logs
- "T" indicates gravel; "S" indicates sand
- "U" in symbol denotes unutilized or unknown property
- "W" denotes Colorado Geological Survey Water/Soil and Cretal projects
- 4011 mile
- Location boundary, with where known or observed, shown where approximate or inferred

STATION LOCATION AND GEOLOGICAL CLASSIFICATION OF SYMBOLS

- Sand/gravel thickness (ft)
- Sand/gravel resource thickness (ft)
- Percent sand and fines (passing #4 screen, 0.30 in.), visual estimation
- Significant amount of fines (passing #20 screen, 0.0075 in. or 0.075 mm.)
- Significant amount of decomposed or weak rock
- Significant amount of calcine carbonate (caliche)
- "U" in symbol denotes unutilized or unknown property
- "W" in symbol denotes property shown or investigated



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wickles  
 Date: June 30, 1974

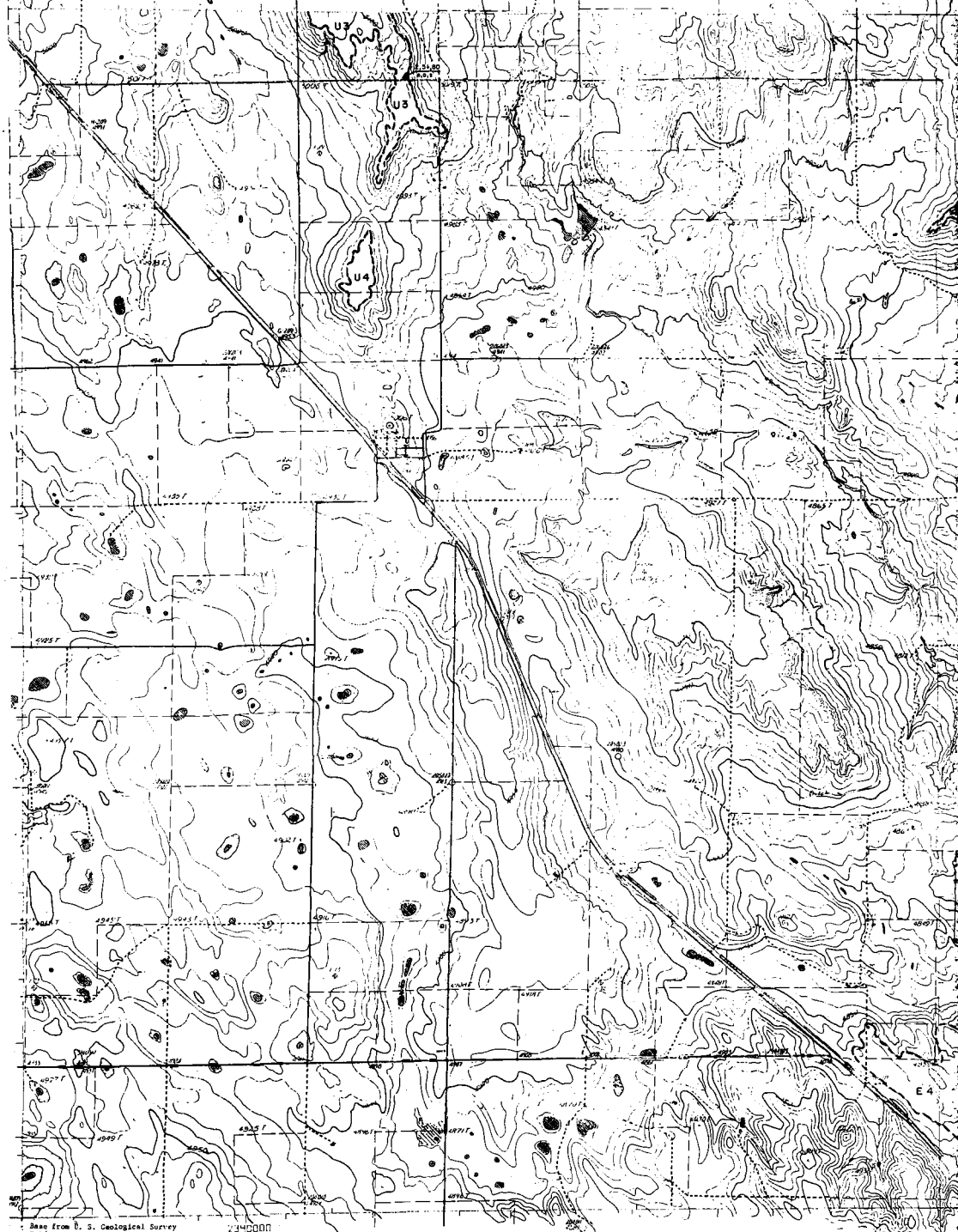
2280000  
 Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET

ROAD CLASSIFICATION  
 Primary highway: Light duty road, hard surface  
 Secondary highway: Unimproved road  
 Interstate Route U.S. Route State Route

SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP GROVER 4 NE

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



EXPLANATION

- Landform units  
 Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
 (at least 20 percent on 84 screen, usual extraction)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Fine Aggregate**  
 (greater than 75 percent 84 screen, 25 retained on 100 screen, usual extraction)
- 3 Sand
  - 4 Partially decomposed aggregate
  - 5 Probable aggregate resources
- MAP SYMBOLS**
- \* Operating gravel and/or sand pit
  - ⊙ Abandoned gravel and/or sand pit
  - ⊙ Abandoned stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Relative well or drill-hole location with measured thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - ⊙ "f" indicates gravel; "s" indicates sand
  - "s" in symbol denotes unutilized or unknown property
  - "w" denotes Colorado Geological Survey Modified/Used and Crowned projects
  - ⊙ Well hole
  - Landform boundary, solid shows known or observed; dashed shows approximate or inferred
- SYMBOL, LOCATION AND ORIENTATION**
- DESCRIPTION OF SYMBOLS**
- meowhite thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (greater 84 screen, 0.075 in.), usual extraction
  - Light/floest amount of fines (greater 100 screen, 0.002 in. or 0.075 mm.)
  - significant amount of decomposed or weak rock
  - significant amount of calcium-carbonate (calcite)
  - "s" in symbol denotes unutilized or unknown property
  - "w" in symbol denotes property shown as unutilized



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Meier, W.C., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colo.: U. S. Geol. Survey Water-Supply Paper 1609-1, p. 1.

Mapped by: Ralph B. Shroba  
 Date: June 30, 1974

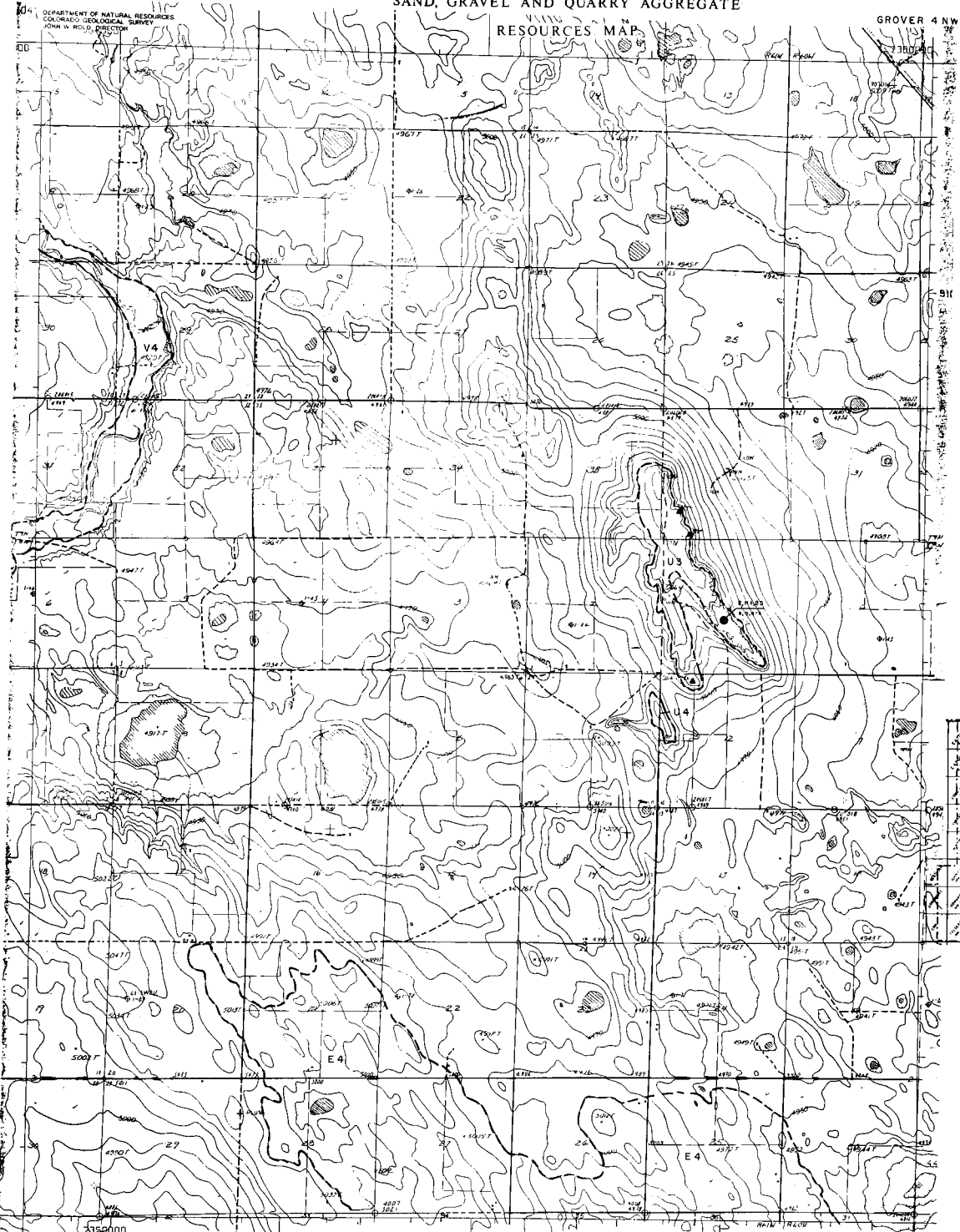
Base from U. S. Geological Survey 7-1/2 minute quadrangle 734000

# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

GROVER 4 NW

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



### EXPLANATION

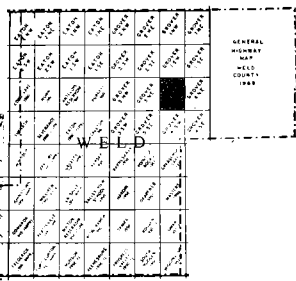
Contour interval  
 Contour classification

- MAPPER'S DATA**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposit
  - A Alluvial fan
  - E Wind-blown sand (eolian)
  - M Mudslope deposit (slag, tailings, spalls...)

- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (as found, not processed or reworked, actual extraction)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Fine Aggregate**  
 (material less than 75 passing #20 screen, dry, reduced to 100 percent, actual extraction)
- 3 Sand
  - 4 Probable aggregate resource

- WELL SYMBOLS**
- Operating gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable heavy aggregate resource area
  - Reclaimed well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); obtained from well logs
  - "I" indicates gas; "M" indicates mud
  - "U" in symbol denotes unconsolidated or unknown resource
  - "W" denotes Colorado Geological Survey drill hole
  - Landline boundary, solid where known or inferred; dashed where approximate or inferred

- STATUS, LOCATION AND GEOLOGICAL SIGNIFICANCE OF SYMBOL**
- overburden thickness (ft)
  - reworked resource thickness (ft)
  - correct sand and gravel spacing by screen, 0.25 in. x, actual extraction
  - significant amount of fines (passing #100 screen, 0.075 in. or 0.075 mm.)
  - significant amount of decomposed or weak rock
  - significant amount of soluble carbonate (calcium carbonate)
  - "U" on symbol denotes unconsolidated or unknown property
  - "W" on symbol denotes property, status or uncertainty



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

Scale from U. S. Geological Survey  
 7-1/2 minute quadrangle

**ROAD CLASSIFICATION**

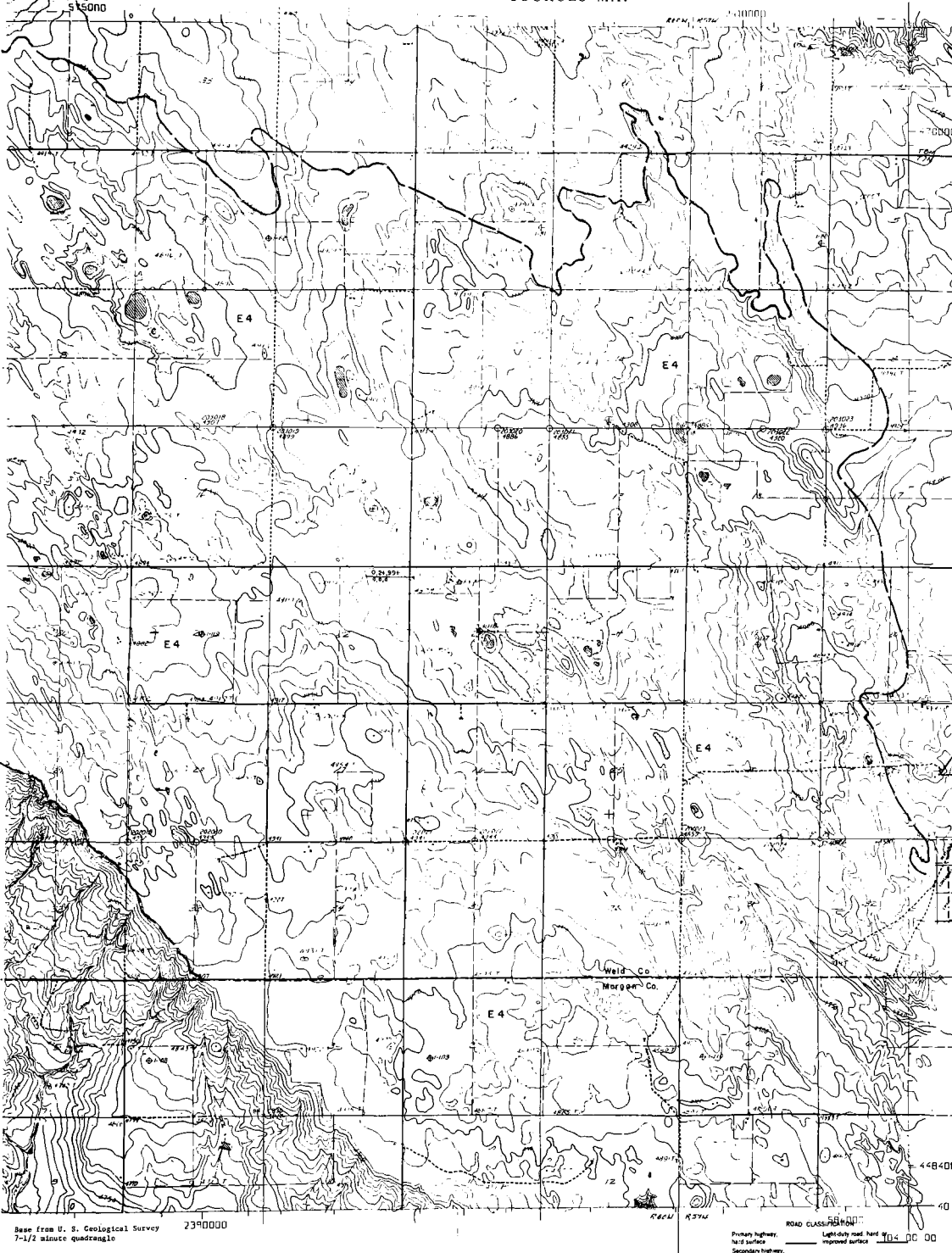
Primary highway: Light-duty road, hard or improved surface  
 Secondary highway: Unimproved road  
 Interstate Route: U.S. Route: State Route

CONTOUR INTERVAL: 10 FEET



SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

GROVER 4 SE



EXPLANATION

- Sand with resource classification
- LANDFORMS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-mine deposit (dike, tailings, waste, ...)
- RESOURCE CLASSIFICATION**
  - 1 Class: relatively clean and sound
  - 2 Class: significant fines, decomposed, calc. carbonate
  - 3 Sand
  - 4 Probable aggregate resources
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Relieved well or fill-hole location with associated thickness (ft) over sand/gravel resource
  - Thickness (ft) obtained from well logs
  - "S" indicates gravel, "G" indicates sand
  - "L" symbol denotes unvestigated or unknown property
  - "M" denotes Colorado Geological Survey Material Used and Gravel project's drill hole
  - Landform boundary, solid where known or dashed where approximate or inferred
- POSITION, LOCATION AND COORDINATE INFORMATION**
  - contour interval (ft)
  - contour interval (ft)
  - permanent road and fence (spacing 40' or more, 0.10 mi., 0.05 mi. section)
  - significant amount of fines (spacing 200' across, 2.00 mi. or 0.10 mi.)
  - significant amount of decomposed or weak rock
  - significant amount of calcareous material or within property
  - "L" in symbol denotes unvestigated or unknown property
  - "M" in symbol denotes property absent or investigated

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

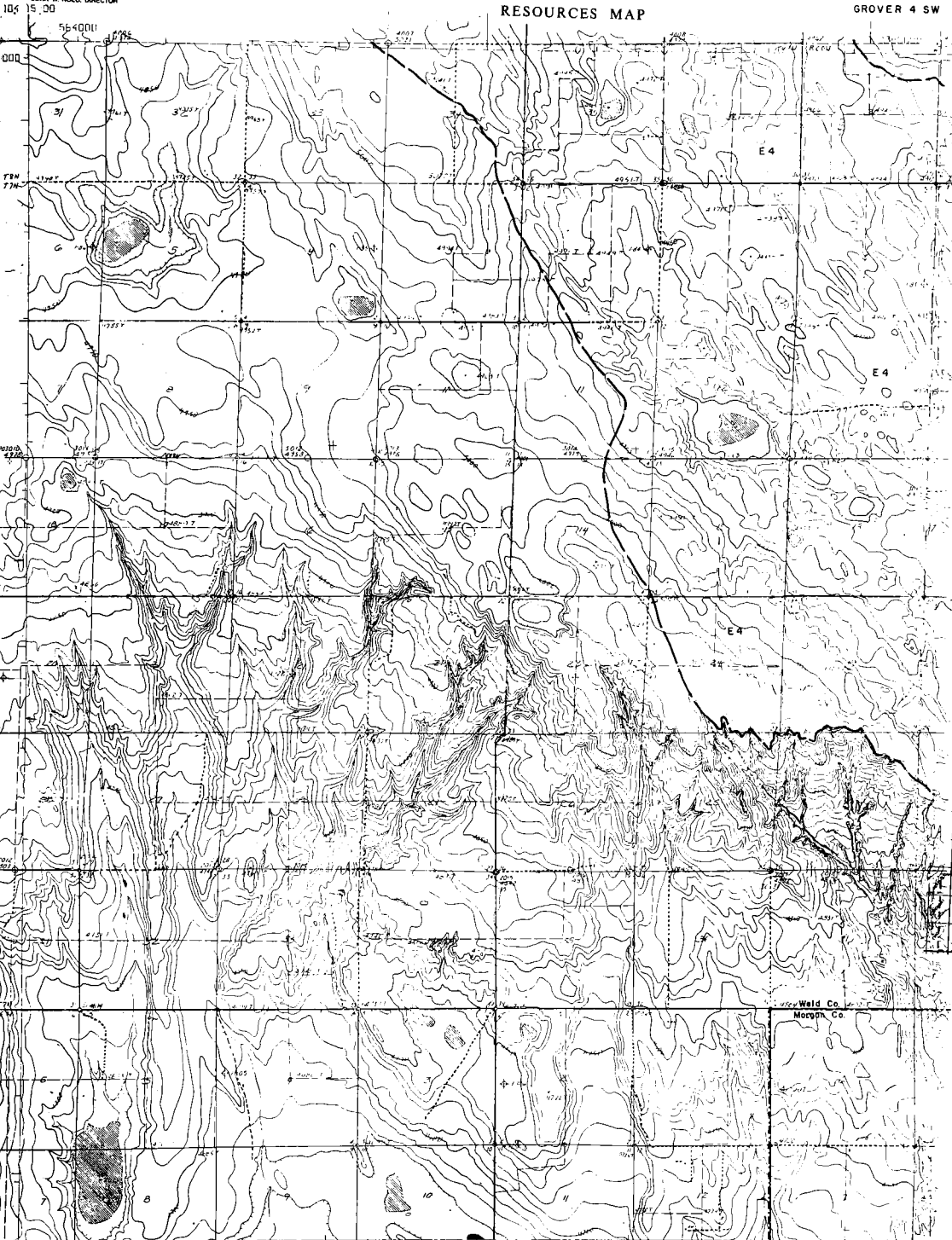
Base from U. S. Geological Survey 2390000  
 7-1/2 minute quadrangle

**ROAD CLASSIFICATION**  
 Primary highway, hard surface  
 Secondary highway, hard surface  
 Light-duty road, hard or improved surface  
 Unimproved road  
 Interstate Route U.S. Route State Route

CONTOUR INTERVAL, 10 FEET

SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

GROVER 4 SW



EXPLANATION

- CONTOUR**  
 Contour interval 10 feet
- LANDFORMS**  
 F Floodable deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Wind deposits  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Non-mud deposits (shale, siltstone, etc.)
- RESOURCE CLASSIFICATION**  
 (as listed on map unless otherwise indicated)  
 1 Coarse: relatively clean and sound  
 2 Coarse: significant fines, decomposed rock, calcareous  
 3 Fine aggregate  
 4 Possible aggregate resource
- ROAD CLASSIFICATION**  
 Opened gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Related well or drill-hole bottom log with overburden thickness (ft) and sand/gravel resource thickness (ft), obtained from well logs  
 "m" indicates mud; "s" indicates sand  
 "x" in symbol denotes unclassified or unknown aggregate  
 "m" denotes Colorado Geological Survey Waterflood and Gravel Project well logs  
 Landform boundary, solid where known or inferred; dashed where approximate or inferred
- FLATTON, LOCATION AND CHARACTERISTICS OF QUARRIES**  
 sand/gravel resource thickness (ft)  
 potential sand and fines (using 4% screen, 0.15 in.), usual restriction  
 significant amount of fines (using 200 screen, 0.0075 in. or 0.075 mm)  
 significant amount of abandoned or wash rock  
 significant amount of calcareous material  
 "m" in symbol denotes unclassified or unknown aggregate  
 "x" in symbol denotes property absent or unclassified



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR MITHRIMAN AREA

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974

**ROAD CLASSIFICATION**  
 Primary highway  
 Hard surface  
 Secondary highway  
 Hard surface  
 Light-duty road, hard or unpaved surface  
 Unimproved road  
 Interstate Route  
 U.S. Route  
 State Route

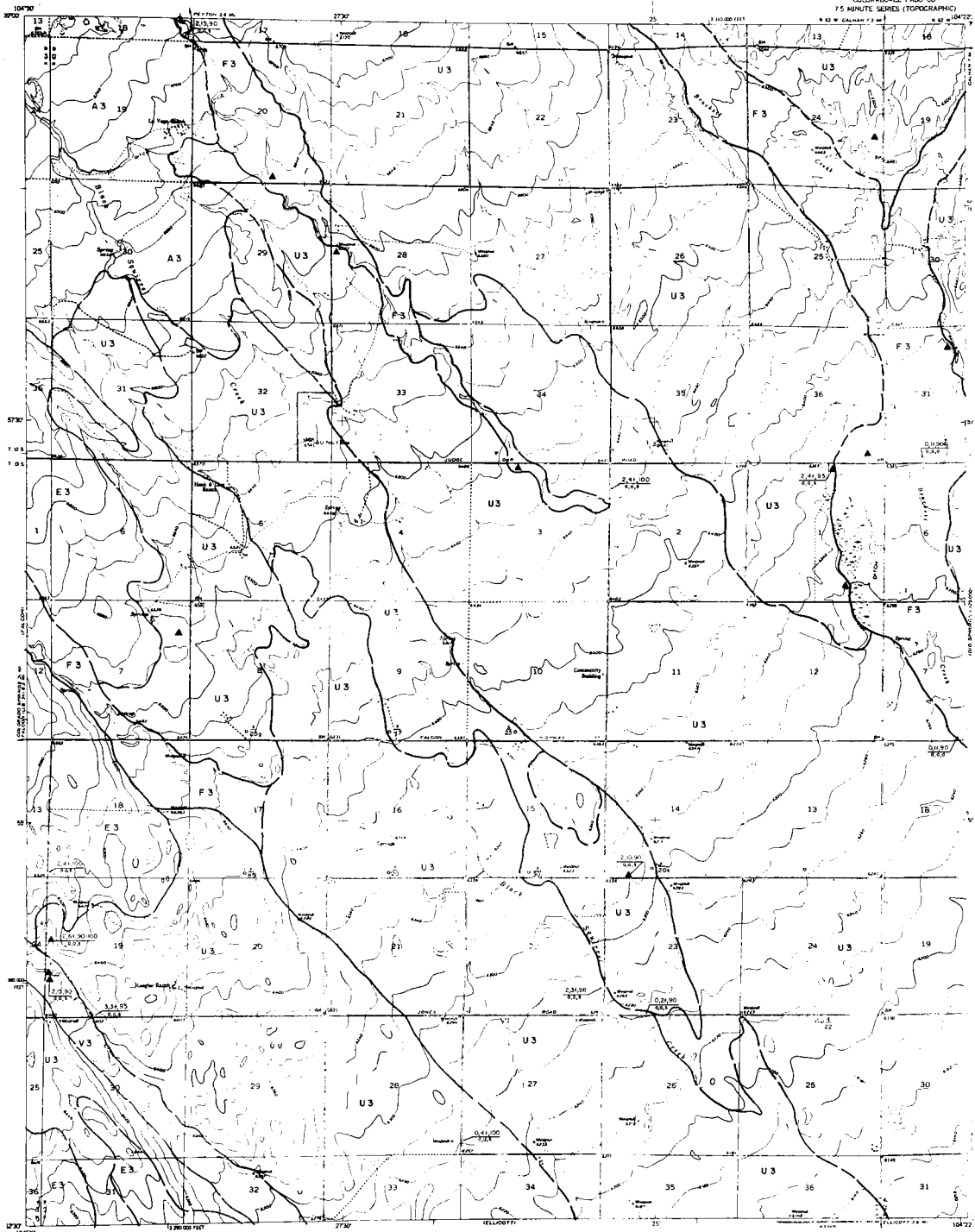
CONTOUR INTERVAL 10 FEET

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

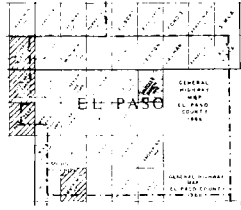
HAEGLER RANCH QUADRANGLE  
COLORADO-EL PASO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



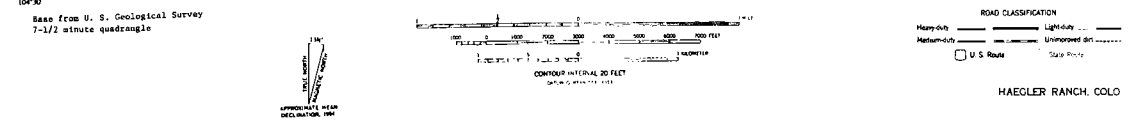
EXPLANATION

- Landform units
- Resource classification
- LOCALITY**
- W Well site
- T Screen surface deposit
- V Valley fill (F & T)
- U Unwind deposits
- A Alluvial fan
- E Erosional deposit and channel
- U Unwind deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel, relatively free and sound
- 2 Gravel, significant fines, increased wash, certain categories
- 3 Sand
- 4 Probable aggregate resource
- MAP SYMBOLS**
- Abandoned gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Relieved well or drilled-in location with overburden thickness (ft) over designated resource thickness (ft), obtained from well logs
- "\*" indicates gravel, "S" indicates sand
- "\*" in symbol denotes unclassified or unknown quantity
- "W" denotes Colorado Geological Survey Water/Food and Ground projects
- "E" in symbol denotes unclassified or unknown quantity
- Landform boundary, solid where known or dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
- Colorado-El Paso Co. Well site
- Well site, resource thickness (ft)
- Location and from contour at station, U.S. 24, visual estimate
- Approximate amount of fines (percent)
- 100' screen, 0.25 ft, or 0.75 ft
- Approximate amount of unclassified or unknown quantity
- Approximate amount of unclassified or unknown quantity
- "\*" in symbol denotes unclassified or unknown quantity
- "\*" in symbol denotes property status or classification



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schuchow  
Date: July 30, 1974



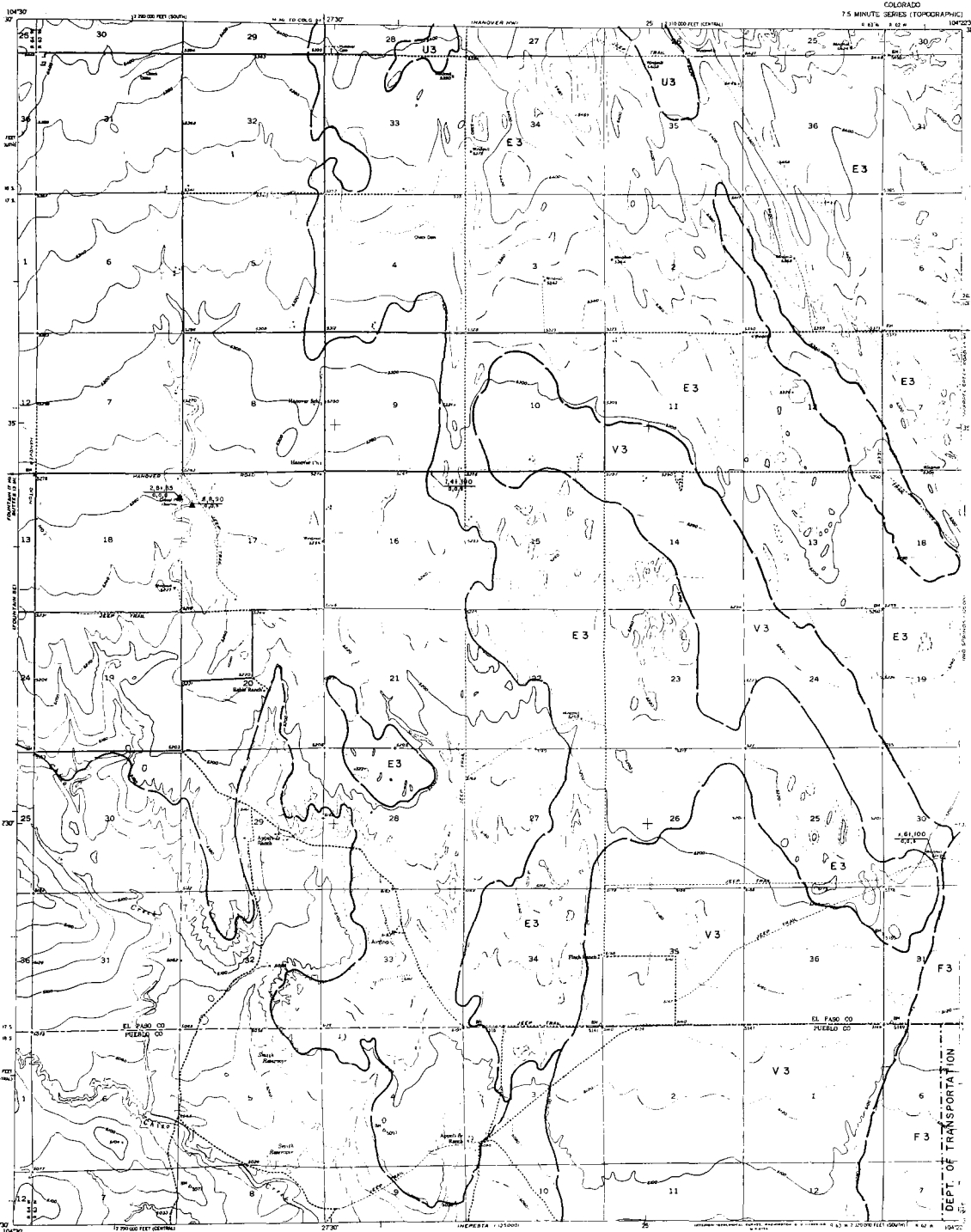
HAEGLER RANCH, COLO



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

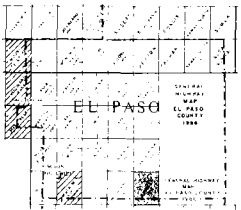
HANOVER QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
4 1/2" x 6 1/2" = 1" = 100,000'

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



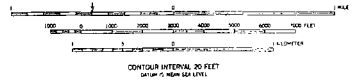
## EXPLANATION

- Resource Classifications**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (clay, siltstone, sandstone)
- ROAD CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, shallow surface
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Mineral well or drill-hole location with water
  - Mineral well or drill-hole location with sand/gravel resource
  - Mineral well, located from well logs
  - "m" indicates gravel; "s" indicates sand
  - "u" in symbol denotes unmineralized or unknown property
  - "m" denotes Colorado Geological Survey
  - Mineral location and gravel prospect
  - Drill hole
  - Landmark boundary, well data known or observed; dashed where approximate or inferred
- STATION, LOCATION AND CHRONOLOGICAL SIGNIFICATION OF SYMBOLS**
- overburden thickness (ft)
  - mineral resource thickness (ft)
  - percent sand and fines (percent of screen, 0.25 in.), gravel estimation
  - significant amount of fines (percent)
  - significant amount of decomposed or weak rock
  - "u" in symbol denotes unmineralized or unknown property
  - "m" in symbol denotes mineral property absent or insignificant



Base from U. S. Geological Survey  
7-1/2 minute quadrangle

APPROXIMATE MEAN  
DECLINATION 1994



**ROAD CLASSIFICATION**

Heavy duty    Light duty

Medium duty    Unimproved dirt

US Route    State Route

HANOVER, COLO.

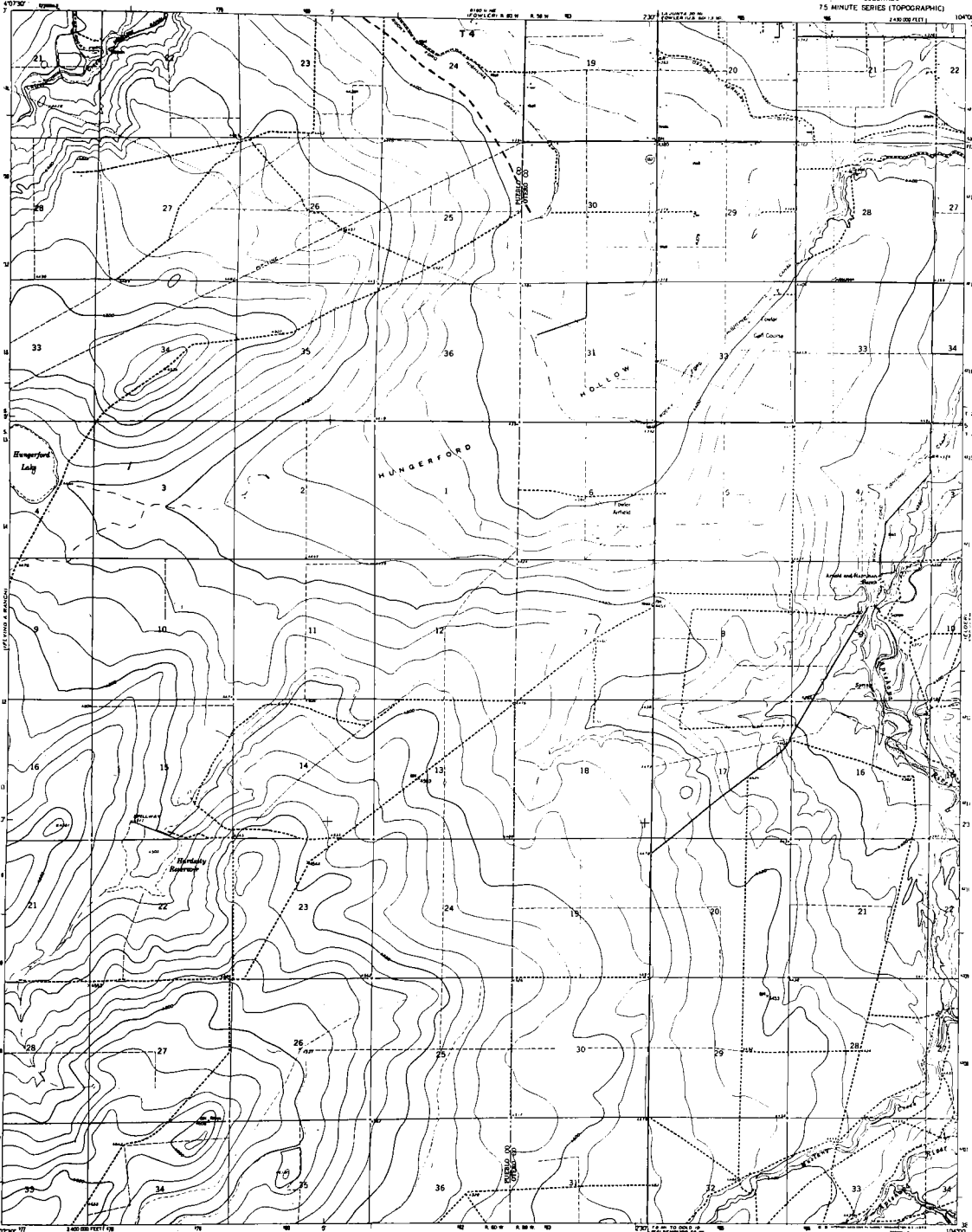
Mapped by: Stephen D. Schuchow  
Date: June 30, 1974



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

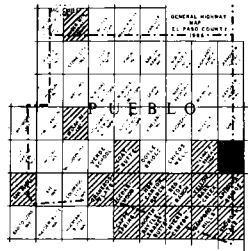
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLL, DIRECTOR

HARDESTY RESERVOIR QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



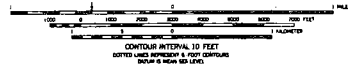
## EXPLANATION

- Contour units**  
— Resource classification
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Outwash deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mesa-mound deposits (shale, sandstone, siltstone...)
- RESOURCE CLASSIFICATION**
- GRAVEL AGGREGATE**  
1st QUANT. 200 PPM (100 ft. or more, 10% extraction)
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, solution carbonates
- SAND AGGREGATE**  
1st QUANT. 200 PPM (100 ft. or more, 10% extraction)
- 3 Sand
  - 4 Probably aggregate resource
- WATER RESOURCES**
- WATER**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Remotely quarry aggregate resource area
  - Reclaimed well or drill-hole location with overburden thickness (ft.) over sand/gravel resource thickness (ft.), obtained from well logs.
  - "r" indicates gravel; "s" indicates sand
  - "u" symbol denotes unutilized or unknown property
  - "m" denotes Colorado Geological Survey "Mesa-land and Gravel projects" drill hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND CHRONOLOGICAL SUBDIVISION OF SEDIMENT**
- overburden thickness (ft.)
  - sand/gravel resource thickness (ft.)
  - percent sand and fines (passing #4 screen, 0.35 in.), visual estimation
  - significant amount of decomposed or weak rock
  - significant amount of fines (passing #200 screen, 0.0075 in. or 0.274 mm.)
  - significant amount of silt/clay in overburden (silt/clay)
  - "u" symbol denotes unutilized or unknown property
  - "m" symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL, 10 FEET  
DOTTED LINES APPROXIMATE 100' CONTOURS  
DASHED LINES 100' INTERVAL

**ROAD CLASSIFICATION**

———— Light-duty  
———— Unimproved det.  
○ State Route

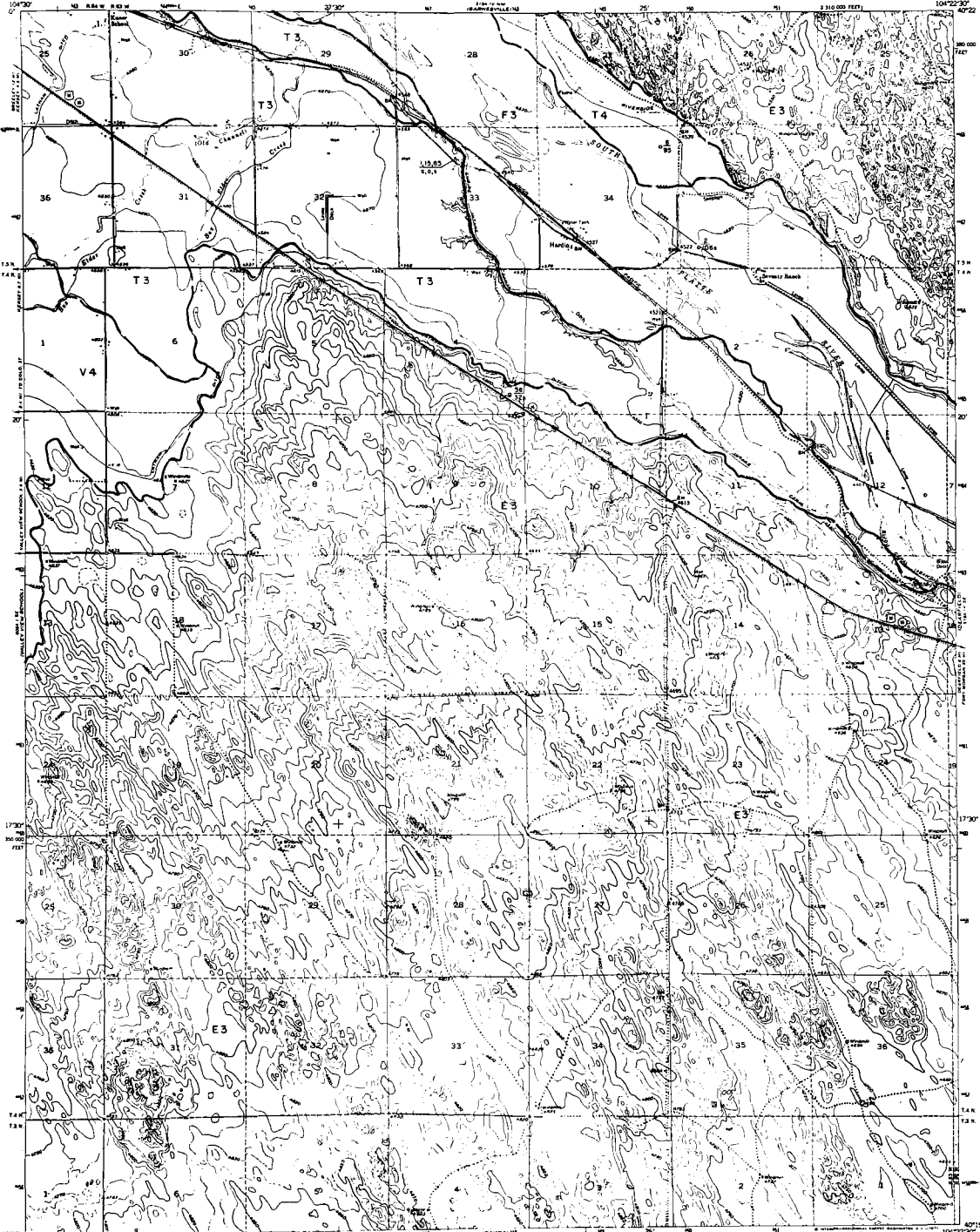
HARDESTY RESERVOIR, COLO.

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974



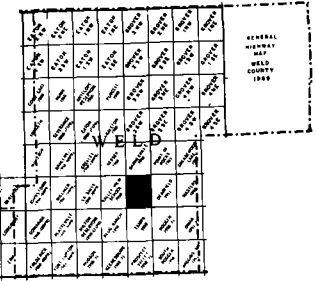
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

HARDIN QUADRANGLE  
 COLORADO-WELD CO.  
 7.5 MINUTE SERIES (TOPOGRAPHIC)  
 104°22'30" W  
 37°22'30" N



EXPLANATION

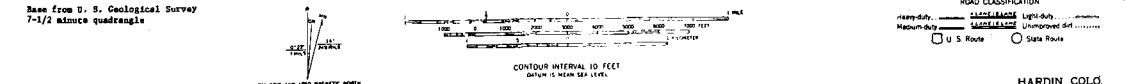
- Landform unit
- Resource classification
- LANDFORM UNITS**
  - F Fine sand deposit
  - T Terrace surface deposit
  - V Valley fill (F & T)
  - U Unglacial deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M (deglaciation, spalls...)
- RESOURCE CLASSIFICATION**
  - GRAVEL CLASSIFICATION**  
 1st (over 100% retained on #4 screen, visual estimation)  
 1 Gravel: relatively clean and round  
 2 Gravel: significant fines, decomposed, etc., medium washwater  
**FINE AGGREGATE**  
 (greater than 100 passing #4 screen, 200 retained on #20 screen, visual estimation)  
 3 Sand  
**UNCLASSIFIED AGGREGATE**  
 4 Probable aggregate sources
- QUARRY SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relieved well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "s" indicates gravel; "m" indicates sand
  - "s" in circles denotes unclassified or unknown property
  - "m" denotes Colorado Geological Survey hydrological and gravel studies
  - Well hole
  - Landform boundary, solid short lines or observed shaded where appropriate or inferred
- RELIEF, LOCATION AND GEOLOGICAL INFORMATION OF WELLS**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (greater #4 screen, 200 (s), visual estimation)
  - Significant amount of fines (greater than screen, 200 (s), or 0.075 in.)
  - Significant amount of decomposed or weak rock
  - Significant amount of solution carbonate (cavities)
  - "s" in circles denotes unclassified or unknown property
  - "m" in circles denotes property owned or leased



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Bjorklund, L.J., and Brown, R.F., 1957, Geology and ground-water resources of the lower South Platte River valley between Huerfano, Colorado, and Fawns, Nebraska: U. S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1376, p. 1.

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974



ROAD CLASSIFICATION  
 Heavy-duty, 2-lane, 12-14 ft  
 Medium-duty, 2-lane, 10-12 ft  
 Light-duty, 2-lane, 8-10 ft  
 Unimproved dirt  
 U.S. Route  
 State Route

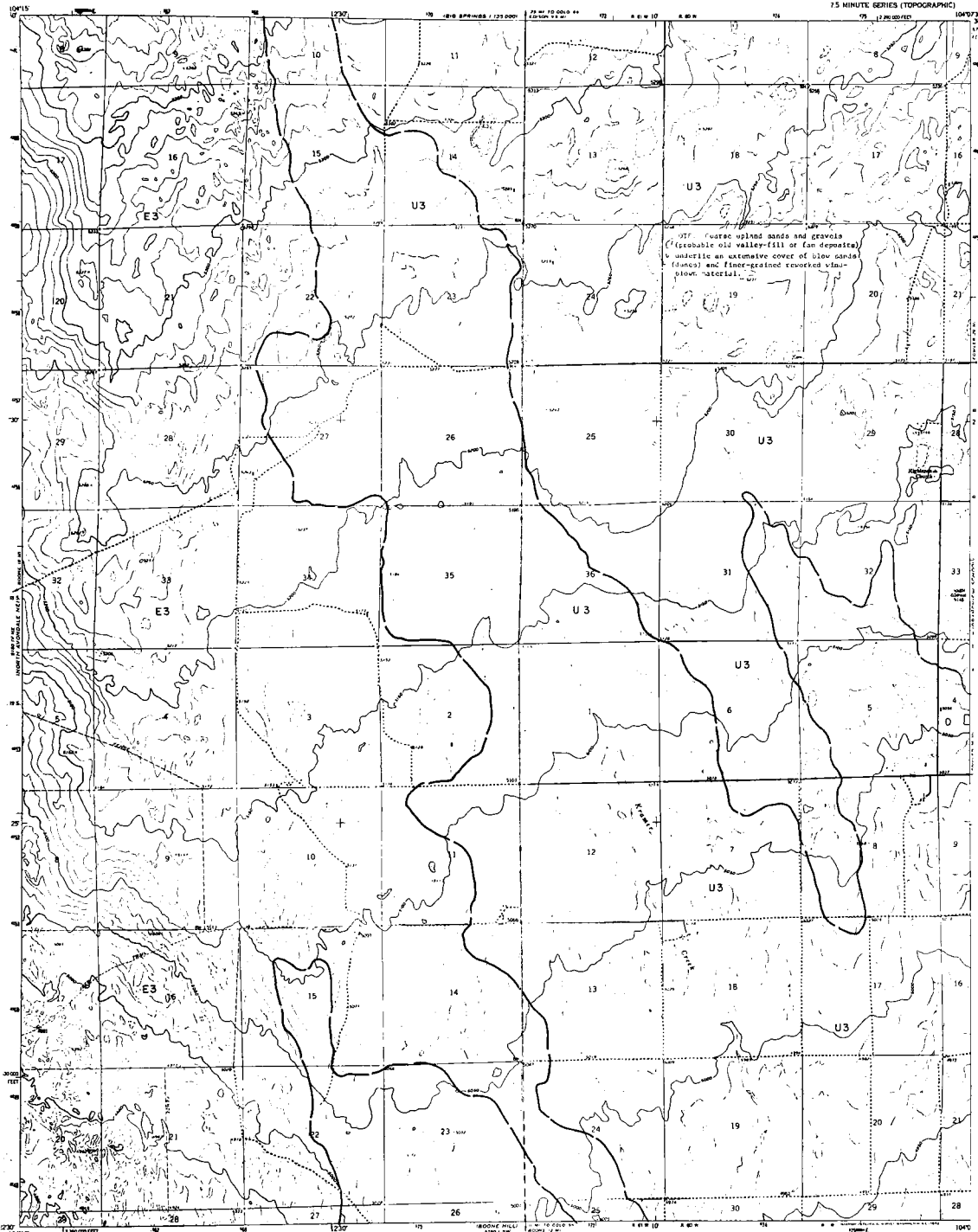
HARDIN COLO.  
 NAD83 1042237.5  
 1960  
 AMS 5184 IV SW-SERIES Y877

SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

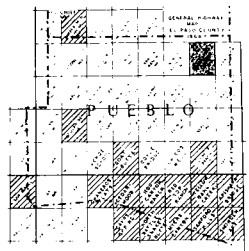
HIGHLANDS CHURCH QUADRANGLE  
 COLORADO-PUEBLO CO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)

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



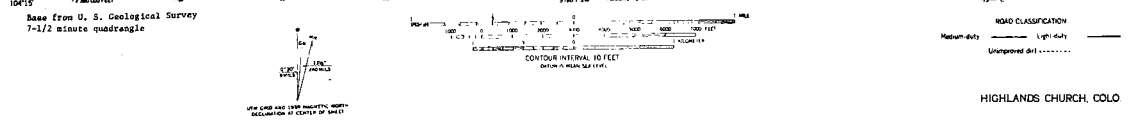
EXPLANATION

- Landform unit
- Boundary of landform unit
- LANDFORM UNIT
- F Floodplain deposit
- T Terrace terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Marine deposits (e.g., dunes, spits, etc.)
- RESOURCE CLASSIFICATION
- Coarse aggregate
- 1 Gravel: relatively clean and round
- 2 Gravel: significant fines, decomposed rock, calcine carbonates
- 3 Sand
- 4 Probable aggregate resource
- MAP SYMBOLS
- Operating gravel and/or sand pit
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected unit of drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
- "G" indicates gravel; "S" indicates sand
- "2" in symbol denotes unventilated or shallow storage
- "M" denotes Colorado Geological Survey withdrawal and gravel production drill hole
- Landform boundary, with where known or observed; dashed where approximated or inferred
- STATION LOCATION AND GEOLOGICAL DESCRIPTION OF BORING
- Overburden thickness (ft)
- Sand/gravel resource thickness (ft)
- Percent sand and fines (ignoring the coarse, 0.075 in. or 2.0 mm)
- Significant amount of fines (exceeding 15% fines, 0.075 in. or 2.0 mm)
- Significant amount of decomposed or weak rock
- "\*" in symbol denotes unventilated or shallow storage
- "M" in symbol denotes properly placed or charged/loaded



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schewchow  
 Date: June 30, 1974



HIGHLANDS CHURCH, COLO

**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

**HIGHLANDS RANCH QUADRANGLE**  
(1:25,000 Scale)  
MINUTE SERIES (TOPOGRAPHIC)

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

**EXPLANATION**

Resource Classification

- LEGEND (RZ)**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (E & T)
  - U Wind deposit
  - A Alluvial fan
  - E Wind-deposited sand (medium)
  - M Non-made deposits (lake, alluvial, etc.)

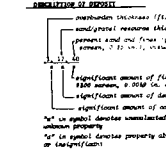
**GRADE CLASSIFICATION**

- GRADE CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed, etc.
  - 3 Sand
  - 4 Probable aggregate resource

**MAP SYMBOLS**

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Related well or drill-hole location with source
- Surface elevation (1) low sand/gravel resource
- "X" indicates grade, "Y" indicates sand
- In symbol denotes unclassified or unknown property
- "M" denotes Colorado Geological Survey "Underfoot and Gravel Project" drill hole
- Location boundary, solid when shown or dashed when shown as inferred

**STATION, LOCATION AND GEOMORPHIC SUBDIVISION OF SOURCE**



**QUADRANGLE LOCATION**

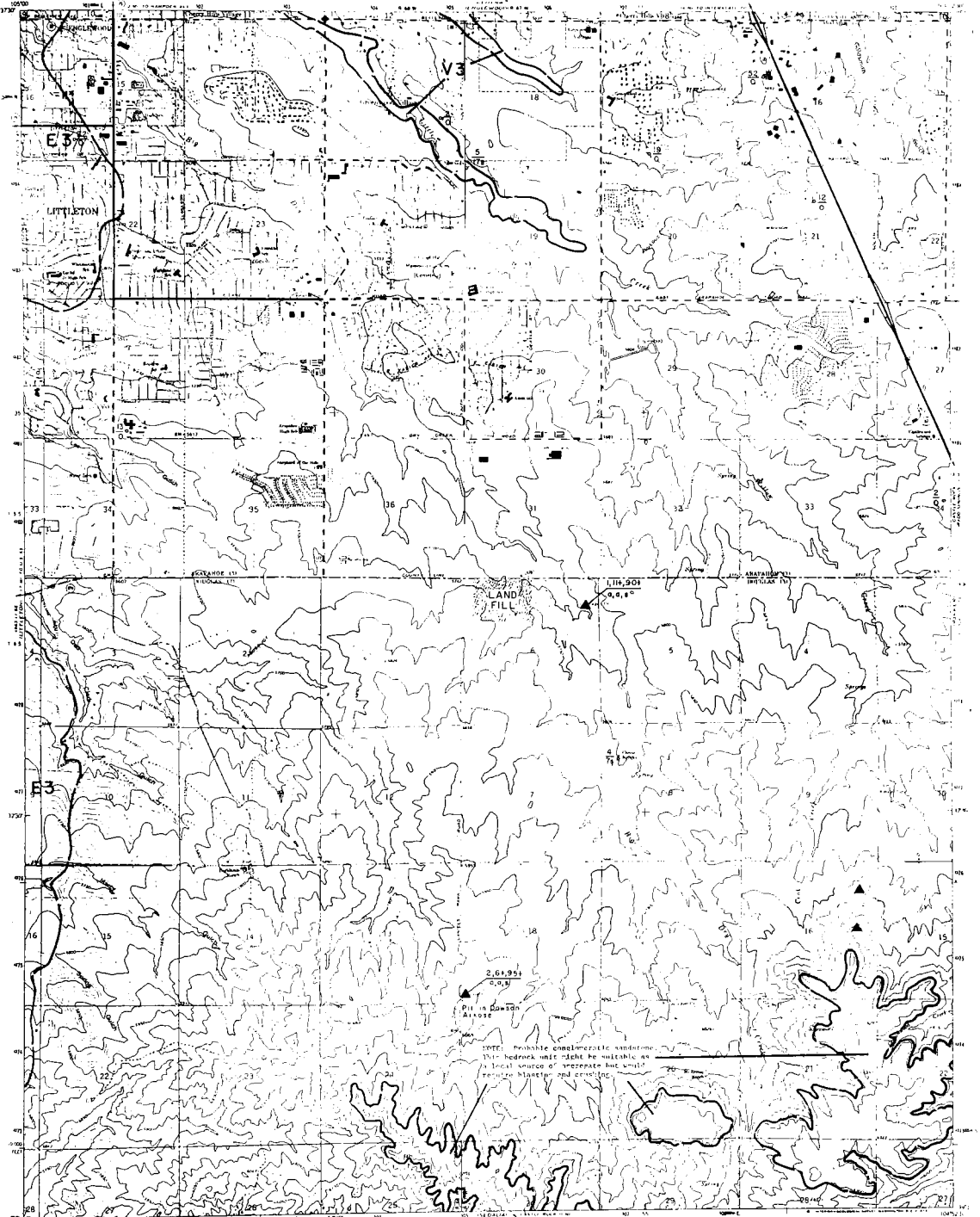


**REFERENCE:**

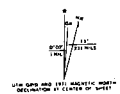
Chase, C.H., and McCaskey, J.A., 1972. Generalized surficial geologic map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map T-731.

Perible, D.F., and Pritch, S.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map T-856-A.

Mapped by: Ralph B. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.



Map from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy Duty
- Medium Duty
- Light Duty
- Unimproved dirt
- Gravel Road
- U.S. Road
- State Road

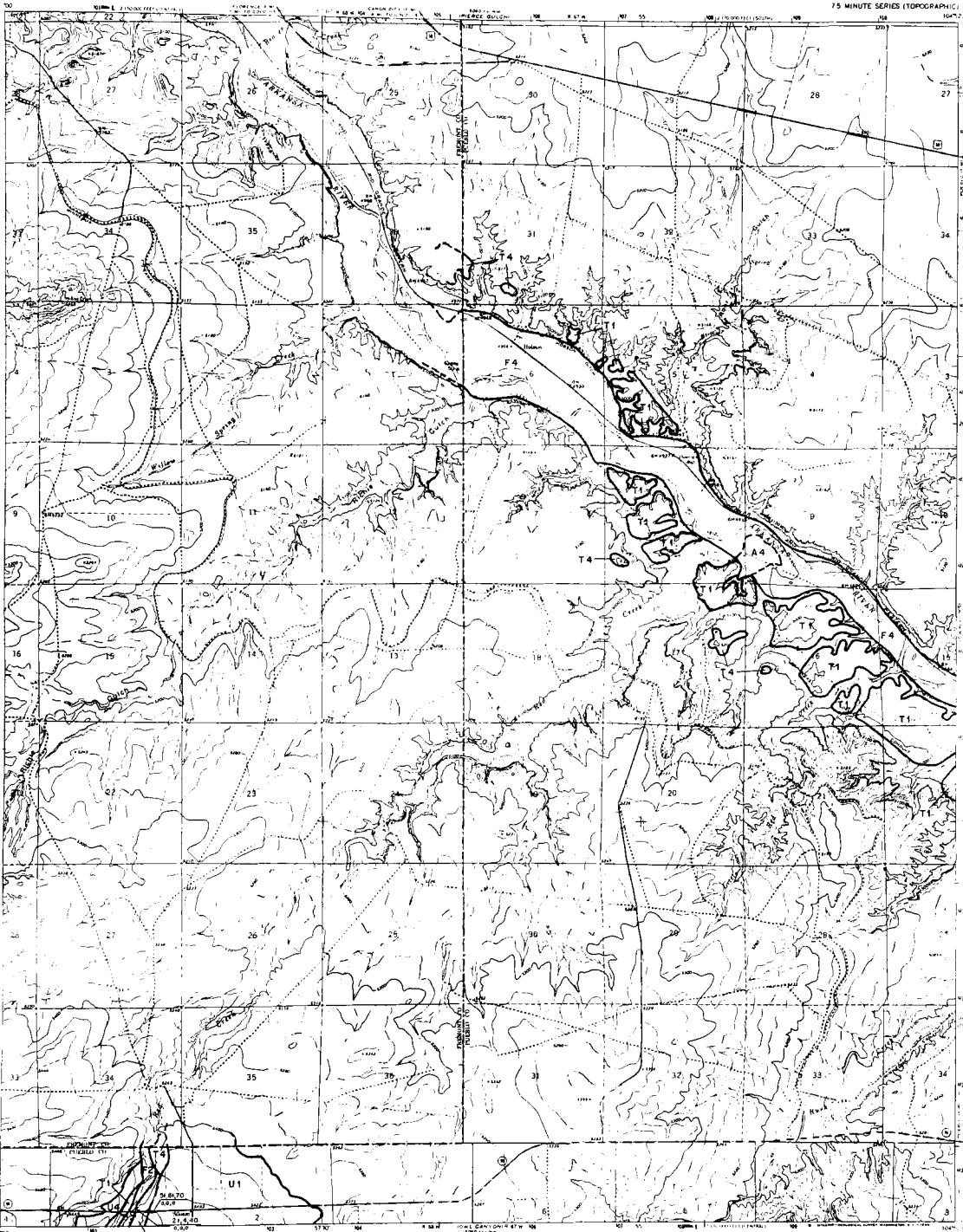
HIGHLANDS RANCH COLO



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

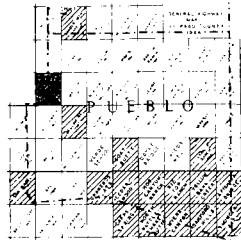
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLD, DIRECTOR

HOBSON QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Uniform units  
Resource classification
- LAPPOCK UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (alluvial)
  - M Marine deposits (sand, silt, clay, etc.)
- RESOURCE CLASSIFICATION**
- Gravel Deposits**
- 1 Gravel: thickness less than 24 inches, gravel content 10%
  - 2 Gravel: thickness less than 24 inches, gravel content 10-20%
  - 3 Gravel: thickness less than 24 inches, gravel content 20-30%
  - 4 Gravel: thickness less than 24 inches, gravel content 30-40%
- Sand Deposits**
- 1 Sand: thickness less than 24 inches, sand content 10%
  - 2 Sand: thickness less than 24 inches, sand content 10-20%
  - 3 Sand: thickness less than 24 inches, sand content 20-30%
  - 4 Sand: thickness less than 24 inches, sand content 30-40%
- Geological Features**
- 1 Potential aggregate resource
  - 2 Operating gravel and/or sand pit
  - 3 Abandoned gravel and/or sand pit
  - 4 Operating stone quarry
  - 5 Abandoned stone quarry
  - 6 Potential quarry aggregate resource area
  - 7 Related well or drill-hole location with over-burden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - 8 "T" indicates gravel; "S" indicates sand
  - 9 "L" symbol denotes unutilized or unknown quantity
  - 10 "M" symbol denotes Geological Survey "Water/Soil and Gravel" projects
  - 11 "M" symbol denotes unutilized or unknown quantity
  - 12 Landform boundary, solid where known or dashed where approximate or inferred
- Fitform, Location and Geological Interpretive Symbols**
- 13 Unutilized thickness (ft)
  - 14 Utilized thickness (ft)
  - 15 Unutilized and/or utilized thickness (ft)
  - 16 Unutilized and/or utilized thickness (ft)
  - 17 Significant amount of fines (sandy)
  - 18 Significant amount of fines (sandy)
  - 19 Significant amount of fines (sandy)
  - 20 Significant amount of fines (sandy)
  - 21 Significant amount of fines (sandy)
  - 22 Significant amount of fines (sandy)
  - 23 Significant amount of fines (sandy)
  - 24 Significant amount of fines (sandy)
  - 25 Significant amount of fines (sandy)
  - 26 Significant amount of fines (sandy)
  - 27 Significant amount of fines (sandy)
  - 28 Significant amount of fines (sandy)
  - 29 Significant amount of fines (sandy)
  - 30 Significant amount of fines (sandy)
  - 31 Significant amount of fines (sandy)
  - 32 Significant amount of fines (sandy)
  - 33 Significant amount of fines (sandy)
  - 34 Significant amount of fines (sandy)
  - 35 Significant amount of fines (sandy)
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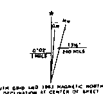


QUADRANGLE LOCATION  
NON-RESOURCE OR WETDRAIN AREA

Geology modified after Scott, C. R., 1972,  
U. S. Geological Survey Map MF-353.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL: 20 FEET  
VERTICAL SCALE: 1" = 100' (VERTICAL)  
DATE: 4 MAY 1974

**ROAD CLASSIFICATION**

Medium-duty Light-duty  
Unimproved det. State Route  
US Route

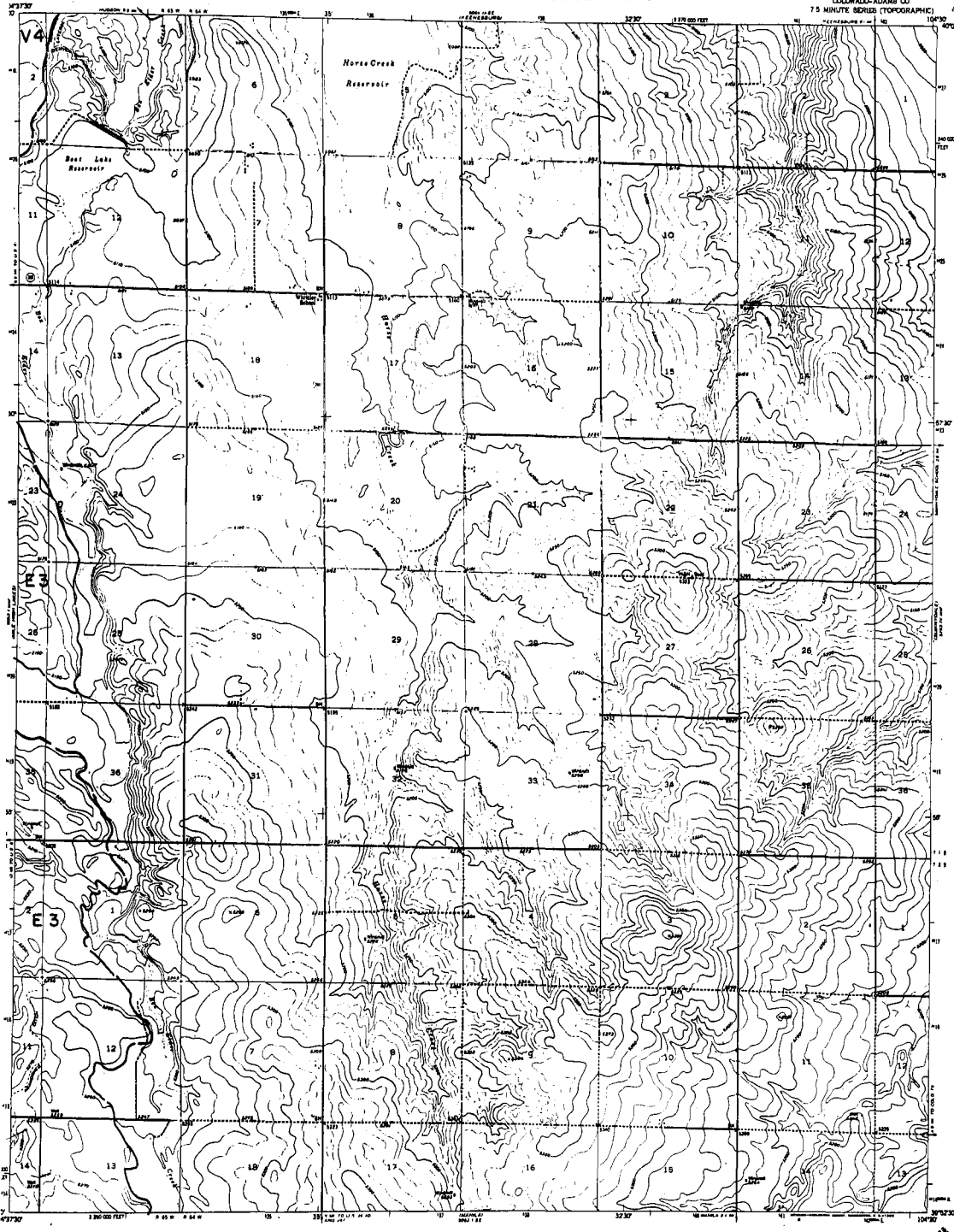
HOBSON, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

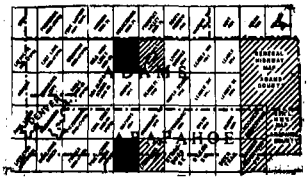
HORSE CREEK QUADRANGLE  
 COLORADO-ADAMS CO.  
 7 1/2 MINUTE SERIES (TOPOGRAPHIC)

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



### EXPLANATION

- Landform unit
  - Resource class/location
- LANDFORM UNITS**
- P Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Outwash deposit
  - A Alluvial fan
  - B Wind-deposited sand (colluvial)
  - M Man-made deposits (fill, railroad, spoil, ...)
- RESOURCE CLASSIFICATION**
- CLASS 1 GRAVEL**  
 (as defined by Federal Reserve Bank of Denver, manual revision)
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, unrounded rock, clayey substrate
- CLASS 2 SAND**  
 (as defined by Federal Reserve Bank of Denver, manual revision)
- 3 Sand
- UNCLASSIFIED SANDS**
- 4 Probable aggregate resource
- USE SYMBOLS**
- a Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
- SYMBOLS**
- ① (circle with 1) indicates location with overburden thickness (ft) over aggregate resource
  - ② (circle with 2) indicates location with overburden thickness (ft) over aggregate resource
  - "s" indicates gravel; "g" indicates sand
  - "u" in symbol denotes unvalued or unknown resource
  - "M" denotes Colorado Geological Survey Modified Road and Gravel Project
  - ④ (circle with 4) indicates location with overburden thickness (ft) over aggregate resource
  - ⑤ (circle with 5) indicates location with overburden thickness (ft) over aggregate resource
  - ⑥ (circle with 6) indicates location with overburden thickness (ft) over aggregate resource
  - ⑦ (circle with 7) indicates location with overburden thickness (ft) over aggregate resource
  - ⑧ (circle with 8) indicates location with overburden thickness (ft) over aggregate resource
  - ⑨ (circle with 9) indicates location with overburden thickness (ft) over aggregate resource
  - ⑩ (circle with 10) indicates location with overburden thickness (ft) over aggregate resource
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  - ⑫ (circle with 12) indicates location with overburden thickness (ft) over aggregate resource
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  - ⑭ (circle with 14) indicates location with overburden thickness (ft) over aggregate resource
  - ⑮ (circle with 15) indicates location with overburden thickness (ft) over aggregate resource
  - ⑯ (circle with 16) indicates location with overburden thickness (ft) over aggregate resource
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  - ⑱ (circle with 18) indicates location with overburden thickness (ft) over aggregate resource
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- SYMBOLS FOR ROAD CLASSIFICATION**
- ① (circle with 1) indicates location with overburden thickness (ft) over aggregate resource
  - ② (circle with 2) indicates location with overburden thickness (ft) over aggregate resource
  - ③ (circle with 3) indicates location with overburden thickness (ft) over aggregate resource
  - ④ (circle with 4) indicates location with overburden thickness (ft) over aggregate resource
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QUADRANGLE LOCATION

NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Smith, L.D., Schneider, P.A., Jr., and Petri, L.R., 1988, Ground-water resources of the South Platte River basin to western Adams and southeastern Weld Counties, Colorado, U. S. Geol. Survey Water-Supply Paper 1058, p. 5.

Mapped by: Phillip G. Wickless  
 Date: June 30, 1974



HORSE CREEK, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

HORSETOOTH RESERVOIR

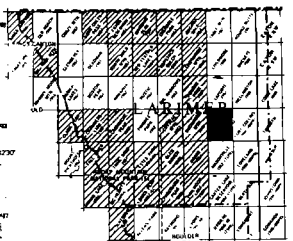
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HULL, DIRECTOR



NOTE: The gravel in these alluvial fans are of poor quality, having a considerable percentage of clay, weak sedimentary rocks, and highly weathered, decomposed metamorphic and igneous rocks. Inasmuch as four gravel pits were noted in these fans, they are not important resources because 1) most of the area has already been lost to suburbanization and 2) the higher quality gravels along the Cache La Poudre River will amply meet the area's needs.

EXPLANATION

- Landform unit**  
 (See map classification)
- MATERIALS**
- T Alluvial deposit
  - V Yellow fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Man-made sand (excavated)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- ROAD CLASSIFICATION**
- CONTOUR CLASSIFICATION**
- CONTOUR INTERVALS**
- 1 Contour interval 40 feet
  - 2 Contour interval 20 feet
  - 3 Contour interval 10 feet
  - 4 Contour interval 5 feet
- ROAD CLASSIFICATION**
- 1 Paved
  - 2 Gravel
  - 3 Unimproved
- UNCLASSIFIED RESOURCES**
- 1 Potential aggregate resources
- QUARRY TYPES**
- 1 Operating gravel and/or sand pit
  - 2 Abandoned gravel and/or sand pit
  - 3 Operating stone quarry
  - 4 Abandoned stone quarry
  - 5 Potential quarry aggregate resource area
  - 6 Potential well or drill-hole location with overburden thickness (ft.)
  - 7 Potential well or drill-hole location with overburden thickness (ft.) obtained from well logs
  - 8 "X" indicates gravel, "O" indicates sand
  - 9 "Y" in symbol denotes unclassified or unknown property
  - 10 "M" indicates Colorado Geological Survey (under lease) gravel pit(s)
  - 11 "L" indicates landform symbol, with lease known or unknown
  - 12 "S" indicates landform symbol, with lease approximate or unknown
- SYMBOL LOCATION AND CHARACTERIZATION OF DEPOSIT**
- 1 Overburden thickness (ft.)
  - 2 Sandstone thickness (ft.)
  - 3 Gravel and sand (ft.)
  - 4 Gravel and sand (ft.)
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  - 100 Gravel and sand (ft.)



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Sims, F. B., III, 1972. Map of surficial geology of part of the Horsetooth Reservoir quadrangle: Basem. mapping for Colorado Geol. Survey Midsize Environmental Geology Project, open-file map.

Braddock, W. A., Calvert, R. H., O'Connor, J. T., and Swann, C. A., 1973. Geologic map of the Horsetooth Reservoir quadrangle, Larimer County, Colorado: U.S. Geological Survey Open-File map.

Berghy, L.A., and Schmalzer, P.A., Jr., 1972. Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-687.

Shelton, D.C., 1974, personal communication.

Geology modified after: Colton, B.B., and Pritch, B.A., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Greeley Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-835 D.

Mapped by: Stephen D. Schuchow  
 Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL, 40 FEET  
 QUOTE UNQUOTE INTERVALS AT 100 FEET INTERVALS  
 QUOTE UNQUOTE INTERVALS AT 50 FEET INTERVALS

ROAD CLASSIFICATION  
 Paved  
 Gravel  
 Unimproved

HORSETOOTH RESERVOIR, COLO.



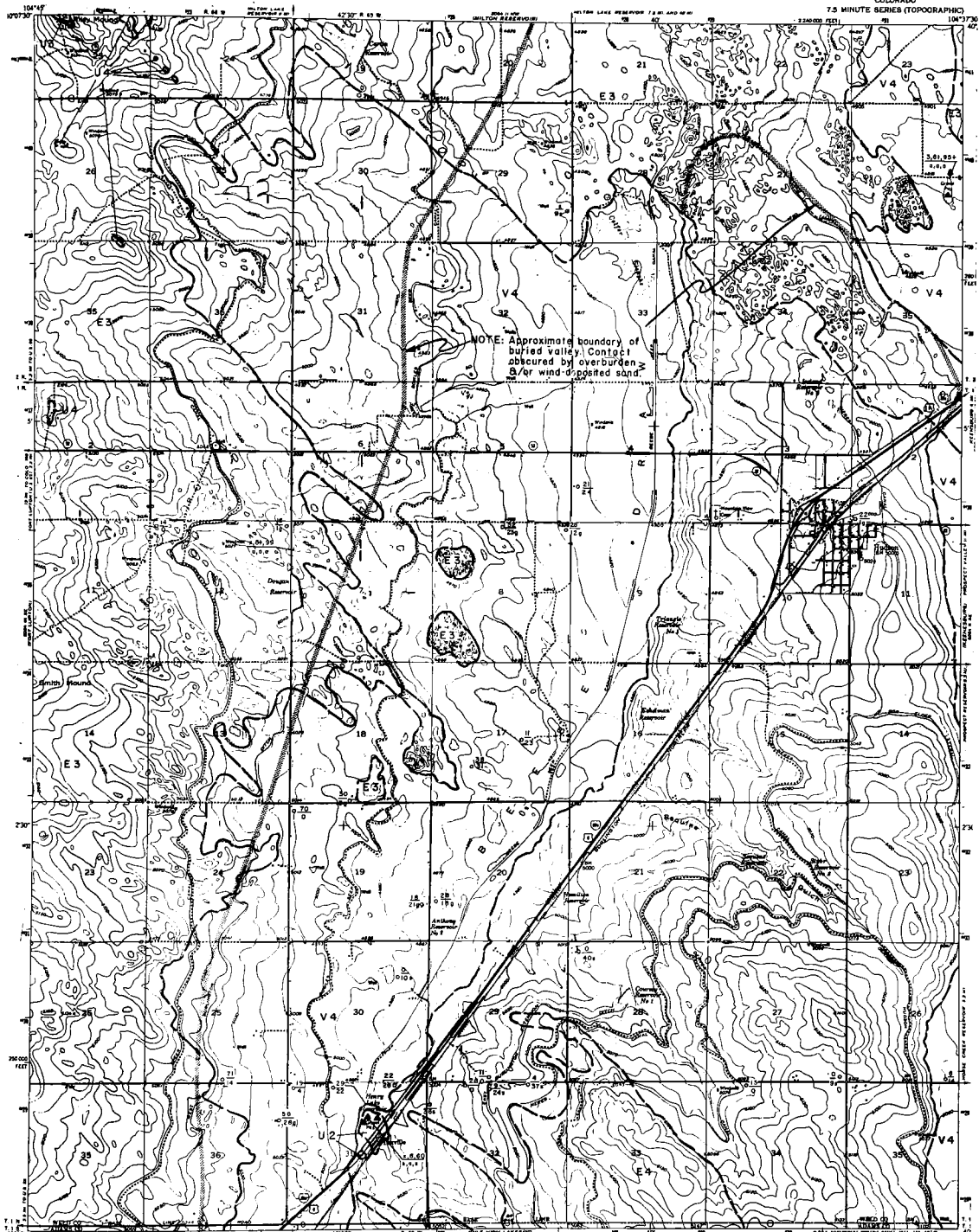
# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

HUDSON QUADRANGLE  
COLORADO

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

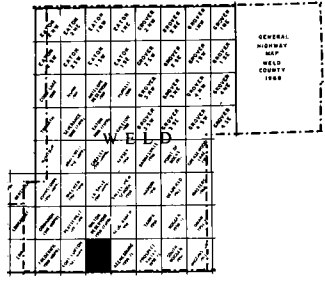
7.5 MINUTE SERIES (TOPOGRAPHIC)



NOTE: Approximate boundary of buried valley. Contact obscured by overburden or wind-dugged sand.

### EXPLANATION

- Contour interval  
Topographic classification
- LITHOLOGICAL TYPES**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Eolian deposit and (cont.)
  - M Man-made deposits (slag, tailings, spalls, etc.)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, detritus, rock, calcination, etc.
  - 3 Sand
  - 4 Overburdened resource
  - 5 Probable aggregate resource
- SYMBOLS**
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Indicated well or drill-hole location with penetration thickness (ft) over sand/gravel; thickness (ft) obtained from well logs
  - "\*" in symbol denotes unconsolidated or unknown property
  - "u" in symbol denotes geological survey method used and (Gravel) projected
  - Landform boundary, solid where known or inferred
- STATION, LOCATION AND ORIENTATIONAL INFORMATION OF SYMBOL**
  - penetration thickness (ft)
  - penetration thickness (ft)
  - penetration and fines (spacing #1 screen, 0.25 in.), visual estimation
  - significant amount of fines (spacing #20 screen, 0.0075 in. or 0.275 mm.)
  - significant amount of detritus or small rock
  - significant amount of material unconsolidated or unknown property
  - "u" in symbol denotes unconsolidated or unknown property
  - "u" in symbol denotes property about or unprojected



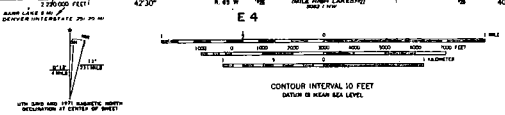
■ QUADRANGLE LOCATION  
▨ RESOURCE OR WITHDRAWN AREA

Co-line modified after Colston, P. E., 1965, U. S. Geological Survey, Geologic Quadrangle Map, GQ-398.

Colton, R.B., and Petch, J.K., 1974, Map showing potential sources of gravel and crushed-rock aggregates in the Boulder-Fort Collins-Ordway Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map I-835-D.

Mapped by: Ralph B. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**  
Primary highway: Light-duty road, hard or hard surface  
Secondary highway: Improved surface  
Unimproved road  
Interstate Route U S Route State Route

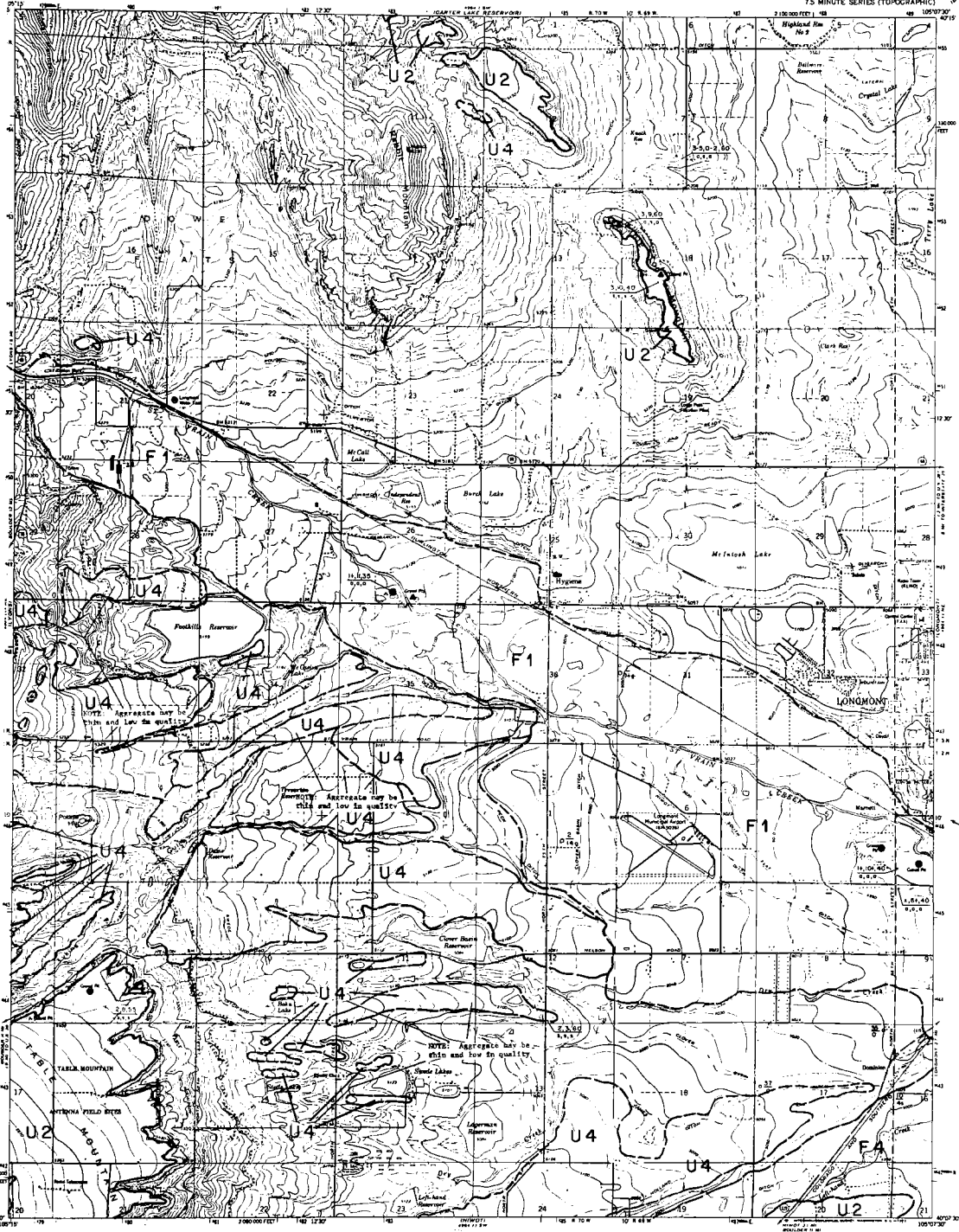
CONTOUR INTERVAL 10 FEET  
OTHER 25 FEET INTERVALS

HUDSON, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

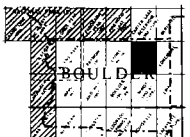
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLL, DIRECTOR

HYGIENE QUADRANGLE  
COLORADO-Boulder CO  
15 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Landform units**  
Resource class/function
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-sand resource (sandstone, siltstone, ...)
- RESOURCE CLASSIFICATION**
- Coarse aggregate**  
100% or more sand on 48 screen, 0% on 20 screen
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, various textures
  - 3 Sand
  - 4 Probable aggregate resource
- Fine aggregate**  
75% or more sand on 20 screen, 0% on 10 screen, 0% on 5 screen
- Probable aggregate resource**
- MAP SYMBOLS**
- Open-pit gravel and/or sand pit
  - ⊙ Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Potential well or drilled-tapeout sand source
  - ⊙ Borehole (thickness (ft) over sand/gravel resource)
  - ⊙ Thickness (ft) obtained from well logs
  - ⊙ "x" indicates gravel; "s" indicates sand
  - ⊙ "x" in circle denotes unmineralized or unknown resource
  - ⊙ "x" in circle denotes Colorado Geological Survey (Hygiene and Grand projects) drill hole
  - ⊙ Lashline boundary, well where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL**
- BOUNDARIES OF AREAS**
- ⊙ Overburden (thickness (ft))
  - ⊙ Sand/gravel resource (thickness (ft))
  - ⊙ Gravel and fine (thickness (ft) over 48 screen, 2.0 ft in 100 ft interval)
  - ⊙ Significant amount of fines (using 100 screen, 0.075 to 0.25 mm)
  - ⊙ Significant amount of decomposed or weak rock
  - ⊙ Significant amount of material not suitable for use
  - ⊙ "x" in circle denotes unmineralized or unknown property
  - ⊙ "x" in circle denotes property absent or insignificant



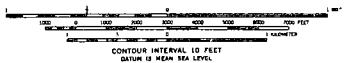
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
Colton, R.B., and Fitch, W.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Greeley Area, Front Range Urban Corridor, Col.: U. S. Geol. Survey Misc. Geol. Inv. Map I-835-D.

Mapped by: Ralph E. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
ELEVATION IN FEET SEA LEVEL

- ROAD CLASSIFICATION**
- Heavy-duty
  - Light-duty
  - Medium-duty
  - Unimproved dirt
  - U. S. Route
  - State Route

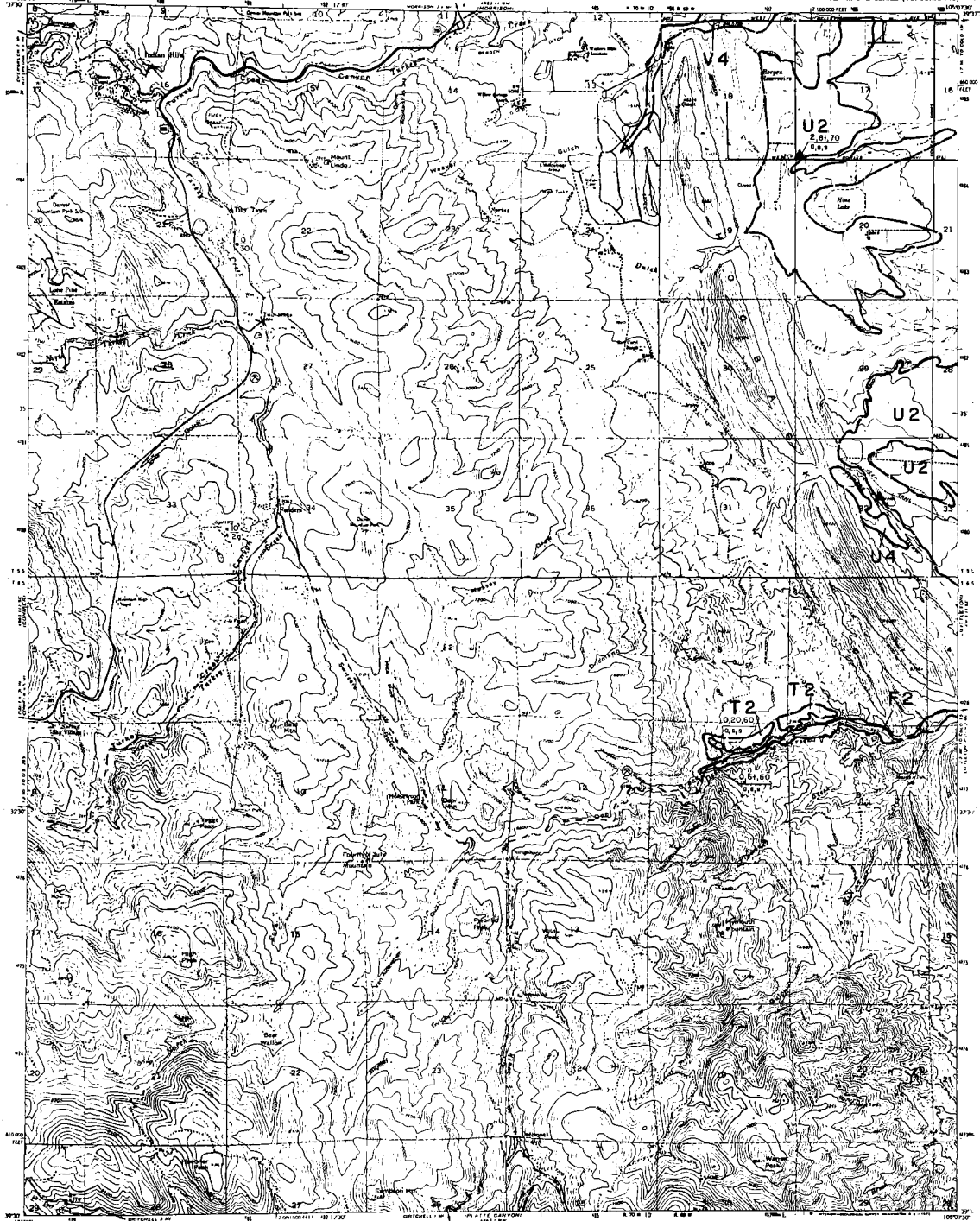
HYGIENE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

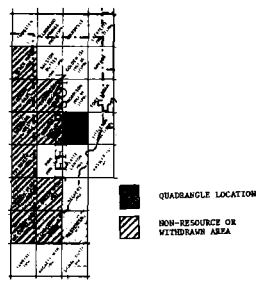
INDIAN HILLS QUADRANGLE  
COLORADO—JEFFERSON CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

EXPLANATION



- LAZARUS UNIT**
- F Floodable deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unaltered deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (landfill, spoil, etc.)
- RESOURCE CLASSIFICATION**
- Gravel: (relatively) fine and coarse  
Gravel: significant fines, decomposed rock, natural carbamate
- ROAD CLASSIFICATION**
- 1 Road
  - 2 Road
  - 3 Road
  - 4 Road
- ROAD CLASSIFICATION**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Related well or drill-hole location with unconsolidated thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "\* indicates gravel, "0" indicates sand
  - "\* in symbol denotes unconsolidated or untested property
  - "\* in symbol denotes Colorado Geologic Survey Water/Soil and Gravel projects data only
  - Local on boundary, solid when known or otherwise dashed where approximate or inferred
- STATION LOCATION AND PHYSICAL CHARACTERISTICS OF SYMBOLS**
- contour interval thickness (ft)
  - contour interval thickness (ft)
  - percent sand and fines (quantity of gravel, 0 to 100, visual estimation)
  - significant amount of fines (quantity of sand, 0 to 100, visual estimation)
  - significant amount of decomposed or weak rock
  - significant amount of material unconsolidated or untested property
  - "\* in symbol denotes property shown as unconsolidated



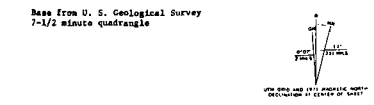
**Geology modified after**  
SEVET, G.R., 1961, Preliminary geologic map of the Indian Hills quadrangle, Jefferson County, Colorado; U.S. Geol. Survey Misc. Geol. Inv. Map T-373.

**References:**  
Chase, G.R., and McConaghy, J.A., 1972, Generalized surficial geologic map of the Denver area, Colorado; U.S. Geol. Survey Misc. Geol. Inv. Map T-731.

Trumble, D.E., and Pritch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map T-856-A.

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

Prepared in cooperation with the  
U. S. Geological Survey



**ROAD CLASSIFICATION**

Heavy-duty Light-duty  
Unimproved rd

U.S. Road State Road

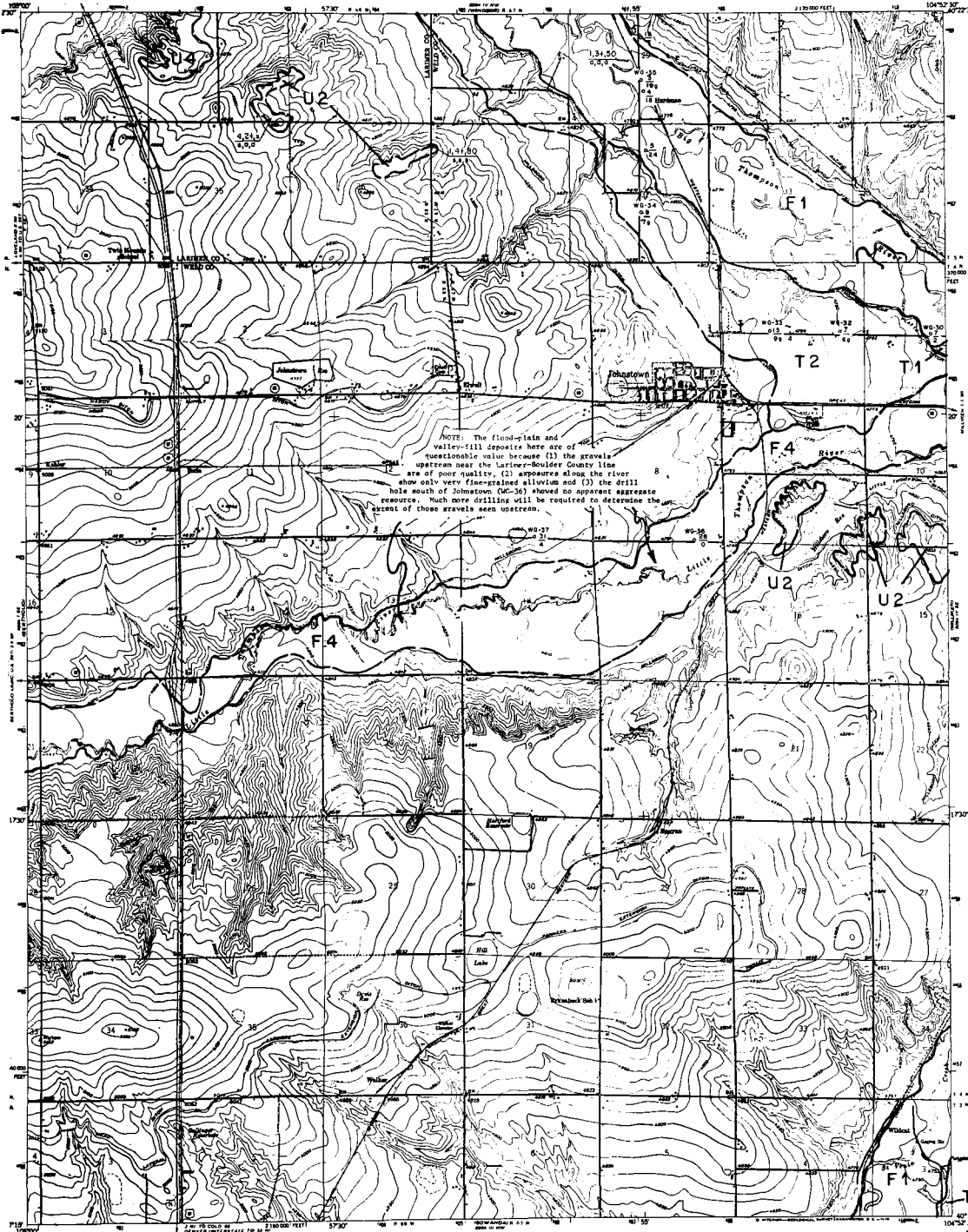
INDIAN HILLS, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

JOHNSTOWN QUADRANGLE  
COLORADO  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

Contour lines  
Resource classification

### LANDFORMS

- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- C Non-deposited sand (alluvium)
- M Non-mine deposits (slag, tailings, spalls...)

### AGGREGATE CLASSIFICATION

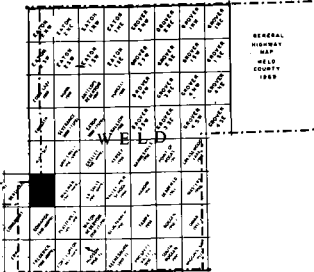
- Gravel aggregate**  
(at least 50% gravel, 40% or more, clean aggregate)
- 1 Gravel, relatively clean and sound
  - 2 Gravel, significant fines, unconsolidated rock, calcium carbonate
- Fill aggregate**  
(at least 10% gravel, 40% or more, 75% material > 200 screen, usual aggregate)
- 3 Sand
  - 4 Probable aggregate resource

### USE SYMBOLS

- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected well or drill-hole location with over-burden thickness (1) over sand/gravel, maximum thickness (1/2) obtained from well logs.
- "s" indicating gravel; "f" indicating sand
- "\*" in symbol denotes unmineralized or unknown prospect
- "\*\*" denotes active Geological Survey "Underfoot and Gravel projects"
- Landform boundary, solid where known or observed, dashed where approximate or inferred

### SYMBOL, LOCATION AND GEOLOGICAL DESCRIPTION OF EXPOSURE

- Overburden thickness (ft)
- Unmineralized resource thickness (ft)
- Percent sand and fines (passing #4 screen, 7.5 in.), usual abbreviation
- Significant amount of fines (passing #20 screen, 0.85 in. or 0.075 mm.)
- Significant amount of decomposed or weak rock
- Significant amount of surface moisture (saturation)
- "\*" in symbol denotes unmineralized or unknown prospect
- "\*\*" in symbol denotes property absent or insignificant

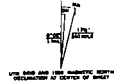


- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:  
Colton, R.B., and Petch, H.R., 1974, Map showing potential source of gravel and crushed-rock aggregates in the Boulder-Fort Collins-Creeley Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map I-855-D.

Mapped by: Stephen D. Schwechow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



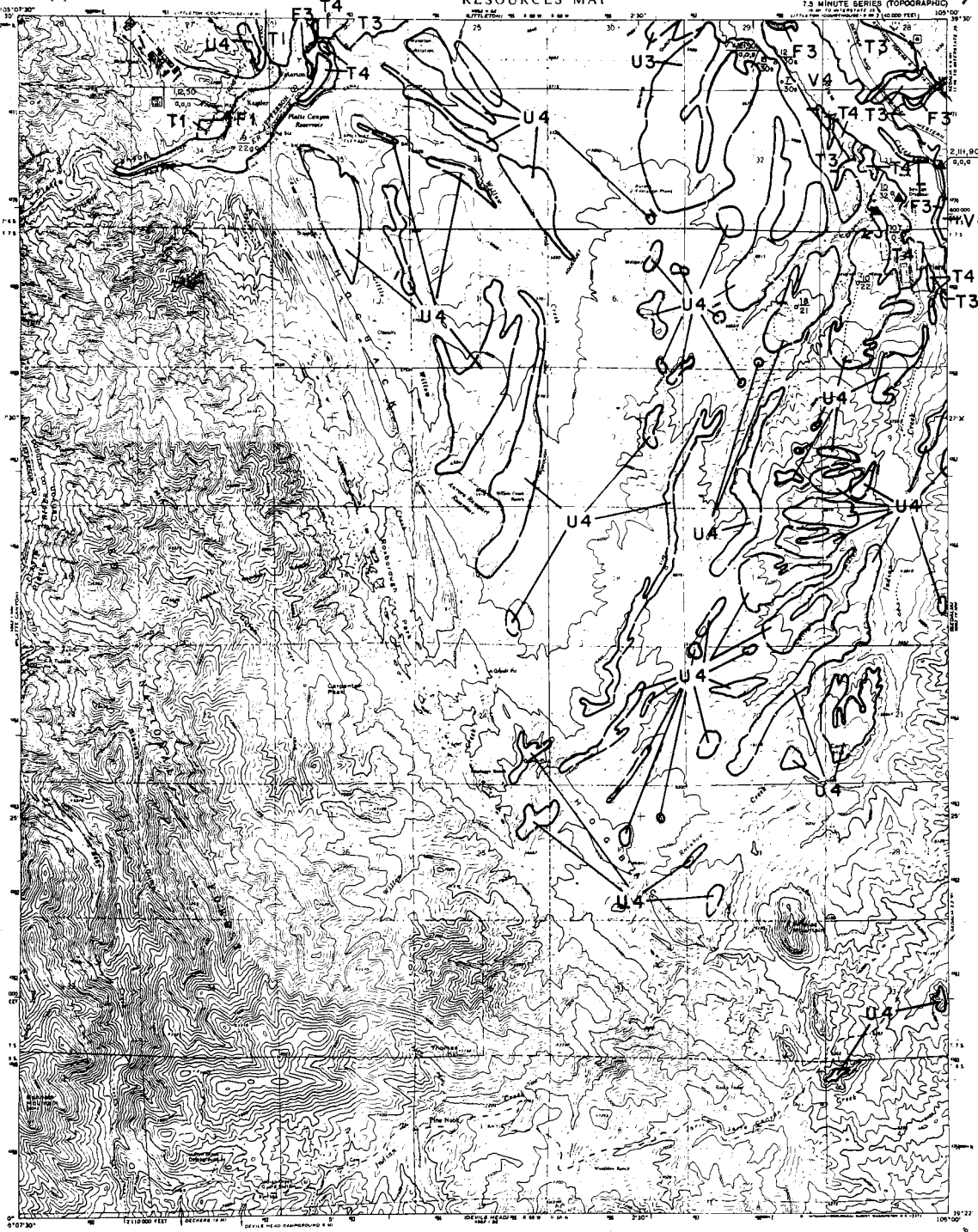
CONTOUR INTERVAL 10 FEET  
DATA IN MEAN SEA LEVEL

- ROAD CLASSIFICATION
- Heavy-duty
  - Light-duty
  - Medium-duty
  - Unimproved det.
  - U. S. Route
  - State Route

JOHNSTOWN, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

KASSLER QUADRANGLE  
 COLORADO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



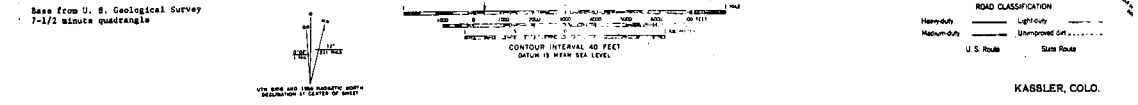
EXPLANATION

- SYMBOLS**  
 (See legend for symbols and their meanings)
- LANDFORMS**  
 F Floodplain deposit  
 T Stream terrace deposit  
 W Alluvial fan (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Marine deposit  
 (Other symbols for landforms)
- ROCK CLASSIFICATION**  
 (See legend for rock types and their meanings)
- ROAD CLASSIFICATION**  
 (See legend for road types and their meanings)
- QUADRANGLE LOCATION**  
 (See legend for location symbols)
- NON-RESOURCE OR WITHDRAWN AREA**  
 (See legend for non-resource symbols)

**Copies modified after:**  
 Smith, C.R., 1963, Tertiary geology and geomorphic history of the Kassler quadrangle, Colorado; U.S. Geol. Survey Prof. Paper 421-A, 70 p., 1 pl.

**References:**  
 Chase, G.H., and McConaghy, J.A., 1972, Generalized surficial geology map of the Denver area, Colorado; U.S. Geol. Survey Misc. Geol. Inv. Map I-732.  
 Trimble, D.E., and Petch, H.R., 1979, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.; U.S. Geol. Survey Misc. Geol. Inv. Map I-856-A.

Mapped by: Ralph S. Shrobe  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.



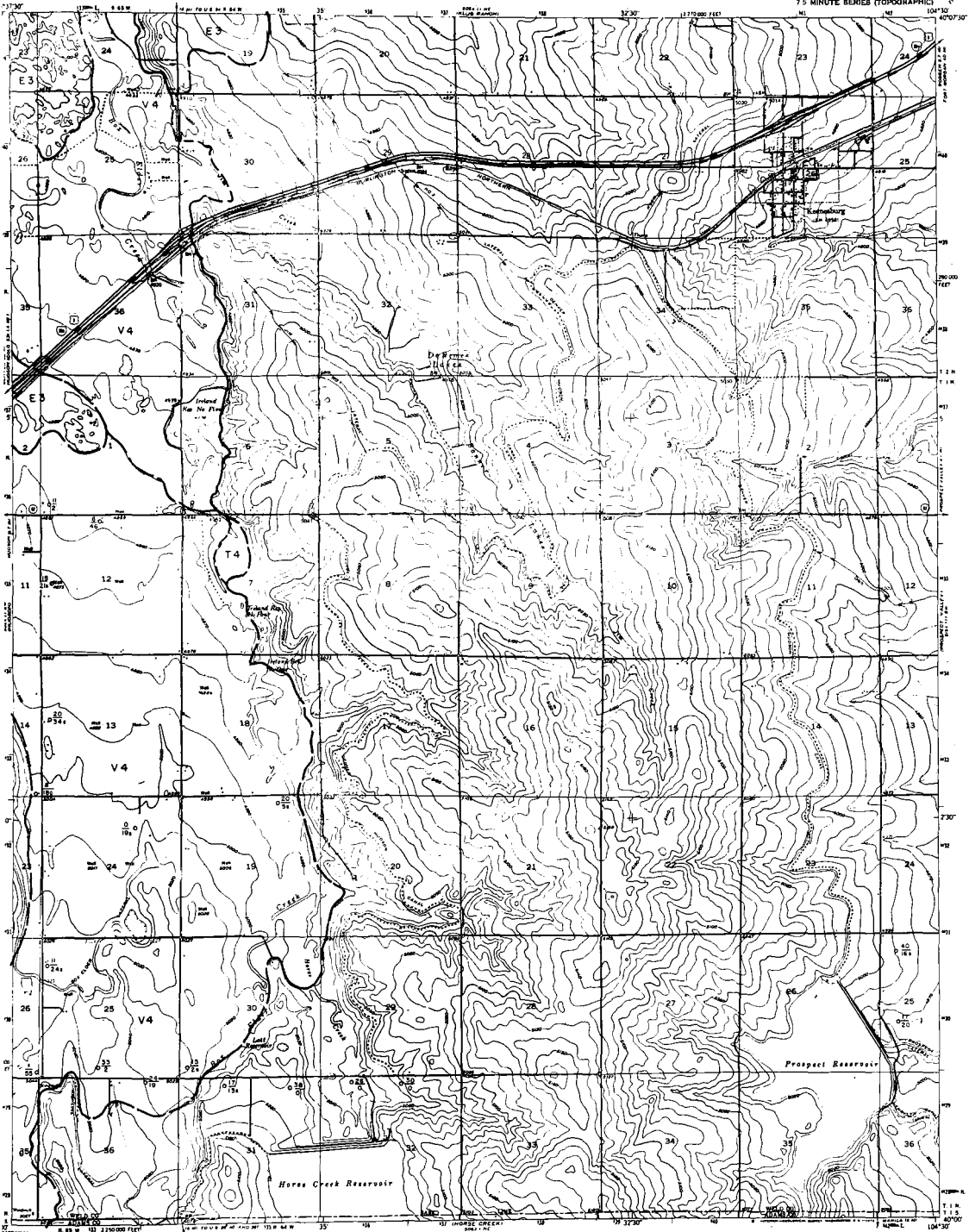
Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

KASSLER, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

KEENESBURG QUADRANGLE  
COLORADO  
7 1/2 MINUTE SERIES (TOPOGRAPHIC)

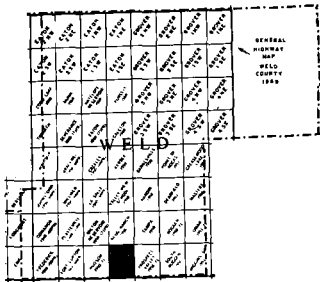
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLL, DIRECTOR



## EXPLANATION

- Contour interval
  - Resource classification
- LAYERS:**
- F Fluvial deposit
  - T Alluvial terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposit
  - A Alluvial fan
  - M Man-made deposit (sand, gravel)
  - E Erosional deposit (clay, silt, gravel, etc.)
- RESOURCE CLASSIFICATION:**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, accompanied each location occurrence
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS:**
- Operating gravel and/or sand pit
  - ▲ Abandoned gravel and/or sand pit
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Rejected well or drill-hole location with over-burden thickness (ft) over sand/gravel resource thickness (ft); obtained from well logs.
  - " " indicates gravel; " " indicates sand
  - " " in symbol denotes unutilized or unknown property
  - " " denotes Colorado Geological Survey Woodruff and Grant section
  - Well hole
  - Land-use boundary, well shown here or observed; dashed where approximate or inferred

- WATER, VEGETATION AND DEMOGRAPHIC CHARACTERISTICS:**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - present well and flow (spacing of arrows, 0.10 in., visual estimation)
  - significant amount of flow (spacing 1/200 arrows, 0.010 in. or 0.175 in.)
  - significant amount of decomposed or weak rock
  - significant amount of solution carbonate (calciferous)
  - " " or symbol denotes unutilized or unknown property
  - " " in symbol denotes property absent or unutilized



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR VETERAN AREA

Mapped by: Phillip C. Wicklin  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
DETAIL SCALE 1:25,000

**ROAD CLASSIFICATION**

- Primary highway: Light-duty road, hard or hard surface
- Secondary highway: Unimproved road
- Interstate Road: U.S. Road: State Road

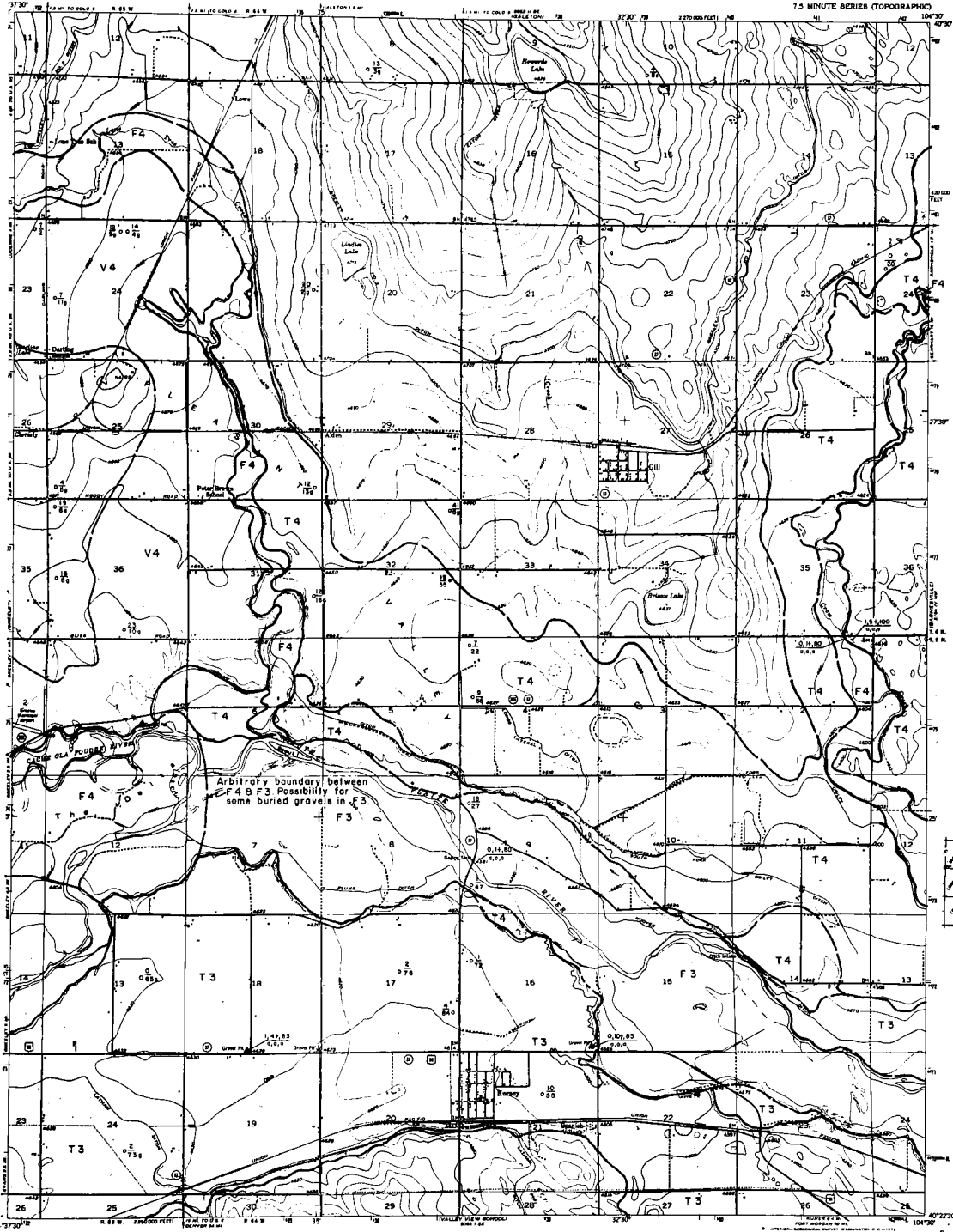
KEENESBURG, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

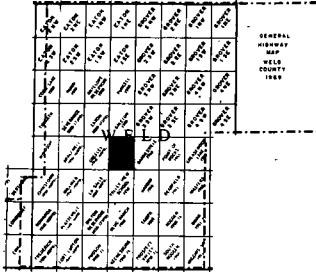
KERSEY QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Contour interval
  - Resource classification
- LANDFORMS**
- F Fluvial deposit
  - T Tectonic surface deposit
  - V Valley fill (Q<sub>1</sub> & T<sub>1</sub>)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (sand, silt, shells, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and well sorted
  - 2 Gravel: significant fines, decomposed, calcareous, or carbonate
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Abandoned stone quarry
  - ▨ Potential quarry aggregate resource area
  - ▧ Selected well-sorted hole location with overburden thickness (ft) and fines (percent of total) (Q<sub>1</sub> & T<sub>1</sub>)
  - ▩ Significant gravel, "x" indicates none
  - In symbol location unutilized at unknown property
  - ▬ Section Colorado Geological Survey project (sand and gravel) project
  - ▭ Landform boundary, wild where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND ORIOGRAPHIC DIMENSION OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (percent of total) (Q<sub>1</sub> & T<sub>1</sub>)
  - Significant amount of fines (percent of total) (Q<sub>1</sub> & T<sub>1</sub>)
  - Significant amount of decomposed or calcareous
  - Significant amount of calcareous material
  - Significant amount of unutilized at unknown property
  - Significant amount of unutilized at unknown property



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHELD AREA

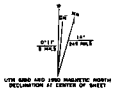
**REFERENCE:**

Smith, R.O., Schneider, F.A., Jr., and Patel, L.N., 1964, Ground-water resources of the South Platte River basin in western Adams and southeastern Weld Counties, Colorado: U. S. Geol. Survey Water-Supply Paper 1658, pl. 1.

Sven, F. B., III, 1972, Map of surficial geology of part of the Kersey quadrangle: Reconnaissance mapping for Colorado Geol. Survey Windsor Environmental Geology Project, open-file map.

Mapped by: Phillip C. Wicklen  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
DATHUM = MEAN SEA LEVEL

**ROAD CLASSIFICATION**

HIGHWAY SURFACE ALL WEATHER ROADS DRY WEATHER ROADS  
Hwy-000 LAGGED/BLASSED IMPROVED GR.  
Hwy-000 LAGGED/BLASSED IMPROVED GR.  
Loose-surface, graded or native hard-surface  
□ U. S. Route ○ State Route

KERSEY, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

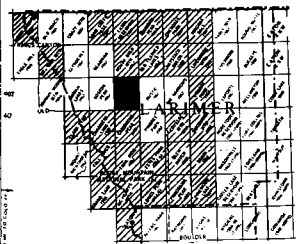
KINKINIK QUADRANGLE  
COLORADO LARIMER CO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

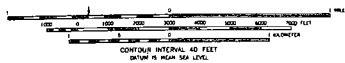
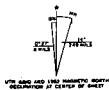
- Landform unit*  
*Resource classification*
- LANDFORM UNIT**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Non-deposited sand (colluvial)
  - M Non-uvic deposits (slag, tailings, spalls, ...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate*  
 (see legend for material on 44 screen, 20-mesh) (contaminated)
- 1 Gravel (relatively clean and sound)
  - 2 Gravel (significant fines, uncombed rock, calcium carbonate)
- Fill Aggregate*  
 (specified from 75 to 100 mesh, 40 screen, 40 mesh) (material on 200 screen, usual retention 40 mesh)
- 3 Sand
  - 4 Probable aggregate resources
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Controlling stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel, thickness (ft), obtained from well logs.
  - Indistinct gravel, indicates sand
  - In symbol denotes unmineralized or unknown property.
  - \* denotes Colorado Geological Survey "underground and gravel projects" drill hole
  - Landform boundary, solid where known or dashed where approximate or inferred
- STATUS, LOCATION AND GEOLOGICAL SIGNIFICANCE OF SPIRIT**
- (overburden thickness (ft))
  - (sand/gravel resource thickness (ft))
  - (percent sand and fines passing 40 screen, 0.15 in.), (sand) (percentage)
  - (significant amount of sand/gravel in soil bank)
  - (significant amount of material unmineralized)
  - \* in symbol denotes unmineralized or unknown property
  - \* in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WILDERNESS AREA

Mapped by: Stephen D. Schwachow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



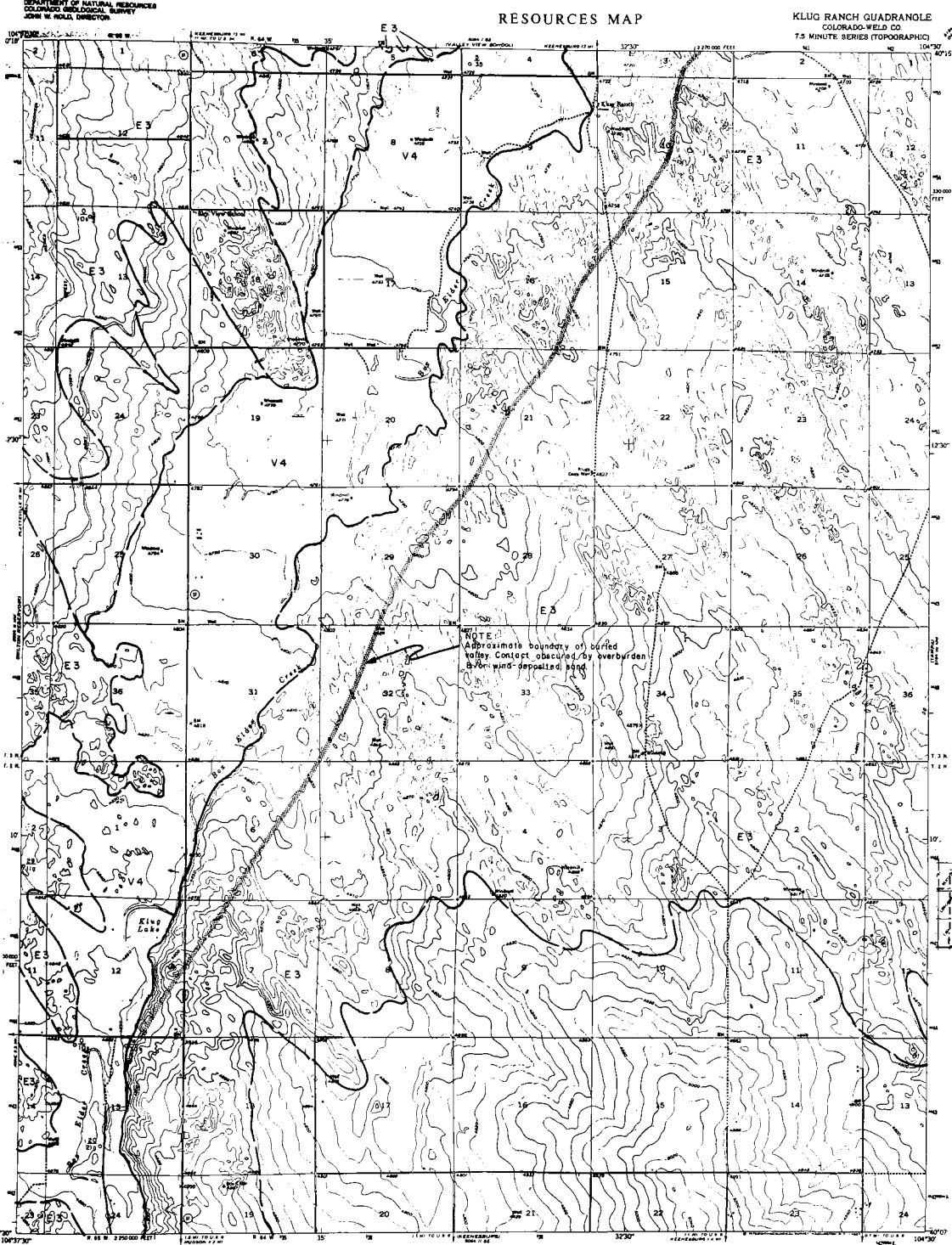
**ROAD CLASSIFICATION**

- Light duty
- Medium-duty
- Unimproved det.
- State Route

KINKINIK, COLO.

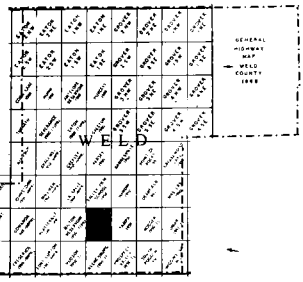
SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

KILG RANCH QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

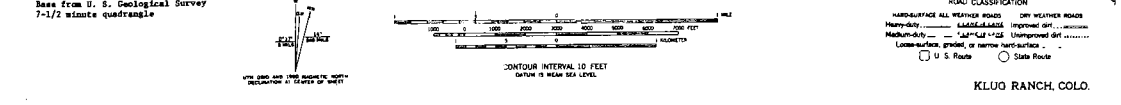
- LITHOLOGICAL UNIT**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U "Old" deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposit (sandstone, siltstone...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
1 Gravel: relatively clean and sound
- Sand Aggregate**  
3 Sand
- Probable Aggregate Resource**  
4 Probable aggregate resource
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with owner's written consent (SI) over sand/gravel resource
  - Distances (SI), obtained from well logs
  - "S" indicates gravel, "F" indicates sand
  - "L" in symbol denotes unconsolidated or unknown property
  - "W" denotes Colorado Geological Survey "water/flood and gravel projects" drill hole
  - Landform boundary, wells where known or observed, datum where appropriate or inferred
- STATION, LOCATION AND ORIENTATIONAL INFORMATION OF SYMBOLS**
- horizontal distance (H)
  - vertical distance (V)
  - point and line (spacing of 4000 ft)
  - significant amount of deposit or sand bank
  - significant amount of erosion (distance indicator)
  - "L" in symbol denotes unconsolidated or unknown property
  - "W" in symbol denotes property above or complete



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Reference: Smith, E. O. and others,  
1964, U.S.G.S. Water Supply Paper  
1658, Plate I.

Mapped by: Phillip C. Wickless  
Date: June 30, 1974

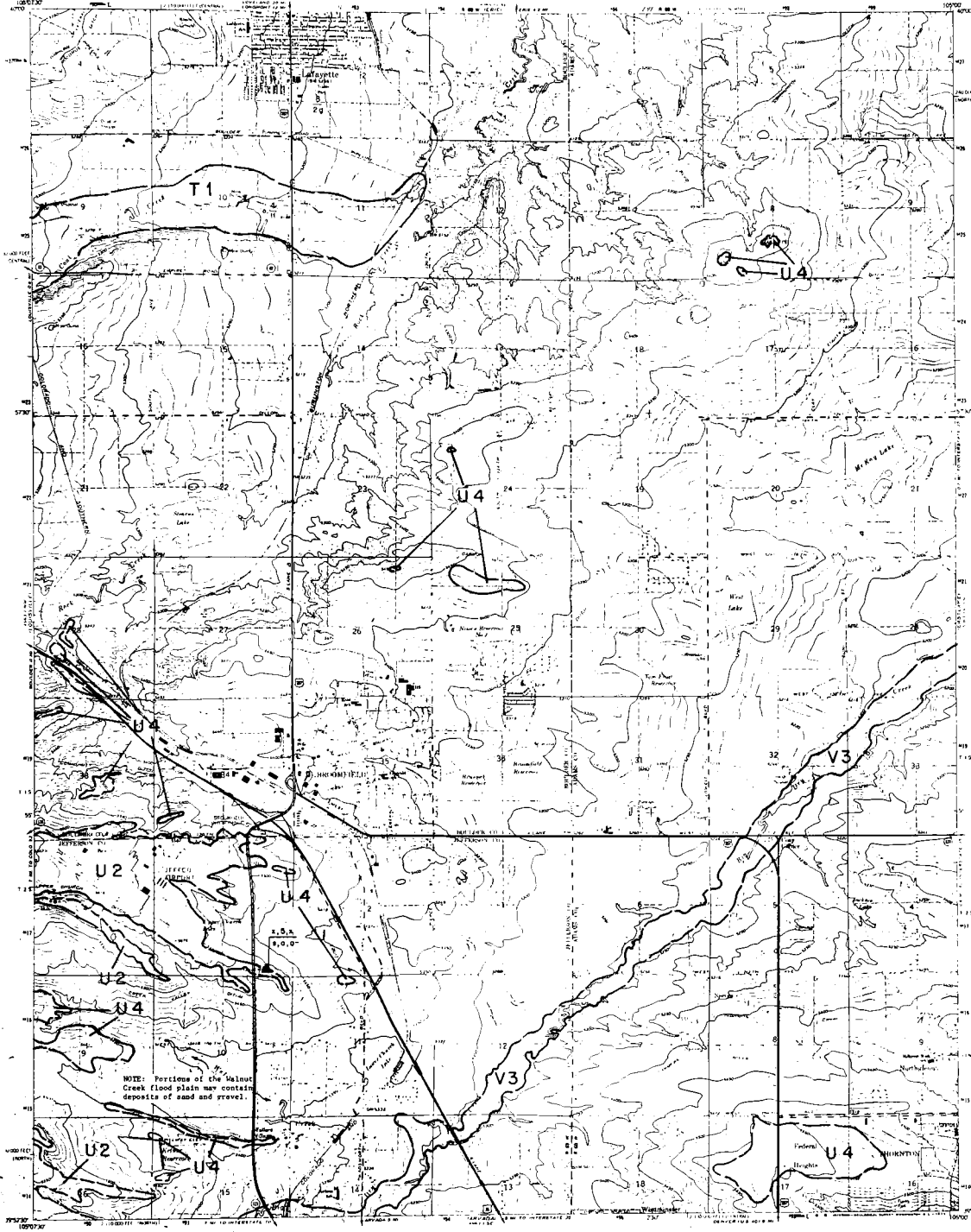




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

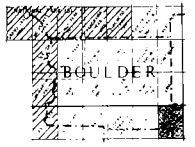
LAFAYETTE QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LEGEND**
- T Floodplain deposit
  - F Fluvial deposit
  - T Fluvial terrace deposit
  - V Valley fill (F & S)
  - U Upland deposit
  - A Alluvial fan
  - M Wind-deposited sand (colluvial)
  - M Marine deposit (beach-ridge, dune, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: resistant, clean and sound
  - 2 Gravel: significant fines, decomposed rock location uncertain
  - 3 Sand
  - 4 Potential aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Gravel well or sand/gravel quarry with known reserves (100,000 cu yd and greater)
  - Gravel well or sand/gravel quarry with known reserves (100,000 cu yd and less)
  - "G" indicates gravel, "S" indicates sand
  - "R" in gravel reserves indicates or indicates reserves
  - "M" denotes Colorado Geological Survey resource (sand and gravel) projects
  - State title
  - Location boundary, solid where known or uncertain, dashed where approximate or inferred
- STATION, LOCATION AND CONDUCTS (DESCRIPTION OF SERVICE)**
- Water supply
  - Electric power
  - Gas
  - Oil
  - Highway
  - Railroad
  - Telephone
  - Power line
  - Water line
  - Gas line
  - Oil line
  - Other



**QUADRANGLE LOCATION**

**NON-RESOURCE OR WETLAND AREA**

**REFERENCE:**

Chase, C.R., and McConahy, J.A., 1972. Generalized surficial geologic map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-723.

Ruchette, M. N., 1974. personal communication.

**Geology modified after:**

Tettable, D.E., and Fitch, R.R., Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map 1-836-A.

Mapped by: Ralph E. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Heavy duty ———— Light duty ————

Medium duty ———— Unimproved dirt ————

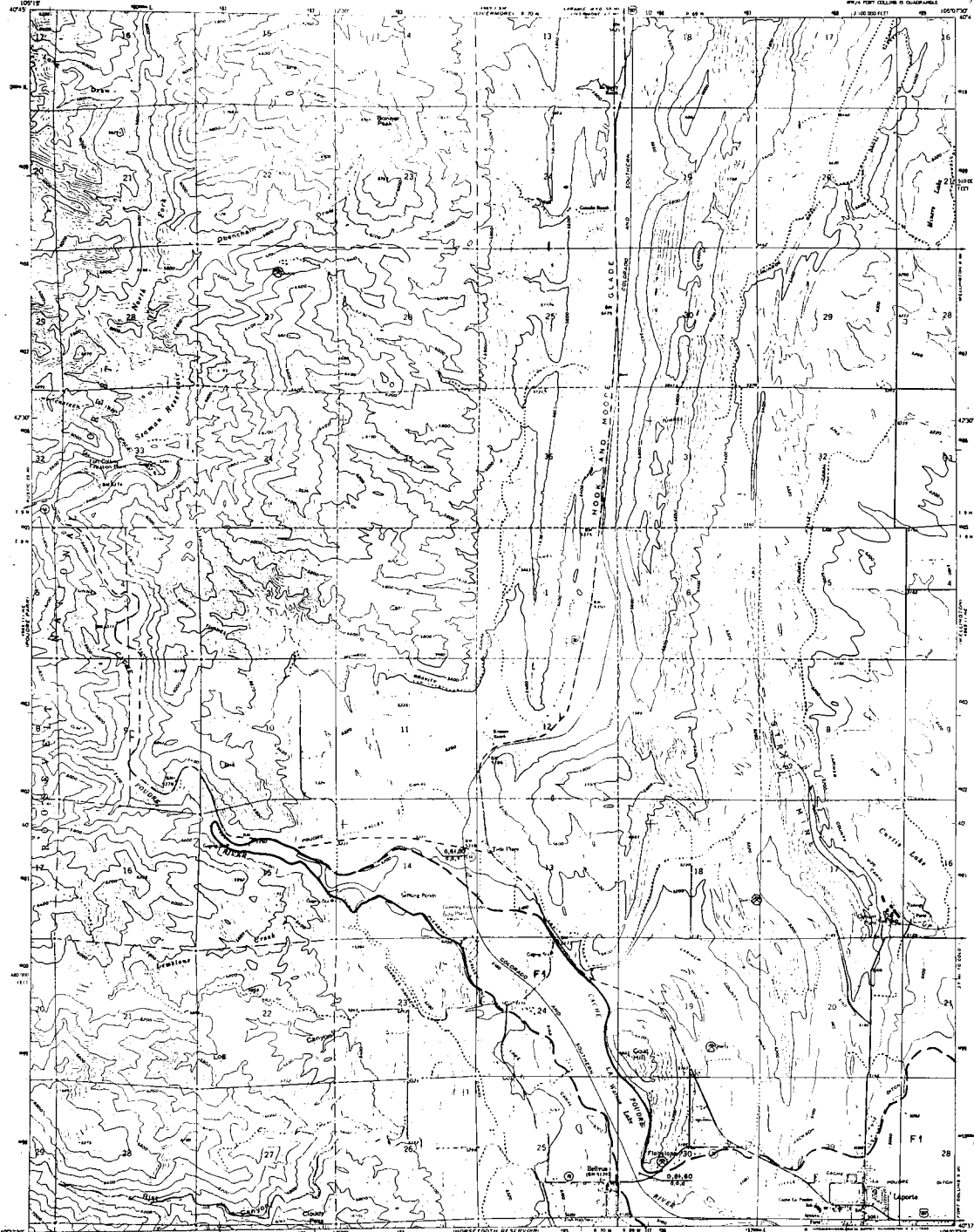
U.S. Route ———— State Route ————

LAFAYETTE, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

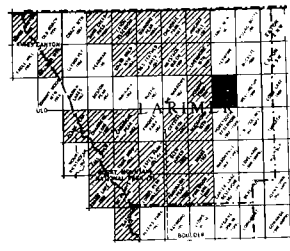
LAPORTE QUADRANGLE  
COLORADO-LAHMER 23  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
U.S. GEOLOGICAL SURVEY

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



## EXPLANATION

- LANDFORM UNIT**  
 Symbol: [Symbol]   
 Name: [Name]   
 Reference: [Reference]
- LANDFORM UNIT**  
 F Fluvial deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Marine deposit (glaciolacustrine, eolian, ...)
- AGGREGATE QUANTITY**  
 1 Good: relatively clean and sound  
 2 Good: significant fines, decomposed rock, calcium carbonate  
 3 Sand  
 4 Problematic aggregate resource
- USE STATUS**  
 a Operating gravel and/or sand pit  
 b Abandoned gravel and/or sand pit  
 c Operating stone quarry  
 d Abandoned stone quarry  
 e Potential quarry aggregate resource area  
 f Selected well or fill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs  
 g " indicates gravel; " indicates sand  
 h In symbol: resource unutilized or unknown quantity  
 i " in symbol: Colorado Geological Survey (Lahmer-23 and Crowl) projects  
 j " in symbol: resource not known or observed; dashed white areas are inferred.
- STATION, LOCATION AND GEOLOGICAL INFORMATION OF SYMBOL**  
 [Symbol] overburden thickness (ft)  
 [Symbol] aggregate resource thickness (ft)  
 [Symbol] percent sand and fines (percent) ft  
 [Symbol] others: 0 to 100 percent sand and fines  
 [Symbol] significant amount of fines (percent)  
 [Symbol] 2000 ft  
 [Symbol] significant amount of decomposed or weak rock  
 [Symbol] significant amount of calcium carbonate (percent)  
 [Symbol] in symbol: resource unutilized or unknown quantity  
 [Symbol] in symbol: service property, absent or deeded/owned



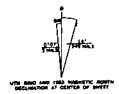
■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**  
 Harshey, L.A., and Schneider, P.A., Jr., 1972, Geologic map of the lower Cache la Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-587.  
 Swan, F. H., III, 1972, Map of surficial geology of part of the Laporte quadrangle: Reconnaissance mapping for Colorado Geol. Survey, Western Environmental Geology Project, open-file map.

Braddock, W.A., Conner, J.J., Swann, G.A., and Wohlford, D.D., 1973, Geologic map and sections of the Laporte quadrangle, Larimer County, Colorado: U. S. Geol. Survey open-file map.

Mapped by: Stephen D. Schwabow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL 40 FEET  
 20110 USGS DEMONSTRATION OF 1987 CONTOUR  
 DATA FROM 1:250,000 MAP

**ROAD CLASSIFICATION**  
 Heavy-duty ————— Light-duty - - - - -  
 Medium-duty - - - - - Unimproved dirt - - - - -  
 U.S. Route (circle) State Route (circle)

LAPORTE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

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

LARKSPUR QUADRANGLE  
COLORADO

7.5 MINUTE SERIES (TOPOGRAPHIC)  
7500 FEET AT 10' INTERVAL



EXPLANATION

- Legend**
- Contour lines
  - Topographic classification
- LANDFORMS**
- F Fluvial deposit
  - Y Shallow surface deposit
  - V Valley fill (F & Y)
  - U Unconsolidated deposit
  - A Alluvial fan
  - E Wind-deposited sand (alluvial)
  - M Marine deposit (beach, dune, etc.)
- ROAD CLASSIFICATION**
- 1 Heavy-duty
  - 2 Medium-duty
  - 3 Light-duty
- ROAD CLASSIFICATION**
- 1 Heavy-duty
  - 2 Medium-duty
  - 3 Light-duty
- ROAD CLASSIFICATION**
- 1 Heavy-duty
  - 2 Medium-duty
  - 3 Light-duty

**EXPLANATION**

**ROAD CLASSIFICATION**

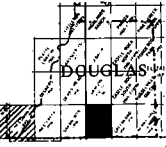
- 1 Heavy-duty
- 2 Medium-duty
- 3 Light-duty

**ROAD CLASSIFICATION**

- 1 Heavy-duty
- 2 Medium-duty
- 3 Light-duty

**ROAD CLASSIFICATION**

- 1 Heavy-duty
- 2 Medium-duty
- 3 Light-duty



**EXPLANATION**

- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Technology Modified after:  
Harris, J.C., 1951, Structural geology of the western flank of the southern Front Range, Colorado; University of Colorado Ph.D. Thesis, 121 p., 3 pls.

Tribble, D.E., and Fitch, B.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map I-437 A.

REFERENCE: Tribble, Donald, 1974, U.S.C.S.p.2 Personal Communication

Lee, W.T., 1902, Areal geology of the Castle Rock region; Am. Geologist, v. 29, p. 96-109, Pl. 1:250,000.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved dirt
- Intermittent Route
- U. S. Route
- State Route

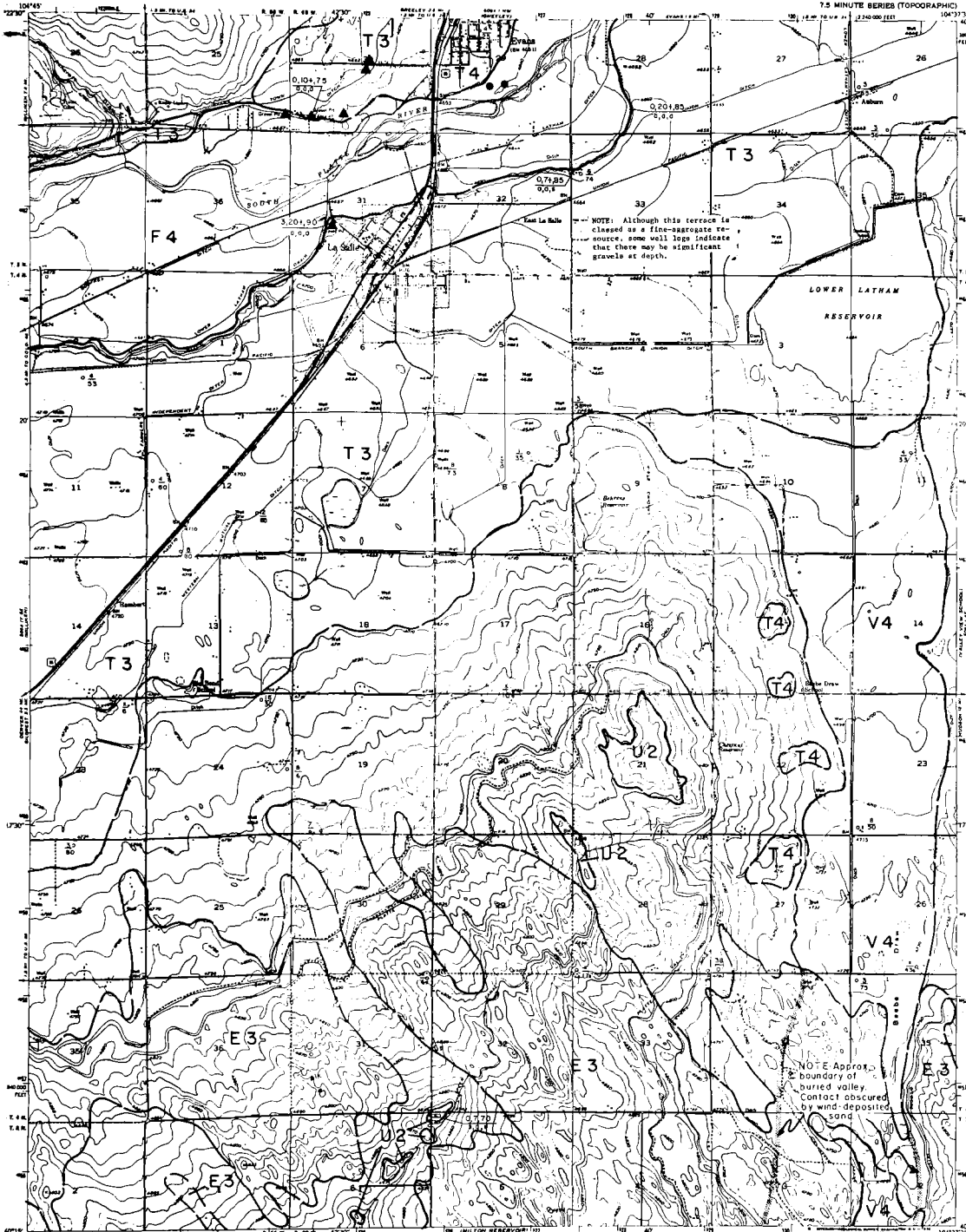
LARKSPUR, COLO.



**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

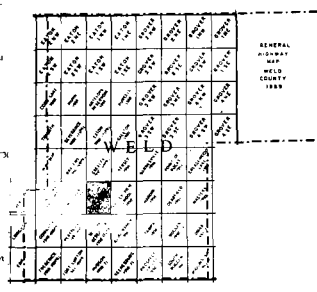
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLL, DIRECTOR

LA SALLE QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



**EXPLANATION**

- SYMBOLS**
- (with dot) - QUADRANGLE LOCATION
  - ▨ - NON-RESOURCE OR WITHDRAWN AREA
- LITHOLOGICAL UNITS**
- F - Floodplain deposit
  - T - Terrace deposit
  - V - Valley fill (F & T)
  - U - Upland deposits
  - A - Alluvial fan
  - E - Eolian deposit (sand dunes)
  - M - Man-made deposits (fill, etc.)
- RESOURCE CLASSIFICATION**
- GRAVEL**
- 1 - Gravel: relatively clean and well sorted
  - 2 - Gravel: significant fines, decomposed rock, talus materials
- SAND**
- 3 - Sand
  - 4 - Probable aggregate resource
- MAP SYMBOLS**
- (with dot) - Operating gravel and/or sand pit
  - (with cross) - Abandoned gravel and/or sand pit
  - (with diagonal lines) - Operating stone quarry
  - (with horizontal lines) - Abandoned stone quarry
  - (with vertical lines) - Potential quarry aggregate resource area
  - (with wavy lines) - Selected well or drill-hole location with water-bearing thickness (ft), obtained from well logs
  - (with wavy lines) - Selected well or drill-hole location with water-bearing thickness (ft) indicated on well log
  - (with wavy lines) - In symbol denotes unmineralized or unknown property
  - (with wavy lines) - In symbol denotes Geological Survey resource/land use gravel projects (1973 log)
  - (with wavy lines) - Landform boundary, solid when known or inferred, dashed where approximate or inferred
- STATION, LOCATION AND ELEVATION**
- DESCRIPTION OF SYMBOLS**
- (with wavy lines) - Elevation thickness (ft)
  - (with wavy lines) - Sand/gravel resource thickness (ft)
  - (with wavy lines) - Amount and type of fines (percent of gravel)
  - (with wavy lines) - Equivalent amount of decomposed or well-sorted
  - (with wavy lines) - Equivalent amount of relation modulus (100)
  - (with wavy lines) - In symbol denotes unmineralized or unknown property
  - (with wavy lines) - In symbol denotes property absent or unmineralized

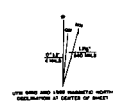


**REFERENCE:**  
Metcalf, R.O., Schneider, P.A., Jr., and Peard, L.R., 1964, Ground-water resources of the South Platte River basin in western Adams and southeastern Weld Counties, Colorado; U. S. Geol. Survey Water-Supply Paper 1658, p. 1.

**Geology modified after:**  
Colton, R.S., and Fitch, H.R., 1974, Map showing potential sources of gravel and crushed-rock aggregates in the Boulder-Fort Collins-Greeley Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map 1-655-D.

Mapped by: Stephen D. Schochow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- (solid) - HARD-SURFACE ALL-WEATHER ROADS
- (dashed) - HEAVY-DUTY
- (dotted) - MEDIUM-DUTY
- (dash-dot) - LOW-SURFACE, GRADED, OR NARROW HARD-SURFACE
- (with cross) - U.S. ROAD

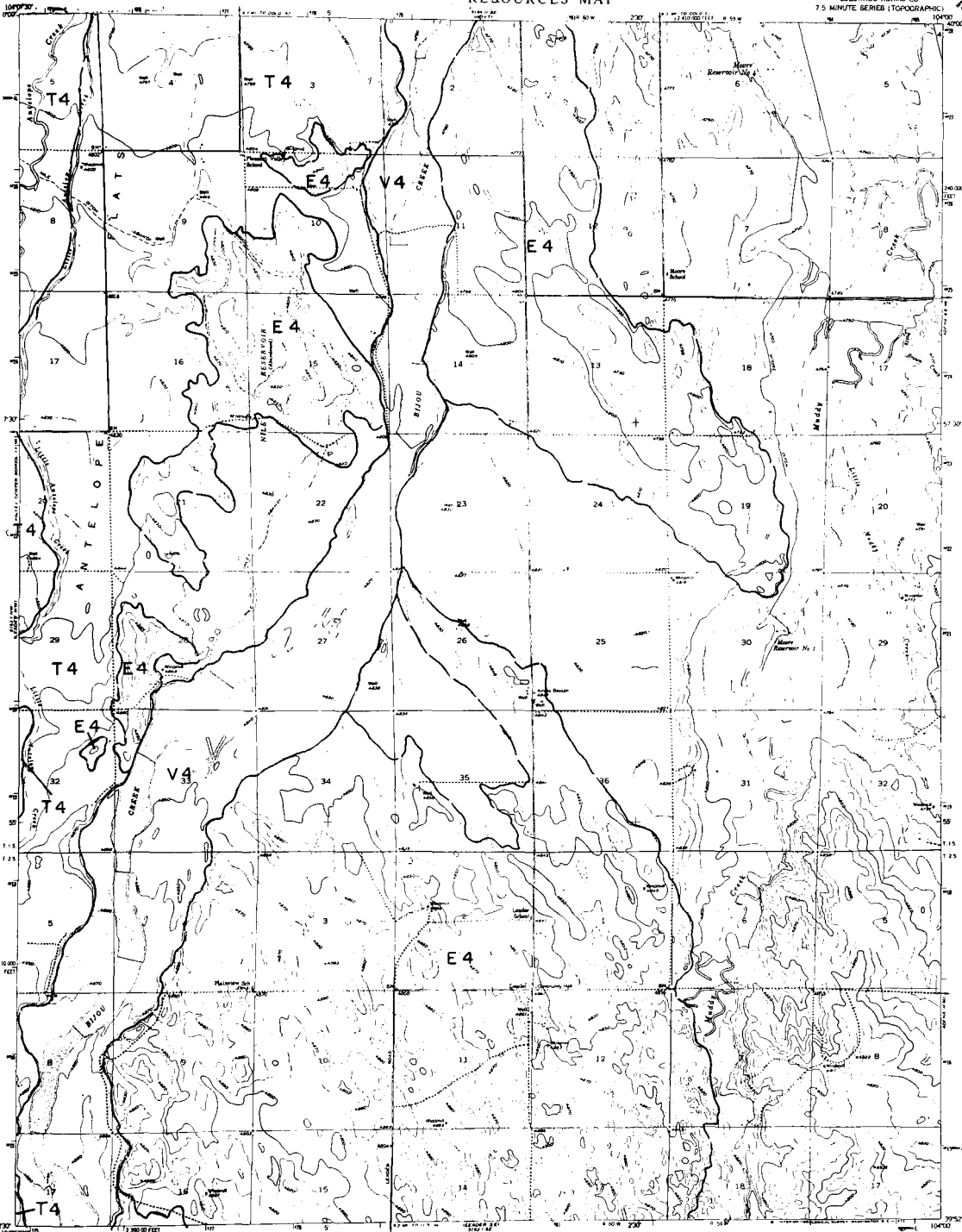
LA SALLE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

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

LEADER QUADRANGLE  
COLORADO ADAMS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION



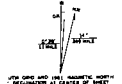
- LANDFORM UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Non-deposited land (swell)
  - M Mesquite formation (shag, caliche, spurs...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
(as shown on 40' contour, 10' interval)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine, caliche
- Fill Aggregate**  
(shown on 20' contour, 10' interval, 10' interval)
- 3 Sand
  - 4 Unavailable resource
  - 5 Probable aggregate resource
- NOT STORED**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "\*" indicates gravel; "x" indicates sand
  - "x" in small circles unutilized or unknown property
  - "\*x" under Colorado Geological Survey boundary lines and cross-sections
  - Landform boundary, solid shows known or observed; dashed shows approximate or inferred
- SECTION LOCATIONS AND ORIENTATIONS**
- DESCRIPTION OF SYMBOLS**
- Overburden thickness (ft)
  - Resource thickness (ft)
  - Gravel and sand (ft) overburden thickness (ft), 10' interval
  - Significant amount of decomposed or weak rock
  - Significant amount of calcine, caliche, or shale
  - "x" in small circles unutilized or unknown property
  - "\*" in small circles unutilized or unknown property



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wickham  
Date: June 30, 1974

Data from D. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
Datum is MEAN SEA LEVEL

- ROAD CLASSIFICATION**
- Heavy-duty Road
  - Medium-duty Road
  - U.S. Route
  - State Route

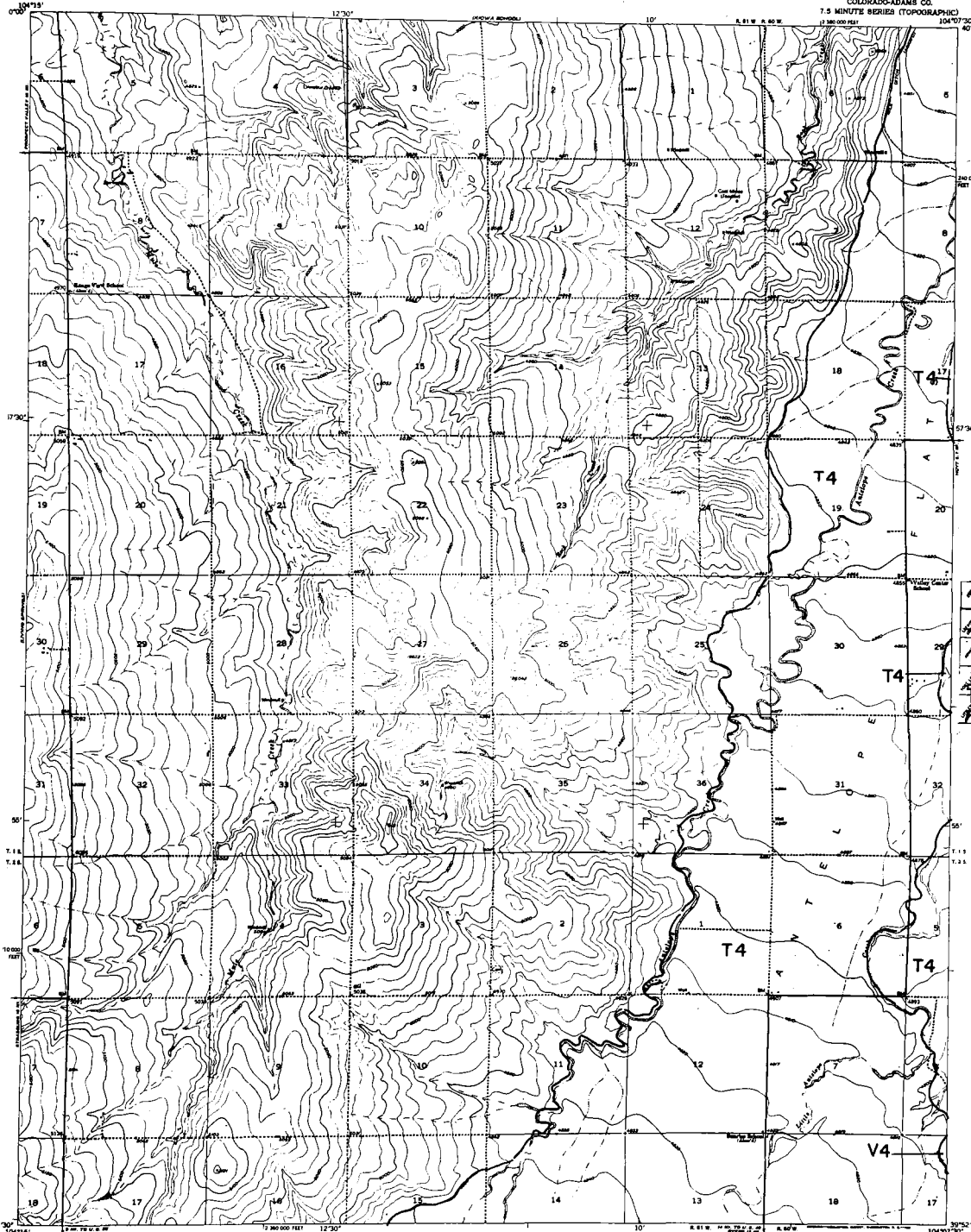
LEADER, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

LEADER NW QUADRANGLE  
COLORADO-ADAMS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
104°07'30"

## EXPLANATION



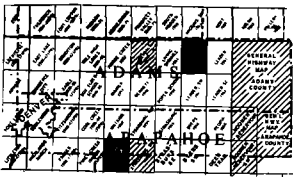
Landform units  
Resource Classification

- LANDFORM UNITS**
- F Floodplain deposit
  - T Trench or river channel
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan -
  - E Wind-deposited sand (eolian)
  - M Mountain deposit (talus, talus, gravel, etc.)

- RESOURCE CLASSIFICATION**
- Gravel Resource**  
(at least 20% restricted on 40 acres, 100% restricted)
- 1 Gravel: relatively clean and smooth
  - 2 Gravel: significant fines, decomposed rock, lacustrine carbonate
- Fill Aggregate**  
(greater than 75% passing #4 screen, 67% retained on #20 screen, 60% retained on #10 screen, 40% retained on #4 screen)
- 3 Sand
  - 4 Probable aggregate resource

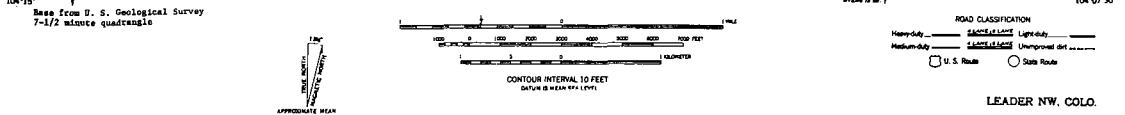
- QUIP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable quarry aggregate resource area
  - Quarried well or drill hole (containing well overburden thickness (ft) over sand/gravel resource thickness (ft); minimum from well logs)
  - "L" indicates gravel, "S" indicates sand
  - "L" in symbol denotes unventilated or unknown property
  - "M" denotes Colorado Geological Survey mineral sand and gravel project drill hole
  - Landform boundary, solid where known or dashed where approximate or inferred

- SYMBOL, LOCATION AND ORIENTATION**
- SYMBOLS FOR QUANTITIES**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (using #4 screen, <math>0.425\text{ mm}</math> or #20 mesh)
  - Significant amount of fines (passing #20 screen, <math>0.850\text{ mm}</math> or #20 mesh)
  - Significant amount of decomposed or weak rock
  - Significant amount of solution carbonate (includes unknown property)
  - "L" in symbol denotes unventilated or unknown property
  - "M" in symbol denotes properly oriented or topographic



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WETDRY AREA

Mapped by: Phillip C. Micklein  
Date: June 30, 1974



- ROAD CLASSIFICATION**
- Heavy-duty STATE HIGHWAY
  - Medium-duty STATE HIGHWAY
  - U.S. Route
  - State Road
  - Unimproved dirt road

LEADER NW, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

LEADER SE QUADRANGLE  
COLORADO-ADAMS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION

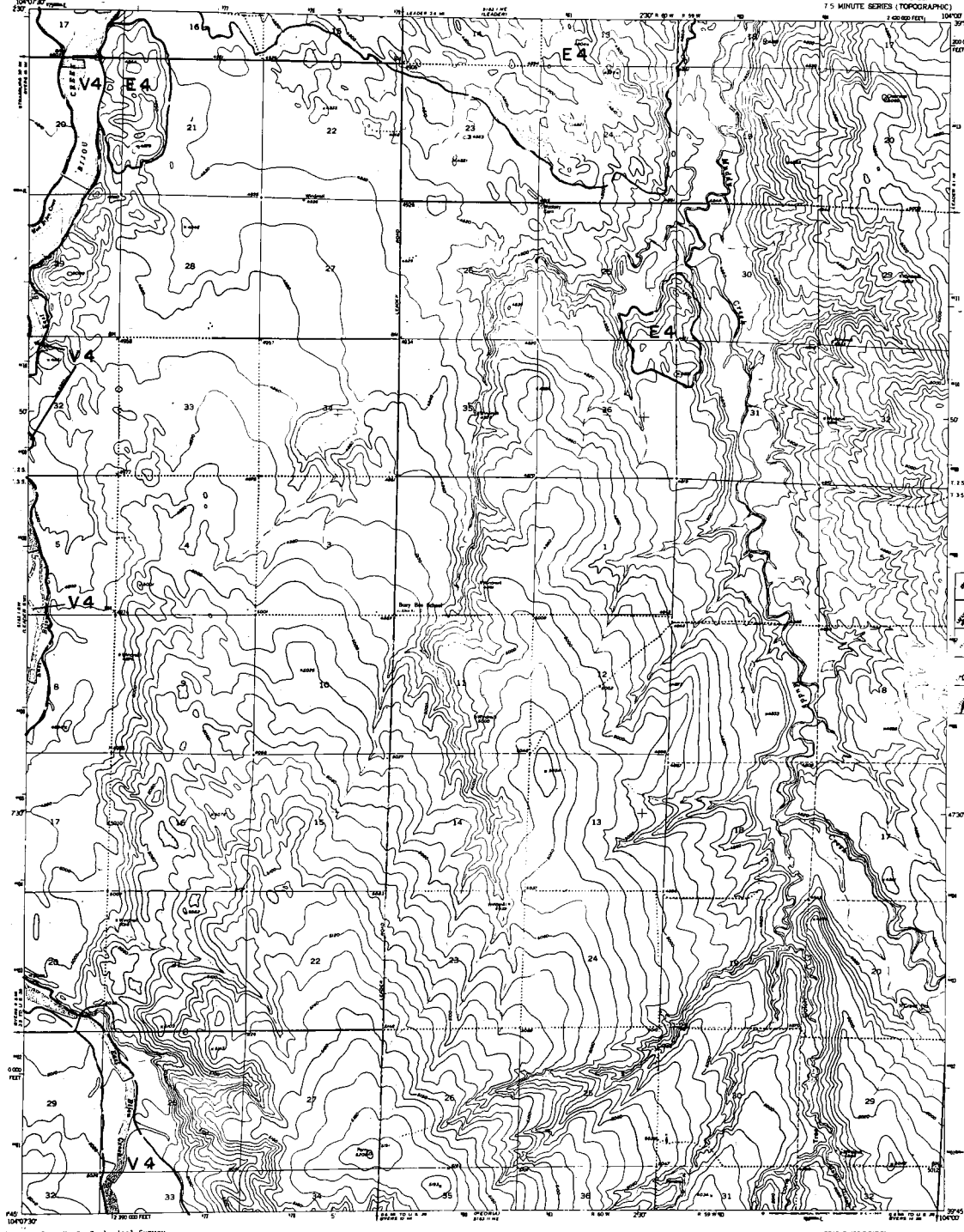
- LANDFORMS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unaltered deposit
  - A Alluvial fan
  - E Eolian-deposited sand (colluvial)
  - M Man-made deposit (tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- COARSE AGGREGATE**  
(at least 20% retained on # 20 mesh, round or angular)
- 1 Coarse: relatively clean and sound
  - 2 Coarse: significant fines, decomposed rock, angular calcareous
- FINE AGGREGATE**  
(greater than 75% passing # 20 mesh, fine retained on # 20 mesh, slight restriction)
- 3 Sand
  - 4 Potential aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Sectioned well or drill hole location with resource thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs. "s" indicates gravel; "m" indicates sand.
  - "s" in circles denotes unmineralized or unknown property.
  - "m" denotes Colorado Geological Survey (interfused and gravel) projects.
  - Landform boundary, solid when known or observed, dashed when approximate or inferred.
- SECTION, LOCATION AND GEOLOGICAL DESCRIPTION OF RESULTS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing # 20 mesh, 0.075 in. or 0.075 mm.)
  - significant amount of fines (passing # 20 mesh, 0.075 in. or 0.075 mm.)
  - significant amount of decomposed or weak rock.
  - significant amount of mineral occurrence (calcite).
  - "s" in symbol denotes unmineralized or unknown property.
  - "m" in symbol denotes property absent or untested/known.



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**  
Shadell, S.A., 1971, The Silver Creek Damites and Reservoirs of Adams and Arapahoe Counties, Colorado, Colorado School of Mines: EE-1327.

Maped by: Phillip C. Wickham  
Date: June 30, 1974



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

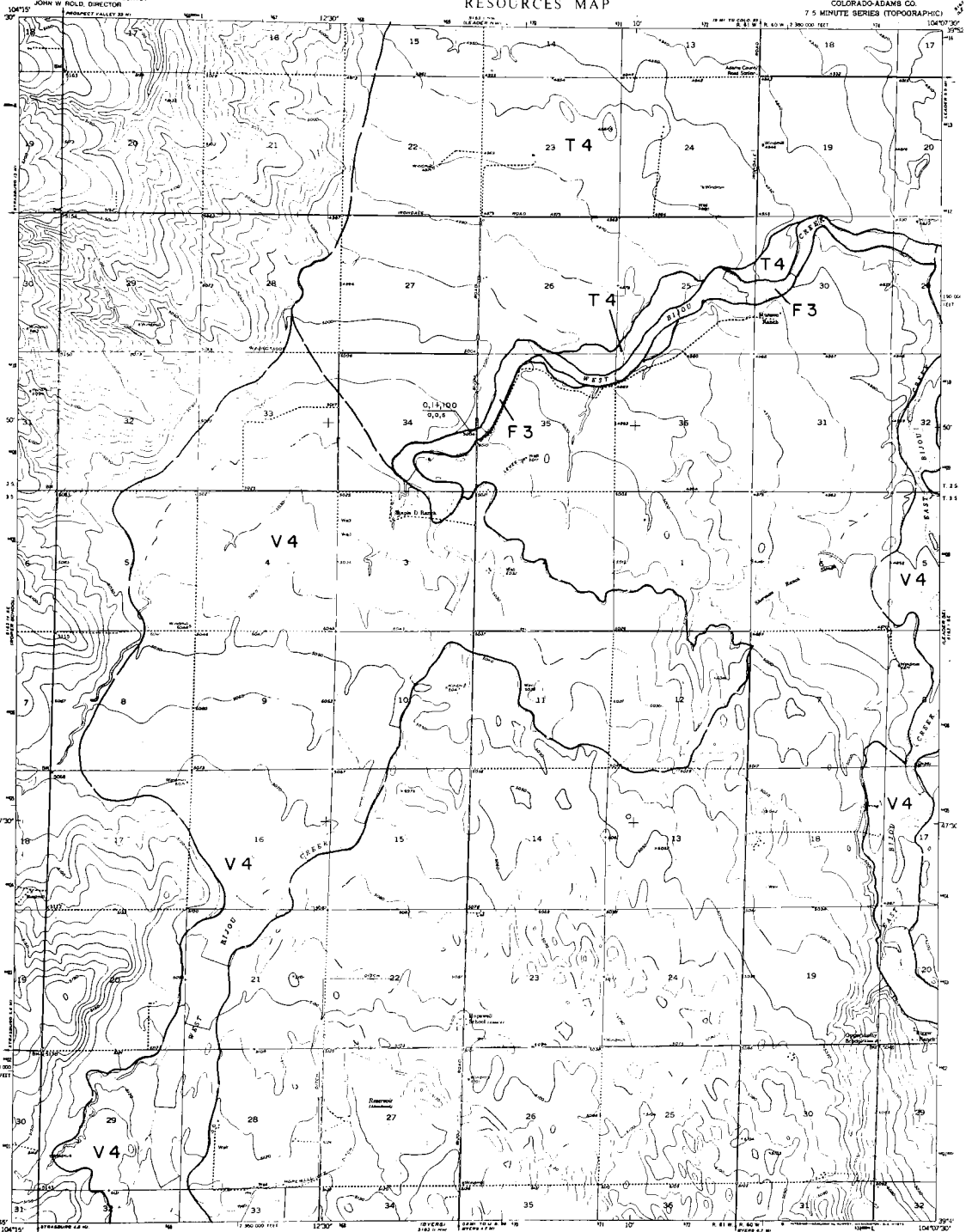
- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved dirt
- U.S. Route
- State Route

**LEADER SE, COLO.**  
H3945-W1040/7.5  
1951  
AMB 5103 1 66-SERIES V077

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

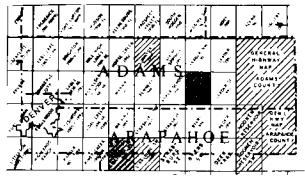
LEADER SW QUADRANGLE  
COLORADO-ADAMS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LEGEND**
- Location unit
  - Resource classification
- RESOURCE CLASSIFICATION**
- F Fluvial deposit**
  - T Tertiary terrace deposit**
  - V Valley fill (F & T)**
  - U Upland deposits**
  - A Alluvial fan**
  - E Wind-deposited sand (eolian)**
  - M Man-made deposits (slag, tailings, opima...)**
- AGGREGATE CLASSIFICATION**
- Coarse Aggregate**
    - 1 Gravel: relatively clean and sound
    - 2 Gravel: significant fines, decomposed rock, calcium carbonate
  - Fine Aggregate**
    - 3 Sand
    - 4 Particle aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Potential quarry aggregate resource area (with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs)
    - " " indicates gravel; " " indicates sand
    - " " in symbol denotes unclassified or unknown property
  - " " denotes Colorado Geological Survey classification and/or " " (ft) data
  - Section boundary, solid where known or observed; dashed where approximate or inferred
- SECTION LOCATION AND DIMENSIONS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - observed sand and gravel spacing (ft)
  - significant amount of fines (spacing 1000 screen, 0.075 in. or 3/250 mm.)
  - significant amount of decomposed or weak rock
  - significant amount of calcium carbonate material
  - " " in symbol denotes unclassified or unknown property
  - " " in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL: 10 FEET  
 DATUM: 1985 NAVD83



**ROAD CLASSIFICATION**

Heavy duty ————— Light duty —————  
 Medium duty ————— Unimproved dirt —————  
 □ U.S. Route      ○ State Route

LEADER SW, COLO.  
 N945-W1040/5/5  
 1952  
 AND 5142 1-6V-SERIES 1977

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

LITTLETON QUADRANGLE  
COLORADO  
MINUTE SERIES (TOPOGRAPHIC)

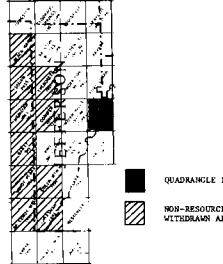
## EXPLANATION

- LITHOLOGIC UNITS**
- F Floodplain deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Erosion-deposited sand (terrace)
  - M Man-made deposits (landfill, spoil, etc.)

- RESOURCE CLASSIFICATION**
- Quarry Potential**
- 1 Green: relatively clean and sound
  - 2 Green: significant fines, decomposed rock, calcium carbonate
- Site Potential**
- 3 Sand
  - 4 Potentially aggregate resource

- MAP SYMBOLS**
- ▲ Operating gravel and/or sand pit
  - ▲ Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Selected well or drill-hole location with overall thickness (ft) and sandstone resource thickness (ft) obtained from well log
  - " " Indicated gravel; " " Indicated sand
  - " " to symbol denotes unvested or unknown property
  - " " to symbol denotes Colorado Geological Survey "Mineral and Geomorphology" title
  - ⊙ Landline boundary, solid where known or observed, dashed where approximate or inferred.

- SECTION, LOCATION AND GENERAL CHARACTER OF RESOURCES**
- ⊙ Section thickness (ft)
  - ⊙ Sandstone resource thickness (ft)
  - ⊙ Significant amount of fines (passing 20 mesh, 0.075 mm, or 0.075 mm)
  - ⊙ Significant amount of decomposed or weak rock
  - ⊙ Significant amount of calcium carbonate (limestone)
  - " " to symbol denotes unvested or unknown property
  - " " to symbol denotes property owned or leased/owned



Geology modified after:  
Scott, C.R., 1961, Geology of the Littleton quadrangle, Jefferson, Douglas, and Arapahoe Counties, Colorado; U.S. Geol. Survey Bull. 1121-I, pl. 1.

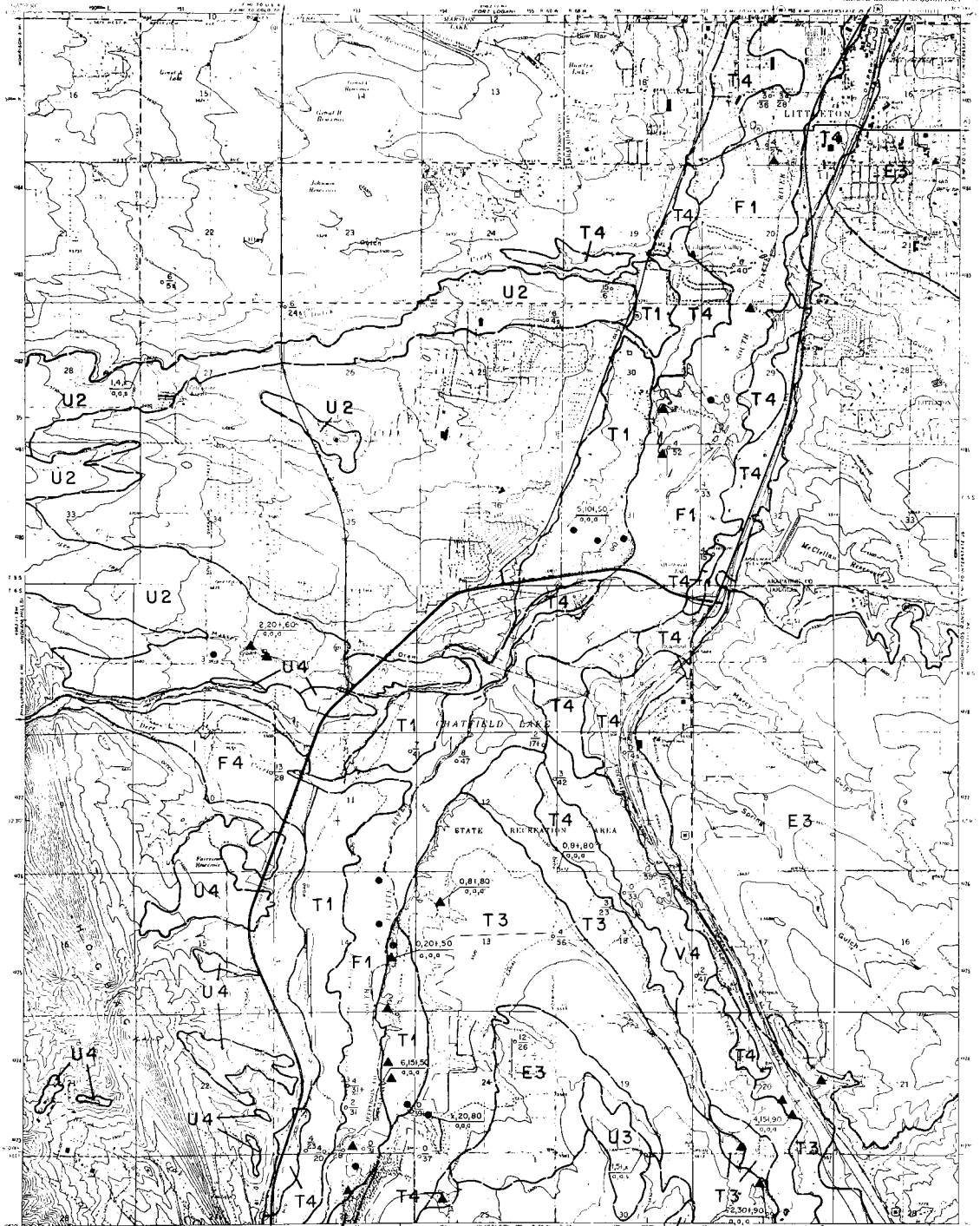
References:  
Inter-County Regional Planning Commission, 1963, Drainage course plan for the Denver region - Part I, Sand and gravel resources; Denver, Colo., Inter-County Reg. Plan. Comm., pl. 1.

Hamilton, J.L., and Owen, W.C., 1972, Geologic aspects, soils and related foundation problems, Denver metropolitan area, Colorado; Colorado Geol. Survey Environmental Geology Rept. 1, pl. 1.

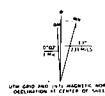
Chase, C.H., and McConaghy, J.A., 1977, Generalized vertical geologic map of the Denver area, Color. Geol. Survey Misc. Geol. Inv. 1-731.

Tribble, D.E., and Fitch, W.R., 1974, Map showing potential sources of gravel and crush-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.; U.S. Geol. Survey Misc. Geol. Inv. Map 1-895-A.

Mapped by: Stephen D. Schuechow  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Heavy duty
  - Medium duty
  - Light duty
  - Unimproved dirt
  - U.S. Route
  - State Route

LITTLETON COLO



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

LIVERMORE QUADRANGLE  
COLORADO-LARIMER CO.  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Landform unit**  
Resource classification
- LARIMER PIT**
- F Fluvial deposit
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-matrix deposits (clay, silt, sand, gravel, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(at least 50% passing #4 screen, based on volume)
- 1 Coarse: relatively clean and sound
  - 2 Coarse: significant fines, decomposed rock, calcine overburden
- Fine Aggregate**  
(greater than 75% passing #4 screen, 20% retained on #20 screen, based on volume)
- 3 Sand
  - 4 Probable aggregate resource
- NOT SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area situated with an overburden thickness (ft) over sand/gravel resource thickness (ft) calculated from well logs
  - "S" indicates gravel; "A" indicates sand
  - "L" symbol denotes material not suitable for use
  - "M" denotes Colorado Geological Survey material from well logs and projective drill hole
  - Location boundary of well shown in red; dashed lines approximate as follows
- SYMBOLS, LOCATION AND ORIENTATIONAL INDICATIONS OF PROPERTIES**
- overburden thickness (ft)
  - non/gravel resource thickness (ft)
  - percent sand and fines (passing #4 screen) of 25 in. or 6.09 m.
  - significant amount of fines (passing #20 screen) of 0.075 in. or 0.019 m.
  - significant amount of decomposed or weak rock
  - significant amount of calcine overburden (m/2 in.)
  - "L" or "M" symbol denotes material not suitable for use
  - "M" or "L" symbol denotes property shown as unsuitable



**QUADRANGLE LOCATION**  
NON-RESOURCE OR WATERSHED AREA

**REFERENCE:**  
Hershey, L. A., and Schneider, P. A., Jr., 1972. Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Surv. Map 1-607.

Mapped by: Stephen D. Schwochow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**  
Light-duty  
Unimproved dirt  
U.S. Route  
State Route

LIVERMORE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

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

LIVING SPRINGS QUADRANGLE  
COLORADO-ADAMS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

Legend symbols for Resource Classification

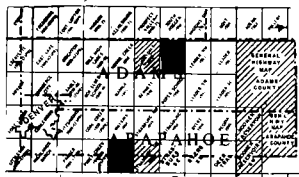
- LITHOLOGIC UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unclastic deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (landfilling, spoils, ...)

- RESOURCE CLASSIFICATION**
- Gravel resources  
(See legend for symbols on 40 acre, 100-foot resolution)
- 1 Gravel: relatively clean and uncoated
  - 2 Gravel: significant fines, decomposed rock, calc. lim. concretions
- Sand resources  
(See legend for symbols on 40 acre, 100-foot resolution)
- 3 Sand

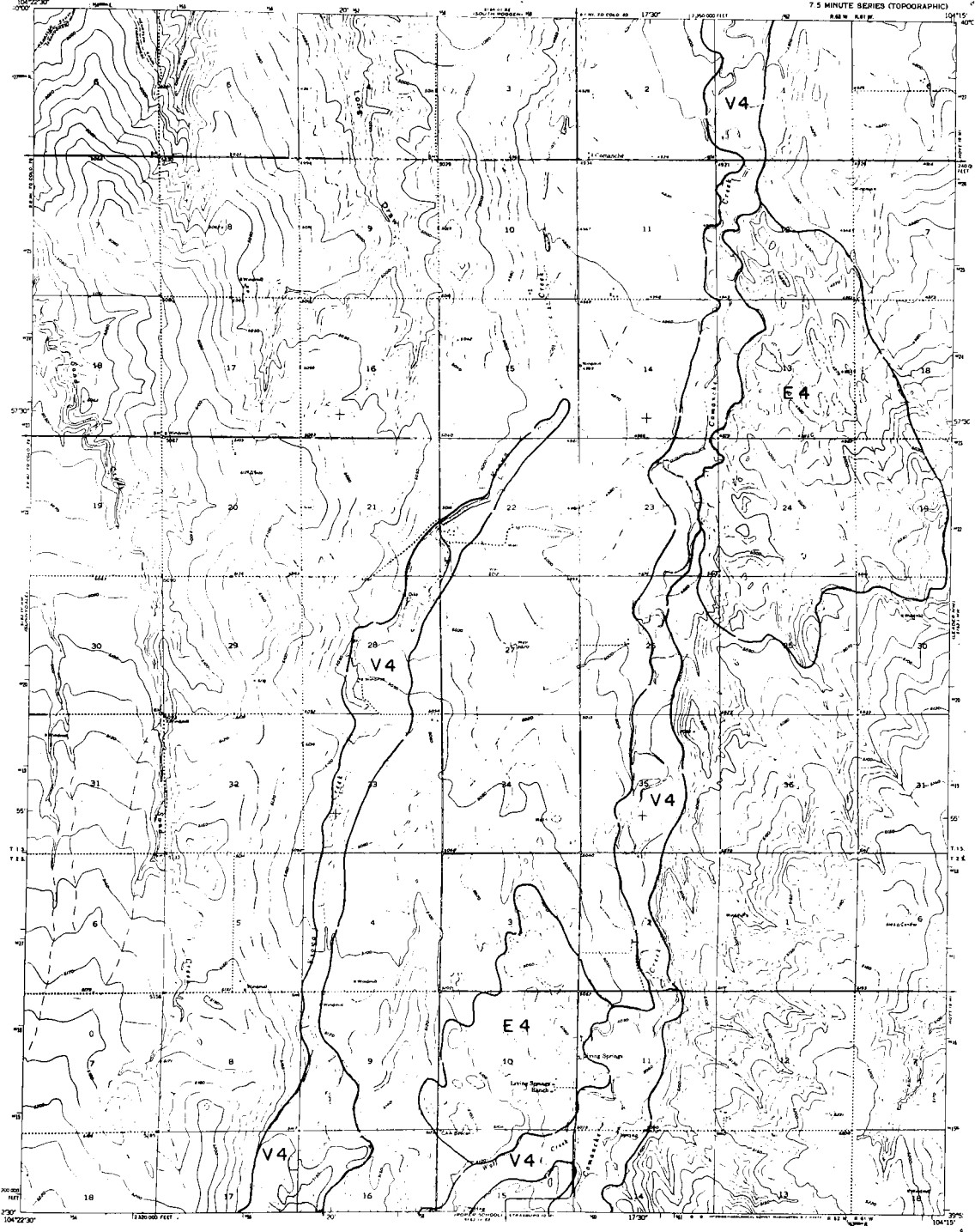
- UNCLASSIFIED RESOURCES**
- 4 Probable aggregate resources

- MAP SYMBOLS**
- A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Proposed quarry aggregate resource area
  - F Related well or drill-hole location with overburden thickness (ft) over sand/gravel resources (thickness (ft) obtained from well logs)
  - G "X" indicates gravel; "S" indicates sand
  - H "X" in symbol denotes unclassified or unknown property
  - I "W" denotes Colorado Geological Survey Water/Gas and/or Oil well
  - J "L" in symbol denotes landform boundary, solid where known or dashed where approximate or inferred

- STATION, LOCATION AND DIMENSIONAL DESCRIPTION OF DEPOSIT**
- Overburden thickness (ft)
  - Sand and/or gravel resources thickness (ft) (related well and/or drill-hole location or symbol of (ft) in (ft) symbol indicates in)
  - Significant amount of fines (less than 20% screen, 0.075 in or 0.015 mm)
  - Significant amount of decomposed or calc. lim. concretions
  - "X" in symbol denotes unclassified or unknown property
  - "W" in symbol denotes water/gas/oil well
  - "L" in symbol denotes landform boundary



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
SHOWS 100-FOOT INTERVAL

- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved dirt
  - U.S. Route
  - State Route

LIVING SPRINGS COLO.

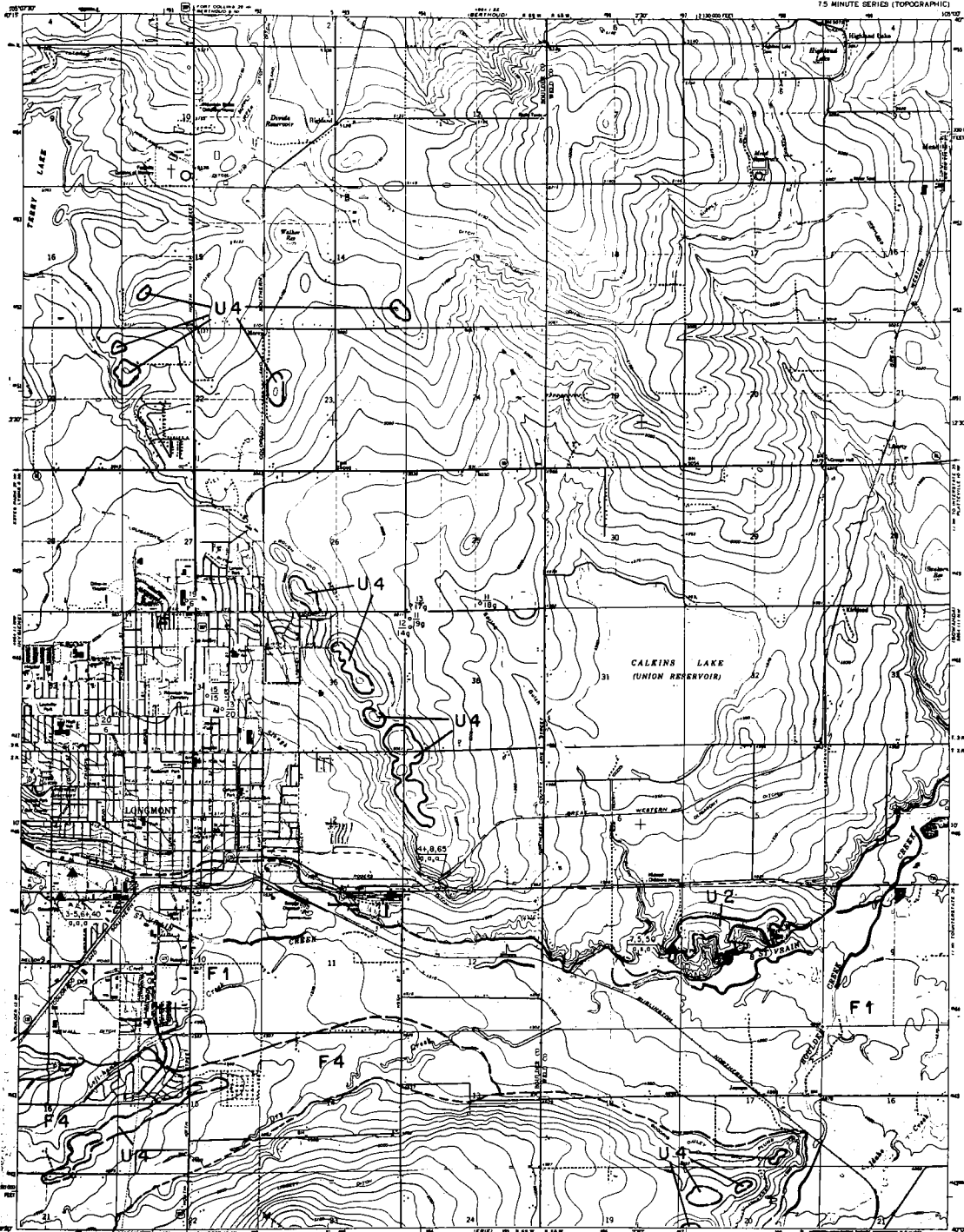
Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

LONGMONT QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



### EXPLANATION

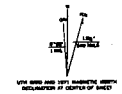
- LANDFORM UNIT**  
— Landform unit  
— Resource classification
- LANDFORM UNIT**  
F Fluvial deposit  
T Stream terrace deposit  
V Valley fill (F & T)  
U Upland deposits  
A Alluvial fan  
E Wind-deposited sand (eolian)  
M Marine deposits (beach-ridge, coral, ...)
- RESOURCE CLASSIFICATION**  
**Gravel**  
1 Gravel - relatively clean and smooth  
2 Gravel - significant fines, unrounded rock, calcium carbonate.  
**Sand**  
3 Sand  
4 Probable aggregate resource
- ROAD CLASSIFICATION**  
— Operating gravel and/or sand pit  
— Operating stone quarry  
— Abandoned stone quarry  
— Potential quarry aggregate resource area  
— Relocated mill or drill-hole location with every-  
hour thickness (1), obtained from mill logs.  
— "T" indicates gravel, "S" indicates sand  
— "S" in symbol denotes unconsolidated or  
unstable stratum.  
— "M" denotes Colorado Geological Survey  
Master/Lead and Gravel projector  
— Drill hole  
— Location boundary, solid black lines or  
dashed lines, indicate where resources are  
located.
- SYMBOL LOCATION AND ORIENTATION**  
**DESCRIPTION OF SYMBOL**  
— sand/gravel resource thickness (1)  
— potential sand and fines (spacing of  
arrows, 0.25 in., visual estimation)  
— significant amount of fines (spacing  
0.50 in., 0.25 in., or 0.125 in.)  
— significant amount of unconsolidated or  
unstable stratum  
— significant amount of calcium carbonate (scale)



Quarry modified after: Colton, R.B., and Finch,  
R.S., 1978, Map showing potential occurrence of gravel  
and crushed-rock aggregate in the Boulder-Over-  
Calfornia-Overley Area, Front Range Urban Corridor,  
Colorado: U. S. Geol. Survey Map 7-859-D.

Mapped by: Ralph E. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the  
U. S. Geological Survey

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**  
Heavy-duty — Light-duty —  
Medium-duty — Unimproved dirt —  
□ U.S. Road ○ State Road

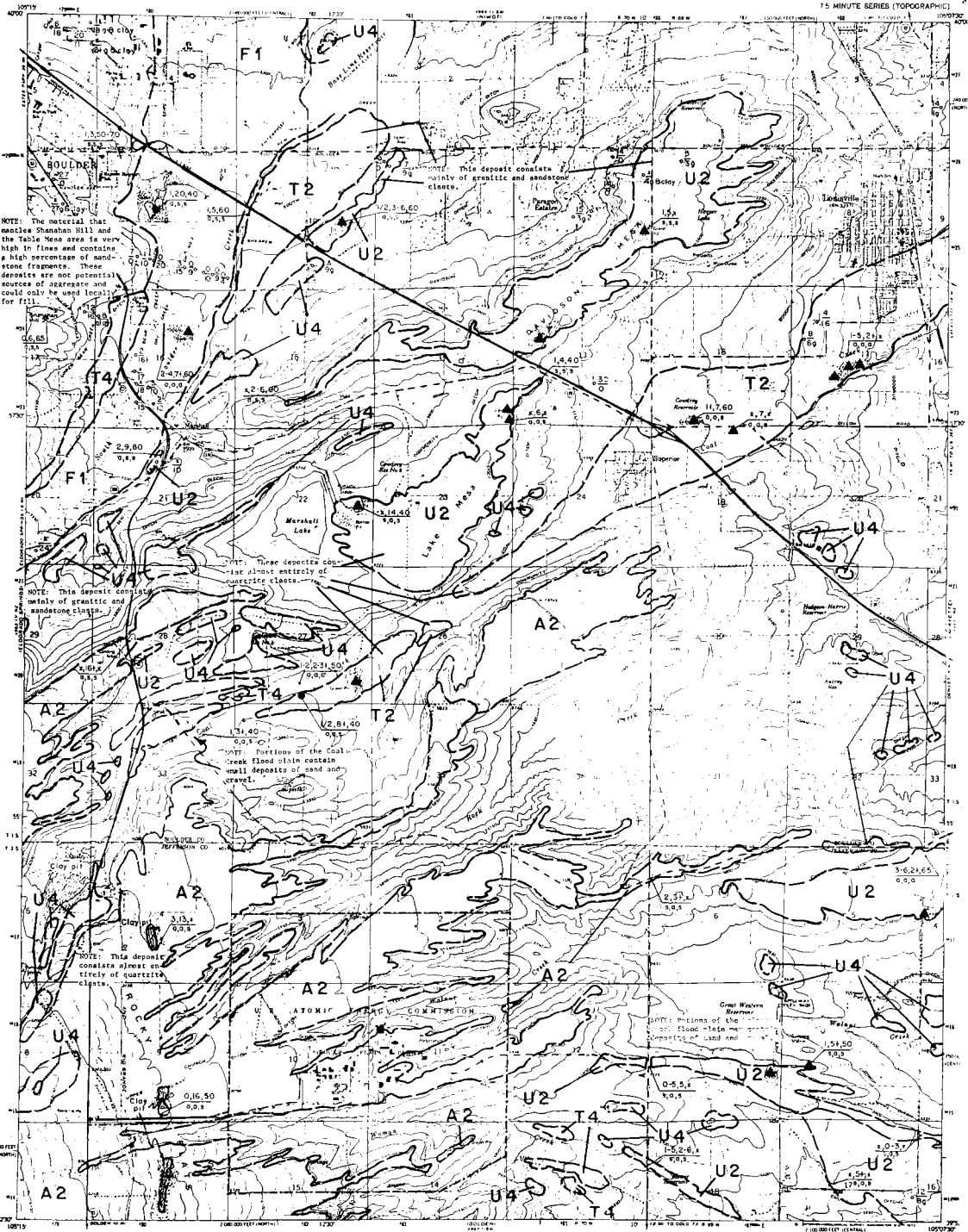
LONGMONT, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

LOUISVILLE QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LANDFORM UNIT**  
See name above location
- LANDFORM UNIT**
- F Floodplain deposit
  - T Terrace deposit
  - U Upland deposit
  - A Alluvial fan
  - E Erosion-deposited sand (alluvium)
  - M Non-resource (sand, gravel, aggregate, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: relatively fine, decomposed rock, volcanic material
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Unsettled (or other) high location with material (e.g., gravel, sand, aggregate, etc.) known to be available for use
  - Indicated gravel or sandstone road
  - Symbol denotes unutilized or unknown property
  - General Colorado Geological Survey (Geological and Geology Project) Well Hole
  - Landform boundary, valid where known or observed, shaded where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF BOLDERS**
- Numbered bolders (1-10) with descriptions of their composition and size.

NOTE: The material that makes Shanahan Hill and the Table Mesa area is very high in lime and contains a high percentage of sandstone fragments. These deposits are not potential sources of aggregate and could only be used local for fill.

NOTE: This deposit consists mainly of granitic and sandstone clasts.

NOTE: Three deposits consist almost entirely of quartzite clasts.

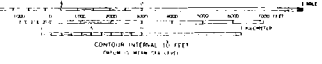
NOTE: This deposit consists mainly of granitic and sandstone clasts.

NOTE: Portions of the coal creek flood plain contain small deposits of sand and gravel.

NOTE: This deposit consists almost entirely of quartzite clasts.

NOTE: Portions of the Great Western River flood plain contain deposits of sand and gravel.

Base from U. S. Geological Survey 7.5-minute quadrangle

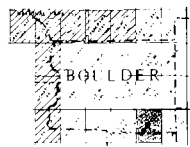


**ROAD CLASSIFICATION**

Heavy duty ————— Light duty —————  
Medium-duty ————— Unimproved dirt —————

State Road  
U.S. Road

LOUISVILLE, COLO.



**QUADRANGLE SOLUTION**  
NON-RESOURCE OR WITHDRAWN AREA

**REFERENCE:**

Chase, C.H., and McCarthy, J.A., 1972, Generalized surficial geology map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-731.

Trumble, D.E., and Petch, W.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map I-584-A.

Geology modified after:

Wade, H.F., 1955, Surficial geology of the Louisville quadrangle, Colorado: U.S. Geol. Survey Bull. 996-B, p. 211-259; Pl. 1

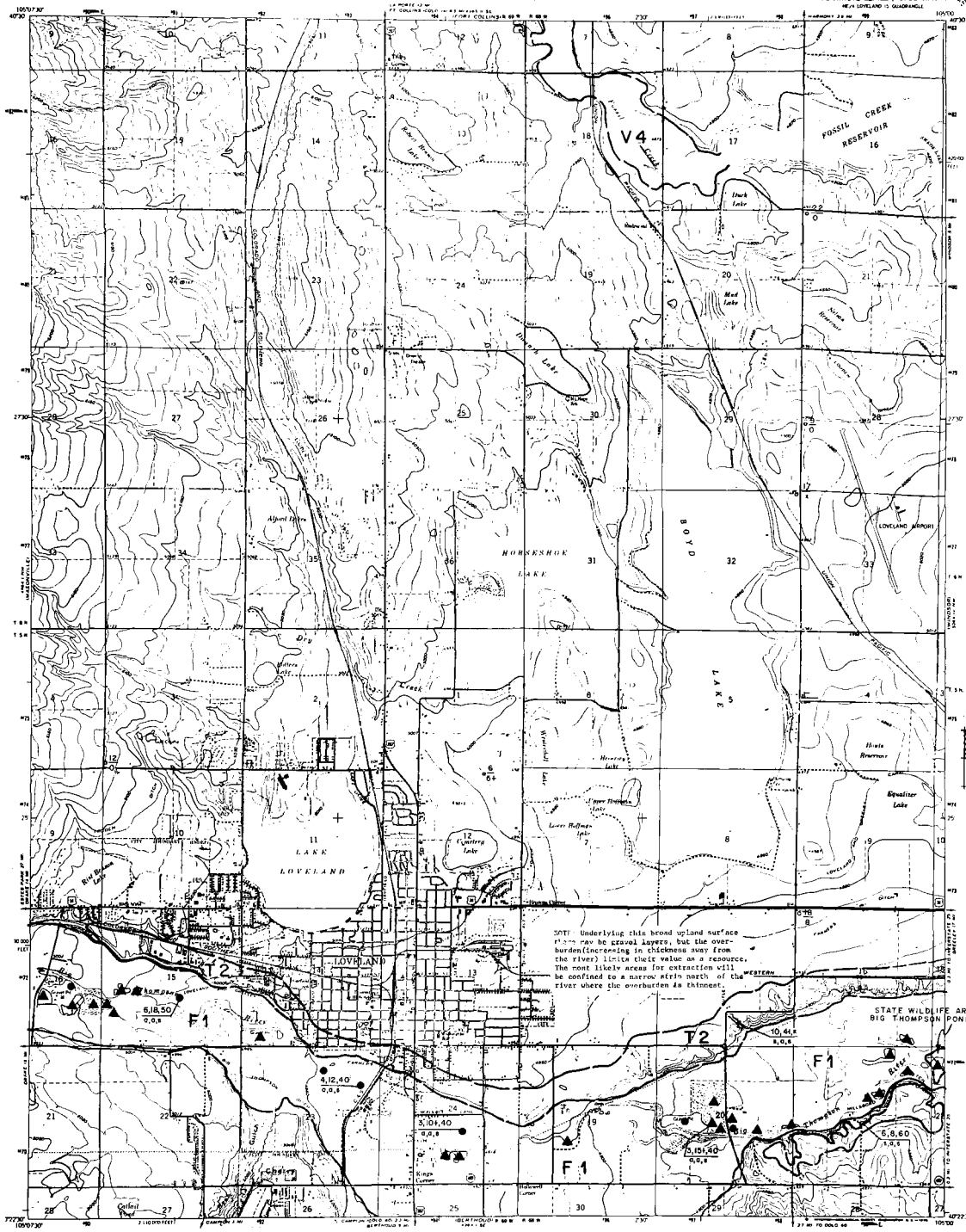
Mapped by: Ralph B. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

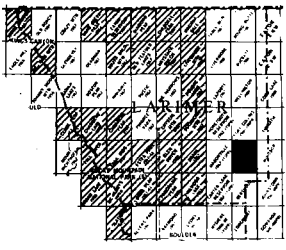
LOVELAND QUADRANGLE  
COLORADO-LARIMER CO.  
75 MINUTE SERIES (TOPOGRAPHIC)  
1:50,000

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



## EXPLANATION

- Topographic Unit**  
 - Reference classification
- LITHOLOGICAL UNIT**  
 F Fossiliferous deposit  
 T Tertiary terrace deposit  
 U Valley fill (F & T)  
 V Volcanic deposit  
 A Alluvial fan  
 E Eolian deposit (sand dunes)  
 M Mudsand deposit (sand, silt, clay, shale, etc.)
- MINERAL CLASSIFICATION**  
 1 Good aggregate  
 2 Fair aggregate  
 3 Poor aggregate  
 4 Probable aggregate resource
- MAP SYMBOLS**  
 Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs  
 "N" indicates strata "N" indicates sand or siltstone property  
 "W" denotes Colorado Geological Survey boundary and gravel gradient  
 Drill hole  
 Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION LOCATION AND GEOMETRICAL SIMILITUDE OF SYMBOL**  
 overburden thickness (ft)  
 sand/gravel resource thickness (ft)  
 percent sand and fines (spacing as common, 0.25 in., detail estimation)  
 significant amount of fines (spacing 1/160 normal, 1/200 in. or 1/100 in.)  
 significant amount of decomposed or weak rock  
 significant amount of medium to coarse (includes)  
 "N" or symbol denotes unsaturated or unknown property  
 "W" or symbol denotes property shown on Geology/soil map



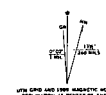
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WILDLIFE AREA

**REFERENCE:**  
 Swan, F. W., III, and Whitney, J. M., 1972, Map of surficial geology of the Loveland quadrangle: Recomm. mapping for Colorado Geol. Survey Wildland Environmental Geology Project, open-file map.  
 Shelton, D.C., 1974, personal communication.

**Geology modified after:**  
 Calkin, R.B., and Pitch, R.B., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Orealey Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map I-855-D.

Mapped by: Stephen D. Schorchow  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



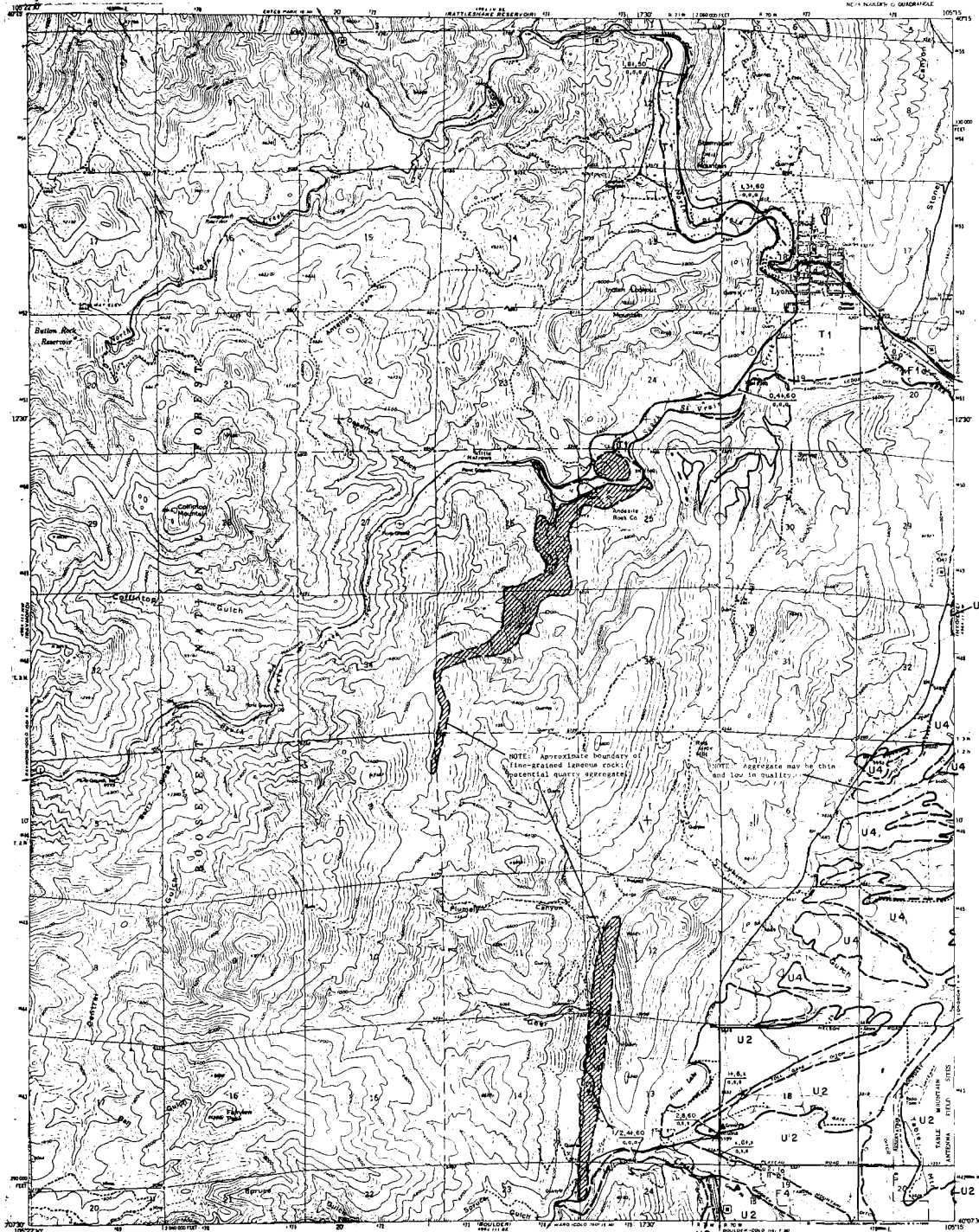
- ROAD CLASSIFICATION**  
 Heavy duty Light duty  
 Medium-duty Unimproved det.  
 U.S. Road State Road

LOVELAND, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

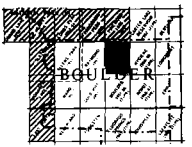
LYONS QUADRANGLE  
COLORADO-Boulder CO  
7.5 MINUTE SERIES (1:50,000)  
N. & N.W. CORNER OF QUADRANGLE

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



## EXPLANATION

- Landform Unit**  
Resource classification
- LANDFORM UNIT**
- F Fluvialite deposit
  - T Tundra terrace deposit
  - V Valley fill (F & T)
  - U Unal deposits
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Man-made deposit (fill, etc.)
- RESOURCE CLASSIFICATION**
- CLASSIFICATION**
- 1 Gravel; relatively clean and sound
  - 2 Gravel; significant fines, decomposed rock, calcium carbonate
  - 3 Sand
  - 4 Probable aggregate resource
- NOT SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relieved well or drill-hole intersect with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "I" indicates gravel; "S" indicates sand
  - "I" in small circles unclassified or unknown property
  - "S" denotes Colorado Geological Survey Woodhead and Cressler properties
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL INFORMATION OF RESOURCES**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (over 40 ft screen, 0.075 in.) (road estimation)
  - significant amount of fines (grading 1000 mesh, 0.0075 in. or 0.075 mm)
  - significant amount of decomposed or weak rock
  - significant amount of calcium carbonate (calciferous)
  - or unclassified deposit unclassified or unknown property
  - or unclassified deposit property classed as insignificant



**QUADRANGLE LOCATION**

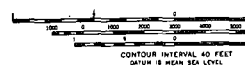
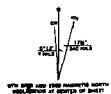
**NON-RESOURCE OR WITHDRAWN AREA**

Geology modified after: Colton, R.R., and Petch, H.S., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Port Collins-Creeley Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map I-855 D.

Mapped by: Ralph S. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7.5 minute quadrangle



**ROAD CLASSIFICATION**

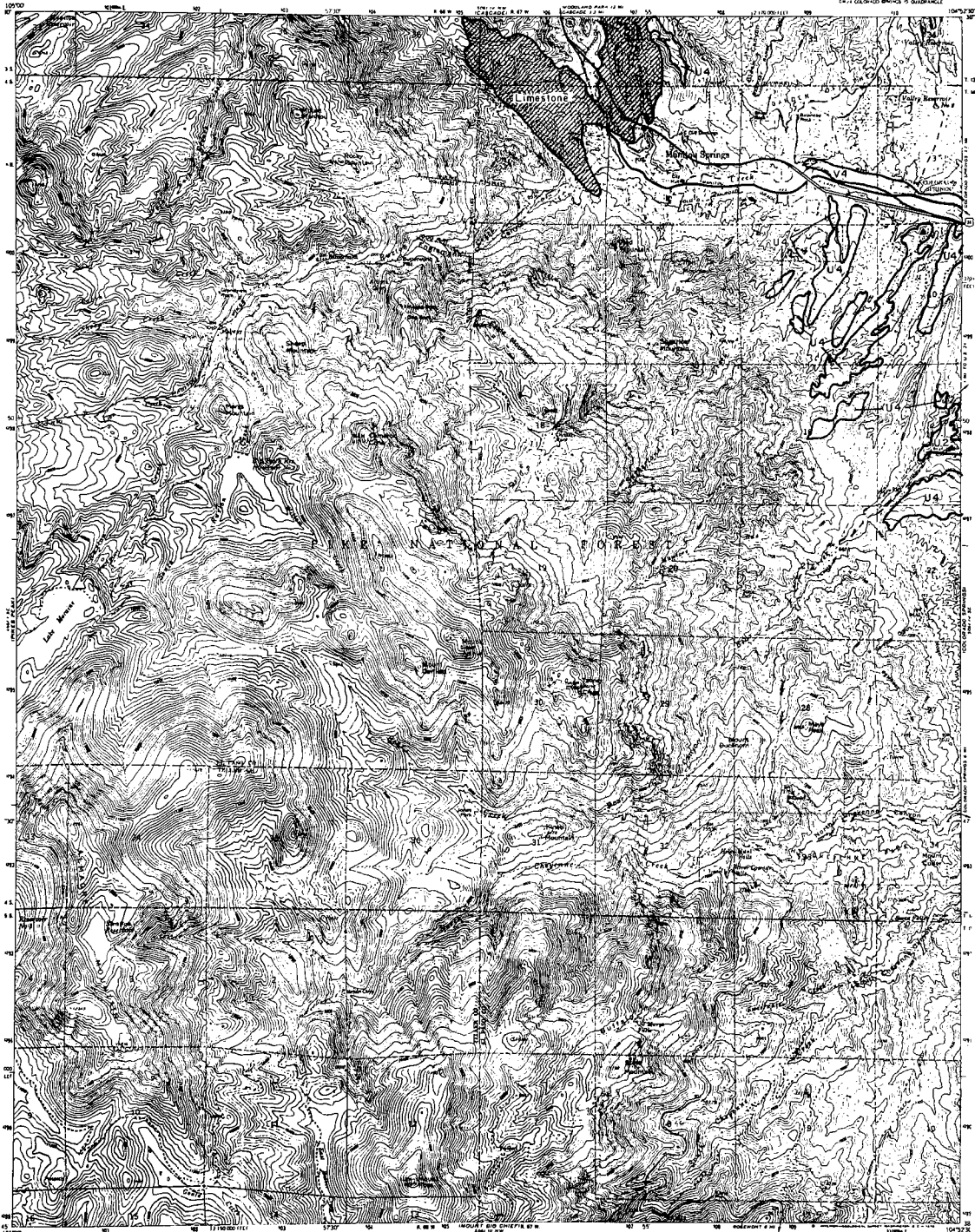
- Heavy-duty
- Medium-duty
- Light-duty
- Unimproved dirt
- U.S. Route
- State Route

LYONS, COLO.



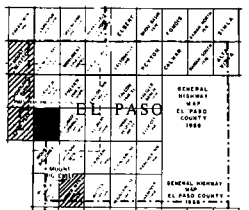


SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP



EXPLANATION

- Landform units  
 Resource classification
- LANDFORM UNITS**
- P Primary deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (e.g., colluvial, spalls, ...)
- RESOURCE CLASSIFICATION**
- Gravel resources**  
 for foot wall material in 24 acres, of total estimation
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous material
- Sand resources**  
 igneous than 75% passing #4 screen, 25% retained on #20 screen, total estimation
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Section well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "G" indicates gravel, "S" indicates sand
  - "I" in symbol denotes unvested or unknown property
  - "M" denotes Colorado Geological Survey Wind-blown sand and gravel project drill hole
  - Landform boundaries, solid where known or observed, dashed where approximate or inferred
- THICKNESS, LOCATION AND QUANTITY**
- CONTOUR INTERVALS (ft)**
- contour interval 100
  - sandy/gravel resource thickness (ft)
  - overburden sand and gravel (ft)
  - overburden sand and gravel (ft)
  - significant amount of fines (passing #20 screen, 2.000 in. or 0.075 in.)
  - significant amount of decomposed or weak rock
  - "I" in symbol denotes unvested or unknown property
  - "M" in symbol denotes property owned or leased/leased



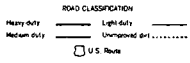
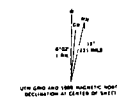
- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, C.R., & Hobbs, R. A. 1973, Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map, M-502.

Trumble, D. E., and Petch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: D. S. Geol. Survey Map M-537 A.

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

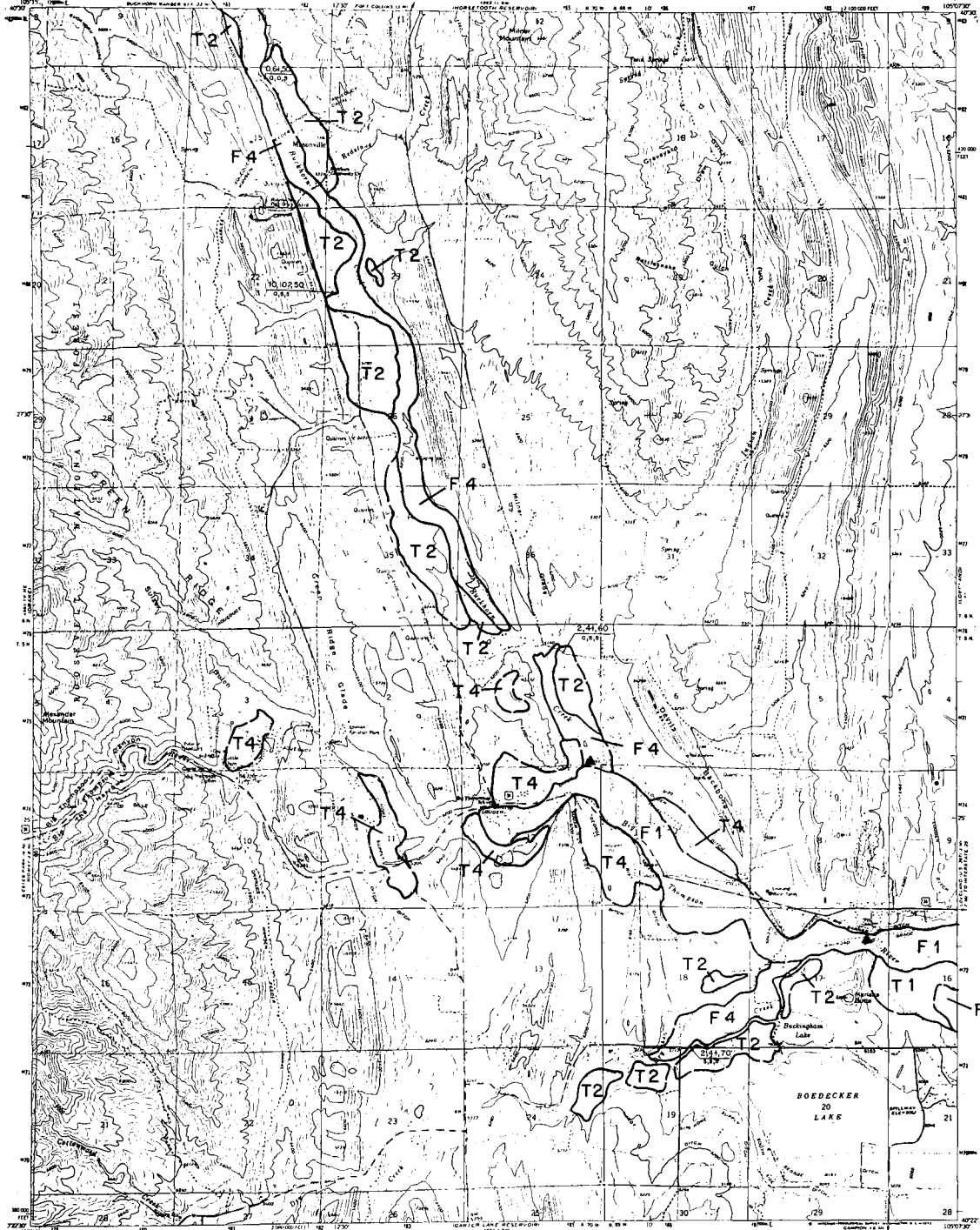


MANITOU SPRINGS, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

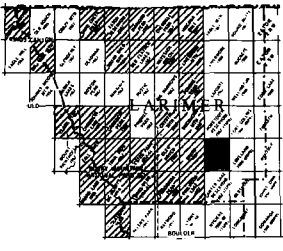
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLL, DIRECTOR

MASONVILLE QUADRANGLE  
COLORADO-LARIMER CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Landform used**  
 - Reservoir (dam, fluctuation)
- LANDFORM TYPE**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M (sand dunes, spalls, etc.)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (of size 20 mesh and 48 screen, usual maximum)
- 1 Coarse, relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, solution cavities
- Fine Aggregate**  
 (finer than 20 mesh) (usually 48 screen, 60 mesh, or 100 mesh, usual maximum)
- 3 Sand
  - 4 Probable aggregate resource
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - ⊙ Related well or fractured limestone with water-bearing thickness (fill over sand/gravel) resource thickness (fill obtained from well logs)
  - ⊙ "L" indicates gravel, "S" indicates sand
  - ⊙ "L" in circle indicates unutilized or unknown property
  - ⊙ "M" denotes Colorado Geological Survey hydrofractured and gravel projects
  - ⊙ 100 ft boundary, well shown where observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL SIGNIFICANCE OF BOREHOLE**
- Borehole thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Summary sand and gravel (percent) of bottom 100 ft of borehole (percent)
  - Large/total amount of fines (percent) (48 mesh, 60 mesh, or 100 mesh)
  - Significant amount of decomposition or weak rock
  - Significant amount of solution cavities (indicator)
  - "M" in circle denotes property unutilized or unknown property
  - "U" in circle denotes property unutilized or unknown property



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR MITHRAH AREA

Geology modified after: Colton, R.R., and Pisch, R.R., 1974; Map showing potential sources of gravel and crushed-rock aggregate for the Boulder-Fort Collins-Owensley Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map I-855 D.

**REFERENCE:**  
 Braddeck, V.A., Calvert, R.R., Gwarsacht, S.J., and Nicksaya, Prady, 1970. Geologic map of the Masonville quadrangle, Larimer County, Colorado: U. S. Geol. Survey Geol. Quad Map GC-832.

Mapped by: Stephan D. Schuchow  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL 40 FEET  
 DOTTED LINES REPRESENT 20 FOOT CONTOURS  
 BELOW 100 FEET SEA LEVEL

ROAD CLASSIFICATION  
 Medium duty  
 Light duty  
 Unimproved dirt  
 U.S. Route

MASONVILLE, COLO.







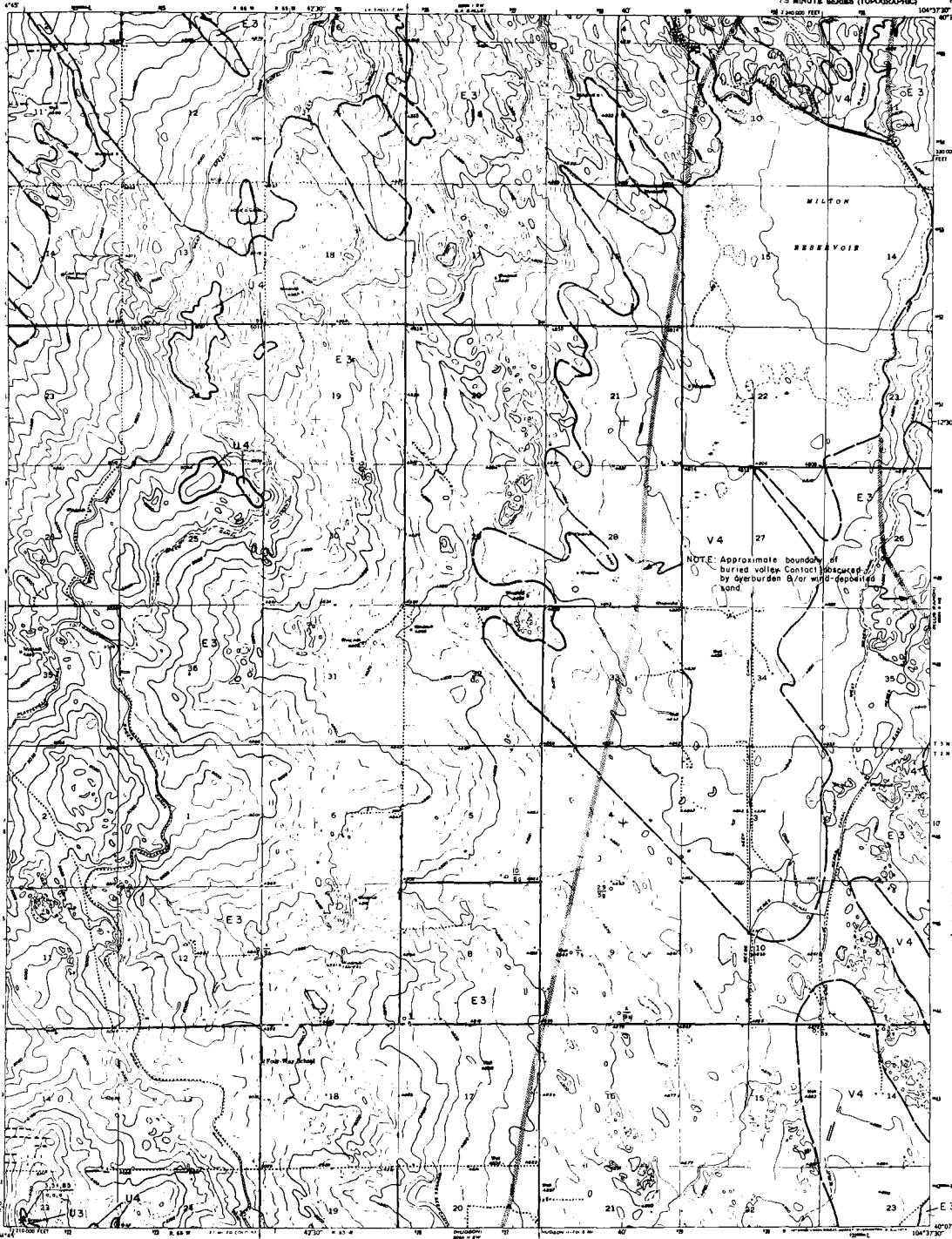




SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

MILTON RESERVOIR  
COLORADO WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- LEGEND**
- LANDFORMS**
- F Floodable deposit
  - T Terrace deposit
  - V Valley fill (F & T)
  - U Wind deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Hummock deposit (e.g., mounds, spits, etc.)
- RESOURCE CLASSIFICATION**
- CLASS 1**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous cementation
- CLASS 2**
- 3 Sand
- UNCLASSIFIED RESOURCES**
- 4 Potential aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Isolated well or fill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log
  - "G" indicates gravel; "S" indicates sand
  - "C" is symbol denoting unclassified or unknown deposits
  - "M" denotes Colorado Geological Survey unclassified and gravel potential drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- SYMBOLS, LOCATIONS AND SYMBOLICAL DESCRIPTIONS OF SYMBOLS**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Gravel and sand (ft) (gravel 25 ft, sand 25 ft, total extraction)
  - Significant amount of fines (greater than 200 mesh, 0.002 in. or 0.01 mm)
  - Significant amount of decomposed or weak rock
  - Significant amount of calcareous cementation
  - "M" is symbol denoting unclassified or unknown property
  - "C" is symbol denoting unclassified or unknown property



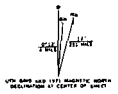
■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Colwell, R.B., and Pich, N.B., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Drexler Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map I-655-D.

Mapped by: Ralph B. Shrobe  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

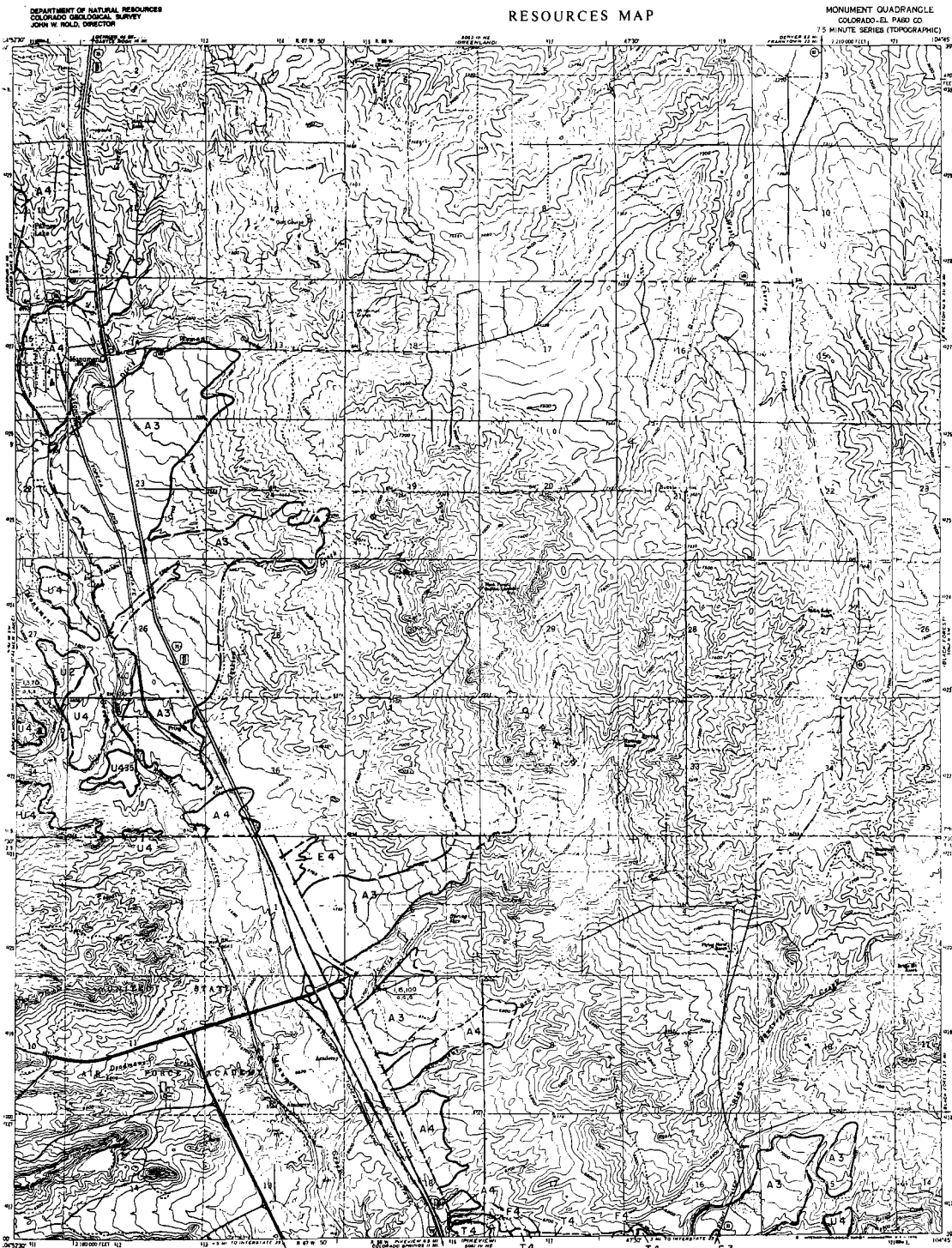
HIGHWAY ALL WEATHER ROADS (BY WEATHER ROAD)

- Heavy-duty Improved dirt
- Medium-duty Unimproved dirt
- Light-duty grade or narrow hard surface
- U.S. Road
- State Road

MILTON RESERVOIR, COLO.

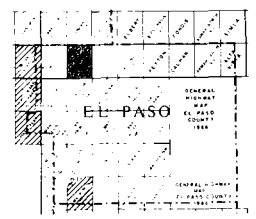
SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

MONUMENT QUADRANGLE  
COLORADO-EL PASO CO.



EXPLANATION

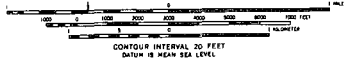
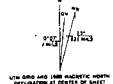
- Contour interval
  - Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F.R.V.)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Masswold deposits (shale/claystone, siltstone...)
- ROCKS**
- GRAVEL RESOURCES**
- 1 Gravel: relatively clean and sand
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
  - 3 Sand
  - 4 Probably aggregate resource
- QUARRY RESOURCES**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Intersected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs:
    - "G" indicates gravel, "S" indicates sand
    - "\*" in symbol denotes unclassified or unknown property
    - "\*\*" denotes Colorado Geological Survey Water/Sand and Gravel project's drill hole
    - Location boundary, solid where known or observed, dashed where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL INFORMATION OF SPECIAL INTEREST**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - gravel and fines (percentage of gravel, 0.075 to 0.075 mm)
  - significant amount of decomposed or weak rock
  - significant amount of solution carbonate (calcite)
  - "\*" in symbol denotes unclassified or unknown property
  - "\*\*" in symbol denotes property absent or designated



REFERENCE:  
 Trimble, D.P., and Fitch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map I-857 A.

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Heavy-duty ————— Light-duty - - - - -
  - Medium-duty ——— Unimproved dirt ———
  - Interstate Route ——— U.S. Route ——— State Route ———

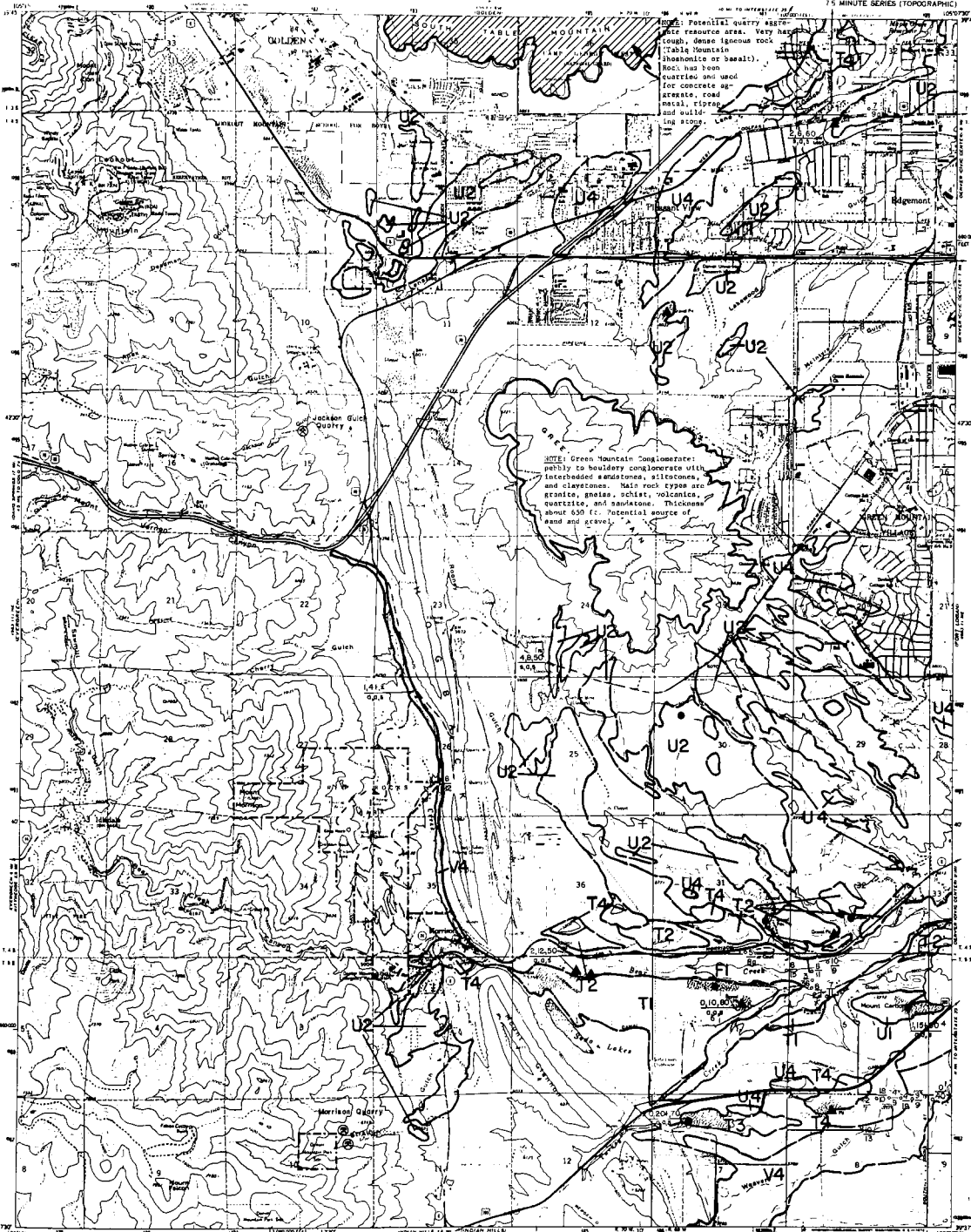
MONUMENT, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

MORRISON QUADRANGLE  
COLORADO-JEFFERSON CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION



Potential quarry aggregate resource area. Very hard, tough, dense igneous rock (table Mountain phonolite or basalt). Rock has been quarried and used for concrete aggregate, road metal, riprap, and building stone.

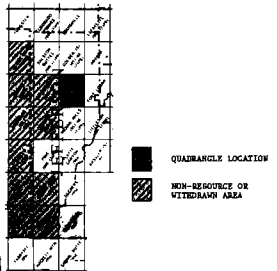
**NOTE:** Green Mountain conglomerate partly to boundary conglomerate with interbedded sandstone, siltstone, and claystone. Main rock types are granite, gneiss, schist, volcanic, quartzite, and sandstone. Thickness about 500 ft. Potential source of sand and gravel.

- ROAD CLASSIFICATION**
- Light-duty
  - Unimproved dirt
  - U.S. Route
  - State Road

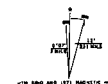
- RESOURCE CLASSIFICATION**
- CONCRETE AGGREGATE**  
(as listed on 1977 map of 41 acres, actual extraction)
- 1 Gravel, relatively clean and sound
  - 2 Gravel, significant fines, decomposed rock, calcium carbonate
- FIN AGGREGATE**  
(as listed on 1977 map of 41 acres, 47% retained on 100 mesh, actual extraction)
- 3 Sand
  - 4 Probable aggregate resource

- AGGREGATE**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relieved well or artificial drainage with maximum thickness (ft.) over sand/gravel resource thickness (ft.) obtained from well log
  - "I" indicates gravel, "S" indicates sand
  - "I" in small circles unavaliable or unknown quantity
  - "No" denotes Colorado Geological Survey "No-Use" and "Crawl" projects
  - "I" in circle
  - Land-use boundary, unless where shown or otherwise noted, shows approximate or inferred

- STATUS, LOCATION AND GEOLOGICAL DESCRIPTION OF RESOURCES**
- overburden thickness (ft.)
  - non/gravel resource thickness (ft.)
  - percent sand and fines (using 41 acres, 47% on 100 mesh extraction)
  - significant amount of fines (using 41 acres, 47% on 100 mesh extraction)
  - significant amount of decomposed or sand rock
  - significant amount of relative abundance (relative to other resources)
  - "I" in small circles unavaliable or unknown quantity
  - "No" in small circles properly shown or indicated



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Light-duty
  - Unimproved dirt
  - U.S. Route
  - State Road

MORRISON, COLO.

Mapped by: Stephen D. Schwechler  
Date: June 30, 1974

Prepared in cooperation with the  
U. S. Geological Survey.

**Citation:** Schwechler, S.D., 1974, Sand, gravel, and quarry aggregate resources map of the Morrison quadrangle, Jefferson County, Colorado. U.S. Geol. Surv. Misc. Geol. Map 1-750-B.

**References:**

- Boyer, C.L., 1972, Map showing potential resource areas for non-metallic mineral resources, Northern Colorado, Jefferson County, Colorado. U.S. Geol. Surv. Misc. Geol. Map 1-750-D.
- Boyer, C.L., 1968, Quaternary geology of the Morrison quadrangle, Colorado. Min. Geol., v. 1, no. 4.
- Boyer, C.L., 1968, Quaternary geology of the Morrison quadrangle, Colorado. Min. Geol., v. 1, no. 4.
- Boyer, C.L., and Owens, W.C., 1972, Geologic resources, soils and related environmental problems, Denver, north-plains area, Colorado. Colorado Geol. Surv. Environmental Geology Report, 1, pl. 1.
- Chase, G.L., and McCannery, S.A., 1972, Generalized geologic map of the Denver area, Colorado. U.S. Geol. Surv. Misc. Geol. Map 1-750-B.
- Trumble, D.E., and Pyle, H.R., 1974, Map showing potential resource areas of gravel and crushed-rock aggregate in the Greater Denver Area. Front Range Urban Corridor, Colo. U.S. Geol. Surv. Misc. Geol. Map 1-750-B.

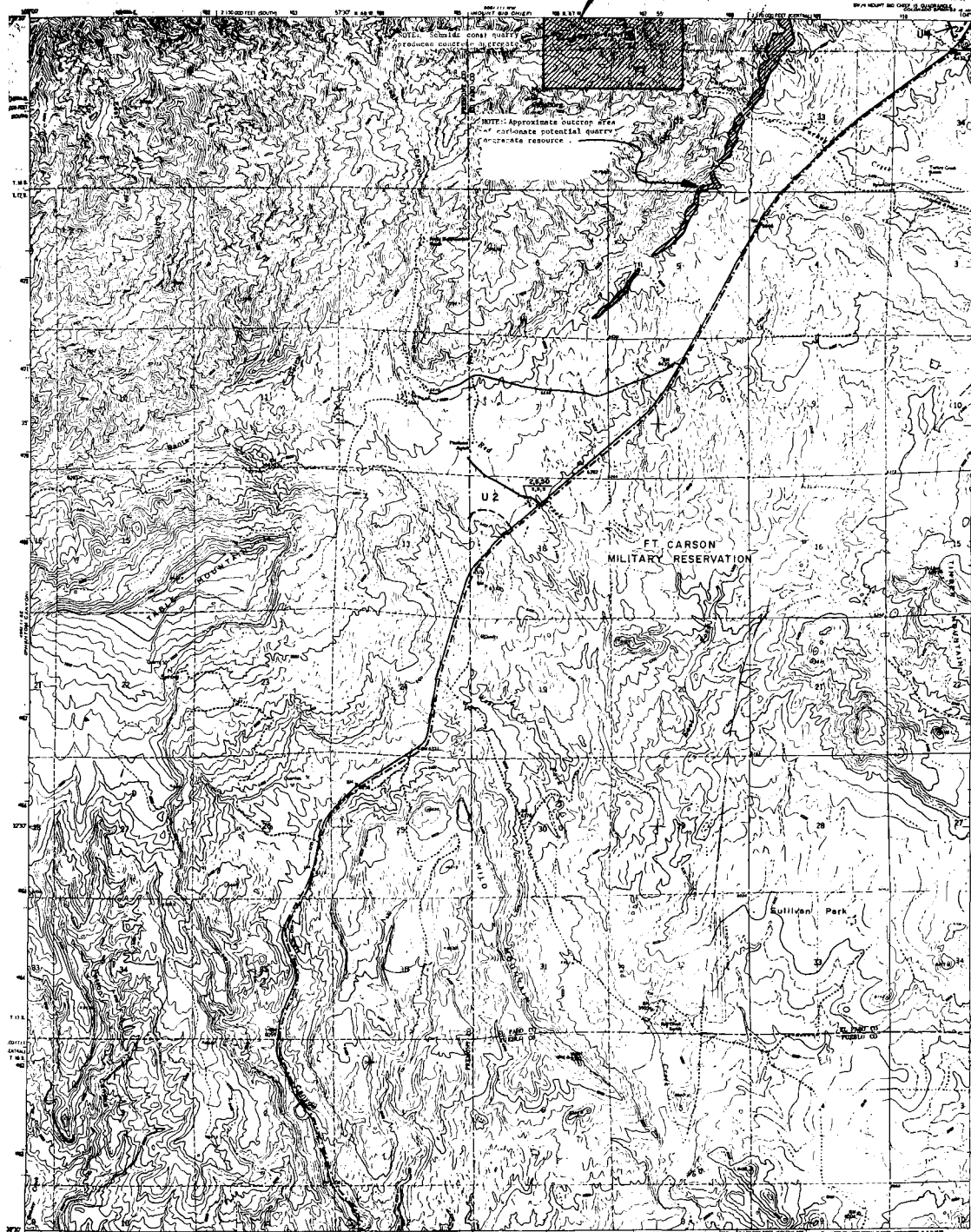




SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

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

MOUNT PITTSBURG QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
REVISED BY USGS IN 1958



EXPLANATION

Landform unit  
Resource classification

- LANDFORM UNIT**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Sand-deposited sand (colluvium)
  - M Non-sand deposits (shale, limestone, etc.)

- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, unimproved rock, casual carbonate.
  - 3 Sand
  - 4 Probable aggregate resource

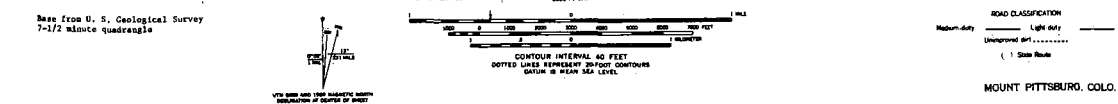
- NOTATIONS**
- Quarries of gravel and/or sand pit
  - Shaded gravel and/or sand pit
  - Operating stone quarry
  - Shaded stone quarry
  - Potential quarry aggregate resource area
  - Selected unit of 300-ft scale topographic map
  - Section thickness (ft) over sand/gravel resource
  - Thickness (ft), obtained from well logs
  - "f" indicates interval of fine sand
  - "s" in symbol denotes unimproved or unknown property
  - "m" denotes Geological Survey Vertical/Horizontal and Crustal products at 1:25,000
  - Landform boundary, unless where known or observed (shown where appropriate or inferred)
- STATION, LOCATION AND ORIENTATIONAL DESCRIPTION OF SANDS**
- Length/Width thickness (ft)
  - Amount/Length measure thickness (ft)
  - Interval sand and fines (spacing ft)
  - Interval, 0.25 ft., interval selection
  - Significant amount of fines (spacing 2500 screens, 0.075 in. or 0.075 mm.)
  - Significant amount of unimproved or unknown rock
  - Significant amount of calcareous material
  - "m" in symbol denotes unimproved or unknown property
  - "s" in symbol denotes property absent or insignificant

[Symbol]	UNIT	CLASSIFICATION
[Symbol]	Upland deposit	1
[Symbol]	Upland deposit	2
[Symbol]	Upland deposit	3
[Symbol]	Upland deposit	4
[Symbol]	Upland deposit	5
[Symbol]	Upland deposit	6
[Symbol]	Upland deposit	7
[Symbol]	Upland deposit	8
[Symbol]	Upland deposit	9
[Symbol]	Upland deposit	10
[Symbol]	Upland deposit	11
[Symbol]	Upland deposit	12
[Symbol]	Upland deposit	13
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[Symbol]	Upland deposit	56
[Symbol]	Upland deposit	57
[Symbol]	Upland deposit	58
[Symbol]	Upland deposit	59
[Symbol]	Upland deposit	60

QUADRANGLE LOCATION  
NON-RESOURCE OR WINDY AREA

- REFERENCE:**
- McLaughlin, R.P., 1947, Pennsylvanian stratigraphy of Colorado Springs quadrangle. Am. Assoc. Petroleum Geol. Bull. v. 31, p. 1936-1981.
  - Finley, G.L., 1936, Colorado Springs Folio, Colorado: U.S. Geol. Survey Folio no. 203.
  - Geology Modified after:
    - Horn, J.C., 1951, Structural geology of the eastern flank of the southern Front Range, Colorado: University of Colorado Ph.D. Thesis, 121 p., 3 pls.

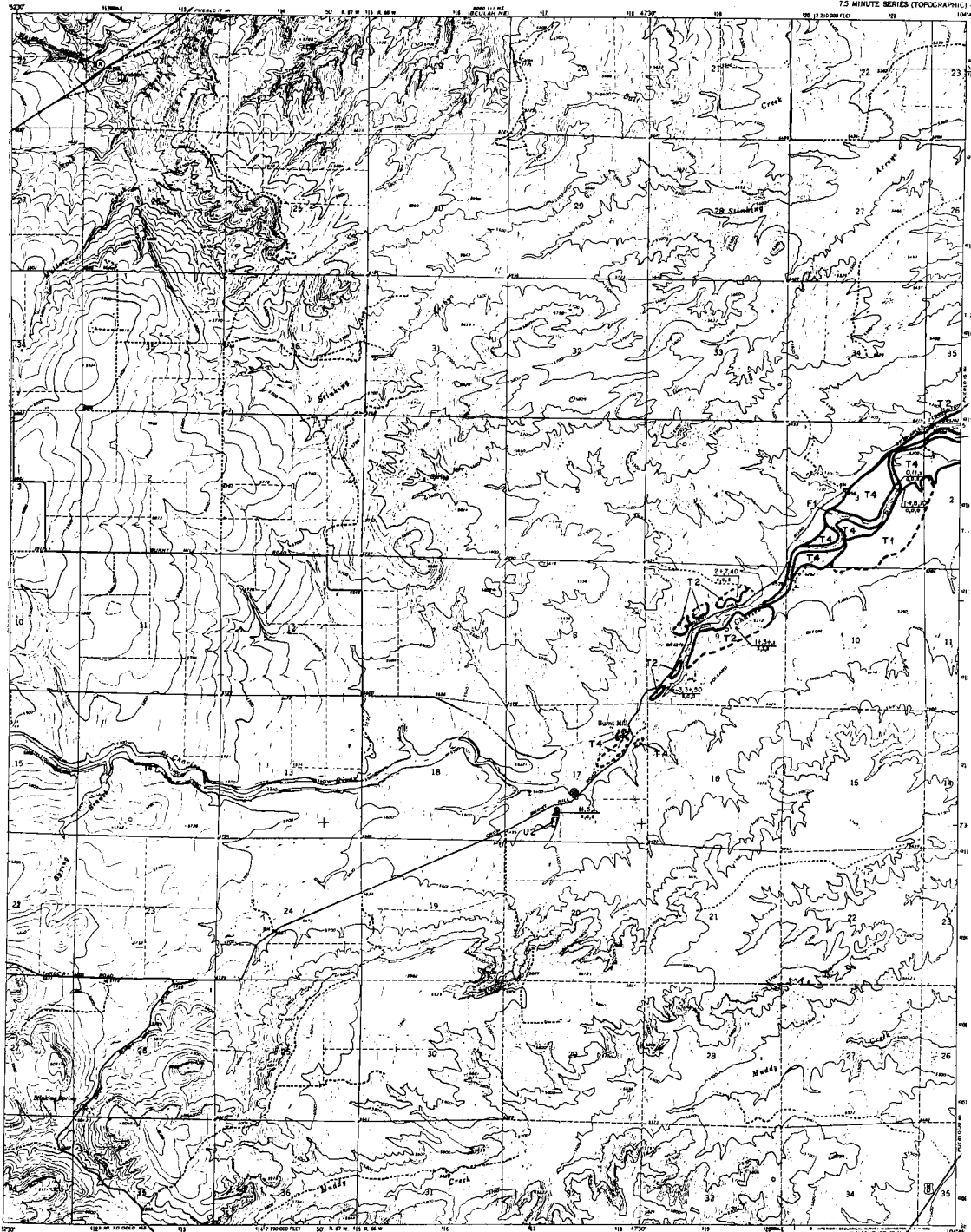
Mapped by: Phillip C. Wickless  
Date: June 30, 1974



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

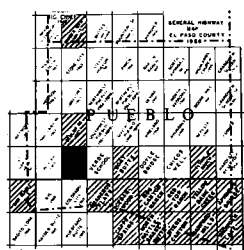
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. KOLA, DIRECTOR

MULDON HILL QUADRANGLE  
COLORADO—PUEBLO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

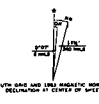
- Landform unit
- Resource classification
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Manmade deposits (landfill, etc.)
- RESOURCE CLASSIFICATION**
  - 1 Sand, aggregate (1/2" to 20" passing 48 screen, 40% retained on #200 screen, visual retention)
  - 2 Gravel: relatively clean and sound
  - 3 Gravel: significant fines, unclean rock, calcium carbonate
  - 4 Sand
  - 5 Unconsolidated resources
  - 6 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource site
  - Material well or drilled location with uncertain thickness (T) over sand/gravel resource
  - Observed thickness (T) over sand/gravel resource
  - "s" indicates gravel, "g" indicates sand
  - "i" in symbol denotes unconsolidated or unknown property
  - "m" denotes Colorado Geological Survey boundary line and ground projects (fill) hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- FRATTION, LOCATION AND ORIENTATIONAL INDICATION OF SYMBOL**
  - overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (ignoring 48 screen, 2.0 to 4.75 mm)
  - right/float amount of decomposed or weak rock
  - right/float amount of fines (passing 200 screen, 0.075 to 0.25 mm)
  - right/float amount of calcium carbonate (calcite)
  - unknown property
  - "i" in symbol denotes property absent or insufficient



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



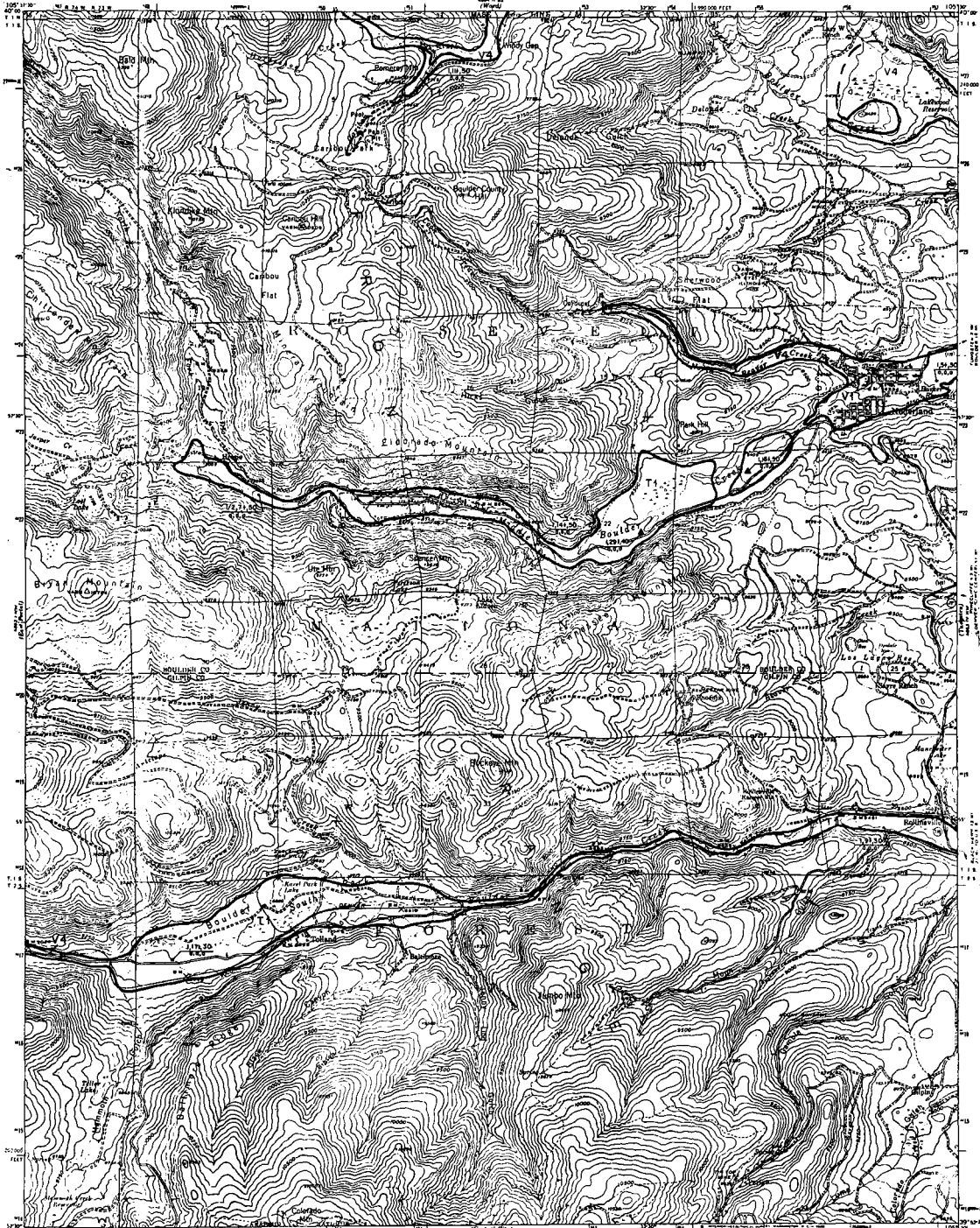
**ROAD CLASSIFICATION**  
 Heavy-duty ————— Light-duty - - - - -  
 Medium-duty ..... Unimproved dirt .....  
 U.S. Route     State Route

MULDON HILL, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

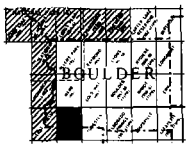
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HULL, DIRECTOR

COLORADO  
NEDERLAND QUADRANGLE  
7 1/2-MINUTE SERIES



## EXPLANATION

- BOUNDARY**
- Landform unit
  - Township, county, section
- LANDFORM UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposit (beach, dunes, spits, etc.)
- RESOURCE CLASSIFICATION**
- Coarse aggregate**  
(at least 75 percent > # 20 mesh, actual estimation)
- 1 Gravel: relatively open and loose
  - 2 Gravel: significant fines, increased rock, actual estimation
- Fine aggregate**  
(greater than 75 percent > # 20 mesh, 0/20 retained on # 20) coarse, actual estimation
- 3 Sand
- Unutilized Resource**
- 4 Probable aggregate resource
- NOT SYMBOLIZED**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with contour thickness (ft); obtained from well logs
  - "T" indicates sand
  - "G" in symbol denotes unutilized or unknown property
  - "W" denotes Colorado Geological Survey Water/Head and Gravel projects (fill wells)
  - Landform boundary, solid when known or observed, dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATIONAL CHARACTERISTICS OF SPILLS**
- road/gravel thickness (ft)
  - road/gravel resource thickness (ft)
  - percent sand and fines (using 40 percent, 0.25 G.S.I., actual estimation)
  - significant amount of fines (using 2500 screen, 0.250 in. or 0.375 in.)
  - significant amount of decomposed or soft rock
  - significant amount of soluble carbonate (calcite)
  - "W" in symbol denotes unutilized or unknown property
  - "G" in symbol denotes property absent or designated

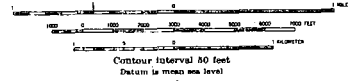
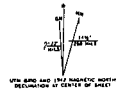


- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE:  
Gable, D. J., 1969,  
U. S. Geol. Survey Geol.  
Quad Map GQ-833.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7 1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Medium-duty
  - Light-duty
  - Unimproved dirt
  - State Road
- NEDERLAND, COLO.

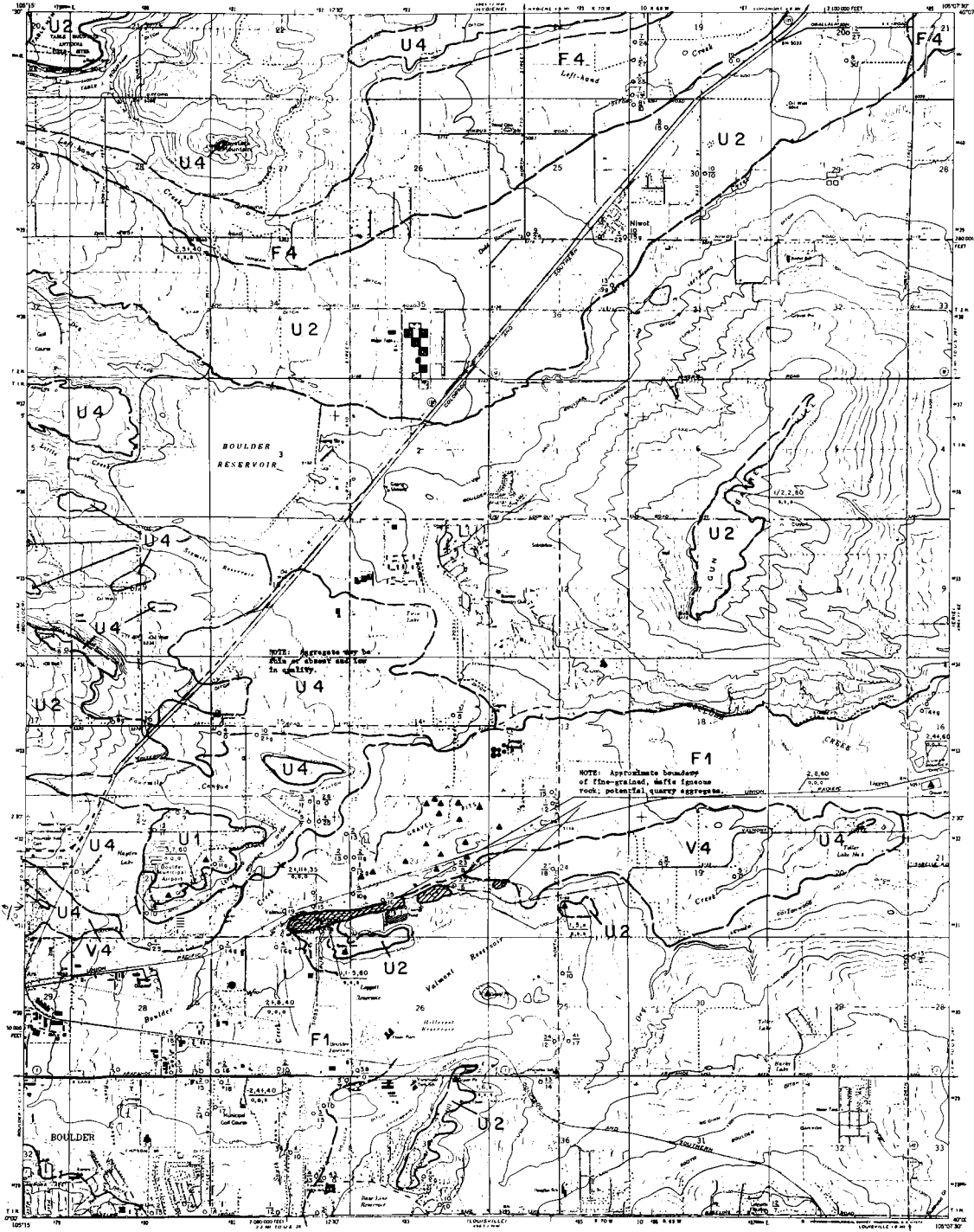




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

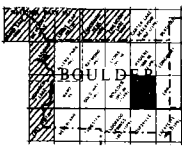
NIWOT QUADRANGLE  
COLORADO - BOULDER CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Resource Classification**
- LATERAL DRAINAGE**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - M Wind-deposited sand (colluvial)
  - E Hummock deposits (sand, silt, clay, gravel, etc.)
- RESOURCE CLASSIFICATION**
- Gravel**
- 1 Gravel: primarily clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous
- Sand**
- 3 Sand: primarily clean and sound
  - 4 Sand: significant fines, decomposed rock, calcareous
- Other Resources**
- 5 Potential aggregate resource
  - 6 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Material used for fill-hole locations with maximum thickness (fill over sand/gravel resource)
  - Material used for fill-hole locations with maximum thickness (fill over sand/gravel resource)
  - "S" indicates gravel, "M" indicates sand
  - "S" in symbol denotes unmaterialized or unknown property
  - "M" denotes Colorado Geological Survey Mineral (Sand and Gravel) project
  - "S" in symbol denotes unmaterialized or unknown property
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND CORRELATION**
- THICKNESS OF SOURCE**
- contour thickness (ft)
  - non-gravel resource thickness (ft)
  - potential sand and fines (spacing of contours, 0.2 or 0.1, actual surface)
  - significant amount of fines (spacing 100, 500, 1,000 ft, or 0.2 ft)
  - significant amount of decomposed or weak rock
  - significant amount of solution surfaces (outside)
  - "S" in symbol denotes unmaterialized or unknown property
  - "M" in symbol denotes property owned or leased



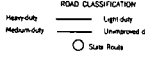
**QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

Geology modified after: Colton, H.B., and Piteh, U.S.G.S., 1976, Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Oreley Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map I-855 D.

Mapped by: Ralph R. Shroba  
Date: June 30, 1976  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

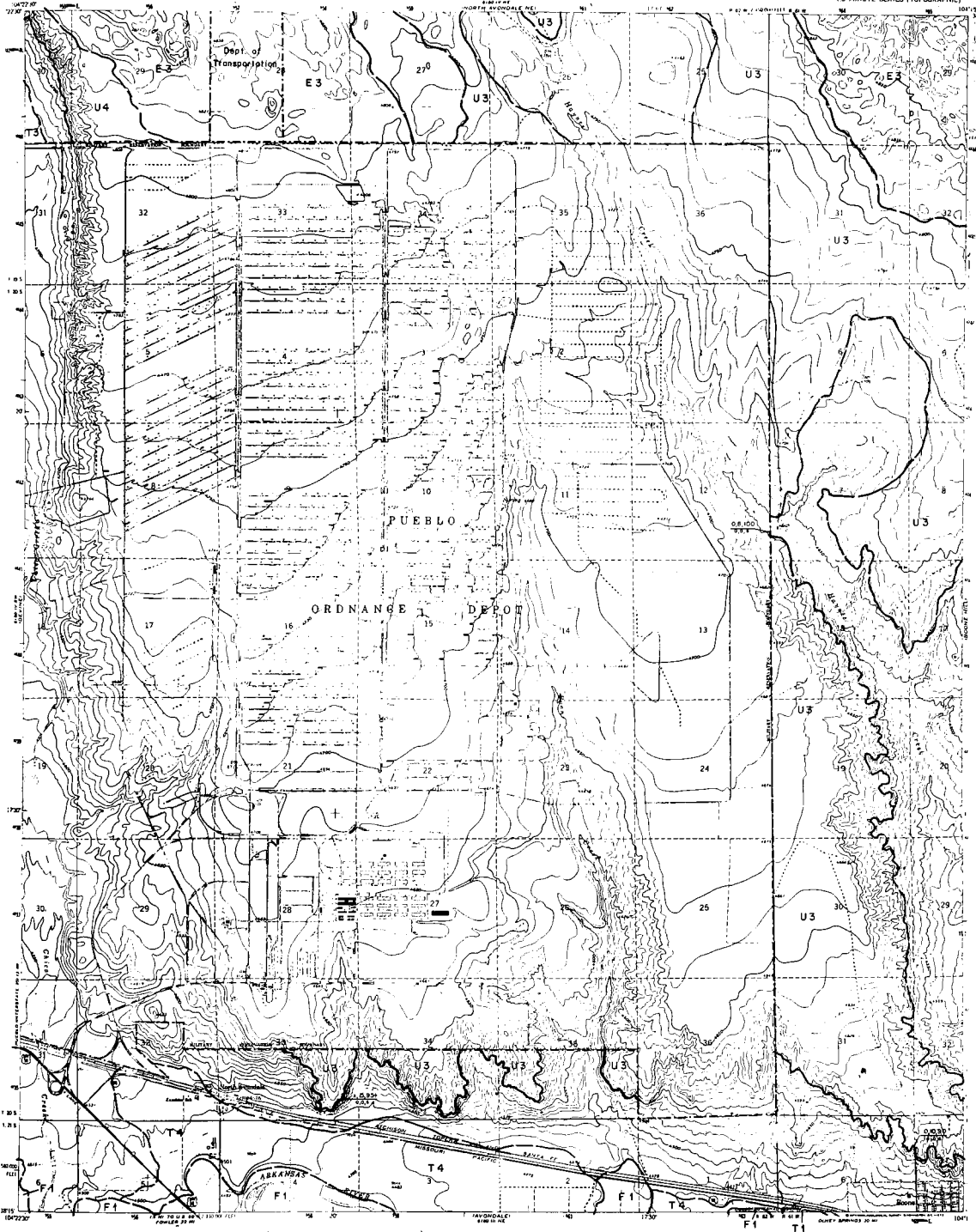


NIWOT, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

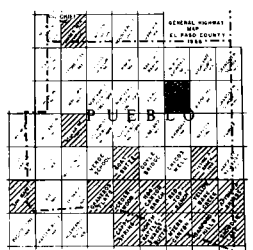
NORTH AVONDALE QUADRANGLE  
COLORADO: PUEBLO CO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

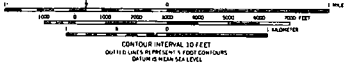
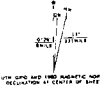
- Landform Unit**  
Resource Classification
- LANDFORM UNIT**
- F Fluvialite deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposit (clay, siltstone, sandstone, ...)
- RESOURCE CLASSIFICATION**
- Gravel Aggregate**  
at least 20% retained on #10 screen, 60% retained on #20 screen, visual estimation
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed int. medium carbons
  - 3 Sand
- Fine Aggregate**  
greater than 75% passing #10 screen, 60% retained on #20 screen, visual estimation
- Probable aggregate resource**
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft) obtained from well logs
  - "a" indicates gravel; "s" indicates sand
  - "L" is symbol denoting unconsolidated or unknown property
  - "M" denotes Colorado Geological Survey "Mined and Gravel Products" #111 hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATUS, LOCATION AND ORIENTATION**
- OVERBURDEN THICKNESS (ft)**
- solid: gravel resource thickness (ft)
  - arrows: sand and fines (passing #10 screen, > 25 (in.), visual estimation)
  - significant amount of fines (passing #10 screen, > 25 (in.), visual estimation)
  - significant amount of decomposed or weak rock
  - significant amount of solution nodules (calcite)
  - "L" is symbol denoting unconsolidated or unknown property
  - "M" is symbol denoting properly mined or landfilled



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwach  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



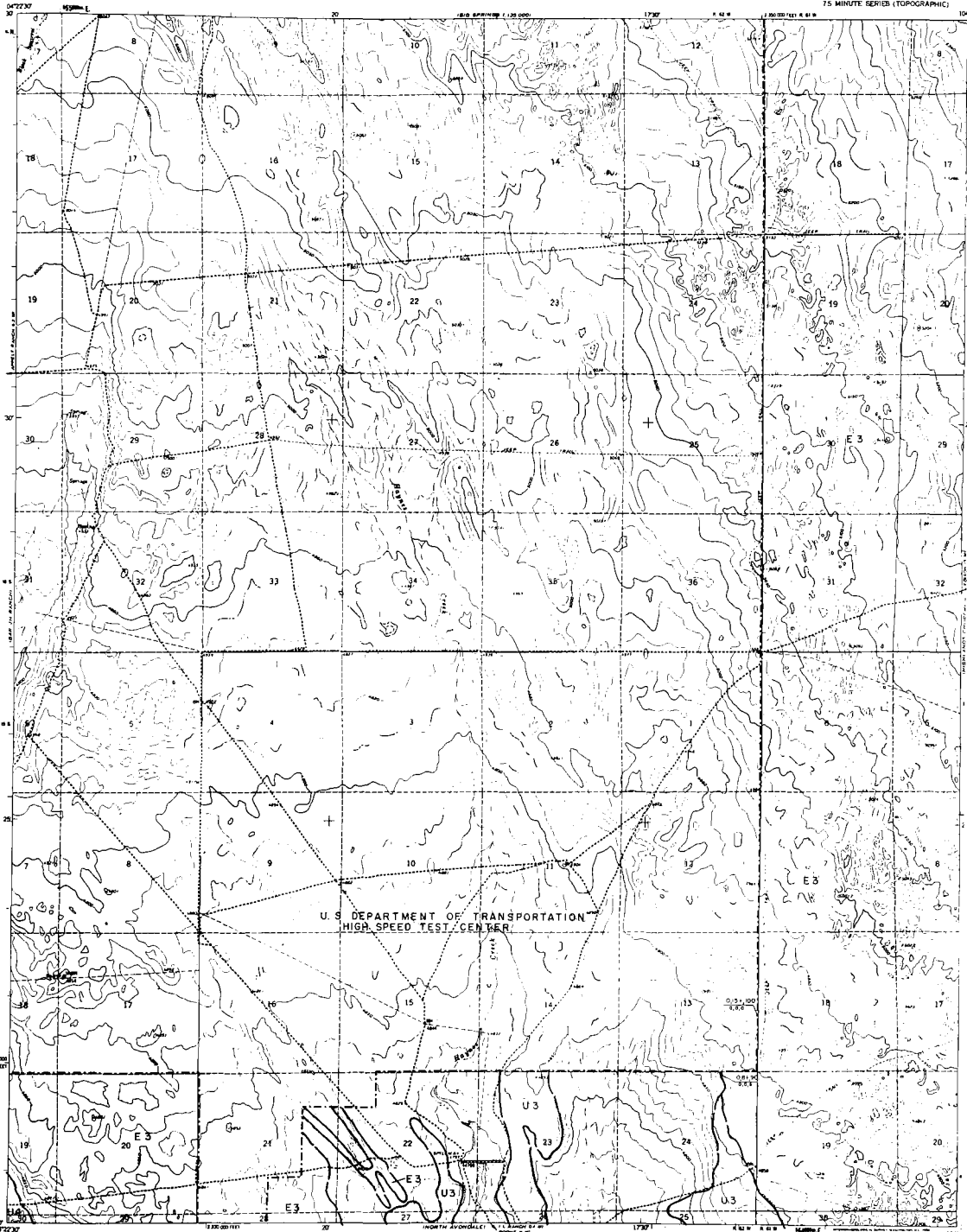
- ROAD CLASSIFICATION**
- Heavy-duty
  - Light-duty
  - Medium-duty
  - Unimproved dirt
  - U.S. Route
  - State Route

NORTH AVONDALE, COLO

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

NORTH AVONDALE NE QUADRANGLE  
COLORADO-PUEBLO CO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

Contour interval  
Elevation class/classification

LANDFORMS

- F Floodplain deposit
- T Terrace terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Hummock deposits (sand, silt, clay, gravel, etc.)

RESOURCE CLASSIFICATION

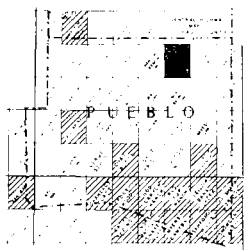
- Gravel (G) is defined on the basis of relative classification
- 1 Gravel: relatively clean and rounded
  - 2 Gravel: significant fines, unrounded rock, angular particles
- Sand (S) is defined on the basis of relative classification
- 3 Sand
  - 4 Probable aggregate resource

NOTES

- Overlaid gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Overlaid stone quarry
- Abandoned stone quarry
- Revealed quarry aggregate resource area
- Isolated well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), indicated from well logs
- "L" indicates gravel, "S" indicates sand
- "P" in symbol denotes unmineralized or unknown property
- "M" denotes Colorado Geological Survey (landform and gravel) project
- Gravel line
- Landform boundary, solid where known or observed, dashed where approximated or inferred

PLANT, LOCATION AND DIMENSIONAL INDICATIONS OF DEPOSIT

- Overburden thickness (ft)
- Gravel resource thickness (ft)
- Sand resource thickness (ft)
- Gravel resource thickness (ft) over sand/gravel resource thickness (ft), indicated from well logs
- Significant amount of decomposed or weak rock
- Significant amount of relative nonresource material
- "P" in symbol denotes unmineralized or unknown property
- "M" in symbol denotes property owned or leased/leased



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schwachow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



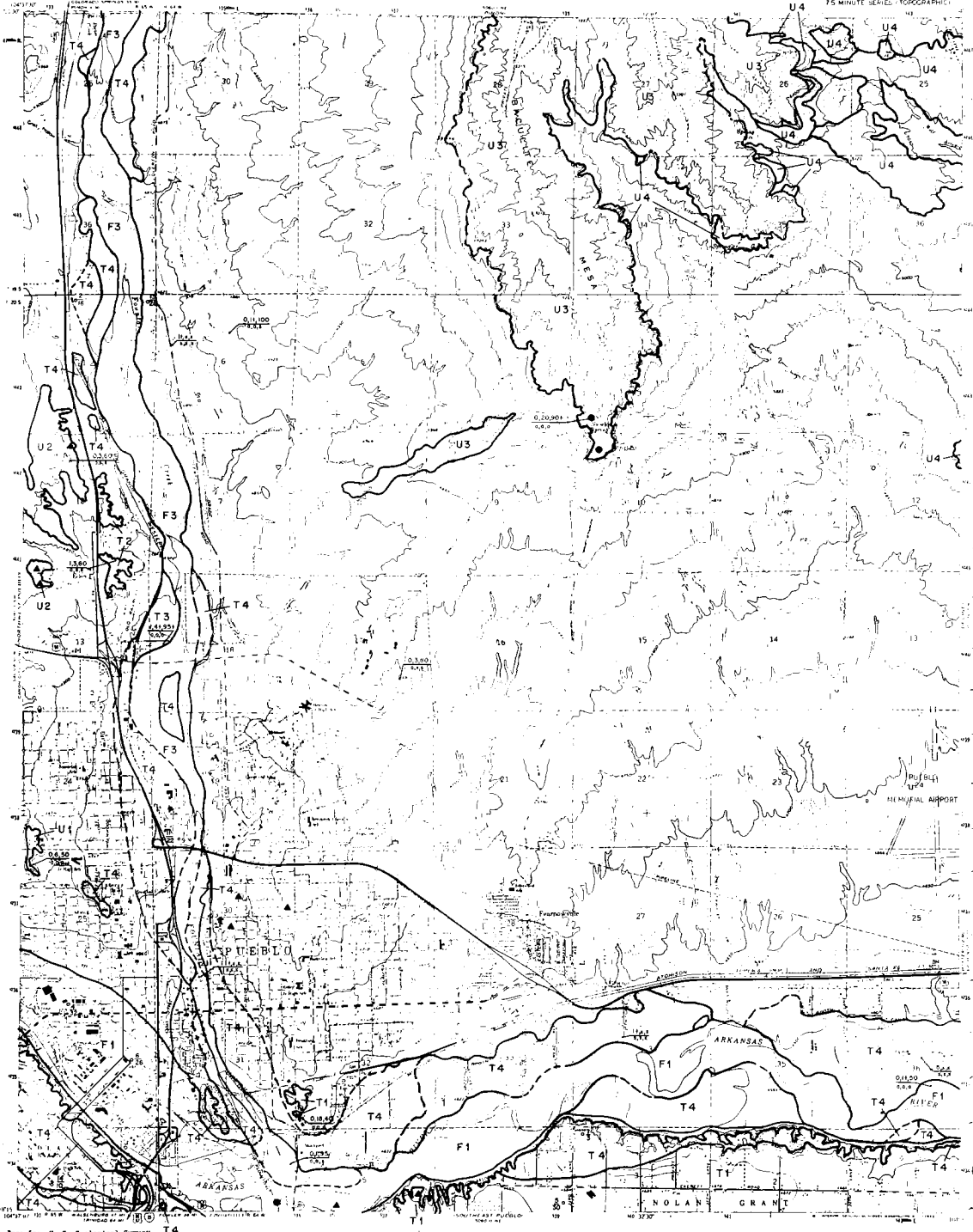
ROAD CLASSIFICATION  
Unimproved det. ....

NORTH AVONDALE NE, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

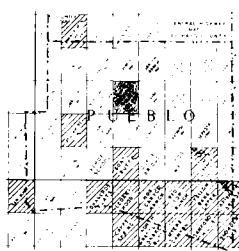
NORTHEAST PUEBLO QUADRANGLE  
COLORADO GEOLOGICAL SURVEY  
7.5 MINUTE SERIES: TOPOGRAPHIC

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



## EXPLANATION

- CONTOUR UNIT**  
 --- Elevation  
 --- Reservoir elevation
- LEGEND**
- F Floodplain deposit
  - T River terrace deposit
  - V Valley fill (B & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (clastic, siltstone, ...)
- RESOURCE CLASSIFICATION**
- GRADE DEPOSIT**  
 1st class: 200 ft or more on 40' stream, 100' or more  
 2nd class: 100' to 200' on 40' stream, 50' to 100' on 20' stream, 25' to 50' on 10' stream, 10' to 25' on 5' stream, 5' to 10' on 2' stream, 2' to 5' on 1' stream
- ROAD CLASSIFICATION**
- 1: gravel, recent, clean and good
  - 2: gravel, significant fines, decomposed rock, calcium carbonate
  - 3: sand
  - 4: probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relative well or drill hole location with resource thickness (ft) from sand/gravel resource thickness (ft), obtained from well logs
  - "T" indicates area of "T" thickness sand
  - "U" in symbol denotes unconsolidated or alluvial deposits
  - "M" denotes Colorado Geological Survey studies (sand and gravel projects)
  - "B" in symbol denotes boundary, solid shows known or observed, dashed shows approximate or inferred
- STATION, LOCATION AND ORIENTAL INFORMATION OF SYMBOLS**
- 1: north-south coordinate (ft)
  - 2: east-west coordinate (ft)
  - 3: significant amount of fines (percent)
  - 4: significant amount of decomposed or weak rock
  - 5: significant amount of calcium carbonate (percent)
  - "M" in symbol denotes unconsolidated or alluvial deposits
  - "B" in symbol denotes property about or abandoned



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, J. R., 1964, U. S. Geol. Surv. map 408.

Map by: Phillip C. Wickline  
 Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy Duty
- Light Duty
- Unimproved dirt
- Interstate
- U.S. Route
- State Route

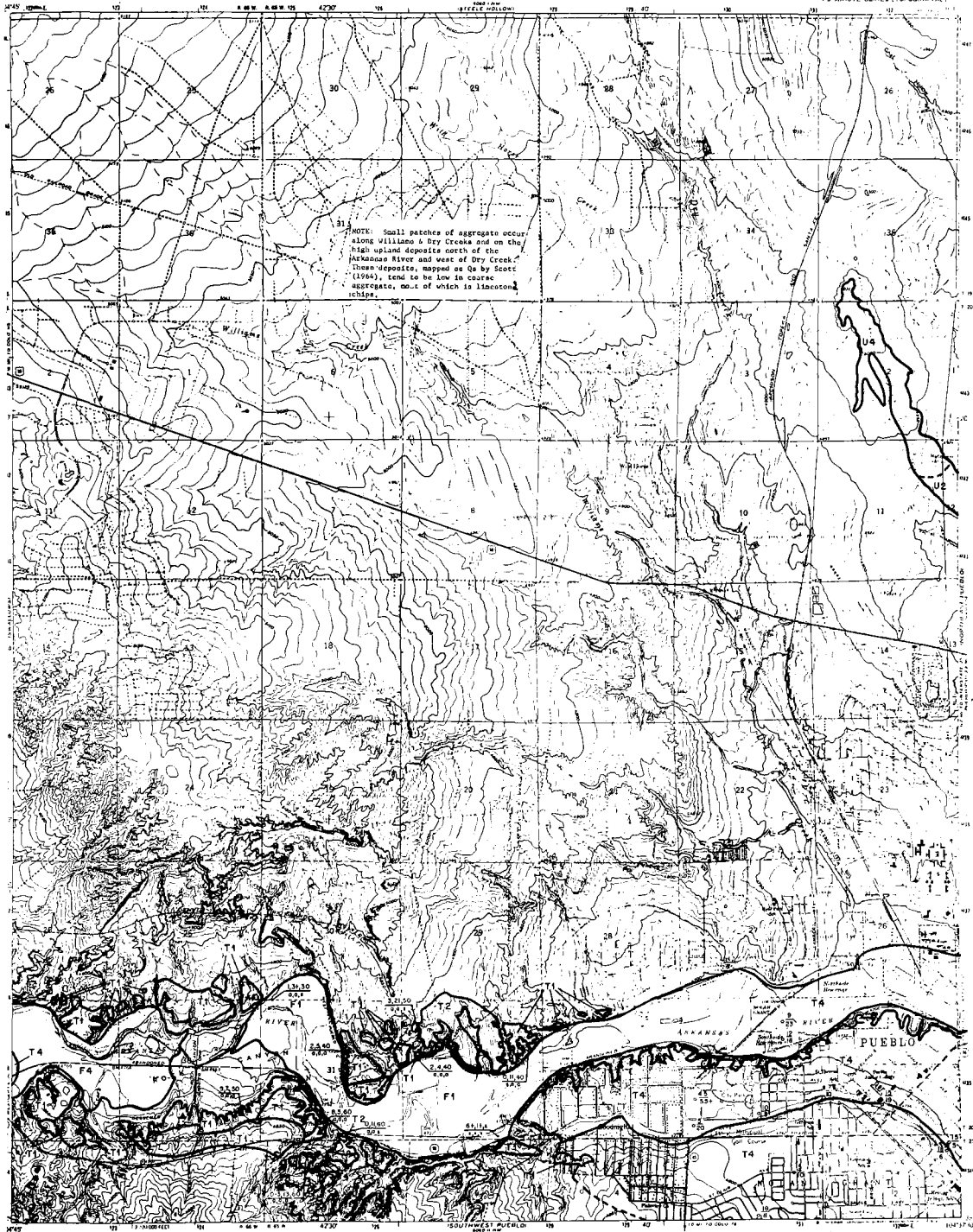
NORTHEAST PUEBLO COLO



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

NORTHWEST PUEBLO QUADRANGLE  
COLORADO - PUEBLO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



NOTE: Small patches of aggregate occur along Williams & Dry Creeks and on the high upland deposits north of the Arkansas River and west of Dry Creek. These deposits, mapped as Qa by Scott (1964), tend to be low in coarse aggregate, most of which is limestone chert.

## EXPLANATION

- Landform units**  
Resource classification
- LANDFORM UNITS**
- F Fluvial deposits
  - T Stream terrace deposits
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (along coastline, etc.)
- RESOURCE CLASSIFICATION**
- (a) **Stream deposits**  
1. Alluvial deposits on F6 surface, (river terrace)

1. Deposits relatively clean and sand, calcareous

2. Deposits significant (fine, medium and calcareous)

(b) **Upland deposits**  
(includes T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30, T31, T32, T33, T34, T35, T36, T37, T38, T39, T40, T41, T42, T43, T44, T45, T46, T47, T48, T49, T50, T51, T52, T53, T54, T55, T56, T57, T58, T59, T60, T61, T62, T63, T64, T65, T66, T67, T68, T69, T70, T71, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100)

3 Sand

**PROBABLE AGGREGATE RESOURCES**

4 Probable aggregate resources

**ROAD CLASSIFICATION**

  - a Operating gravel and/or sand pit
  - A Abandoned gravel and/or sand pit
  - Q Operating stone quarry
  - Q Abandoned stone quarry
  - Q Potential quarry aggregate resource area

Related with or well-sited location with upper bedrock thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.

"T" indicates gravel; "U" indicates sand

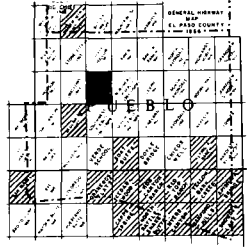
"a" in symbol denotes unmineralized or unknown property.

"m" denotes Colorado Geological Survey "Master/Lead and Creek project" well logs.

Landform boundary, solid when known or inferred, dashed where approximate or inferred.

**PLATON LOCATION AND GEOLOGICAL INFORMATION BY SYMBOL**

  - Symbol: resource thickness (ft)
  - Symbol: sand and fines (percent 84, 80, 76, 72, 68, 64, 60, 56, 52, 48, 44, 40, 36, 32, 28, 24, 20, 16, 12, 8, 4, 0)
  - Symbol: amount of deposit or soil rock.
  - Symbol: amount of relative abundance (scale)
  - "a" in symbol denotes unmineralized or unknown property.
  - "m" in symbol denotes property absent or insignificant.



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, G. R., 1964, U. S. Geological Survey Map I-408.

Map by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy duty
- Light duty
- Medium duty
- Unimproved dirt
- U.S. Route
- State Route

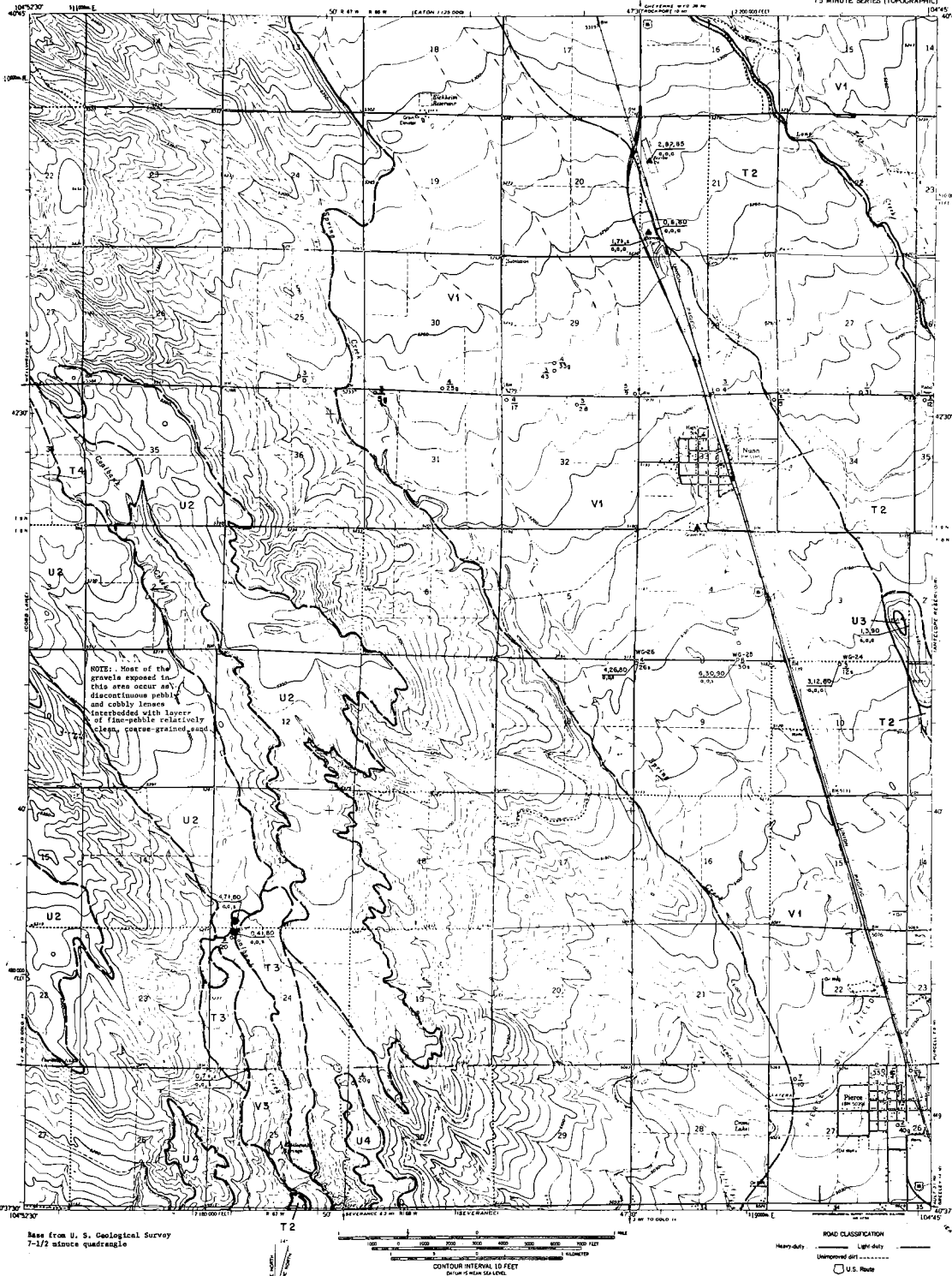
NORTHWEST PUEBLO, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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

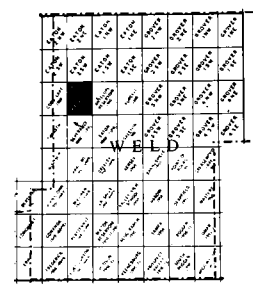
NUNN QUADRANGLE  
COLORADO: WELD CO.

75 MINUTE, SERIES (TOPOGRAPHIC)



## EXPLANATION

- Landform units**  
 - boundary classification
- LANDFORM UNITS**  
 F Floodplain deposit  
 T Terrace terrace deposit  
 V Valley fill (F & T)  
 U Upland deposits  
 A Alluvial fan  
 E Non-deposited sand (alluvial)  
 M Non-made aggregate (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**  
 (Color shaded)  
 1 100% available  
 2 75% available  
 3 50% available  
 4 25% available  
 5 Not available
- MAP SYMBOLS**  
 \* Operating gravel and/or sand pit  
 O Abandoned gravel and/or sand pit  
 X Operating stone quarry  
 O Abandoned stone quarry  
 (Symbol with number) Potential quarry aggregate resource area selected on all or full-hole location with owner's permission (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100) (101) (102) (103) (104) (105) (106) (107) (108) (109) (110) (111) (112) (113) (114) (115) (116) (117) (118) (119) (120) (121) (122) (123) (124) (125) (126) (127) (128) (129) (130) (131) (132) (133) (134) (135) (136) (137) (138) (139) (140) (141) (142) (143) (144) (145) (146) (147) (148) (149) (150) (151) (152) (153) (154) (155) (156) (157) (158) (159) (160) (161) (162) (163) (164) 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(995) (996) (997) (998) (999) (1000)



- QUADRANGLE LOCATION**  
 (Black square symbol)
- NON-RESOURCE OR WETLANDS AREA**  
 (Hatched square symbol)
- ROAD CLASSIFICATION**  
 Heavy-duty  
 Light-duty  
 Unimproved dirt  
 U.S. Road

Mapped by: Stephen D. Schwabach  
 Date: June 30, 1974

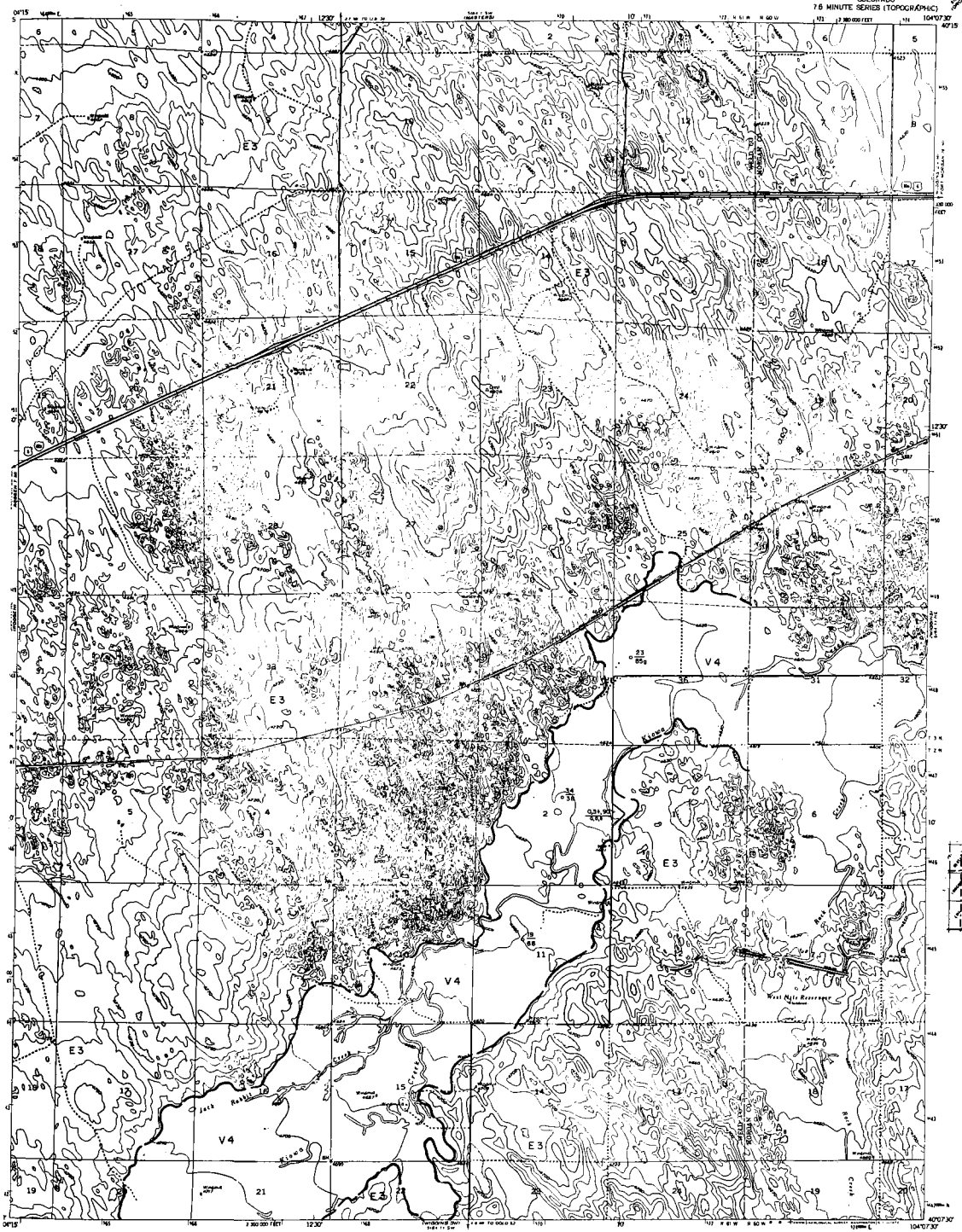
NUNN, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

OMAR QUADRANGLE  
COLORADO  
7.6 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - T Terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
- Coarse aggregate**  
See notes on page 48 of report.
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, increased rock, calcium carbonate
- Fine aggregate**  
See notes on page 48 of report.
- ↓ Sand
- Unconsolidated aggregate**
- 4 Products aggregate resources
- WELLS**
- Operated gravel and/or pit
  - ⊗ Abandoned gravel and/or pit
  - ⊙ Operating stone quarry
  - ⊘ Abandoned stone quarry
  - ⊙ Potential water resource (radius area)
  - ⊙ Isolated well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - " " Isolated gravel; " " Isolated sand
  - " " In urban areas unconsolidated or unknown property.
  - " " Source: Colorado Geological Survey (unconsolidated and gravel properties) 1971-80
  - Landform boundary, solid where known or observed; dashed where approximate or inferred.
- STATION LOCATION AND GEOMETRIC DESCRIPTION OF SIGNAL**
- Corner (see thickness (ft))
  - Bench mark (see thickness (ft))
  - Precise sand and fines spacing at 0.001, 0.05 (in), detail definition
  - Significant amount of fines (spacing 0.001 to 0.05 in)
  - Significant amount of unconsolidated or weak mat.
  - Significant amount of unconsolidated or weak mat.
  - " " In urban areas unconsolidated or unknown property.
  - " " In urban areas property shown or color/floam

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WETDRAIN AREA

REFERENCE: Bjorklund, L.J., and Brown, R.P., 1957, Geology and ground-water resources of the lower South Platte River valley between Bartles, Colorado, and Paxton, Nebraska; U. S. Geol. Survey Water-Supply Paper 1376, pl. 1.

Mapped by: Phillip C. Micklin  
Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET

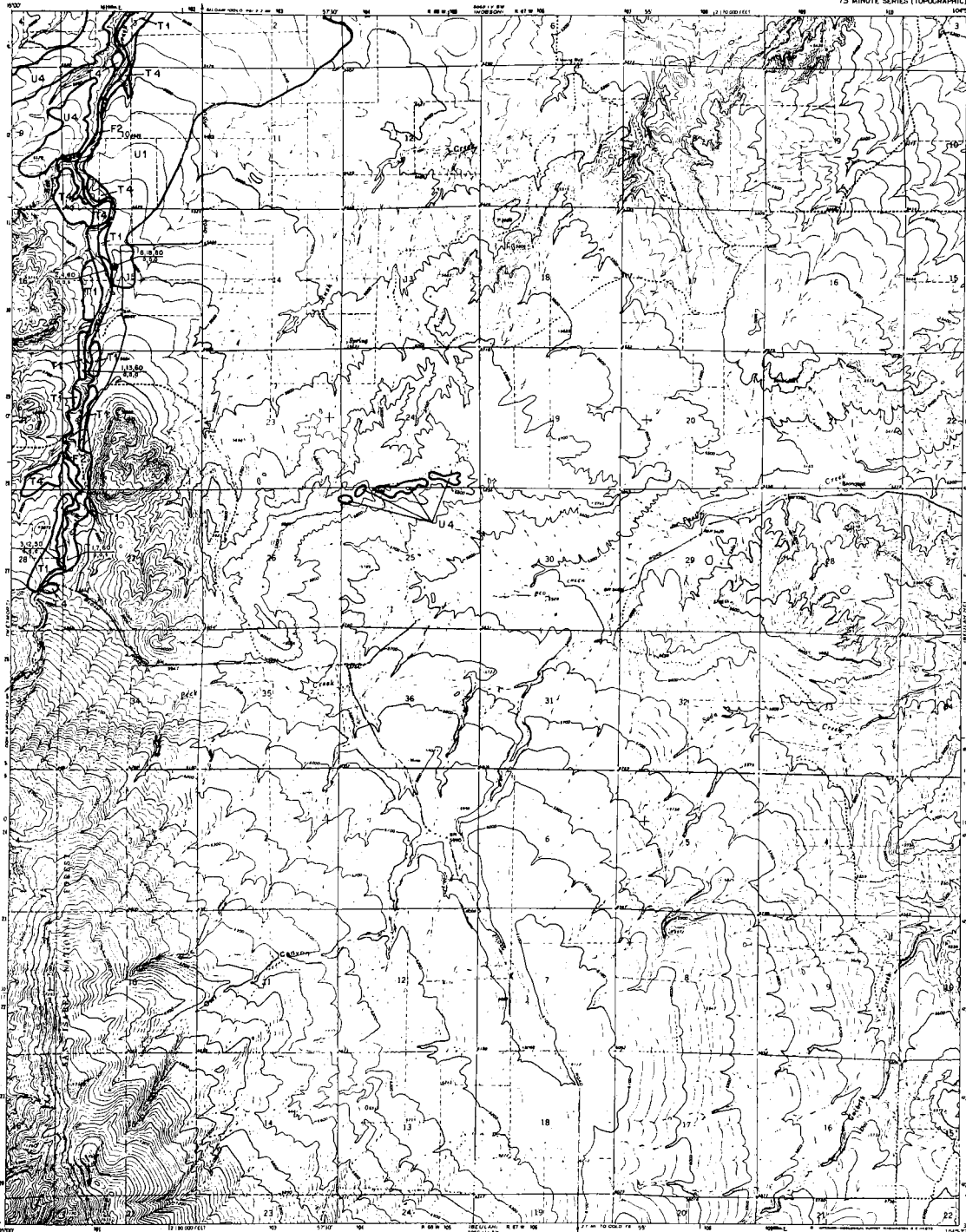
**ROAD CLASSIFICATION**

- Primary highway: hard surface
- Lightly used road or unpaved surface
- Secondary highway: hard surface
- Unimproved road
- Interstate Route
- U. S. Route
- State Route

OMAR, COLO.



SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP



EXPLANATION

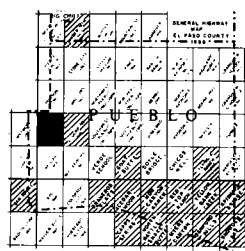
Landform units  
 Resource classification

- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-sand deposits (clay, siltstone, shale, ...)

- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (at least 80% retained on #4 screen, #200 or smaller)
- 1 Gravel: relatively clean and well sorted
  - 2 Gravel: significant fines, unconsolidated, calcareous
- Fine Aggregate**  
 (passes 100% through #4 screen, 40% retained on #200 screen, stream extraction)
- 3 Sand
  - 4 Unconsolidated gravels
- Probable aggregate resources**

- QUANTITIES**
- A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Potential quarry aggregate resource area
  - F Related well or fill-hole location with upper horizon thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs. "x" indicates gravel, "y" indicates sand
  - G "x" or "y" symbol denotes unconsolidated or unknown property.
  - H "x" or "y" symbol denotes geological survey (stream/land use) or gravel pit/related fill hole
  - I Landform boundary, solid where known or inferred; dashed where approximate or inferred

- PLATON, LOCATION AND GEOLOGICAL DESCRIPTION OF ROAD**
- 1 centerline thickness (ft)
  - 2 sand/gravel resource thickness (ft)
  - 3 percent sand and fines (based on screen, 0.30 in., #50) retention
  - 4 length/width amount of flow opening (100 screen, 2,000 sq. ft. or 0.578 ac.)
  - 5 significant amount of development or road work
  - 6 significant amount of erosion (cutbanks, etc.)
  - 7 "x" or "y" symbol denotes unconsolidated or unknown property
  - 8 "x" or "y" symbol denotes property absent or unlogged

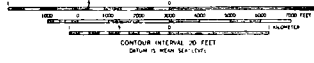
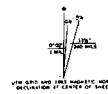


■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, G. R., 1973.  
 U. S. Geological Survey Map MF-547.

Mapped by: Ralph R. Stroba  
 Date: June 30, 1974

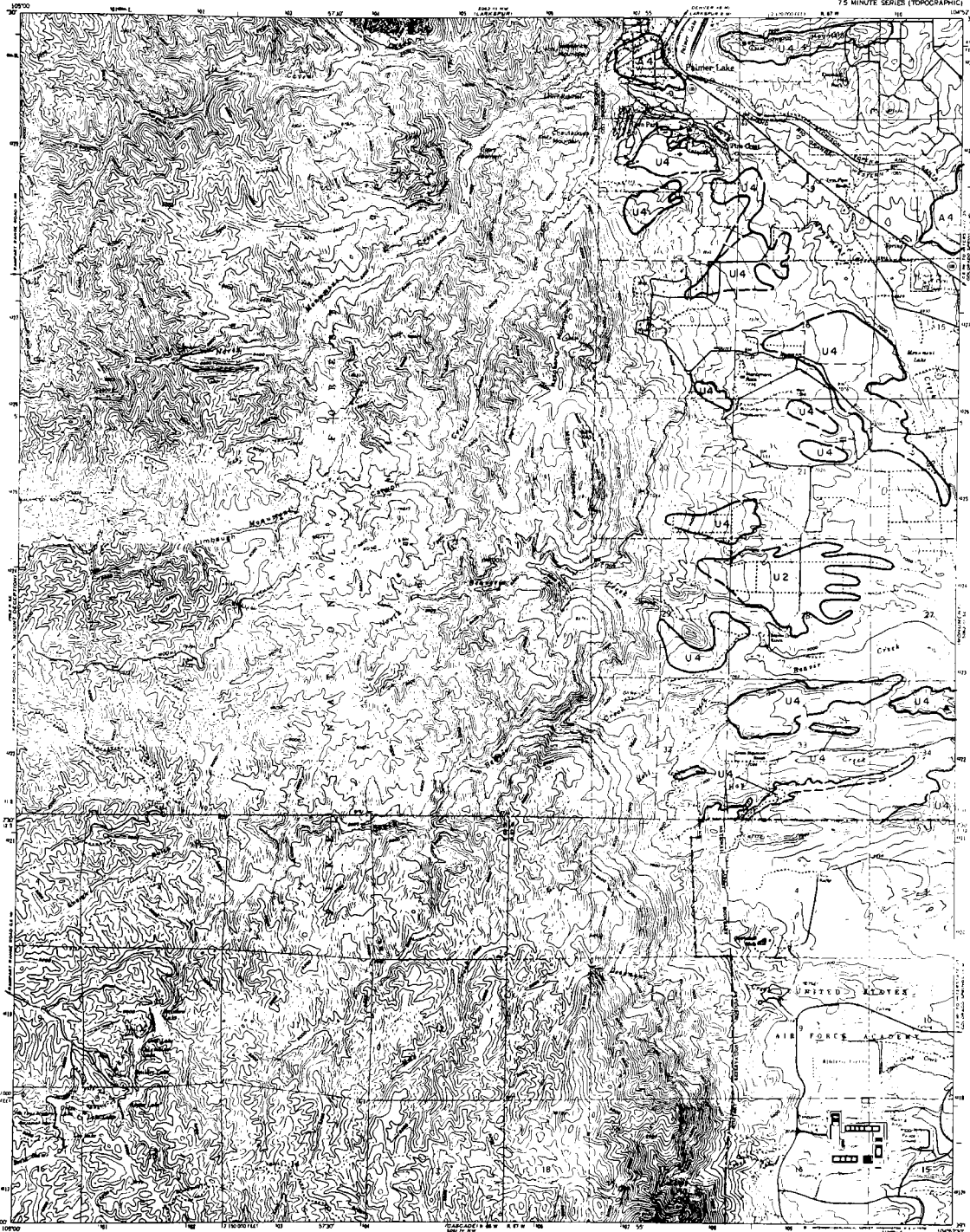
Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



ROAD CLASSIFICATION  
 Light-duty Unimproved dirt

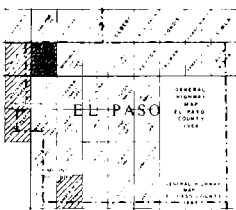
OWL CANYON COLO

SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP



EXPLANATION

- CONTOUR INTERVAL**  
 Contour interval 40 feet  
 Datum: Mean Sea Level
- ROAD CLASSIFICATION**  
 Heavy duty ————  
 Light duty ————  
 Medium duty ————  
 Unimproved det. ————  
 State Route ————
- LANDFORMS**  
 Floodplain deposit  
 Stream terrace deposit  
 Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Human-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**  
 Gravel: relatively clean and sound  
 Gravel: significant fines, decomposed rock, calcine contents  
 Sand  
 Crushed rock aggregate resource
- OTHER SYMBOLS**  
 Operating gravel and/or sand pit  
 Abandoned gravel and/or sand pit  
 Operating stone quarry  
 Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Potential well of aggregate (location only, no depth information)  
 Potential well of aggregate (location and depth information)  
 Potential well of aggregate (location and depth information, with depth information)  
 Potential well of aggregate (location and depth information, with depth information and depth information)  
 Potential well of aggregate (location and depth information, with depth information and depth information)
- EXPLANATION OF SYMBOLS**  
 Potential well of aggregate (location only, no depth information)  
 Potential well of aggregate (location and depth information)  
 Potential well of aggregate (location and depth information, with depth information)  
 Potential well of aggregate (location and depth information, with depth information and depth information)  
 Potential well of aggregate (location and depth information, with depth information and depth information)



QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

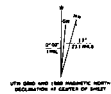
Geology modified after:  
 Trimble, D.L., and Pritch, R.R., 1974, Map showing potential resources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado; U. S. Geol. Survey Map T-857 A.

REFERENCE: Trimble, Donald, 1974, U.S.G.S.; Personal Communication.

Mapped by: Phillip C. Wickline  
 Date: June 30, 1974

Prepared in cooperation with the  
 U. S. Geological Survey.

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



PALMER LAKE, COLO

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

PARKER QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES TOPOGRAPHIC  
1:50,000 (1:62,500)

## EXPLANATION

**SYMBOLS**

  Floodplain deposit  
  Stream terrace deposit  
  V Alluvial fan (E & T)  
  U Upland deposit  
  E Wind-deposited sand (eolian)  
  M Man-made deposits (includes waste, etc.)

**ROAD CLASSIFICATION**

Major Road  
 US Route  
 State Road  
 Local Road

**CONTOUR INTERVAL 10 FEET**

**GRID**

  Abandoned gravel and/or sand pit  
  Operating gravel quarry  
  Abandoned gravel and/or sand pit  
  Operating gravel quarry  
  Potential quarry aggregate resource area  
  Located well or drill-hole location with water table information (see map legend for resource thickness (ft), elevation from well top (ft), substrate gravel (ft), indicator sand (ft) in symbol denotes unshaded as shown property.  
  "M" denotes Colorado Geological Survey Windblown Sand and Gravel project  
  Lead to boundary, solid where shown or dashed where appropriate or lateral.

**STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF SANDS**

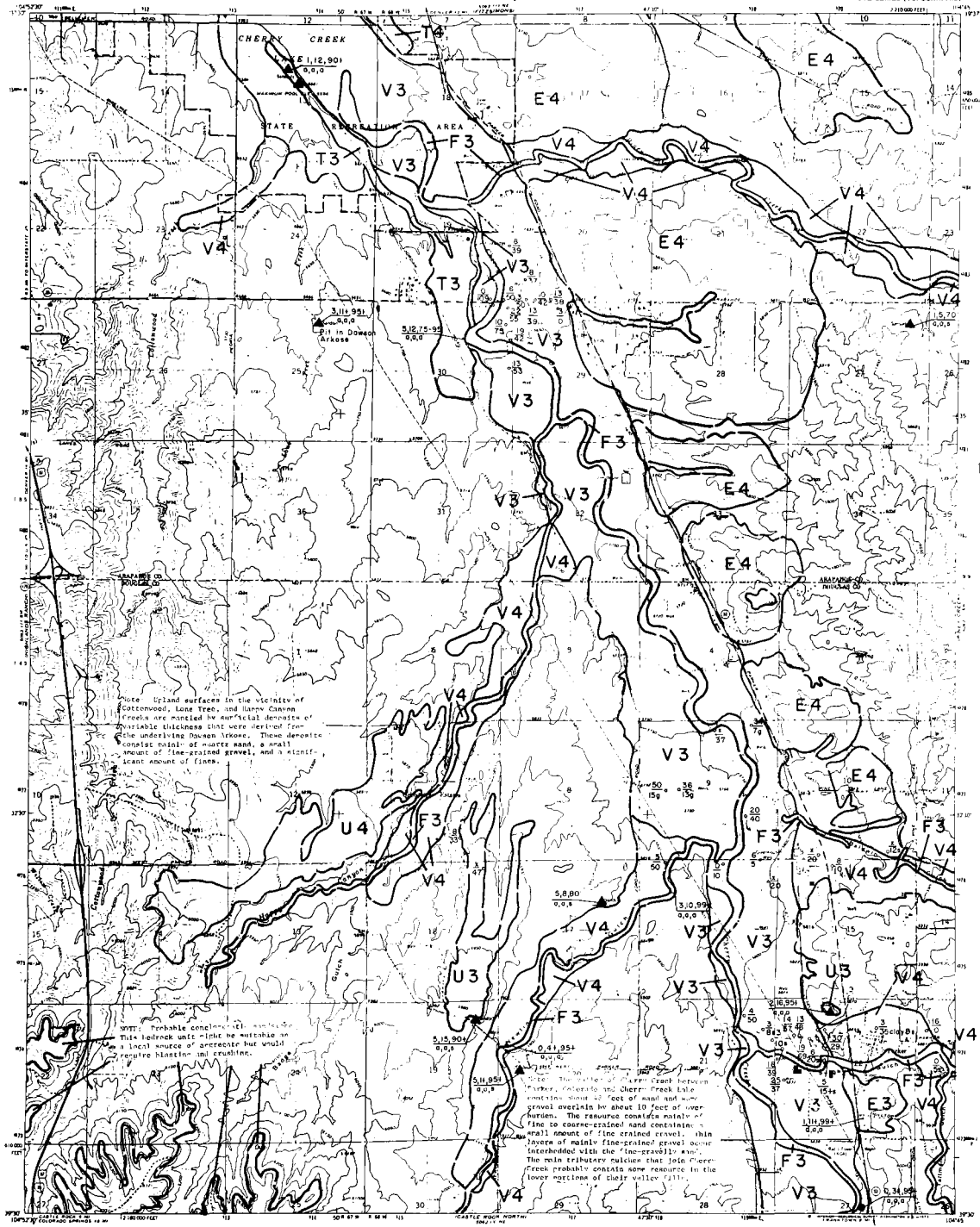
  Station number  
  Location  
  Description of sands  
  Thickness of fine opening (ft) area, (0.075 to 0.075 mm)  
  Thickness of coarse opening (ft) area, (0.075 to 0.075 mm)  
  Elevation from well top (ft)  
  Substrate gravel (ft)  
  Indicator sand (ft)

**DOUGLAS**

**QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

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



Note: Upland surfaces in the vicinity of Cottonwoods, Lane Trees, and large Canyon Creeks are mantled by surficial deposits of variable thickness that were derived from the underlying Dawson rocks. These deposits consist mainly of coarse sand, a small amount of fine-grained gravel, and a significant amount of fines.

Note: Probable conglomerate unit. This unit may be a local source of aggregate but would require blasting and crushing.

Note: The center of Cherry Creek between Parker, Colorado, and Cherry Creek Lake contains about 10 feet of sand and gravel overlain by about 10 feet of overburden. The resource contains mainly fine to coarse-grained sand containing a small amount of fine-grained gravel. This layer of mainly fine-grained gravel occurs interbedded with the "fine-gravel" sand. The main tributary gulches that join Cherry Creek probably contain some resource in the lower portions of their valley fills.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Major Road  
 US Route  
 State Road  
 Local Road

PARKER, COLO

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

DEPARTMENT OF NATURAL RESOURCES  
COLORADO STATE GEOLOGICAL SURVEY  
JOHN W. HOLDS DIRECTOR

PEORIA QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

- LAYERED DEPOSITS**
- F Fluvial deposit
  - T Siliceous terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (dikes, canals, etc.)

- RESOURCE CLASSIFICATION**
- Open-pit aggregate**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, siliceous component
- Fill aggregate**
- 3 Sand
  - 4 Probable aggregate resource

- MAP SYMBOLS**
- Open-pit gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relined well or drill-hole location with associated thickness (ft) over non-aggregate resource thickness (ft), obtained from well logs
  - "T" indicates gravel, "U" indicates sand
  - "S" in symbol denotes unconsolidated or unknown property
  - "M" denotes Colorado Geological Survey Mineral/Soil and Gravel project
  - "A" in symbol denotes agricultural or urban property
  - Landform boundary, solid where known or observed, dashed where approximate or inferred

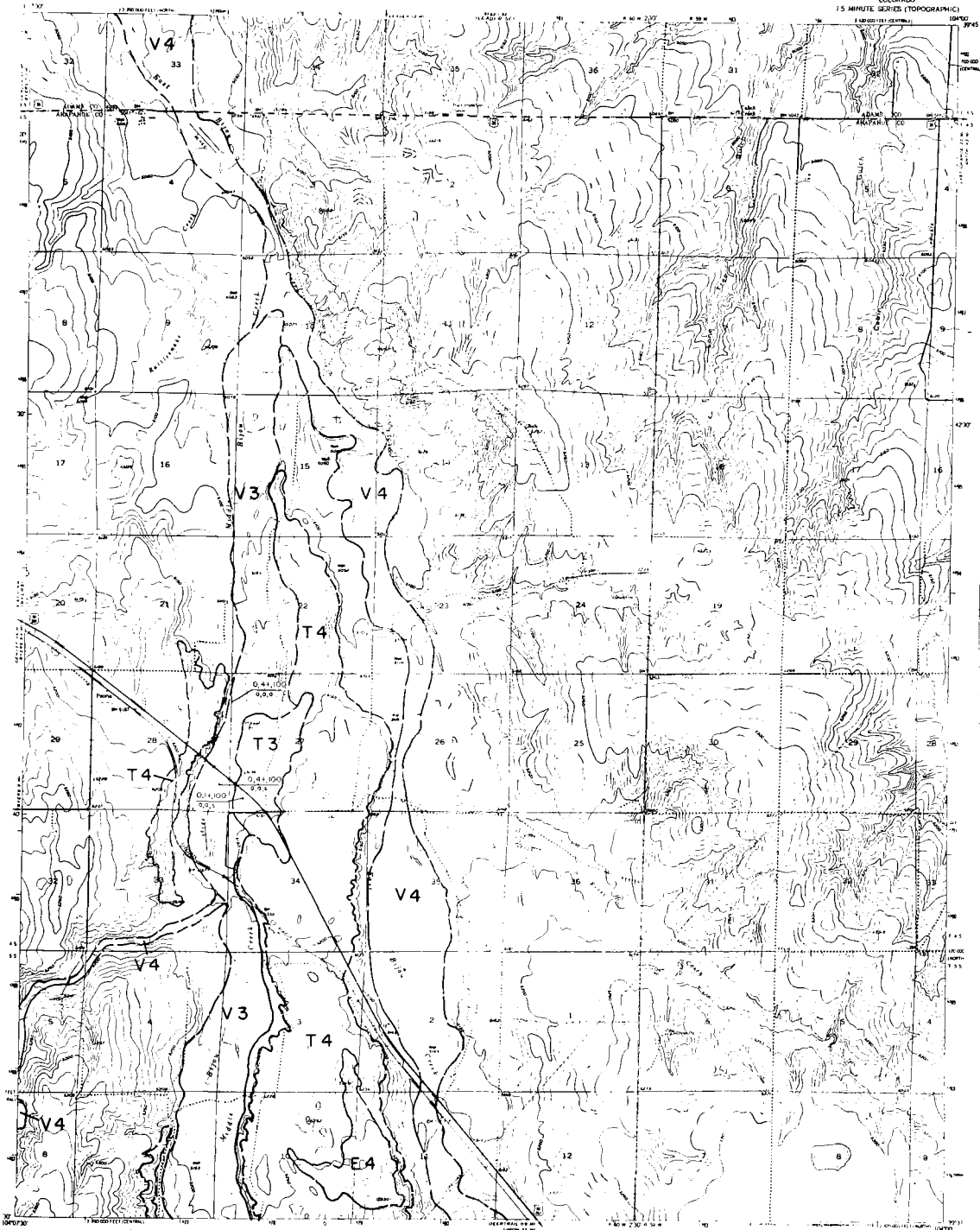
- STATION LOCATION AND GEOLOGICAL INTERPRETATION SYMBOLS**
- cross-hatched thickness (ft)
  - solid/pattern resource thickness (ft)
  - pattern sand and fines (spacing as shown, 0.25 in., detail indication)
  - significant amount of fines (spacing as shown, 0.25 in. or 0.175 in.)
  - significant amount of decomposed or weak rock
  - significant amount of siliceous carbonate (includes "M" in symbol)
  - "A" in symbol denotes agricultural or urban property
  - "S" in symbol denotes property status or development



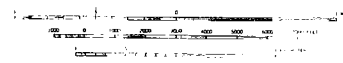
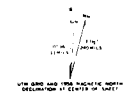
■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WETLAND AREA

Geology modified after  
Holmes, P. L., 1972,  
Regional Geologic Reconnaissance,  
L.S. 14-875.

Mapped by: Phillip C. Wickless  
Date: June 30, 1974



Base from U. S. Geological Survey  
7.5/7.5 Minute quadrangle



ROAD CLASSIFICATION  
Main duty  
Light duty  
Misc. duty  
Unimproved dirt  
U.S. Route

PEORIA COLO  
R5975-W(800)75  
1966

ALS 3163 H. MC-BERGER 1977





# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

PIERCE GULCH QUADRANGLE  
 COLORADO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION

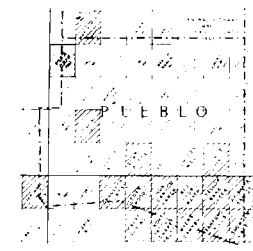
Landform unit  
 Resource classification

- LANDFORM UNITS**
- F Fluvial plain
  - T Trough terrace slope
  - V Valley fill (F & T)
  - U Upland apron
  - A Alluvial fan
  - C Cold-deposited sand (alluvium)
  - M Hummock deposits (colluvium, talus, etc.)

- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
 (at least 20% material on # 20 mesh, 4 mesh retention)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, certain textures
- Fine Aggregate**  
 (material that will pass # 20 mesh, 4 mesh retention on # 100 mesh, 4 mesh retention)
- 3 Sand
  - 4 Probable aggregate resource

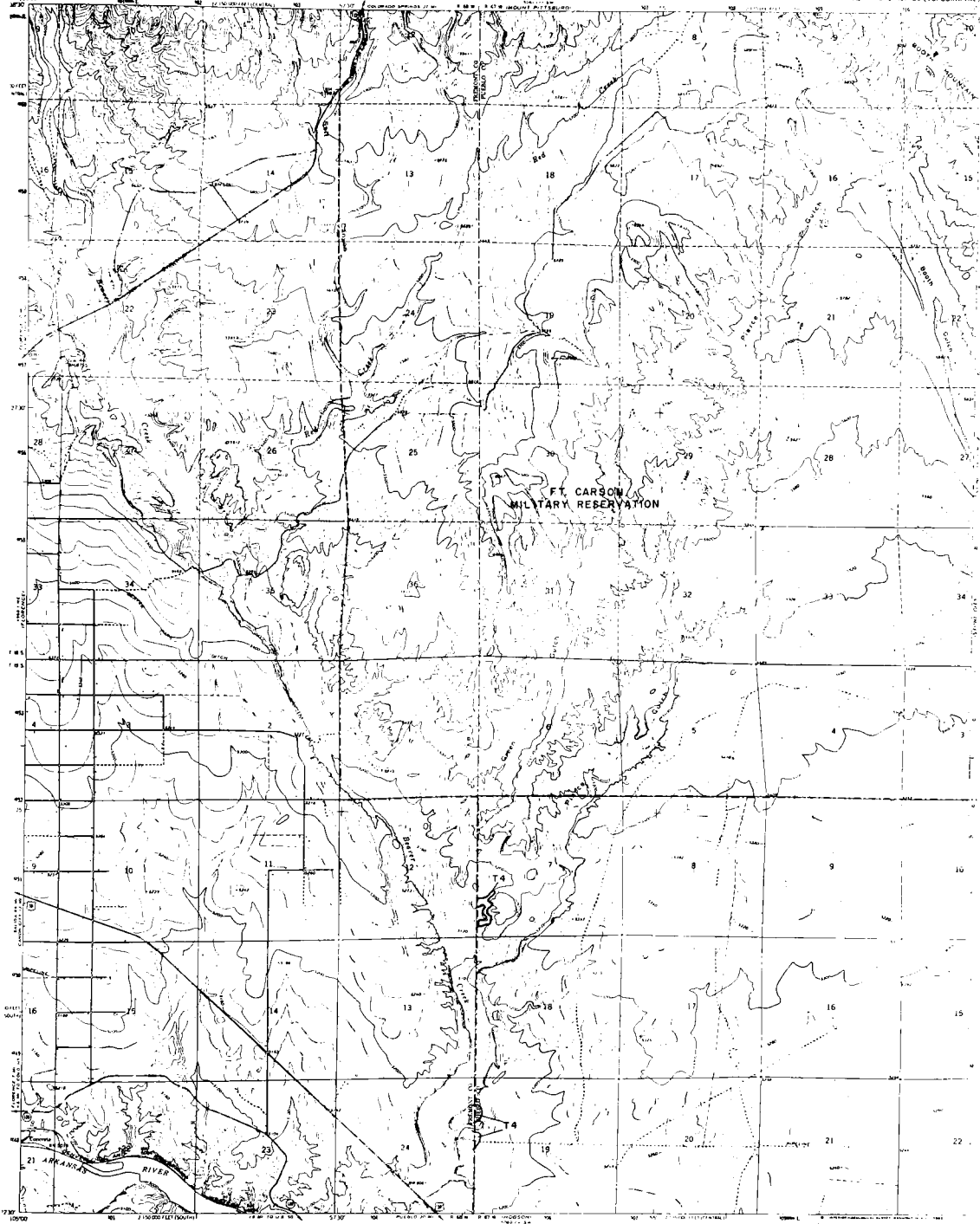
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Historical well or drilling hole location with overburden thickness (ft) over sand/gravel resource
  - Thickness (ft) obtained from well logs
  - "s" indicates gravel; "m" indicates sand
  - "i" in (bracket) indicates intermittent or unknown property
  - "m" denotes Colorado Geological Survey boundary (land and gravel) project
  - Well hole
  - Section boundary, well data from unobserved, dashed short segments or inferred

- POSITION, LOCATION AND CHRONOLOGICAL SIGNIFICANCE OF SECTION**
- Horizontal thickness (ft)
  - Actual gravel thickness (ft)
  - Overburden sand and gravel (ft)
  - Section, 0.50 to 1.0, actual thickness
  - Significant amount of fines (gravel)
  - Significant amount of decomposed rock (gravel)
  - Significant amount of intermittent resource (sand)
  - "i" in (bracket) denotes intermittent or unknown property
  - "m" in (bracket) denotes intermittent or unknown property
  - "s" in (bracket) denotes intermittent or unknown property

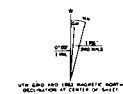


- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1976



Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL: 20 FEET  
 OFFICIAL SURVEY DATA FROM COLORADO  
 GEOLOGICAL SURVEY, 1976

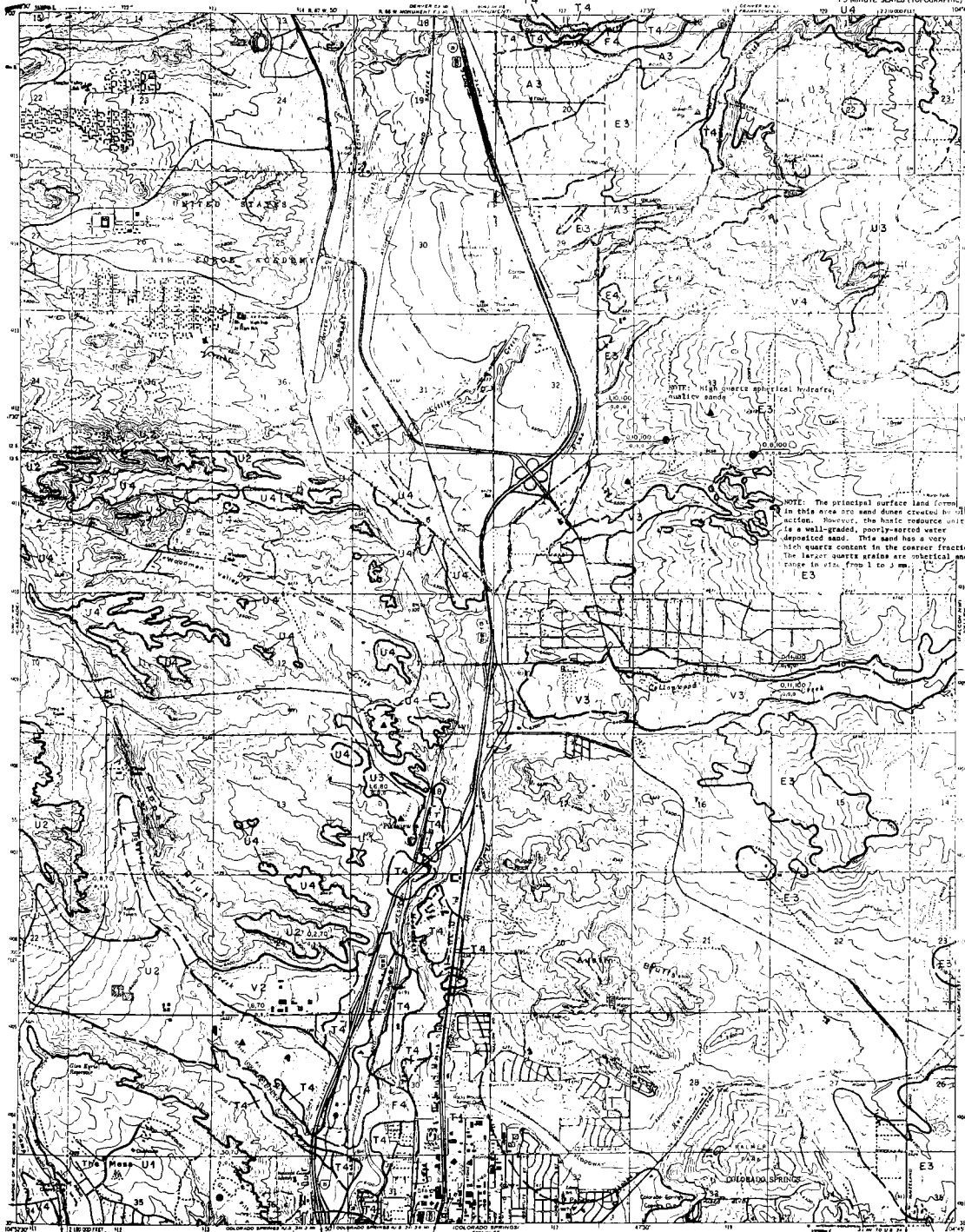
- ROAD CLASSIFICATION**
- Medium duty
  - Light duty
  - Unimproved dirt
  - U.S. Route
  - State Route

PIERCE GULCH COLO

SAND, GRAVEL AND QUARRY AGGREGATE

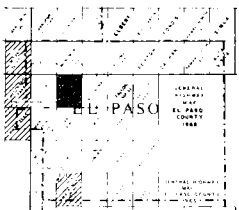
RESOURCES MAP

PIKEVIEW QUADRANGLE  
 COLORADO, EL PASO CO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- LANDFORM UNIT**  
 Non-resource classification
- LANDFORM UNIT**  
 F Floodplain deposit  
 T Tertiary terrace deposit  
 V Valley fill (F & T)  
 U Upland deposits  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Man-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**
- GRAVEL DEPOSIT**  
 Selected well-sorted glacial outwash, or  
 fluvial deposits
- 1 Gravel, relatively clean and well-sorted
  - 2 Gravel, significant fines, decomposed rock, calcareous carbonate
- SAND DEPOSIT**  
 Selected well-sorted glacial outwash, or  
 fluvial deposits
- 3 Sand
- Designated Resource**  
 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well-sorted glacial outwash with overburden thickness (ft) over sand/gravel resource thickness (ft), indicated from well logs
  - "L" indicates gravel; "S" indicates sand
  - "L" in symbol denotes unutilized or unknown property
  - "S" denotes Colorado Geological Survey unutilized and/or "gravel producer" drill hole
  - Landform boundary, solid where known or inferred; dashed where approximate or uncertain
- STATUS, LOCATION AND ORIENTATIONAL**
- AGGREGATE RESOURCE**  
 sand/gravel resource thickness (ft)  
 overburden thickness (ft)  
 gravel/sand resource thickness (ft)  
 overburden thickness (ft)  
 gravel/sand resource thickness (ft)  
 overburden thickness (ft)
- AGGREGATE RESOURCE**  
 Significant amount of fines (less than 100 mesh, 0.075 in. or 0.0075 mm.)
- AGGREGATE RESOURCE**  
 Significant amount of decomposed or weak rock.
- AGGREGATE RESOURCE**  
 Significant amount of calcareous carbonate indicator
- AGGREGATE RESOURCE**  
 "L" in symbol denotes unutilized or unknown property
- AGGREGATE RESOURCE**  
 "S" in symbol denotes property, absent or unutilized



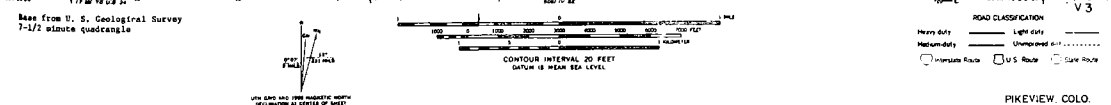
- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHERAWAY AREA

Geology modified after Scott, C. R., & Mohr, R. A. 1973. Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U. S. Geological Survey Map, MF-487.

Geology modified after Eichler, S. J., 1973. Geologic map of Cottonwood Creek area, Plate 1, Colorado School of Mines, M.S. Thesis, T-1516.

**REFERENCE:**  
 Trimble, J. E., and Pich, W. R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range, Western Colorado, Colorado: U. S. Geol. Survey Map I-851 A.

Mapped by: Phillip C. Wicklan  
 Date: June 30, 1974  
 Prepared in cooperation with the U. S. Geological Survey.



PIKEVIEW, COLO.



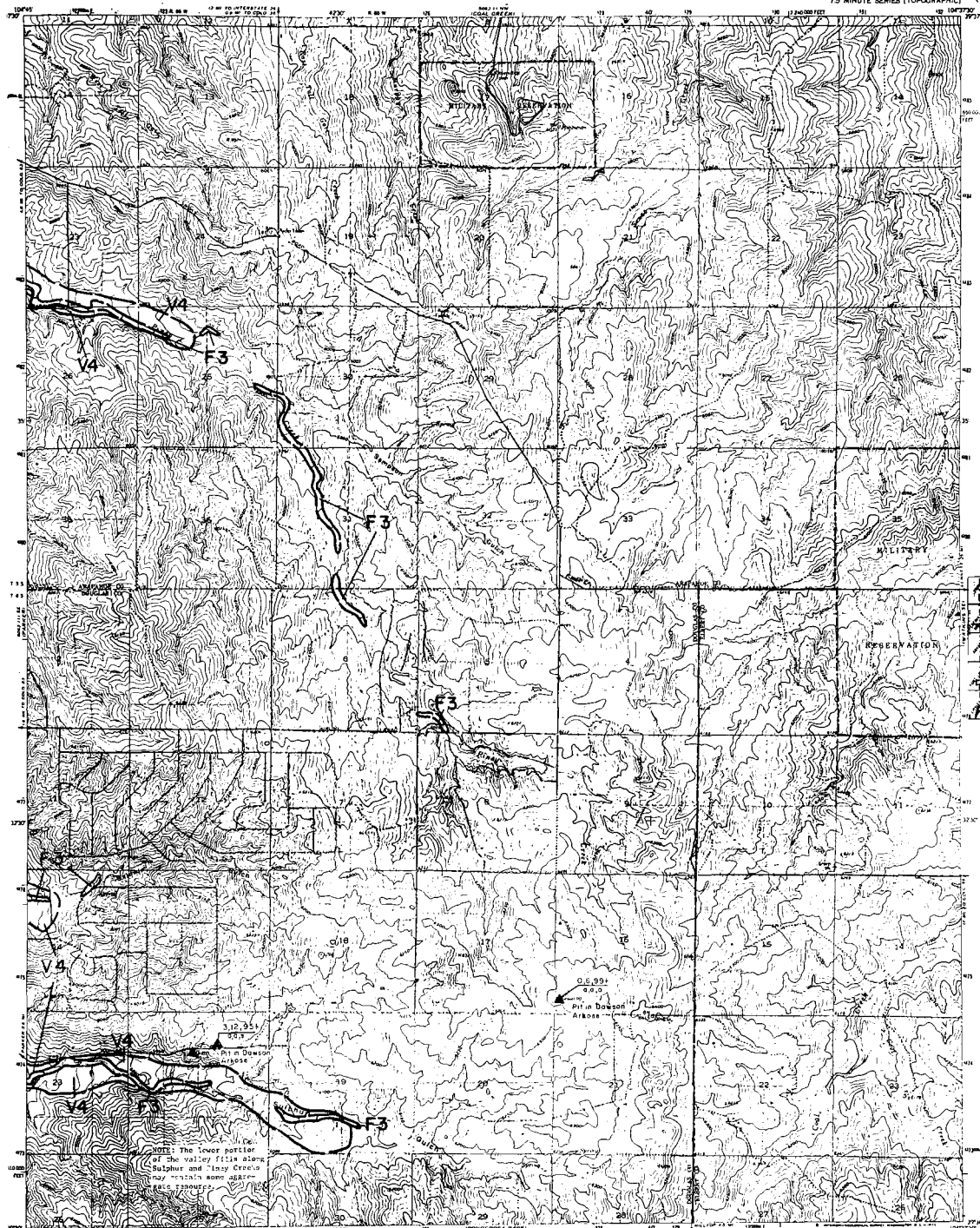


# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

PINEY CREEK QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION

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



- LAGOON FILL**
- F Fine-grained deposit
  - T Siliceous coarse deposit
  - V Valley fill (F & T)
  - U Unclay deposits
  - A Alluvial fan
  - E Eolian deposit (sand dunes)
  - M Man-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**
- Gravel**  
(at least 20% restricted to 40 screen, actual content only)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous contents
- Fill**
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Isolated well-sorted sand location with overburden thickness (ft) over aggregate resource thickness (ft), obtained from well logs
  - "s" indicates gravel; "g" indicates sand
  - "a" in symbol denotes unconsolidated or unknown property
  - "m" denotes Colorado Geological Survey "Mineral Land and Grant" projects
  - "B" in symbol denotes boundary, solid where known or dashed where approximate or inferred
- STATION, LOCATION AND ORIENTATIONAL INDICATION OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (using 40 screen, U.S.C.S.) actual percentage
  - significant amount of fines (passing 100 screen, U.S.C.S. or 200 mesh)
  - significant amount of decomposed or weak rock
  - significant amount of calcareous materials
  - "a" in symbol denotes unconsolidated or unknown property
  - "m" in symbol denotes property claim or leasehold



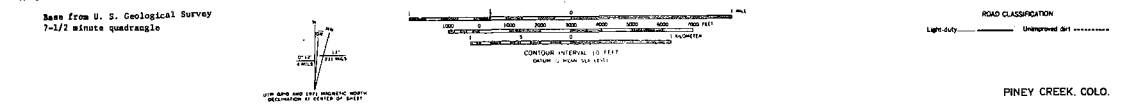
**ROAD CLASSIFICATION**

Light-duty Unimproved dirt

Geology modified after:  
Tribble, D.F., and Piche, H.R., 1974, Map showing potential occurrence of gravel and crushed-rock aggregates in the Greater Denver Area, Front Range Urban Corridor, Colo.; U. S. Geol. Survey Misc. Geol. Inv. Map 3-450-A.

REFERENCE:  
Chase, G.B., and McConaghy, J.A., 1972, Generalized surficial geologic map of the Denver area, Colorado; U. S. Geol. Survey Misc. Geol. Inv. Map 1-731.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.



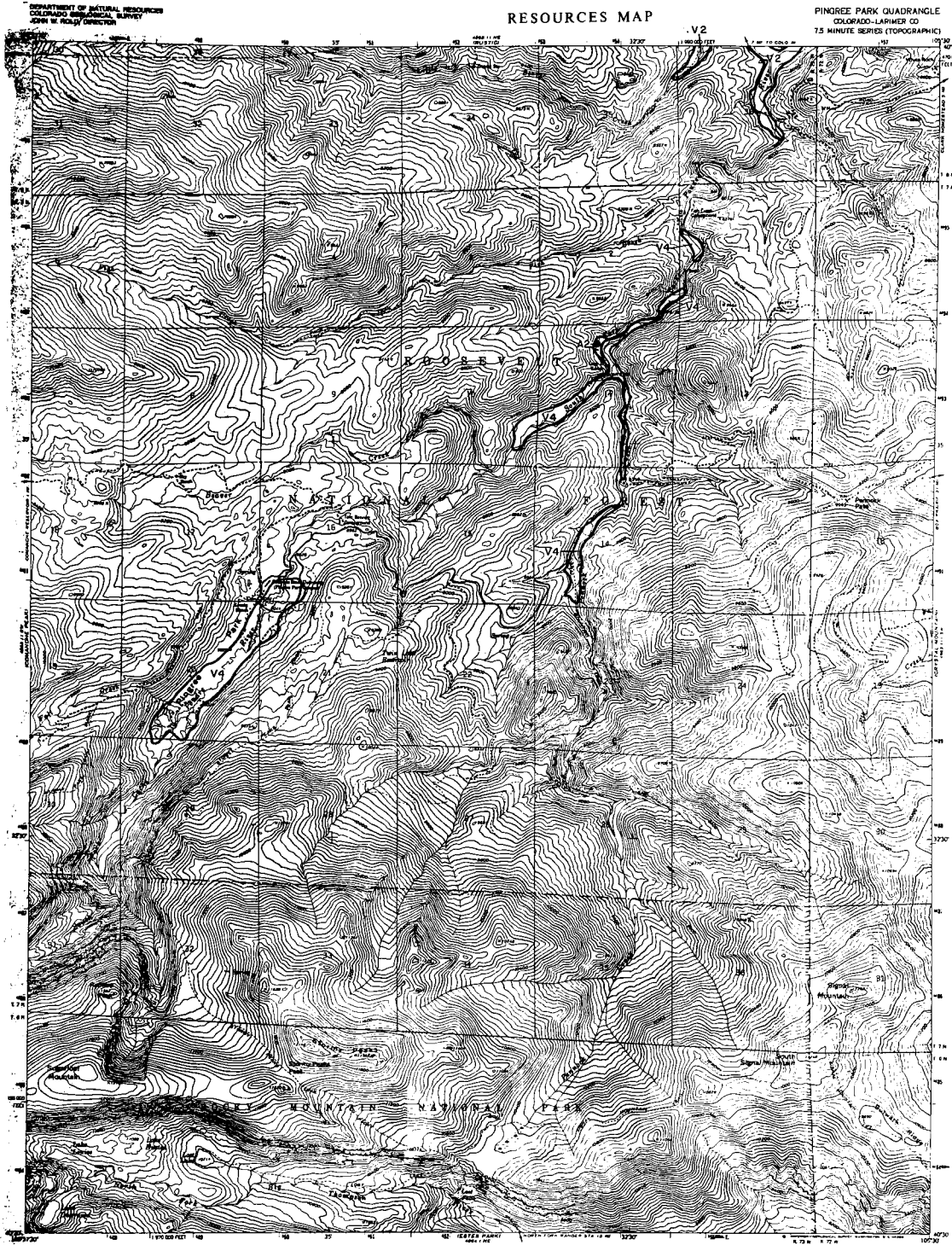
Base from U. S. Geological Survey  
7-1/2 minute quadrangle

ROAD CLASSIFICATION  
Light-duty Unimproved dirt

PINEY CREEK, COLO.

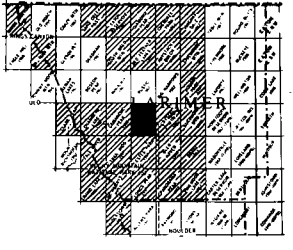
SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

PINGREE PARK QUADRANGLE  
COLORADO-LARIMER CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



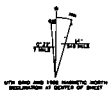
EXPLANATION

- Contour lines
  - Road classification
  - Quarry location
  - Non-resource or Victorian area
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-sand deposits (clay, siltstone, granite...)
- RESOURCE CLASSIFICATION**
- COARSE GRAVELS**  
(see legend for details on 48 screen, visual estimation)
- 1 Coarse: relatively clean and round
  - 2 Coarse: significant fines, decomposed rock, tabular cobbles
- FINE GRAVELS**  
(primary 30/60 screening of screen, 48/100 retained on 250 screen, visual estimation)
- 3 Sand
  - 4 Probable aggregate resources
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource site
  - Selected well or drill-hole location with measured thickness (ft) and sand/gravel resource thickness (ft), obtained from well logs.
  - "A" indicates gravel; "G" indicates sand
  - "S" is symbol denotes unmineralized or unknown property.
  - "M" denotes Colorado Mineral Survey, Mineral and Coal projects.
  - "L" is symbol denotes location of quarry.
  - "N" is symbol denotes location of quarry.
- STATUS, LOCATION AND CHARACTERIZATION OF RESOURCES**
- non-urban thickness (ft)
  - non-urban resource thickness (ft)
  - percent sand and fines (passing 48 screen, 0.25 in.), visual estimation
  - Significant amount of fines (passing 250 screen, 0.075 in. or 0.075 mm.)
  - Significant amount of decomposed or soft rock.
  - Significant amount of mineral resources (includes "M" or symbol denotes unmineralized or unknown property)
  - "L" is symbol denotes location of quarry
  - "N" is symbol denotes location of quarry



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR VICTIMIAN AREA

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



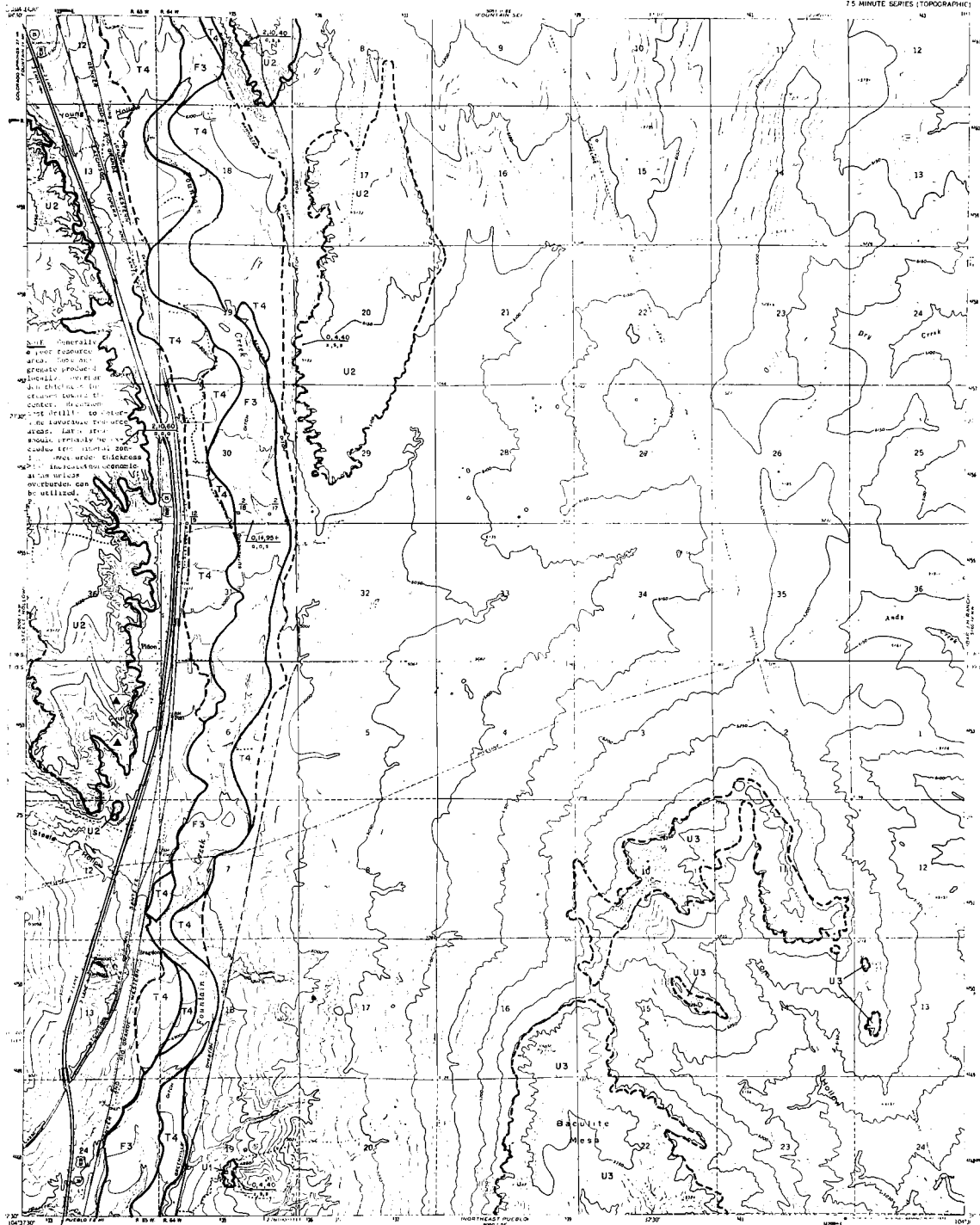
ROAD CLASSIFICATION  
Light duty — Unimproved dirt —

PINGREE PARK, COLO.

Mapped by: Stephen D. Schwochow  
Date: June 30, 1974

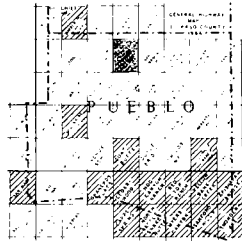
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

PINON QUADRANGLE  
 COLORADO-PUEBLO CO  
 7.5 MINUTE SERIES, TOPOGRAPHIC



EXPLANATION

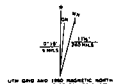
- LANDFORMS**
- Landform with boundary classification
- LANDFORMS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Marine deposits (beach, terrace, spillover...)
- RESOURCE CLASSIFICATION**
- Gravel resources**  
 of size 100 to 425 microns or 40 percent gravel content
- 1 Gravel relatively clean and sound
  - 2 Gravel significant fines, decomposed rock, calcareous nodules
- Fine aggregate**  
 (material 75 microns or smaller, 40% retained on #200 screen, based on 100% screen, based on 100% screen, based on 100% screen)
- 3 Sand
  - 4 Probable aggregate resource
- QUARRY SYMBOLS**
- Operating gravel and/or sand pit
  - ▲ Abandoned gravel and/or sand pit
  - ⊙ Operating stone quarry
  - ⊙ Abandoned stone quarry
  - ⊙ Potential quarry aggregate resource area
  - Selected well or geologic location with overburden thickness (ft) over sand/gravel resource thickness (ft) obtained from well logs. "s" indicates gravel; "m" indicates sand.
  - "s" in symbol denotes unrelieved or unknown property.
  - "m" denotes Colorado Geological Survey identified sand and gravel properties.
  - ⊙ Landform boundary, solid where known or observed, dashed where approximate or inferred.
- POSITION, LOCATION AND GEOLOGICAL INTERPRETATION OF SYMBOLS**
- overburden thickness (ft)
  - aggregate resource thickness (ft)
  - percent sand and fines (percent of screen, 75 to 200 microns), gravel content
  - significant amount of fines (appearing 100% screen, 0.075 to 0.425 mm)
  - significant amount of decomposed or weak rock
  - significant amount of calcareous nodules
  - "s" in symbol denotes unrelieved or unknown property
  - "m" in symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wicklett  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy duty
- Light duty
- Medium duty
- Unimproved dirt
- Interstate Route
- U.S. Route

PINON, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

PLATTE CANYON QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

## EXPLANATION

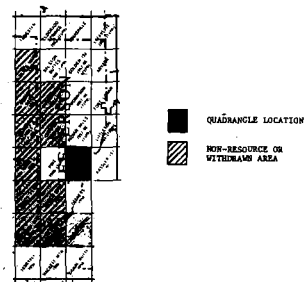
*Response classification*

- LEGEND**
- T Tertiary terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated
  - A Alluvial fan
  - E Eolian deposit (sand)
  - M Marine deposit (sand, silt, clay, etc.)

- RESOURCE CLASSIFICATION**
- Gravel**
- 1 Gravel: relatively clean and sound
  - 2 Gravel: aggregate fines, decomposed rock, siliceous
- Sand**
- 3 Sand
  - 4 Probable aggregate resources

- NON-RESOURCE**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) and gravel resource indicator (1), selected from well log
  - "G" indicates gravel, "S" indicates sand
  - "P" in upper section unmineralized or unknown property
  - "M" denotes Colorado Geological Survey boundary (sand and gravel) principal
  - Well hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred

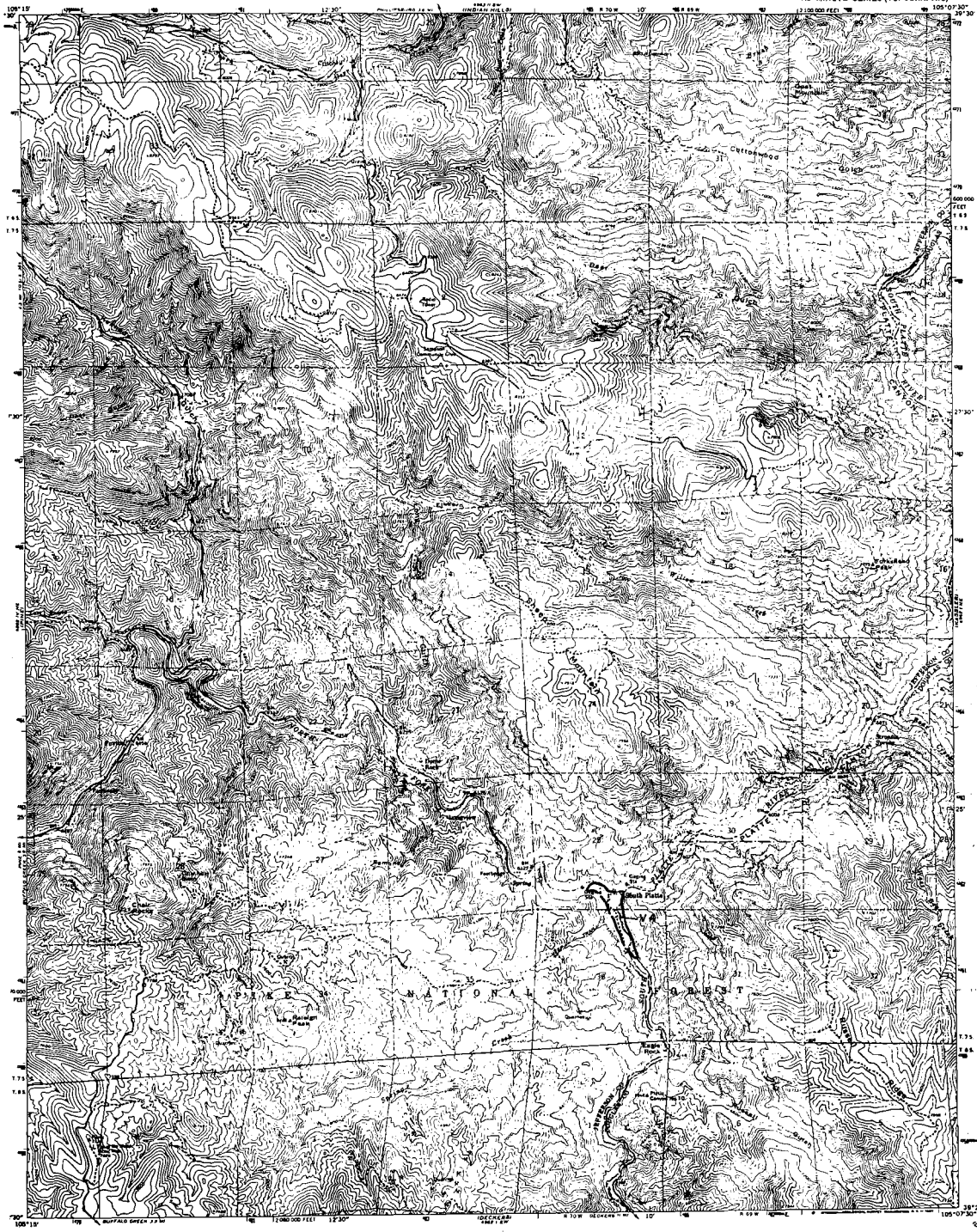
- SECTION, LOCATION AND QUANTITATIVE DESCRIPTION OF RESOURCES**
- Overburden thickness (ft)
  - Estimated resource thickness (ft)
  - Percent sand and fines (based on screen, 0.075 in., gravel retention)
  - Significant amount of fines (based on 200 screen, 0.0075 in. or 0.075 mm.)
  - Significant amount of decomposed or soil rock
  - "M" in upper section unmineralized or unknown property
  - "P" in upper section property absent or unexplored



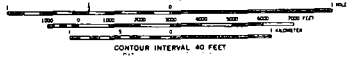
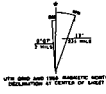
**REFERENCE**

Wickham, D.H., and Vink, R.E., 1974, Map showing potential resources of gravel and crushed-stone aggregate in the Greater Denver Area, Proceedings 1974, Colorado Geol. Surv., U. S. Geol. Surv. Misc. Geol. Div. Map I-459-A.

Mapped by: Phillip C. Wickham  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.



Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Unimproved rd

PLATTE CANYON, COLO.

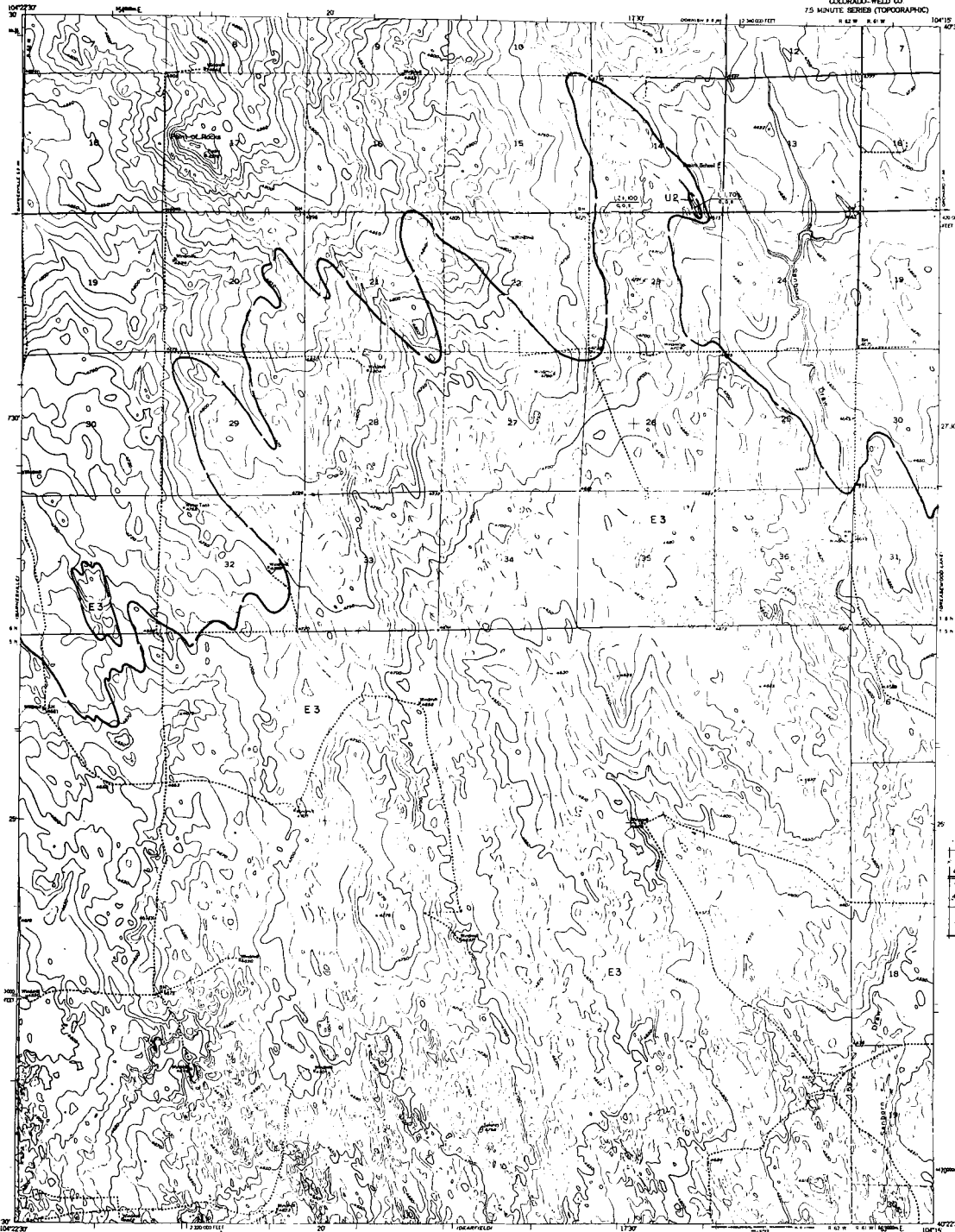




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

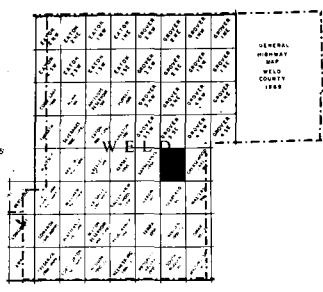
POINT OF ROCKS QUADRANGLE  
COLORADO, WELD CO.  
75 MINUTE SERIES (TOPOGRAPHIC)  
N 42 W R 6 E W

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



## EXPLANATION

- Landform unit**  
Research classification
- LANDFORM UNITS**
- F Fluvialite deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unaltered deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (logs, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
- CLAYE AGGREGATE**  
See notes on potential on p. 2.
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- SAND AGGREGATE**  
See notes on potential on p. 2.
- 3 Sand
- Unvaluated Resource**
- 4 Probable aggregate resource**
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with water-table thickness (ft); sand/gravel resource thickness (ft); obtained from well logs.
  - "s" indicates sand; "g" indicates gravel; "u" indicates unaltered or unknown property.
  - "W" denotes Colorado Geological Survey withdrawal boundary, solid where known or observed, dashed where approximate or inferred.
- STATUS, LOCATION AND GEOLOGICAL SIGNIFICANCE OF DEPOSITS**
- Method of thickness (ft)
  - Method of resource thickness (ft)
  - Percent sand and fines (passing #20 screen, 0.850 in. or 21.5 mm.)
  - Significant amount of fines (passing #100 screen, 0.150 in. or 3.8 mm.)
  - Significant amount of decomposed or unaltered.
  - "u" in symbol denotes unvaluated or unknown property.
  - "s" in symbol denotes property shared or unvaluated.

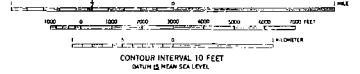
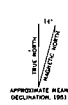


■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Bjorklund, L.J., and Brown, R.F., 1957, Geology and groundwater resources of the lower South Platte River valley between Hardin, Colorado, and Poncha, Nebraska; U. S. Geol. Survey Water-Supply Paper 1378, pl. 1.

Maped by: Phillip C. Wicklin  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Heavy-duty ————  
Medium-duty ————  
Unimproved dirt ————

□ U.S. Route    ○ State Route

POINT OF ROCKS, COLO.



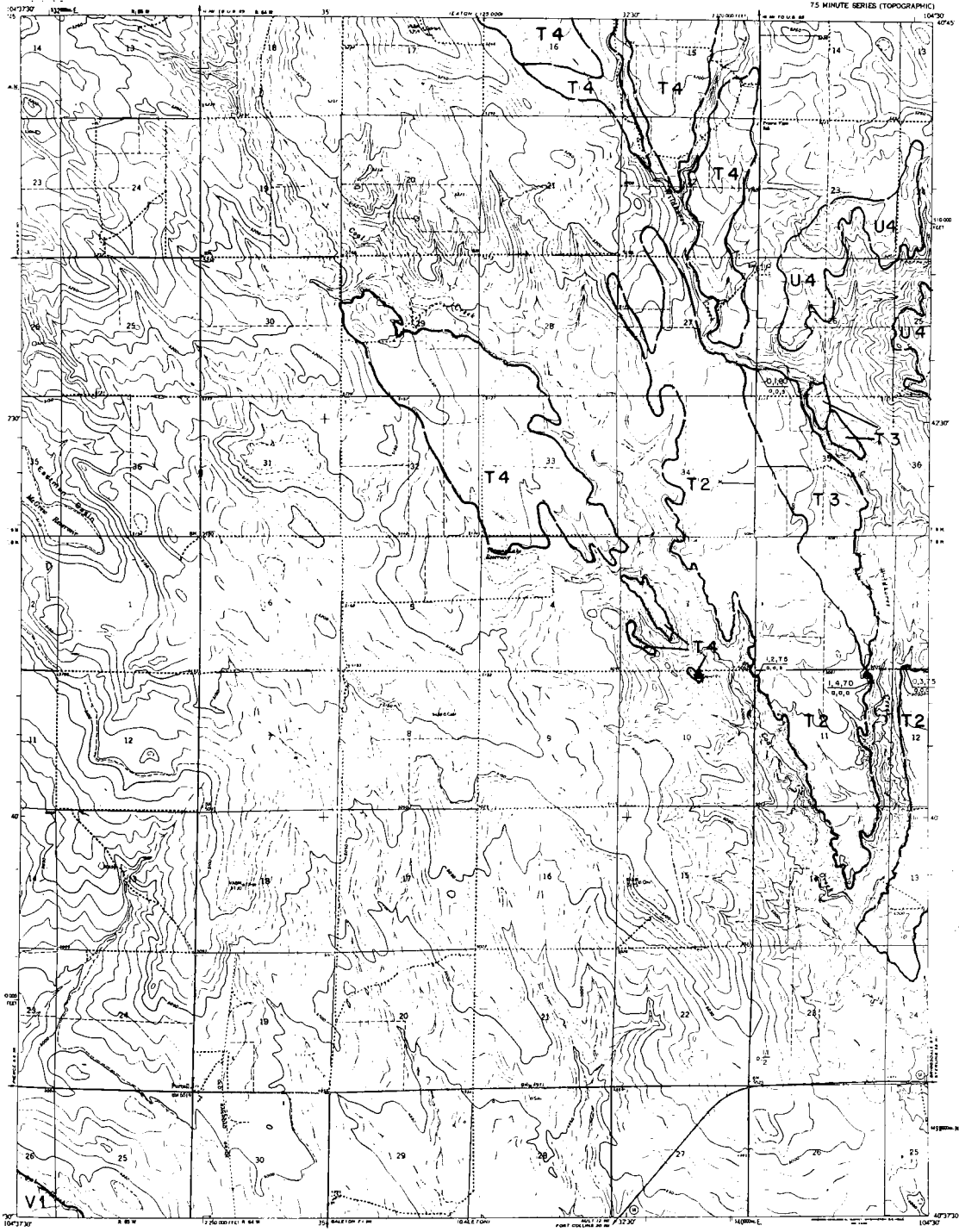




**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

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

PURCELL QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)



**EXPLANATION**

**MODIFIED USGS**

- F Sandstone deposit
- T Stream terrace deposit
- V Valley fill (S&T)

**US**

- U Unfilled deposits
- A Alluvial fan
- E Wet-deltaic sand (silt) and (clay)
- M Non-graded deposits (clay, siltstone, shale, etc.)

**RESOURCE CLASSIFICATION**

**LOCAL DEPOSIT**

- 1 Gravel: relatively clean and round
- 2 Gravel: significant fines, decomposed rock, medium siltstone
- 3 Sand

**OVERLAIN RESOURCE**

- 4 Probable aggregate resource

**NOT SYMBOL**

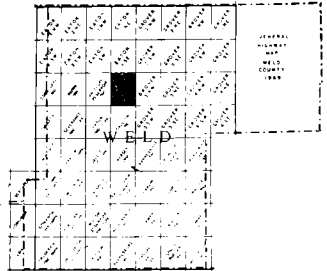
- A Operating gravel or for sand pit
- A Abandoned gravel or for sand pit
- Q Operating stone quarry
- A Abandoned stone quarry
- P Proposed quarry aggregate resource area
- R Rejected well or drill-hole location with overburden thickness (T) over sand/gravel resource thickness (T2), obtained from well logs
- W Well location (W), "N" indicates north "S" in same direction overlain or within property
- W\* denotes Colorado Geological Survey Wellhead Survey and Gravel Producer
- D Drill hole
- L Landform boundary, solid where known or observed, dashed where approximate or inferred

**STATION LOCATION AND GEOLOGICAL SYMBOLIZATION OF QUARRY**

- Q Wellhead (shaded) 2 1/2'
- Q Wellhead (unshaded) 1/2" (radius)
- Q Wellhead (small) 1/4" (radius)
- Q Wellhead (medium) 1/2" (radius)
- Q Wellhead (large) 1" (radius)
- Q Wellhead (very large) 1 1/2" (radius)
- Q Wellhead (extra large) 2" (radius)
- Q Wellhead (giant) 2 1/2" (radius)

**STATION LOCATION AND GEOLOGICAL SYMBOLIZATION OF QUARRY**

- Q Wellhead (shaded) 2 1/2'
- Q Wellhead (unshaded) 1/2" (radius)
- Q Wellhead (small) 1/4" (radius)
- Q Wellhead (medium) 1/2" (radius)
- Q Wellhead (large) 1" (radius)
- Q Wellhead (very large) 1 1/2" (radius)
- Q Wellhead (extra large) 2" (radius)
- Q Wellhead (giant) 2 1/2" (radius)



**QUADRANGLE LOCATION**  
**NON-RESOURCE OR VITIANSKI AREA**

Mapped by: Stephen D. Schowch  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Medium-duty
- Light-duty
- Unimproved dirt
- State Route

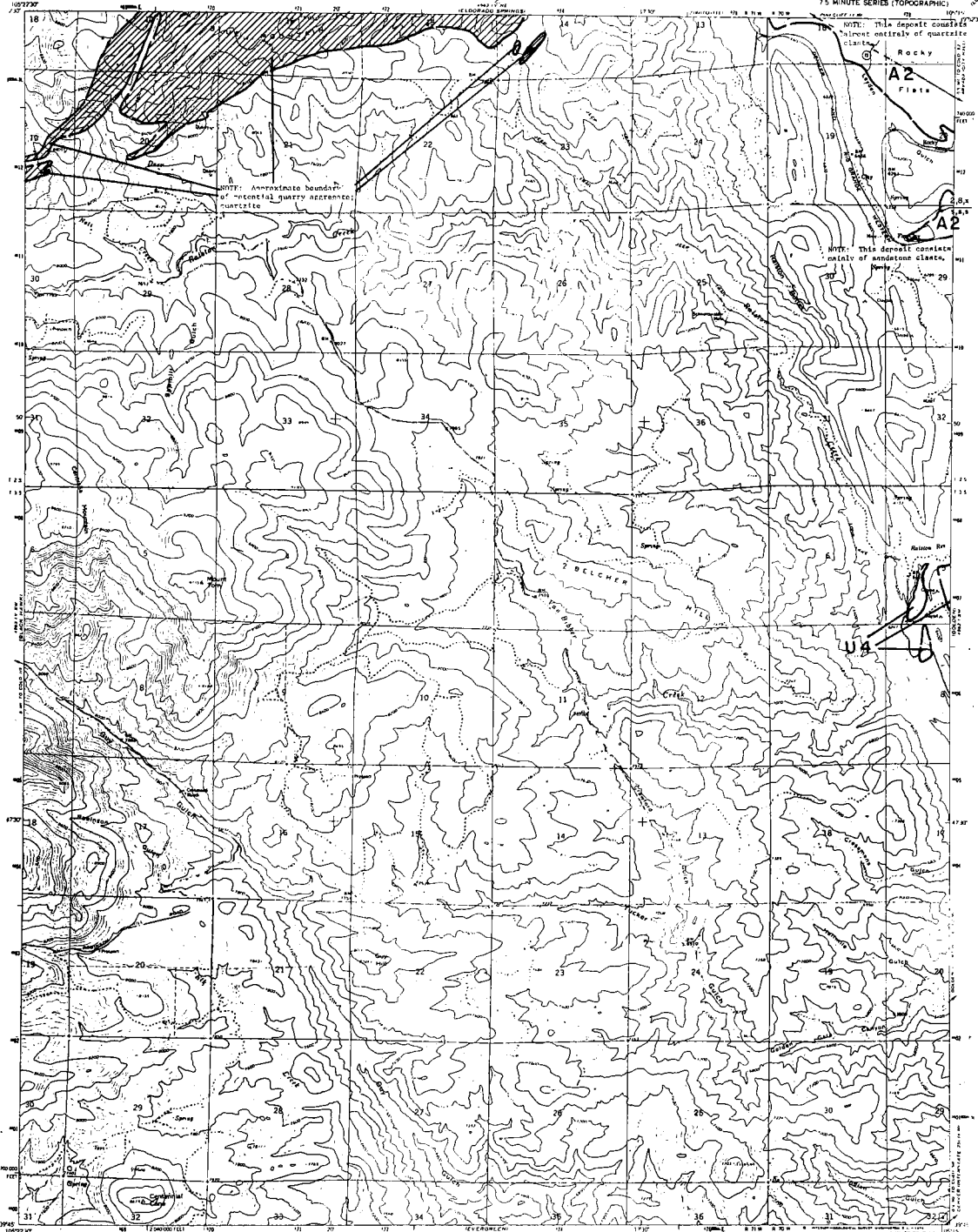
PURCELL COLO

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

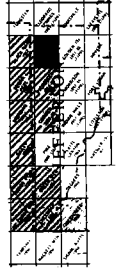
RALSTON BUTTES QUADRANGLE  
COLORADO - JEFFERSON CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

EXPLANATION



- EXPLANATION**
- AGGREGATE UNITS**
- Q Aggregate of Sand/Flats
- AGGREGATE TYPES**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unaltered deposit
  - A Alluvial fan
  - E Non-observed sand (est.)
  - M Non-observed gravel (est.)
- RESOURCE CLASSIFICATION**
- CLASS 1**
- 1 Class 1: relatively clean and sound
  - 2 Class 2: significant fines, decomposed rock, and/or andesite
- CLASS 3**
- 3 Class 3: sand
- CLASS 4**
- 4 Class 4: Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Observed well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); obtained from well logs
  - "s" indicates gravel; "m" indicates sand
  - "x" in symbol denotes unclassified or unknown property
  - "m" denotes Colorado Geologist Survey Methodized and Cross-Sectioned (MCS) drill hole
  - Underground tunnel, well, shaft, mine or other; shaded where appropriate or observed; shaded where appropriate or estimated
- SYMBOLS, LOCATIONS AND GEOLOGICAL DESCRIPTION OF SYMBOLS**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Observed sand and gravel resource thickness (ft); 0.15 to 1.0; small distance
  - Significant amount of fines (passing 100 mesh, 0.075 in. or 0.075 mm.)
  - Significant amount of decomposed or weak rock
  - Significant amount of calcareous material (carbonate)
  - "x" in symbol denotes unclassified or unknown property
  - "m" in symbol denotes property absent or Geology/Class



QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Geology modified after:

Sheridan, D.M., Maxwell, C.H., Albee, A.L., and Van Horn, Richard, 1958, Preliminary map of the bedrock geology of the Ralston Buttes quadrangle, Jefferson County, Colorado: U. S. Geol. Survey Mineral Inv. Field Studies Map MF-179.

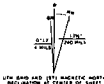
Trumble, D.R., and Fitch, R.R., 1974, Map showing potential sources of gravel and crushed-rock aggregate in the Greater Denver Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map I-856-A.

REFERENCE:

Cham, C.N., and McConaghy, J.A., 1973, Generalized surficial geologic map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-731.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974  
Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Heavy-duty ——— Light-duty ———  
Medium-duty ——— Unimproved det. ———  
U.S. Route ( ) State Route ( )

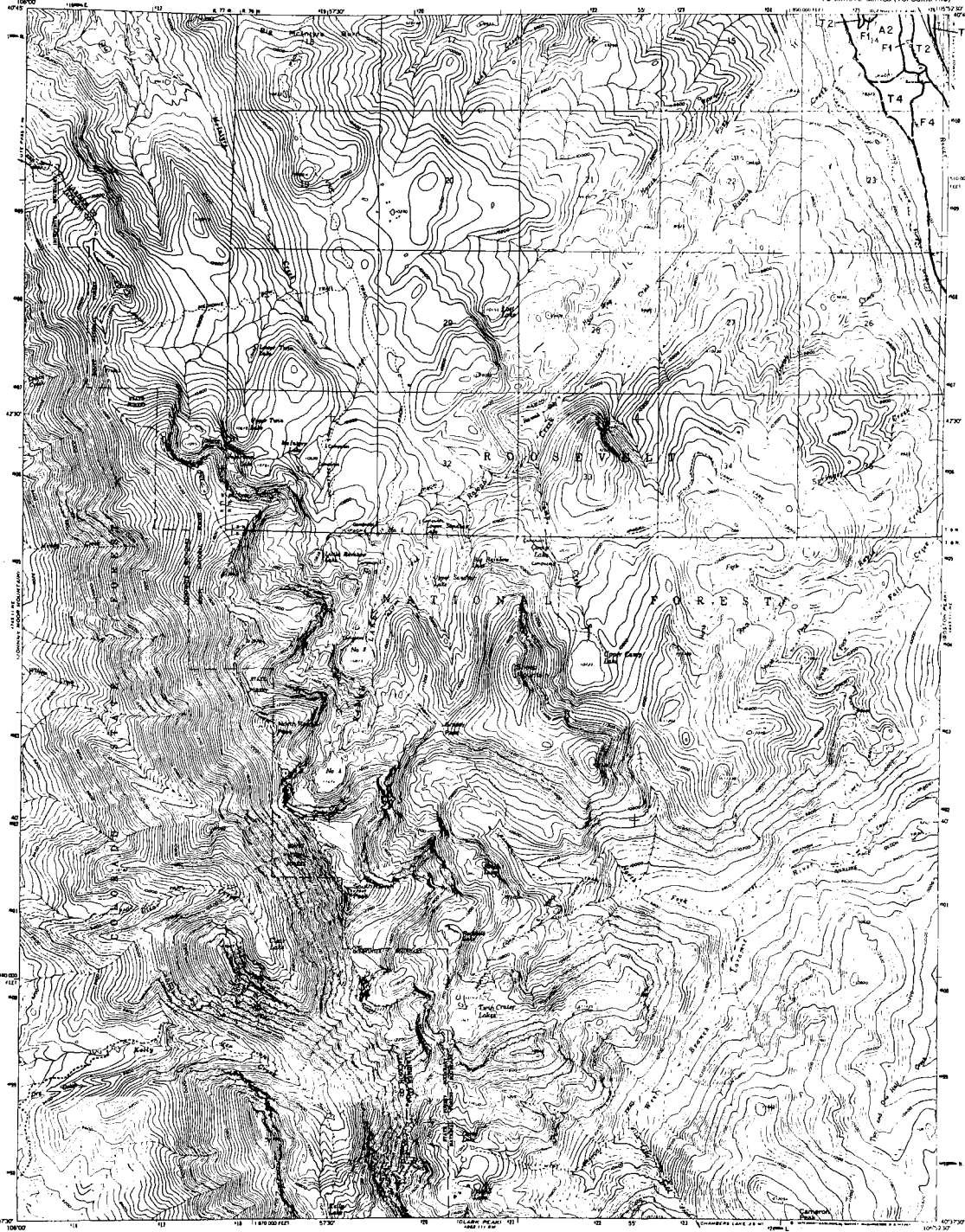
RALSTON BUTTES, COLO



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

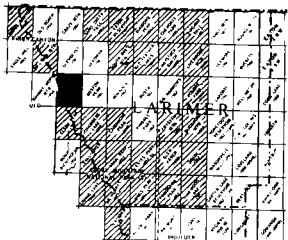
RAWAH LAKES QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- Landform units**  
 (Symbol) Landform class/function
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-made deposits (colluvial, talus, ...)
- ROCK CLASSIFICATION**
- Coarse Aggregate**  
 (at least 80% passing 48 screen, visual estimation)
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Fine Aggregate**  
 (greater than 75% passing 48 screen, 425 retained on 4200 screen, visual estimation)
- 3 Sand
- Unutilized Resources**
- 4 Probable aggregate resources
- MAP SYMBOLS**
- A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
  - E Potential quarry aggregate resource area
  - F Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - G "G" indicates gravel; "S" indicates sand
  - H "H" in symbol denotes unutilized or unknown property
  - M "M" in symbol denotes geological survey (shaded) and/or gravel resource (unshaded)
  - L Landform boundary, solid where known or inferred; dashed where approximate or inferred
- STATION, LOCATION AND CHRONOLOGICAL SUBDIVISION OF DEPOSIT**
- Overburden thickness (ft)
  - Significant resource thickness (ft)
  - Percent sand and fines (percent of screen, 0.075 in., visual estimation)
  - Significant amount of fines (percent of screen, 0.075 in. or 0.25 mm.)
  - Significant amount of decomposed or weak rock
  - Significant amount of calcium carbonate (carbonate)
  - "M" in symbol denotes unutilized or unknown property
  - "H" in symbol denotes property absent or unexplored



**QUADRANGLE LOCATION**  
 (Solid black square symbol)  
**NON-RESOURCE OR WITHDRAWN AREA**  
 (Hatched square symbol)

Mapped by: Stephen D. Schwolow  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL, 40 FEET  
 DOTTED LINES REPRESENT 20-FOOT CONTOURS  
 DATUM: 1985 MEAN SEA LEVEL

**ROAD CLASSIFICATION**  
 Light-duty ... Unimproved dirt ...

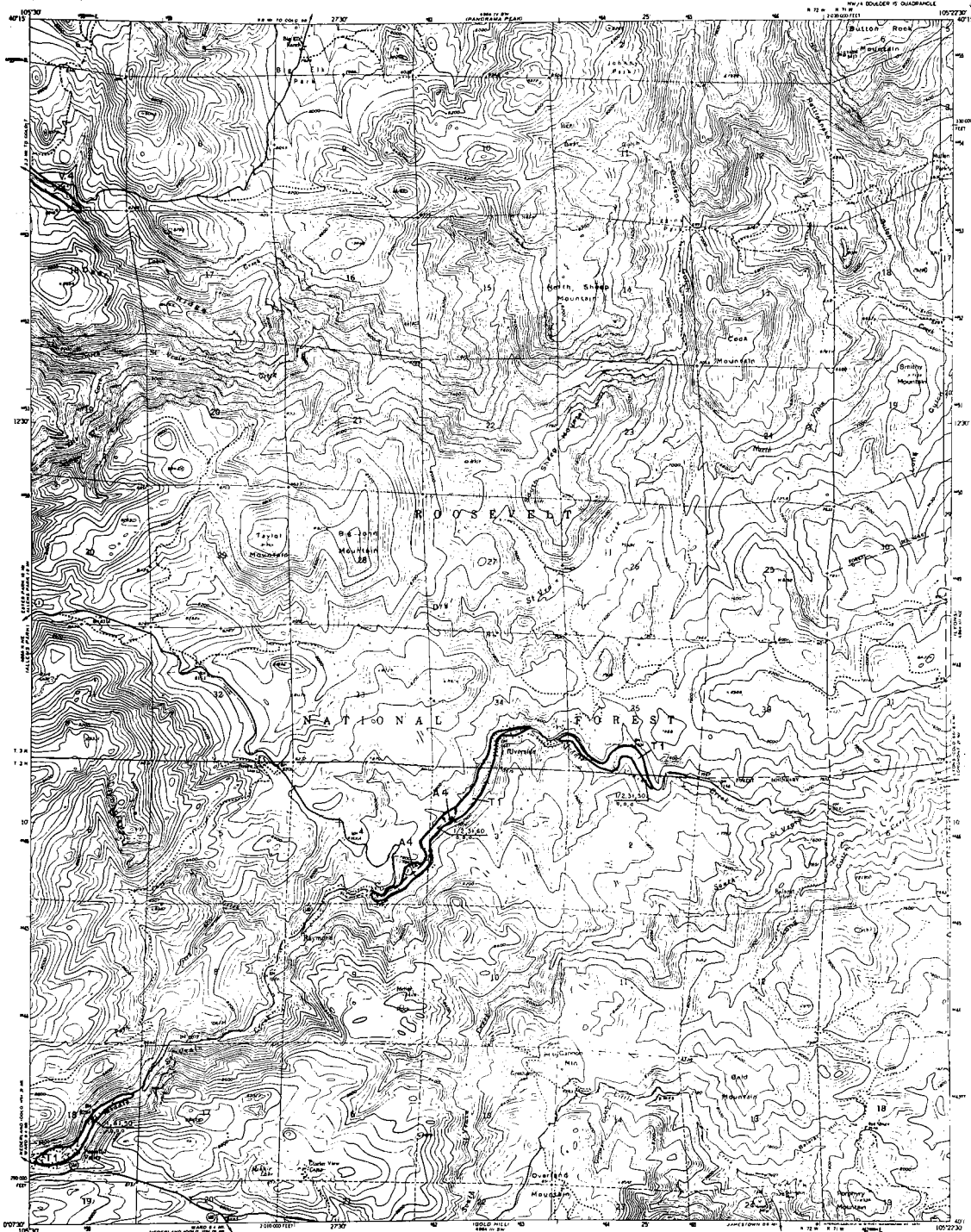
RAWAH LAKES, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

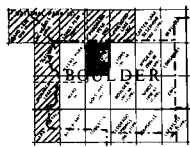
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLL, DIRECTOR

RAYMOND QUADRANGLE  
COLORADO-EXHIBIT 13  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
NO. 14 BORDER 9 QUADRANGLE



## EXPLANATION

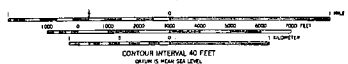
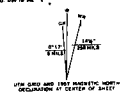
- Landform unit**  
 Landform classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Stream terrace deposit
  - W Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - V Volcanic sand (alluvial)
  - M Man-made deposit (slag, tailings, waste, etc.)
- SOIL CLASSIFICATION**
- COARSE GRAVELS**  
 (at least 35 percent - 48 screen, minus 100 mesh)
- 1 Coarse: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcareous
- FINE SANDS**  
 (greater than 75 percent 48 screen, 67 retained on 100 screen, visual estimation)
- 3 Sand
  - 4 Potential aggregate resource
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with water-bearing thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "G" indicates gravel; "S" indicates sand
  - "\*" in symbol denotes unventilated or unknown property
  - "\*\*" denotes Colorado Geological Survey Water/Soil and Gravel project 0133 hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSITS**
- Well/Drill Hole (Station #)
  - Sand/gravel resource area (Station #)
  - Selected well or drill-hole location with water-bearing thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "G" indicates gravel; "S" indicates sand
  - "\*" in symbol denotes unventilated or unknown property
  - "\*\*" denotes Colorado Geological Survey Water/Soil and Gravel project 0133 hole
  - Landform boundary, solid where known or observed, dashed where approximate or inferred



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph E. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



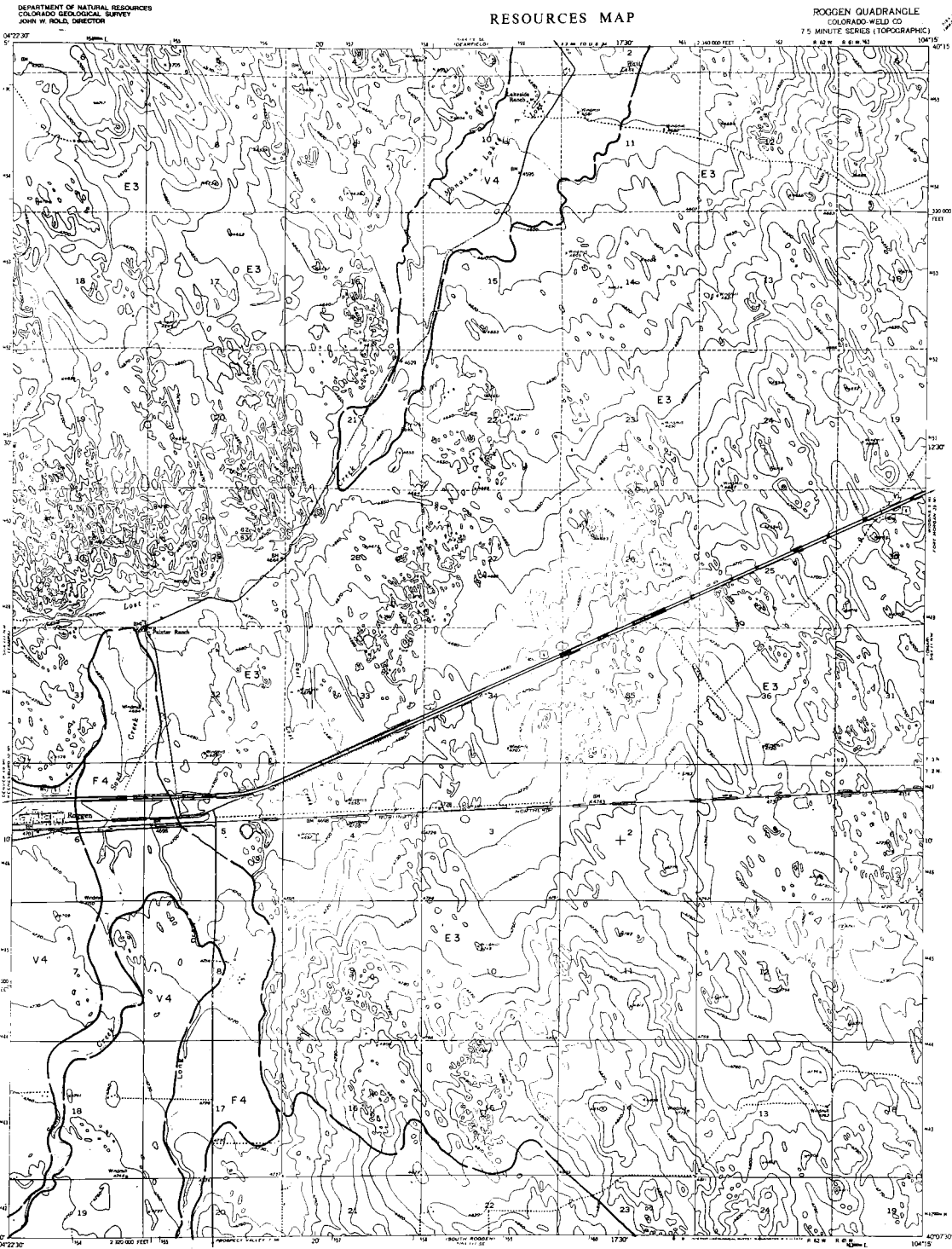
**ROAD CLASSIFICATION**

- Light duty
- Unimproved dirt
- Main Road

RAYMOND, COLO.

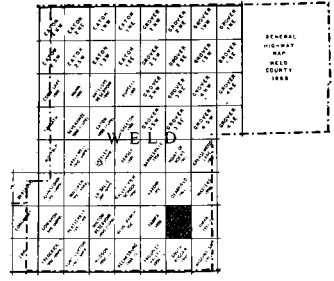
SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

ROGGEN QUADRANGLE  
COLORADO WELD CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- AMOUNTS**
- Fluvial deposits
  - Stream terrace deposit
  - Valley fill (F & I)
  - Upland deposits
  - Alluvial fan
  - Wind-deposited sand (colluvial)
  - Wind-made deposits (sand dunes, spalls, etc.)
- RESOURCE CLASSIFICATION**
- Gravel**
- Gravel: relatively clean and sand
  - Gravel: significant fines, decomposed rock, calcium carbonate
- Sand**
- Gravel: relatively clean and sand
  - Gravel: significant fines, decomposed rock, calcium carbonate
- Quarry Aggregate**
- Gravel: relatively clean and sand
  - Gravel: significant fines, decomposed rock, calcium carbonate
- ROAD CLASSIFICATION**
- Primary highway: hard surface
  - Secondary highway: hard surface
  - Unimproved road
  - Interstate Route
  - U.S. Route
  - State Route



REFERENCE: Bjorklund, L.J., and Brown, R.P., 1957, Geology and ground-water resources of the lower South Platte River valley between Sardin, Colorado, and Paxton, Nebraska; U. S. Geol. Survey Water-Supply Paper 1376, pl. 1.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL: 10 FEET (BASED ON MEAN SEA LEVEL)

ROAD CLASSIFICATION

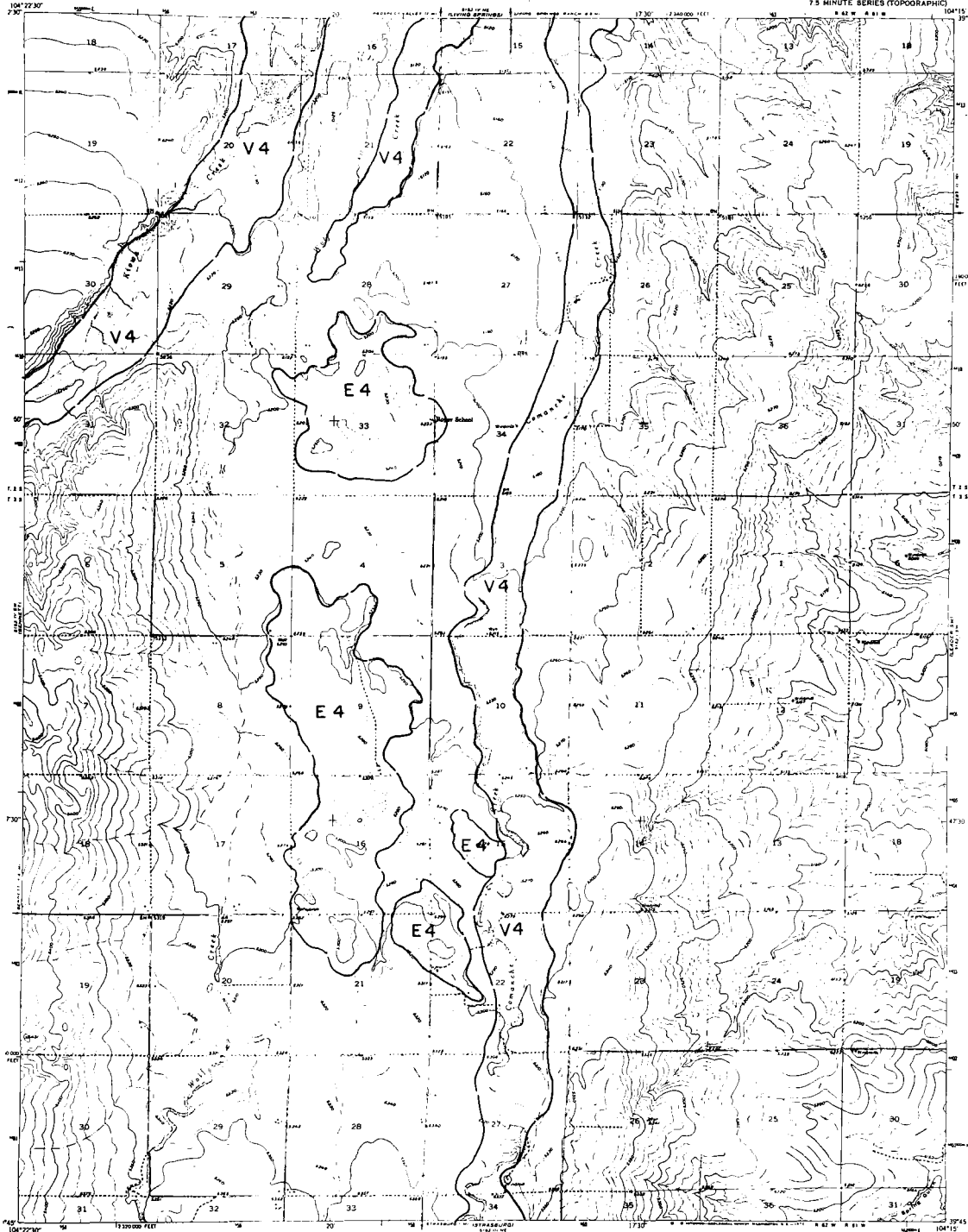
- Primary highway: hard surface
- Secondary highway: hard surface
- Unimproved road
- Interstate Route
- U.S. Route
- State Route

ROGGEN, COLO.

**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

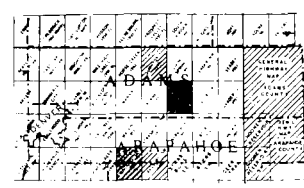
ROPER SCHOOL QUADRANGLE  
COLORADO-ADAMS CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



**EXPLANATION**

- LEGEND**
- V4 Sand deposits
  - E4 Sand deposits (aggregates, spalls, etc.)
  - A Alluvial fan
  - T Stream terrace deposit
  - U Upland deposit
  - M Manganese deposit
- ROAD CLASSIFICATION**
- 1 Heavy-duty
  - 2 Medium-duty
  - 3 Light-duty
  - 4 Unimproved dirt
  - U S. Route
  - State Route
- STATION LOCATIONS AND PRODUCTION CAPACITY OF QUARRIES**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Formerly active aggregate resource area
  - Unexplored aggregate resource area
  - Unexplored aggregate resource area with overburden thickness less than sand/gravel resource thickness (this symbol is used with the "a" indicator symbol)
  - "a" indicates gravel; "s" indicates sand
  - "a" symbol denotes unutilized or unknown property
  - "s" denotes Colorado Geological Survey (C.G.S.) and/or Colorado State University (C.S.U.) drill hole
  - Quarry boundaries: solid where known or observed; dashed where approximate or inferred
- STATION LOCATIONS AND PRODUCTION CAPACITY OF QUARRIES**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Formerly active aggregate resource area
  - Unexplored aggregate resource area
  - Unexplored aggregate resource area with overburden thickness less than sand/gravel resource thickness (this symbol is used with the "a" indicator symbol)
  - "a" indicates gravel; "s" indicates sand
  - "a" symbol denotes unutilized or unknown property
  - "s" denotes Colorado Geological Survey (C.G.S.) and/or Colorado State University (C.S.U.) drill hole
  - Quarry boundaries: solid where known or observed; dashed where approximate or inferred



■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wicklin  
Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET  
DATA IN FEET MEAN SEA LEVEL

ROAD CLASSIFICATION

- HEAVY-DUTY ALL WEATHER ROADS
- MEDIUM-DUTY ALL WEATHER ROADS
- LIGHT-DUTY ALL WEATHER ROADS
- UNIMPROVED DIRT
- U S. Route
- State Route

ROPER SCHOOL COLO.

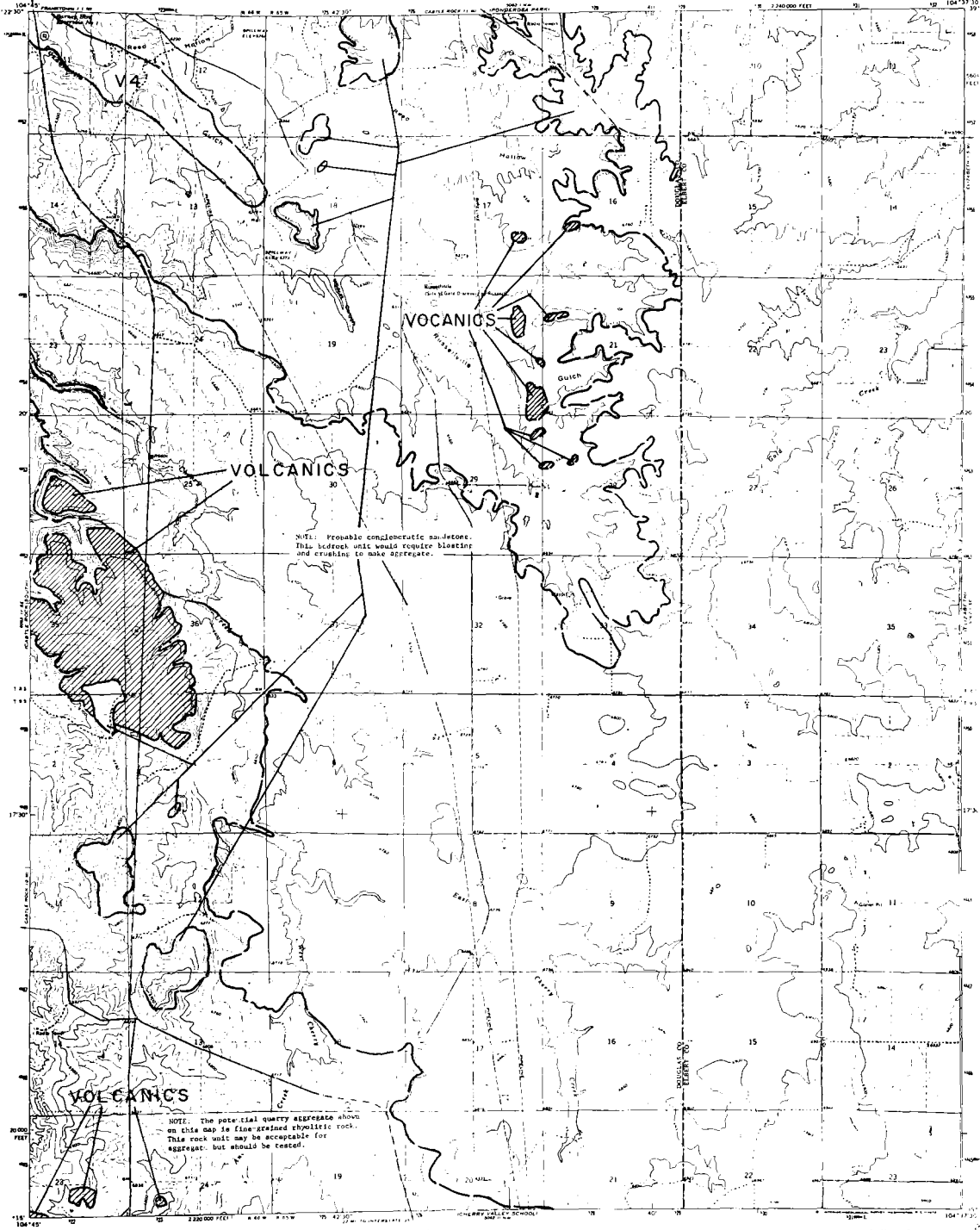




# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

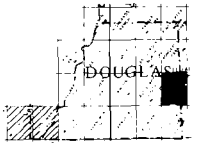
RUSSELLVILLE GULCH  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
BY EUGENE H. QUALLANCE

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



## EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - T Terrace surface deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - M Mined aggregate used (contour)
  - Non-usable deposits (indicated by dots...)
- RESOURCE CLASSIFICATION**
- 1 Coarse aggregate (100% to 75% retained on #4 screen, 25% passing #20)
  - 2 Gravel: relatively clean and sound
  - 3 Gravel: significant fines, increased percentage sandstone
  - 4 Fine aggregate (similar to #1 but passing #40 screen, 20% retained on #100 screen, 10% retained on #200)
  - 5 Sand
  - 6 Unutilized Resource
  - 7 Probable aggregate resource
- MAP SYMBOLS**
- a Operating gravel and/or sand pit
  - b Abandoned gravel and/or sand pit
  - c Operating stone quarry
  - d Abandoned stone quarry
  - e Potential quarry aggregate resource area
  - f Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource indicated (ft) obtained from well logs
  - g "a" indicates gravel; "b" indicates sand
  - h "r" in symbol denotes unutilized or unknown property
  - i "m" denotes Colorado Geological Survey Mined (Sand and Gravel) projects (ft) hole
  - j Landform boundary, solid black lines or dashed lines based upon interpretation of aerial photo
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF AGGREGATE**
- 1 overburden thickness (ft)
  - 2 sand/gravel resource thickness (ft)
  - 3 percent sand and fines (percent) at bottom, 2 ft to 1 ft, interval indicated
  - 4 significant amount of fines (percent) (ft)
  - 5 significant amount of clay (percent) (ft)
  - 6 significant amount of claystone or sandstone
  - 7 significant amount of siliceous carbonate indicate
  - 8 "r" in symbol denotes unutilized or unknown property
  - 9 "m" in symbol denotes property absent or unutilized



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

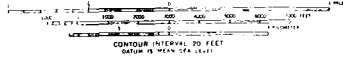
**REFERENCE:**  
Chase, C.H., and McConahy, J.A., 1973. Generalized surficial geologic map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map 1-733.

Geology modified after:  
Trimble, D.E., and Petch, H.R., 1976. Map showing potential sources of gravel and crushed-rock aggregate in the Colorado Springs-Castle Rock Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map 1-857-A.

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

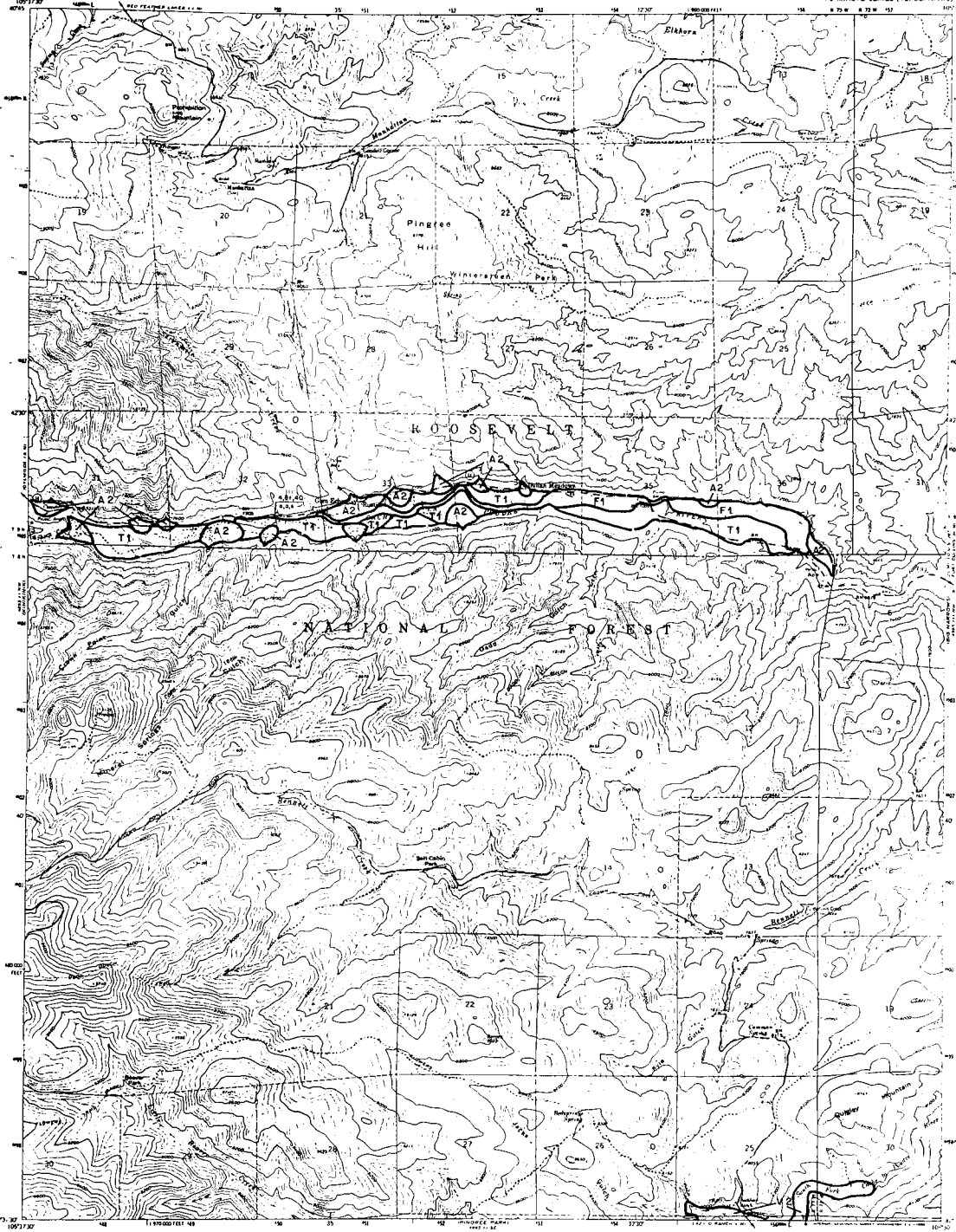
- Major Road
- Local Road
- Unimproved Rd.
- State Route

RUSSELLVILLE GULCH, COLO.

**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

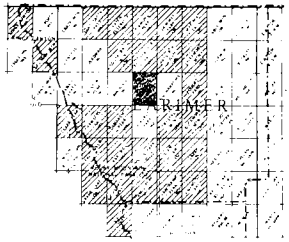
**RUSTIC QUADRANGLE  
COLORADO-LARIMER CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)**

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



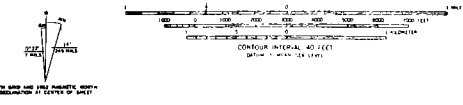
**EXPLANATION**

- LEGEND SOUNDS**
- F Floodplain deposit
- T Stream terrace deposit
- V Valley fill (F & T)
- U Upland deposits
- A Alluvial fan
- E Man-made sand (inclined)
- M Man-made deposits (slag-castings, epine...)
- RESOURCE CLASSIFICATION**
- G1 Gravel: relative fines and sand
- G2 Gravel: significant clasts, decomposed rock, section debatable
- ROAD CLASSIFICATION**
- 1, 2, 3 Road
- DEVELOPED RESOURCES**
- 4 Probable aggregate resource
- MAP SYMBOLS**
- \* Operating gravel and/or sand pit
- \* Abandoned gravel and/or sand pit
- \* Operating stone quarry
- \* Abandoned stone quarry
- \* Abandoned quarry aggregate resource area
- \* Related well or drill-hole location with observation evidence (for sand/gravel) resource thickness (ft), obtained from well logs
- " indicates gravel, " indicates sand
- " in symbol center unobserved or untested interval
- " on symbol Colorado Geological Survey (Classification and Gravel Grades)
- " Well hole
- Landform boundary, wild share known or observed; label where appropriate or inferred
- STATUS, LOCATION AND GEOLOGICAL CLASSIFICATION OF SYMBOLS**
- BOUNDARY CLASSIFICATION**
- LANDFORM BOUNDARY**
- UNOBSERVED INTERVAL**
- UNTESTED INTERVAL**
- UNOBSERVED AND UNTESTED INTERVAL**



**QUADRANGLE LOCATION**  
**NON-RESOURCE OR WITHDRAWN AREA**

Based on U. S. Geological Survey  
7-372 minute quadrangle



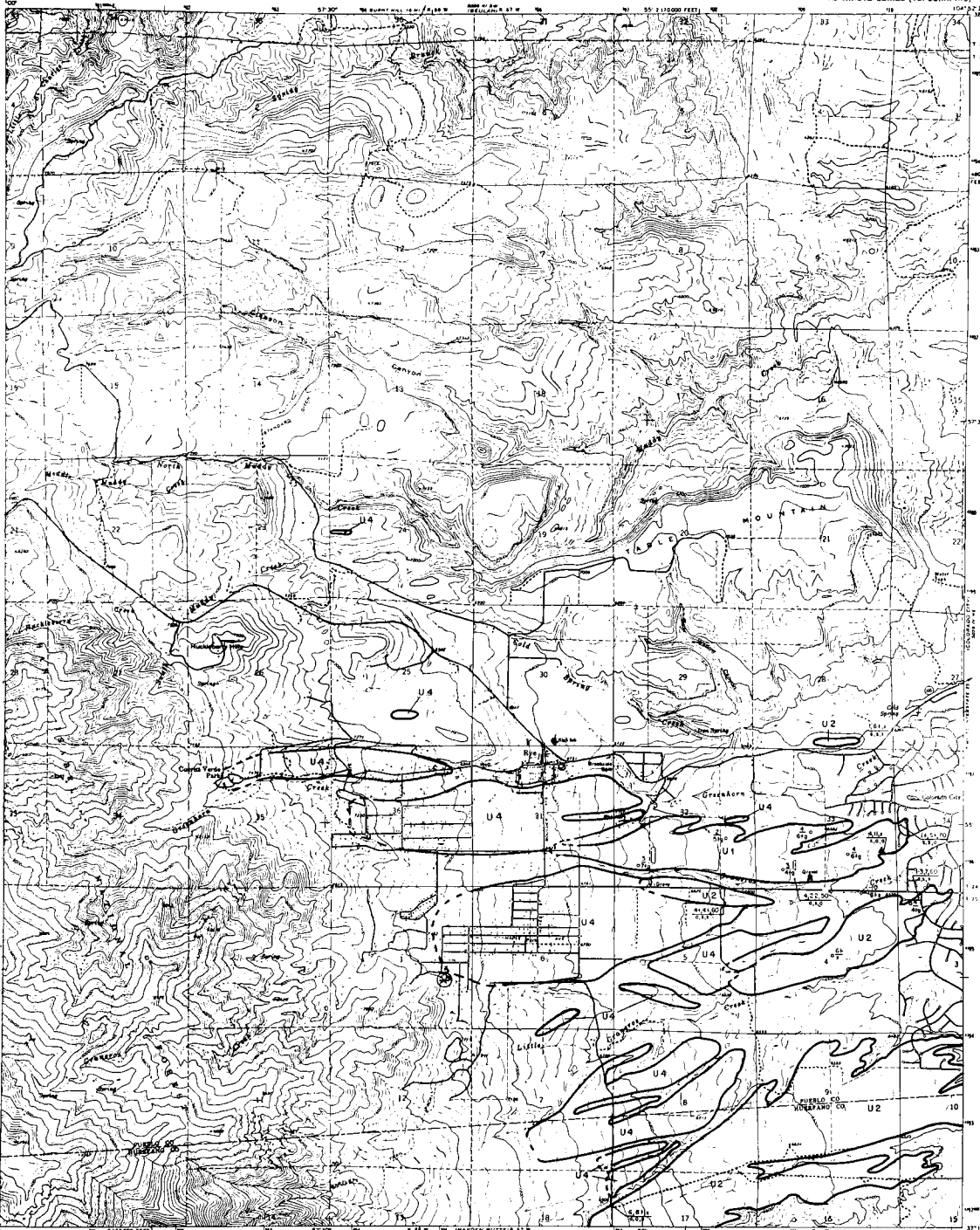
**ROAD CLASSIFICATION**  
Medium duty \_\_\_\_\_  
Light duty \_\_\_\_\_  
Unimproved dirt \_\_\_\_\_  
State Route \_\_\_\_\_

RUSTIC, COLO

Mapped by: Ralph S. Shroba  
Date: June 30, 1974

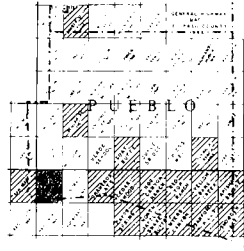
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

RYE QUADRANGLE  
 COLORADO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- Contour units
- Resource classification
- MAPPER UNITS**
  - T Trenchland deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Erosional deposit (contour)
  - M Man-made deposits (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
  - 1 1 Good aggregate
  - 2 2 Fair aggregate
  - 3 3 Poor aggregate
  - 4 4 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); indicated from well logs
  - "L" indicates gravel; "S" indicates sand
  - "\*" in symbol denotes unclassified or unknown property
  - "M" denotes Colorado Geological Survey unclassified and/or "proposed"
  - Section boundary, solid where known or observed; dashed where approximate or inferred
- STATION LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (passing #20 screen, 0.25 in., or 0.075 mm.)
  - Significant amount of fines (passing #200 screen, 0.0075 in., or 0.191 mm.)
  - Significant amount of decomposed or weak rock
  - Significant amount of aluminum hydroxide (industrial property)
  - "\*" in symbol denotes unclassified or unknown property
  - "M" in symbol denotes property absent or unright/float

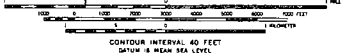


QUADRANGLE LOCATION  
 NON-RESOURCE OR WITHDRAWN AREA

REFERENCE: Stephen Blasco, 1971, Geologic Map of the Rye-Coloredo City Area, Pueblo and Huerfano Counties, Colorado; Colorado School of Mines, U. S. Thesis T 1360, Plate 1.

Mapped by: Ralph S. Shobe  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL, 40 FEET  
 DATUM: 8 MEAN SEA LEVEL

ROAD CLASSIFICATION  
 Secondary highway, all weather Light-duty road all weather  
 hard surface improved surface  
 Unimproved road fair or dry weather  
 State Route

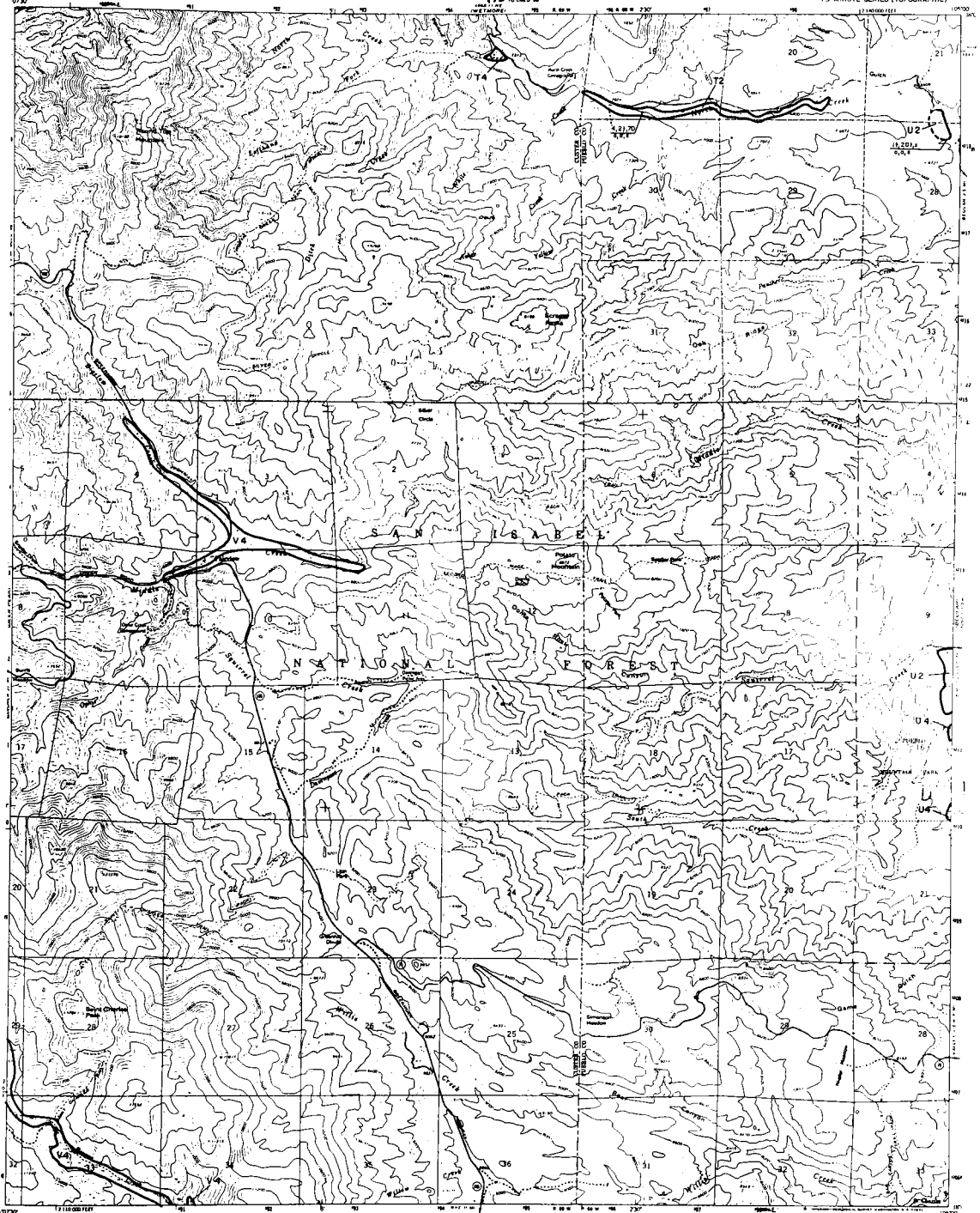
RYE, COLO.





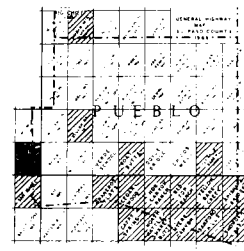
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

SAINT CHARLES PEAK QUADRANGLE  
 COLORADO  
 75 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

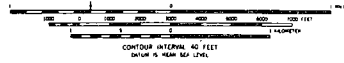
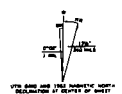
- Contour unit
  - Resource classification
- AGGREGATE TYPE**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Near-deposited sand (colluvial)
  - M Man-made deposits (fill, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
- CLASS 1**  
 (at least 100 ft<sup>2</sup> on 40 acres, visual estimation)
- 1 Gravel, relatively clean and sound
  - 2 Gravel, significant fines, decomposed rock, broken boulders
- CLASS 2**  
 (greater than 100 ft<sup>2</sup> on 40 acres, 4% retained on #20 screen, visual estimation)
- 3 Sand
  - 4 Inevaluated Resource
  - 5 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Located well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log
  - "G" indicates gravel, "S" indicates sand
  - "\*" in symbol denotes unevaluated or unknown property
  - "M" denotes Colorado Geological Survey Method 1 (Sand and Gravel procedure)
  - Landform boundary, with where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF RESOURCES**
- Overburden: thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (passing #10 screen, 0.25 in., visual estimation)
  - Significant amount of fines (passing #20 screen, 0.075 in. or 0.275 mm)
  - Significant amount of decomposed or weak rock
  - Significant amount of material with mica (siltstone)
  - "\*" in symbol denotes unevaluated or unknown property
  - "\*" in symbol denotes property absent or insufficient



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph B. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL: 40 FEET  
 (ON A 1:62,500 SCALE)

**ROAD CLASSIFICATION**

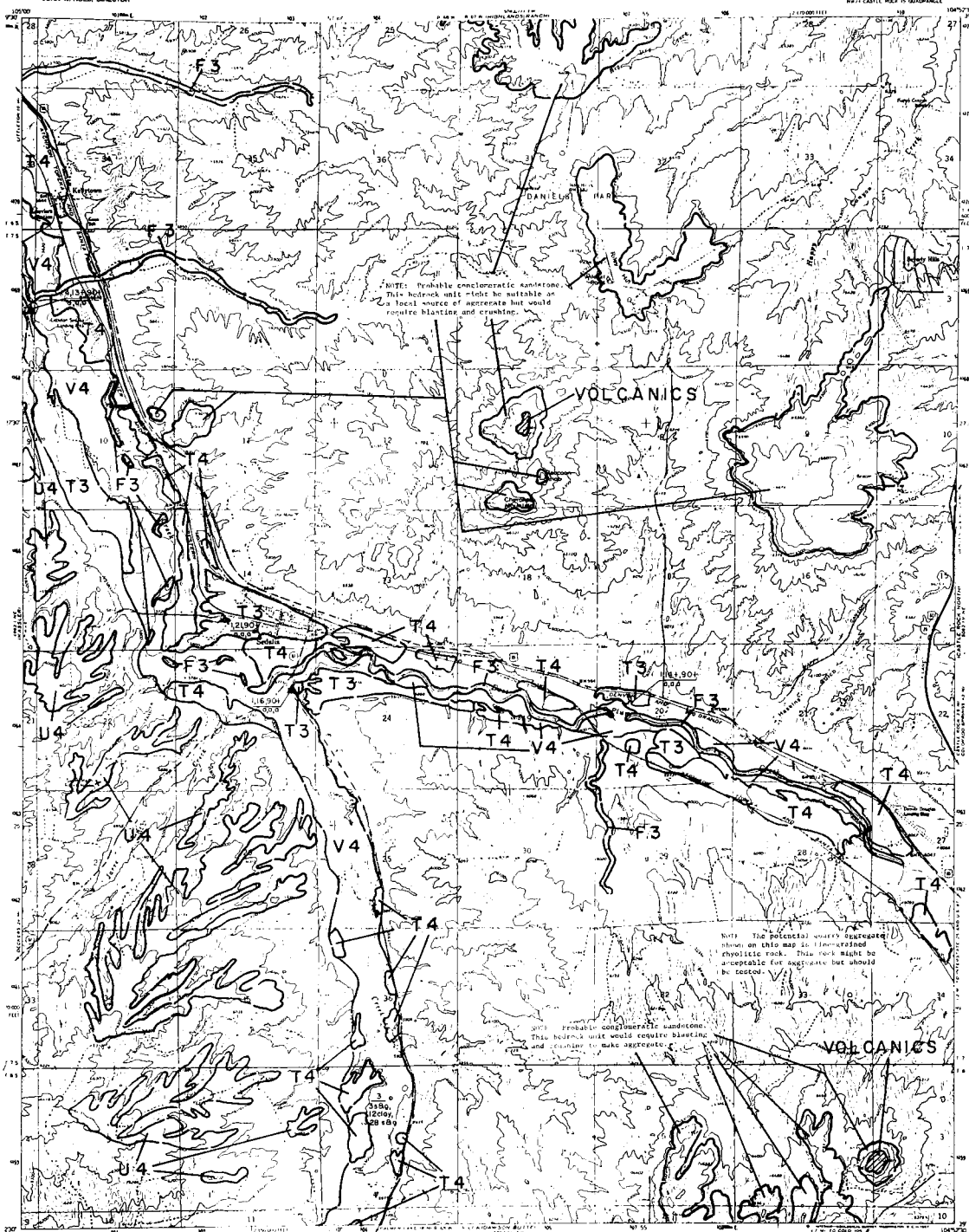
- Light Duty
- - - Unimproved path
- State Road

SAINT CHARLES PEAK COLO

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

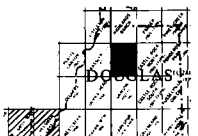
SEDALIA QUADRANGLE  
COLORADO-DOUGLAS CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
MAP SCALE: 1:62,500

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



## EXPLANATION

- Landform and Resource Classification**
- MATERIAL TYPE**
- T Tephritic deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unad. deposits
  - A Alluvial fan
  - E Eolian deposit (sand, silt, loess)
  - M Man-made deposits (slag, tailings, etc.)
- MATERIAL CLASSIFICATION**
- GRAVEL**  
(as used in concrete or as aggregate, actual estimation)
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, actual estimation
- SAND**  
(actual estimation)
- 3 Sand
  - 4 Probable aggregate resource
- USE STATUS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
- Potential quarry aggregate resource area**  
Related well or fill-hole location with overburden thickness (ft) over sand/gravel resource (thickness (ft), obtained from well logs, " indicates gravel, "s" indicates sand)
- "s" in symbol denotes unconsolidated or unknown gravels
- "w" indicates Colorado Geological Survey "Well-Related and Geology Project" drill hole
- Landform boundary, solid where known or observed, dashed where approximate or inferred
- SYMBOL LOCATION AND ORIENTATION**
- OVERBURDEN THICKNESS (ft)**
- solid/gravel resource thickness (ft)
  - relevant sand and fines (spacing 4 ft above, 2.5 ft in, 1 ft below)
  - relevant amount of fines (spacing 4 ft above, 2 ft in, 1 ft below)
  - relevant amount of decomposed or weak rock
  - relevant amount of siliceous carbonate (includes)
- "s" in symbol denotes property owned or controlled
- "w" in symbol denotes property owned or controlled



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR VITRIAM AREA

**REFERENCE:**  
Chase, G.H., and McGowen, J.A., 1971. Generalized surficial geology map of the Denver area, Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map T-731.

**Geology modified after:**  
Trumble, D.E., and Pirsch, H.S., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Denver Denver Area, Front Range (Front Range), Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map T-856-A.

Map by: Ralph B. Shrobs  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

- ROAD CLASSIFICATION**
- Heavy duty
  - Medium duty
  - Light duty
  - Unimproved dirt
  - Interstate Route
  - U.S. Route
  - State Route

SEDALIA, COLO.

Base from U. S. Geological Survey 7.5-minute quadrangle

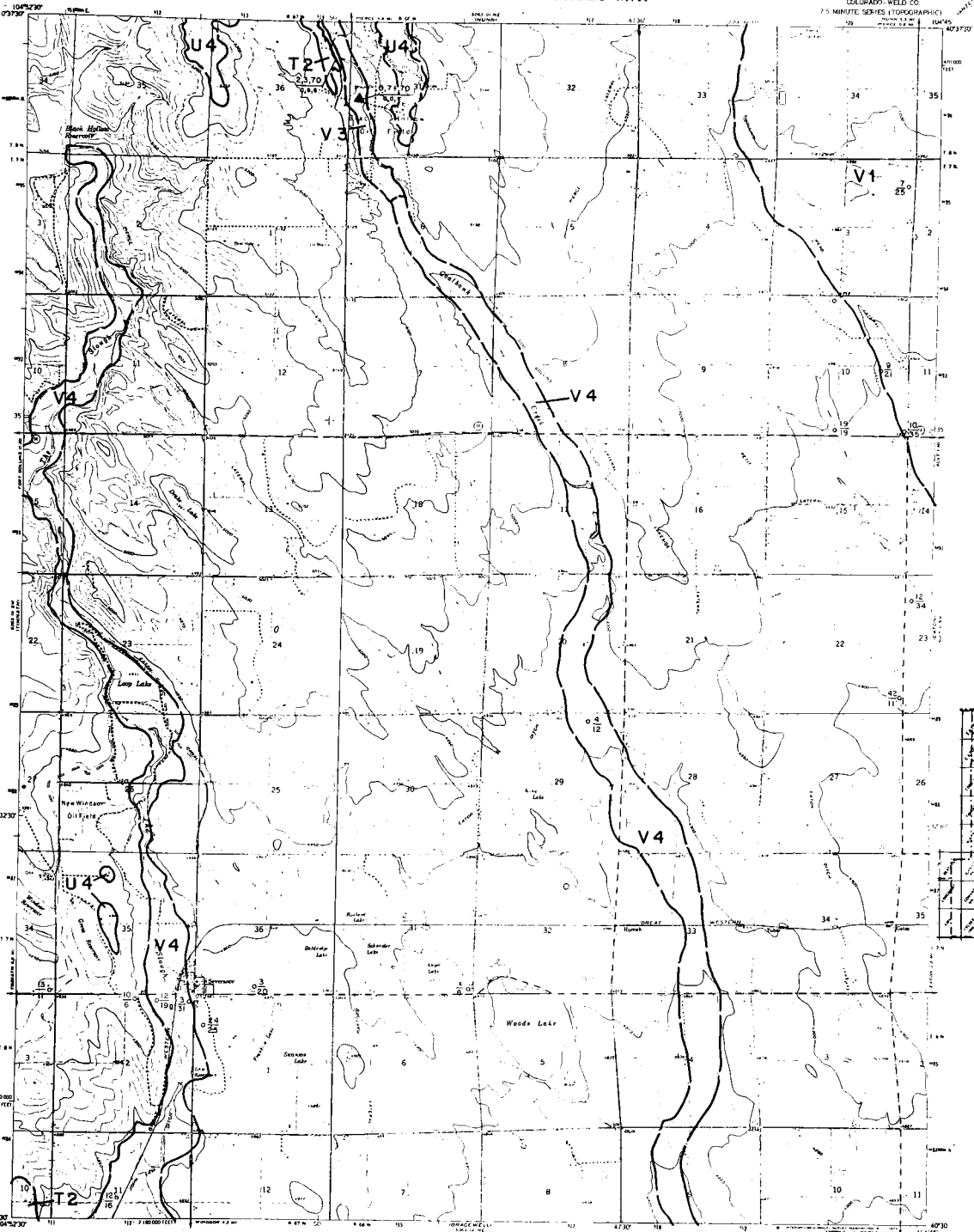


# SAND, GRAVEL AND QUARRY AGGREGATE

## RESOURCES MAP

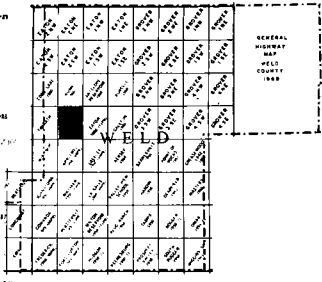
SEVERANCE QUADRANGLE  
COLORADO, WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



### EXPLANATION

- Contour line
- Stream channel
- AGGREGATE TYPES**
  - T Terraced deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eolian-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine, etc.
  - 3 Sand
  - 4 Probable aggregate resources
- AGGREGATE SYMBOLS**
  - A Operating gravel and/or sand pit
  - AB Abandoned gravel and/or sand pit
  - OS Operating stone quarry
  - AS Abandoned stone quarry
  - PA Potential quarry aggregate resource area
  - SA Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource (thickness (ft), obtained from well logs)
  - "G" Indicates gravel, "S" indicates sand
  - "\*" in symbol denotes unclassified or unknown quantity
  - "\*\*" in symbol denotes Colorado Geological Survey Watershed and Great Artesian Basin
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION LOCATION AND GEOLOGICAL DESCRIPTION OF SYMBOL**
  - Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (based on #1 screen, 0-10 in.), visual estimation
  - Significant amount of fines (based on #100 screen, 0.075 in. or 3/16 in.)
  - Significant amount of decomposed or weak rock
  - Significant amount of solution nodules (calcine)
  - "\*" in symbol denotes unclassified or unknown quantity
  - "\*\*" in symbol denotes property owned or leased



**SEVERANCE QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

**REFERENCE:**

Scherer, L.A., and Schneider, F.A., Jr., 1973. Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-487.

Shelton, D.C., 1974, personal communication.

Svan, F. H., III, 1972. Map of surficial geology of part of the Severance quadrangle: Recon. mapping for Colorado Geol. Survey Mesozoic Environmental Geology Project, open-file map.

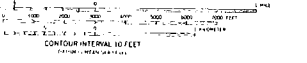
Geology modified after:

Colton, R.B., and Petch, H.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Stouley Area, Front Range Urban Corridor, Colo.: U. S. Geol. Survey Misc. Geol. Inv. Map I-855-D.

Mapped by: Stephen D. Schwochow  
Date: June 30, 1974

Prepared in cooperation with the U. S. Geological Survey.

Base from U. S. Geological Survey 7-1/2 minute quadrangle



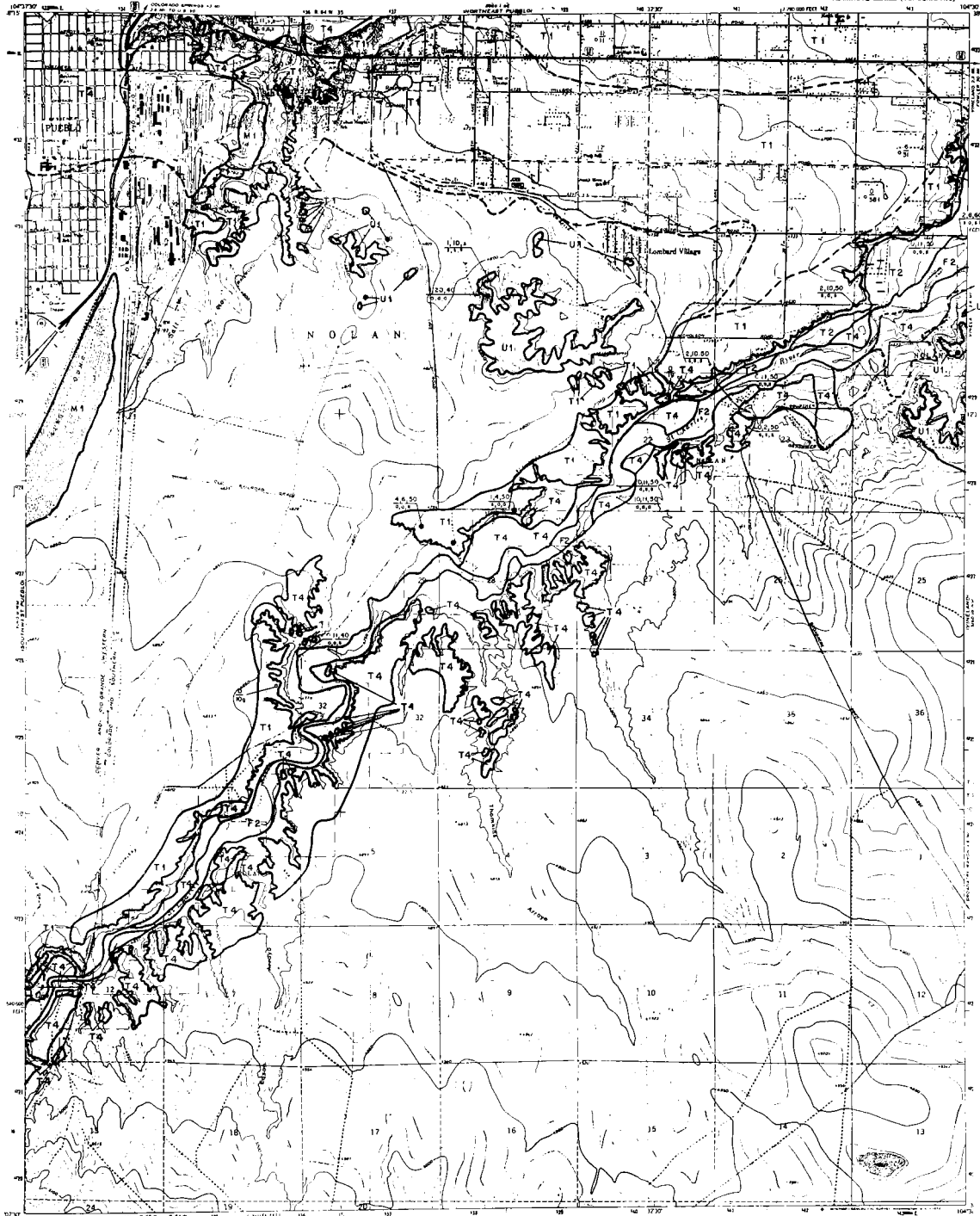
**ROAD CLASSIFICATION**

Medium duty    Light-duty    Unimproved dirt    State Route

SEVERANCE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

SOUTHEAST PUEBLO QUADRANGLE  
 COLORADO-PUEBLO CO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

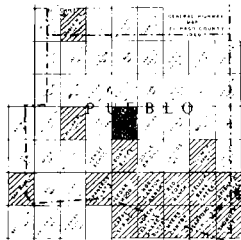
Landform unit  
 Resource classification

- LANDFORM UNITS**
- F Floodplain deposit
  - T Tertiary terrace deposit
  - V valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eold-deposited sand (colluv)
  - M Mesquite deposits (along cañons, arroyos, ...)

- RESOURCE CLASSIFICATION**
- GRAVEL QUANTITIES**
1. Less than 100,000 cu yd in 40 acres, (small quantities)
  2. Gravel: indurated, clean and sized below 100 mesh; fine sand/gravel; massive calcareous.
- SAND QUANTITIES**
1. Greater than 100,000 cu yd in 40 acres, (large quantities)
  2. Sand
- Chemical Resources**
4. Probable aggregate resource

- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Relined well or drilled hole location with open bottom (indicated by asterisk and quarry reference numbers (T1), obtained from well logs.
  - "T" indicates gravel; "U" indicates sand
  - "S" in symbol denotes unutilized or unmined deposits
  - "W" denotes Geologic Geological Survey "Watershed and Creek project" drill hole
  - Landform boundary, solid black lines or observed shaded where appropriate or inferred

- STATION, LOCATION AND GEOLOGICAL IDENTIFICATION OF SYMBOLS**
- 1. Station: 1000 ft interval (50)
  - 2. Location: 1000 ft interval (50)
  - 3. Geological: 1000 ft interval (50)
  - 4. Significant amount of deposit on each rock
  - 5. Significant amount of deposit on each rock
  - 6. Significant amount of deposit on each rock
  - 7. Significant amount of deposit on each rock
  - 8. Significant amount of deposit on each rock
  - 9. Significant amount of deposit on each rock
  - 10. Significant amount of deposit on each rock
  - 11. Significant amount of deposit on each rock
  - 12. Significant amount of deposit on each rock
  - 13. Significant amount of deposit on each rock
  - 14. Significant amount of deposit on each rock
  - 15. Significant amount of deposit on each rock
  - 16. Significant amount of deposit on each rock
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  - 38. Significant amount of deposit on each rock
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  - 40. Significant amount of deposit on each rock
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  - 43. Significant amount of deposit on each rock
  - 44. Significant amount of deposit on each rock
  - 45. Significant amount of deposit on each rock
  - 46. Significant amount of deposit on each rock
  - 47. Significant amount of deposit on each rock
  - 48. Significant amount of deposit on each rock
  - 49. Significant amount of deposit on each rock
  - 50. Significant amount of deposit on each rock



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Scott, C. R., 1959, U. S. Geological Survey Map 1-597.

Mapped by: Phillip C. Wickles  
 Date: June 30, 1974

Base from U. S. Geological Survey 7-1/2 minute quadrangle



- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Light-duty
  - Unimproved det.
  - Interstate Route
  - U.S. Route
  - State Route

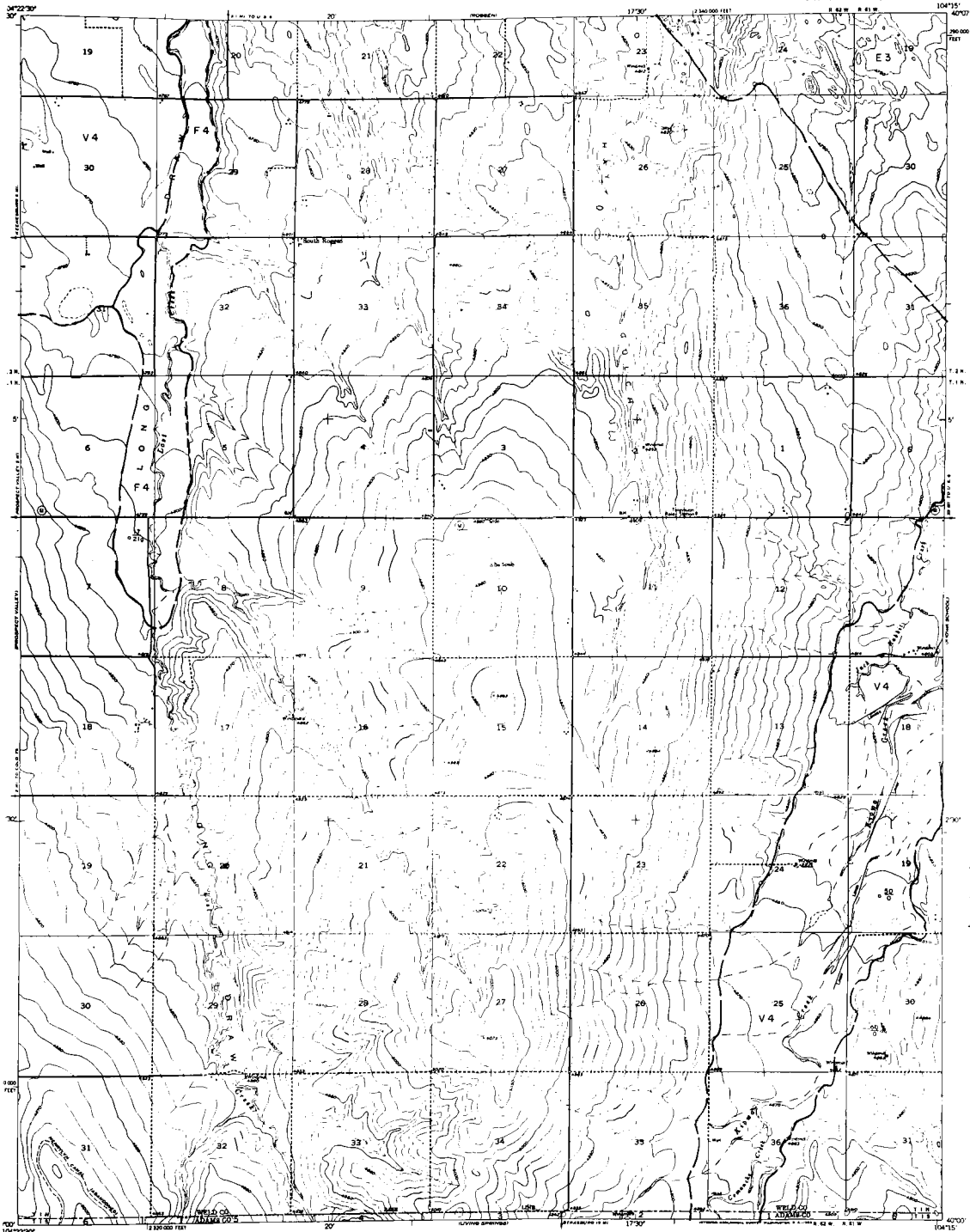
SOUTHEAST PUEBLO, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

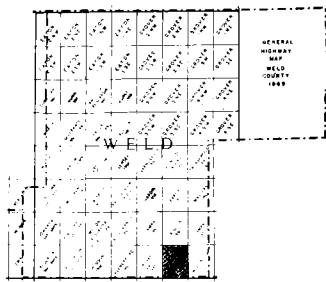
SOUTH ROOGEN QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LANDFORM UNIT**  
Resource classification
- LANDFORM UNIT**  
F Floodplain deposit  
T Stream terrace deposit  
V Valley fill (F & T)  
U Upland deposit  
A Alluvial fan  
E Wind-deposited sand (eolian)  
M Man-made deposits (including spoil...)
- RESOURCE CLASSIFICATION**
- GRAVEL RESOURCES**  
1 Gravel: relatively clean and sound  
2 Gravel: significant fines, decomposed rock, calcium carbonate  
**SAND RESOURCES**  
(greater than 200 mesh, 40 mesh, 60 mesh retained on 200 screen, usual reduction)  
3 Sand  
**Other landform deposits**  
4 Probable aggregate resource
- ROAD SYMBOLS**  
Operating gravel and/or sand pit  
Abandoned gravel and/or sand pit  
Operating stone quarry  
Abandoned stone quarry  
Potential quarry aggregate resource area  
Subsided well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs  
"G" indicates gravel; "S" indicates sand  
"U" in symbol denotes unvested or unknown property  
"M" denotes Colorado Geological Survey "Mineral and Gravel Projects" drill hole  
Landform boundary, solid where known or inferred, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL CHARACTERIZATION OF BORNE**
- Quadrangle reference ID  
Reference to the resource thickness (ft) and/or sand/gravel resource thickness (ft) obtained from well logs  
"G" in symbol denotes unvested or unknown property  
"S" in symbol denotes property absent or height/flow

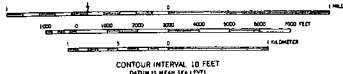


- QUADRANGLE LOCATION  
▨ NON-RESOURCE OR WITHDRAWN AREA

REFERENCES: Bjorklund, L.J., and Brown, R.P., 1957, Sand and gravel resources of the lower South Platte River valley between Hardin, Colorado, and Paxton, Nebraska: U. S. Geol. Survey Water-Supply Paper 1378, pl. 1.

Mapped by: Phillip C. Wicklin  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



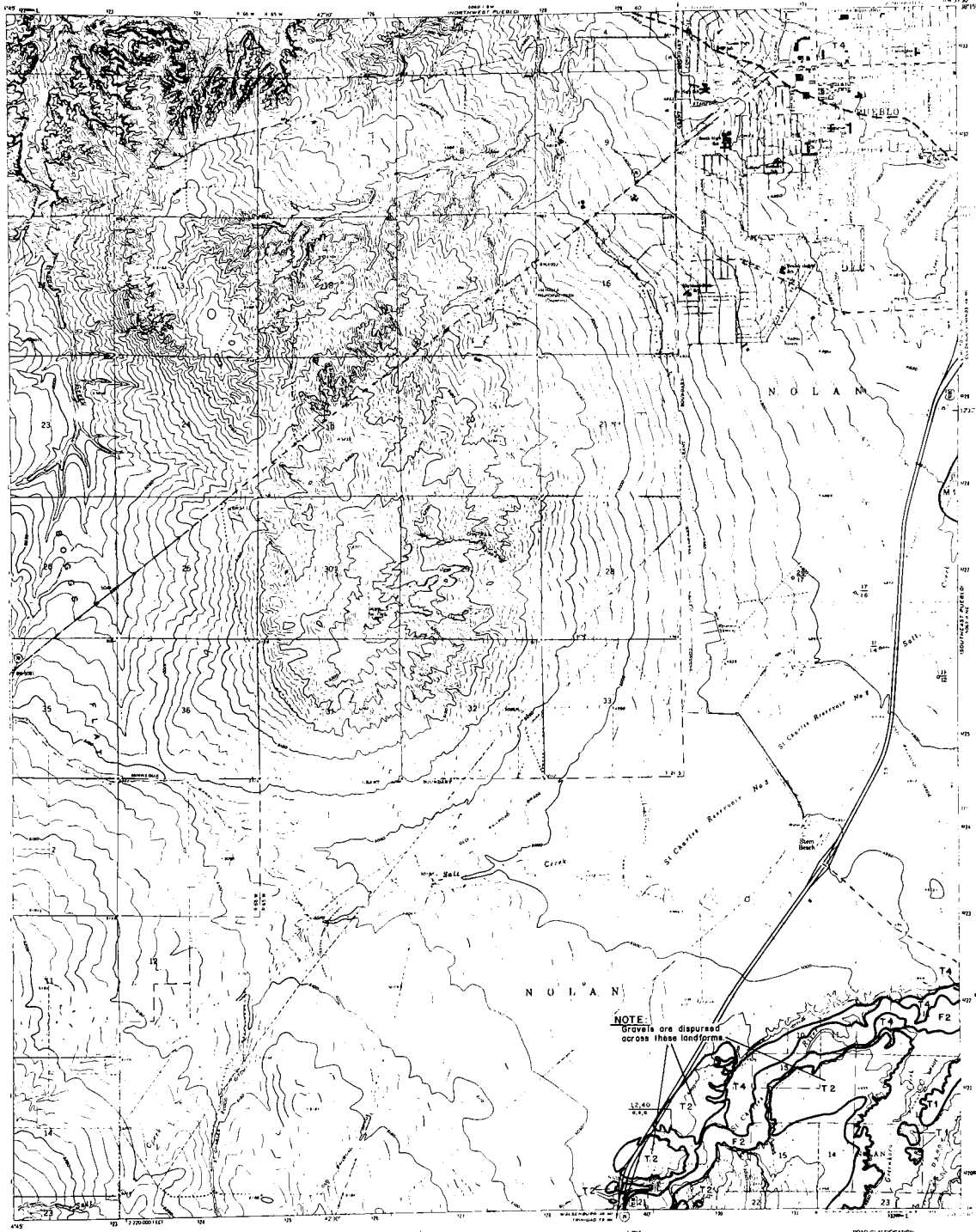
- ROAD CLASSIFICATION**
- Heavy-duty **GRADE 1/2 INCH** Light-duty  
Medium-duty **GRADE 1/4 INCH** Unimproved dirt  
□ U. S. Route    ○ State Route

SOUTH ROOGEN, COLO.

APPROXIMATE MEAN DECLINATION 1960

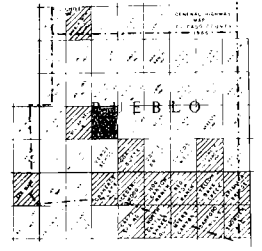
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

SOUTHWEST PUEBLO QUADRANGLE  
 COLORADO-PUEBLO CO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- Landform unit  
 Resource classification
- LANDFORM UNITS**
- F Floodplain deposit
  - T Alluvial terrace deposit
  - V Valley fill (F & T)
  - U Upland domestic
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Man-made deposits (landfills, etc.)
- RESOURCE CLASSIFICATION**
- Gravel**  
 1 Gravel: red to brown clay and some  
 2 Gravel: significant fines, decomposed rock, calcium carbonate.
- Fine aggregate**  
 3 Sand  
 4 Possible aggregate resources
- Map symbols**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating quarry
  - Abandoned quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel; resource thickness (ft); obtained from well logs.
  - "R" indicates gravel; "S" indicates sand
  - "I" in symbol denotes investigated or known projects
  - "M" in symbol denotes Geological Survey Window (Sand and Gravel projects) drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred.
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF PITS**
- Hand-drawn thickness (ft)
  - Hand-drawn resource thickness (ft)
  - Current sand and fines (spacing of screen, 0.5 ft to 1 ft, visual estimation)
  - Significant amount of fines (spacing of screen, 0.075 in. to 0.15 in.)
  - Significant amount of decomposed or weak rock
  - Significant amount of soluble materials or other projects
  - "I" in symbol denotes investigated or known projects
  - "M" in symbol denotes proposed, absent or uninvestigated



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974

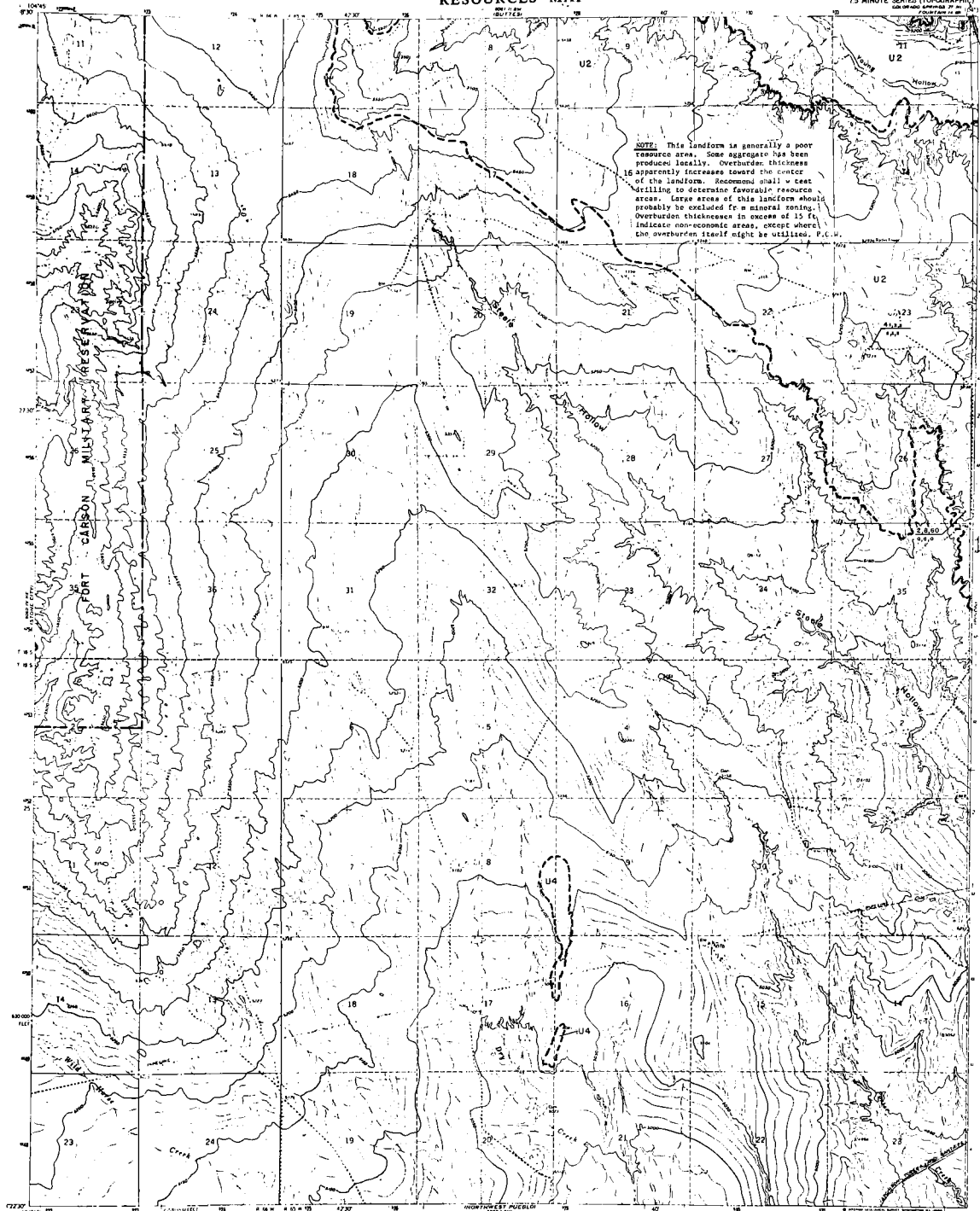
Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

**ROAD CLASSIFICATION**

- Heavy Duty
- Light Duty
- Medium Duty
- Unimproved dirt
- Interstate Route
- U.S. Route
- State Route

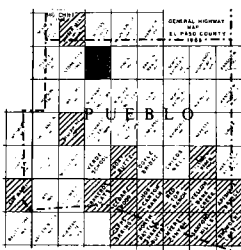
SOUTHWEST PUEBLO, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP



EXPLANATION

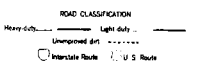
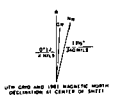
- Landform units**  
 Resource classification
- LANDFORM UNITS**  
 F Fluvial deposit  
 T Stream terrace deposit  
 V Valley fill (F & T)  
 U Upland deposit  
 A Alluvial fan  
 E Wind-deposited sand (eolian)  
 M Mountain deposits (clay, siltstone, granite...)
- ROAD CLASSIFICATION**  
 (See legend for symbols)  
 1 Gravel: relatively clean and good  
 2 Gravel: significant fines, decomposed, calcareous carbonates  
 3 Sand  
 4 Probable aggregate resource
- MAP SYMBOLS**  
 \* Overlying gravel and/or sand pit  
 \* Abandoned gravel and/or sand pit  
 \* Overlying stone quarry  
 \* Abandoned stone quarry  
 Potential quarry aggregate resource area  
 Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.  
 \* "s" indicates gravel; "d" indicates sand  
 \* In symbol denotes unclassified or unknown property.  
 \* In American Geological Survey Uniform/Local and Geol project's drill hole  
 Landform boundary, solid where known or observed, dashed where approximate or inferred.
- SYMBOL LOCATION AND ORIENTATION**  
 \* In symbol denotes unclassified or unknown property.  
 \* In symbol denotes property absent or insignificant
- QUALITY OF SYMBOLS**  
 [Symbol] Overburden thickness (ft)  
 [Symbol] Sand/gravel resource thickness (ft)  
 [Symbol] Percent sand and fines (passing #10 sieve), 0-100%, gravel retention  
 [Symbol] Percent amount of fines (passing #200 sieve), 0-100% (in or 0.075 mm.)  
 [Symbol] Significant amount of decomposed or weak rock.  
 [Symbol] Significant amount of calcareous carbonate particles.  
 \* In symbol denotes unclassified or unknown property.  
 \* In symbol denotes property absent or insignificant



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WILDBURN AREA

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



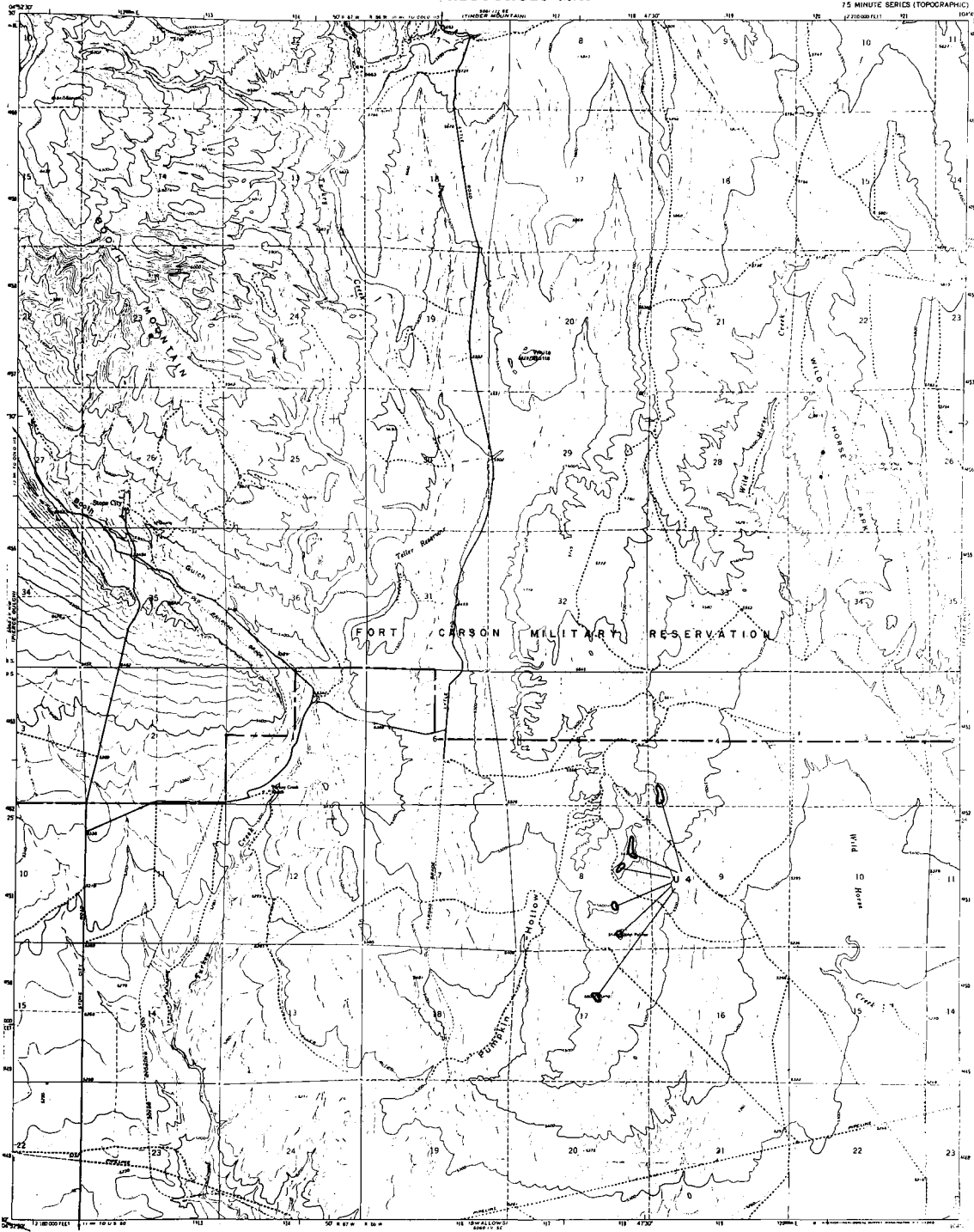
STEELE HOLLOW, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

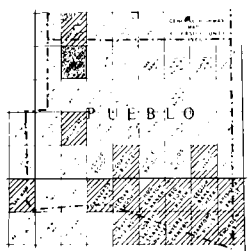
STONE CITY QUADRANGLE  
 COLORADO-PUEBLO CO  
 75 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

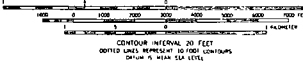
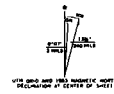
- Contour interval
- Resource classification
- MAPPER'S NOTES**
- F Fluvialite deposit
- T Stream terrace deposit
- V Valley fill (R & T)
- U Unconsolidated
- A Alluvial fan
- E Wind-deposited sand (eolian)
- M Man-made deposits (landfills, spalls, etc.)
- MINERAL CLASSIFICATION**
- GRAVEL DEPOSIT**  
 (at 100% sieve retained on 48 screen, visual estimation)
- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock, calcium carbonate
- SAND DEPOSIT**  
 (gravel: 100% passing 48 screen, 60% retained on 100 screen, visual estimation)
- 3 Sand
- PROBABLE QUARRY RESOURCES**
- 4 Probable aggregate resources
- MAP SYMBOLS**
- Operating gravel and/or sand pit
- Abandoned gravel and/or sand pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Isolated well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
- "C" indicates gravel; "S" indicates sand
- "L" in symbol denotes unconsolidated or unknown projects
- "W" denotes Colorado Geological Survey Widened/Leased and/or Cretaceous projects
- Drill hole
- Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND ORIOGRAPHIC DESCRIPTION OF SYMBOLS**
- non-gravel thickness (ft)
- sand/gravel resource thickness (ft)
- gravel sand and fines (passing 48 screen, 2 to 100% retained on 100 screen)
- significant amount of decomposed or weak rock
- significant amount of calcium carbonate (limestone)
- "L" in symbol denotes unconsolidated or unknown projects
- "W" in symbol denotes Widened/Leased and/or Cretaceous projects



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHERMAN AREA

Mapped by: Phillip C. Wicklein  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



CONTOUR INTERVAL 20 FEET  
 DOTTED LINES REFERRED TO ROAD CONTOURS  
 OTHER TO MEAN SEA LEVEL

ROAD CLASSIFICATION  
 Light duty      Unimproved dirt

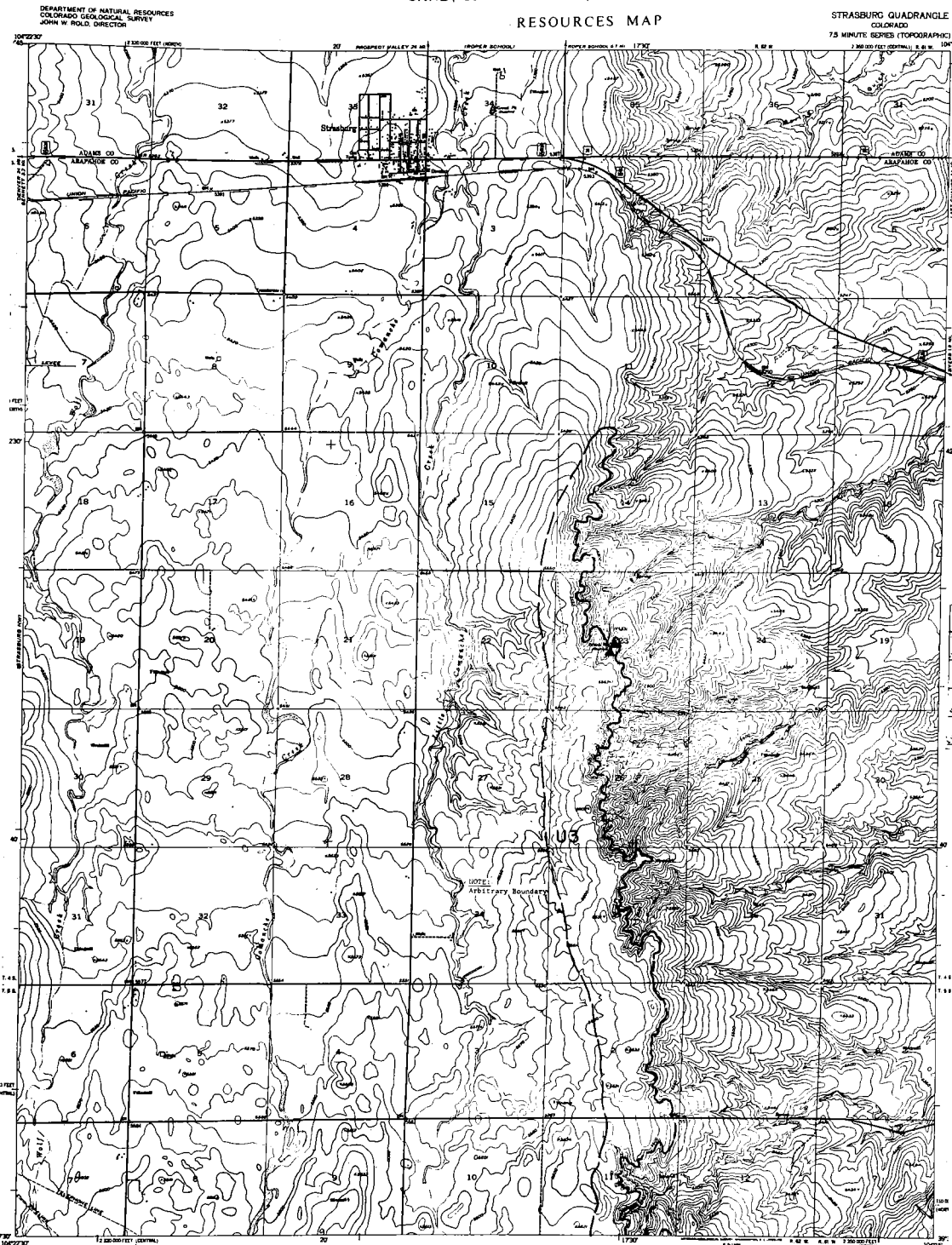
STONE CITY, COLO.



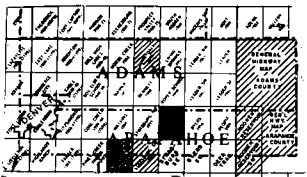
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

STRASBURG QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION



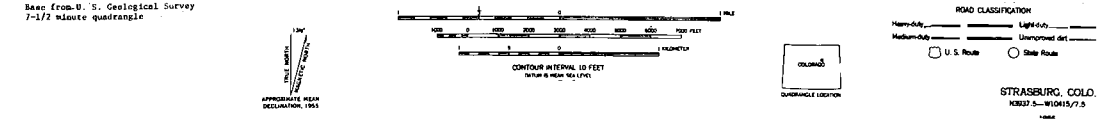
- Landform units**  
Landform classification
- LANDFORM UNITS**
- F Floodable deposit
  - T Trench terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Mudslope deposits (talus/cliff, apron, ...)
- AGGREGATE CLASSIFICATION**
- Grade Statistics**  
for 1000' x 1000' grid on 40' elev.,  
"visual estimation"
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcitic carbonates
- Thin Sandstone**  
Indicator: thin sandstone #1 screen, 60%  
fractured on #100 screen, visual estimation
- 3 Sand
- Unutilized Resources**
- 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs.
  - "r" indicates gravel; "s" indicates sand
  - "\*" in symbol denotes unutilized or unknown property.
  - "w" denotes Colorado Geological Survey Window/Lead and Gravel projects' drill hole
  - Landform boundary, well where known or observed, labeled where appropriate or inferred.
- STATION, LOCATION AND DIMENSIONAL CHARACTER OF DEPOSIT**
- Symbol: thickness (ft)
  - Symbol: resource thickness (ft)
  - percent sand and fines (spacing of screen, 0.075 in. / 3/4" visual estimation)
  - Symbol: amount of fines (spacing of screen, 0.075 in. or 3/4" mm)
  - Symbol: amount of decomposed or weak rock
  - Symbol: amount of calcitic carbonate (talus)
  - "\*" in symbol denotes unutilized or unknown property
  - "w" in symbol denotes property absent or unexplored



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR INTERDRAIN AREA

**Reference:**  
Shedden, S.A., 1971, The Big Joe Creek Damites and Reservoir of Adams and Arapahoe Co. Council, Colorado: Colo. Sch. Mines, CB-1327.

Mapped by: Phillip C. Wickham  
Date: June 30, 1974

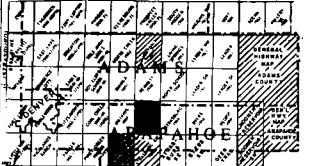
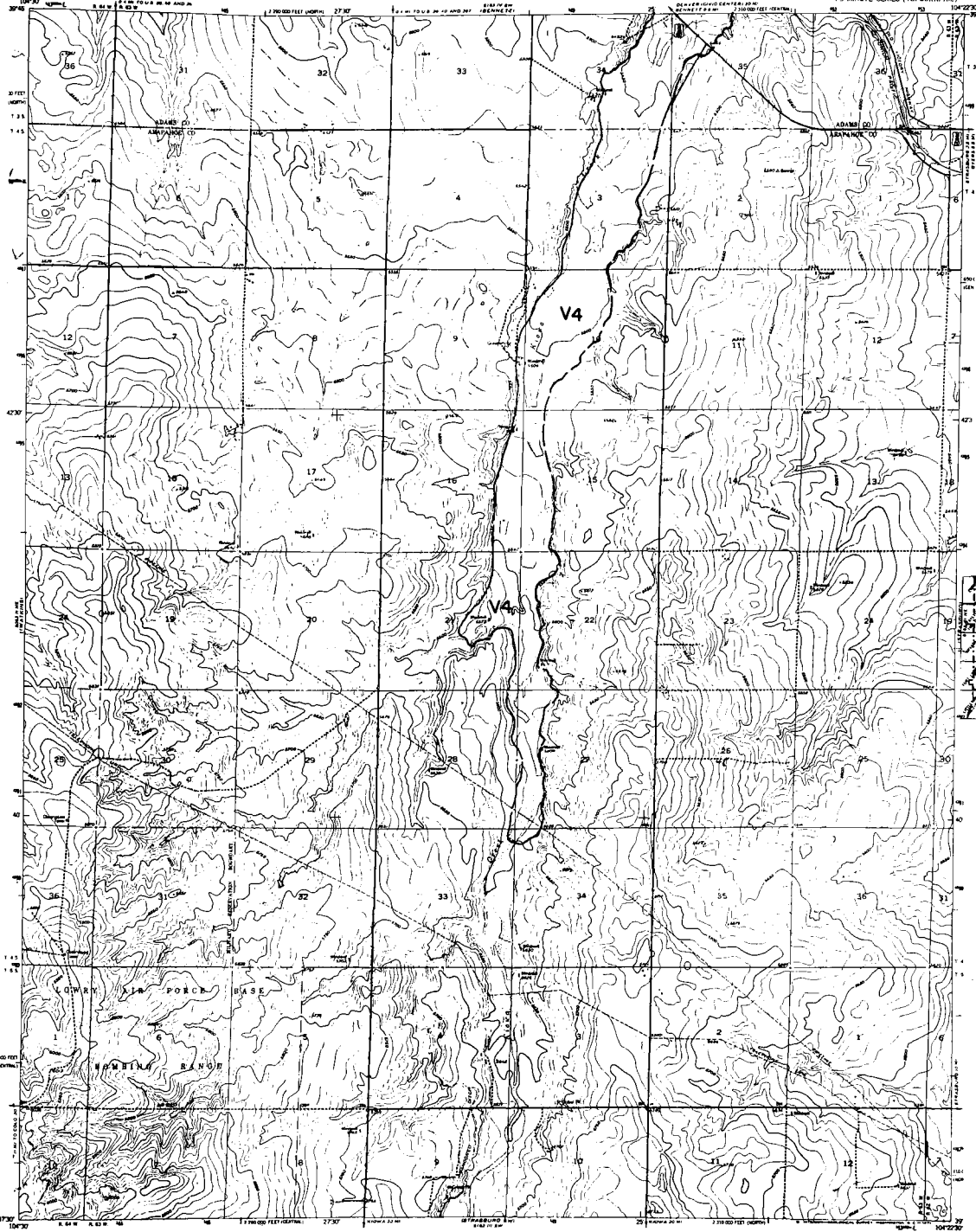


# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

STRASBURG NW QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

## EXPLANATION

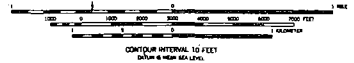
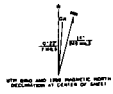
- LEGEND**
- Blanket deposit
  - Stream terrace deposit
  - Valley fill (F & T)
  - Upland deposits
  - Alluvial fan
  - Well-sorted sand (silt)
  - Well-sorted deposits (sand, silt, gravel, etc.)
- RESOURCE CLASSIFICATION**
- CORRELATION**
- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock, calcareous
- FINE AGGREGATE**
- 3 Sand
- Unutilized Resource**
- 4 Potentially aggregate resource
- NO SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Section well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft); distance from well top
  - "s" indicates gravel; "m" indicates sand
  - "s" in symbol denotes unutilized or unknown property
  - "m" in symbol denotes unutilized or unknown property
  - Landline boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL SIGNIFICANCE OF SYMBOLS**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - section well and fines (spacing at bottom, 0.25 in., total section)
  - significant amount of fines (spacing 1000 ft, 500 ft, or 250 ft)
  - significant amount of decomposed or weak rock
  - significant amount of calcareous material
  - "s" in symbol denotes unutilized or unknown property
  - "m" in symbol denotes property absent or insignificant



- QUADRANGLE LOCATION
- ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wicklin  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 10 FEET  
Dotted & dash-dot level



**ROAD CLASSIFICATION**

Heavy-duty \_\_\_\_\_ Light-duty \_\_\_\_\_

Medium-duty \_\_\_\_\_ Unimproved dirt \_\_\_\_\_

□ U.S. Route    ○ State Route

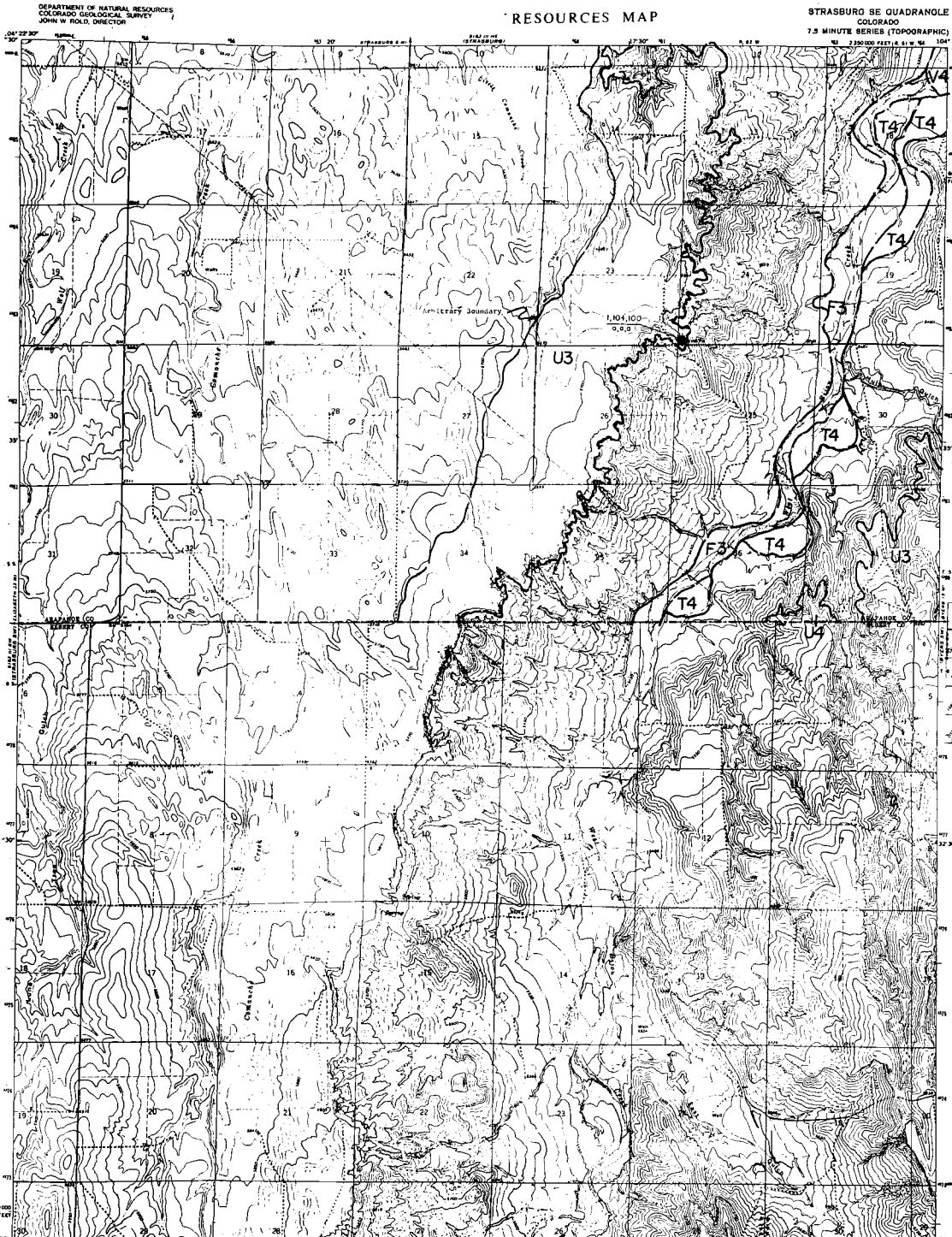
STRASBURG NW, COLO  
R3973--R0423.5/7.5  
1955  
ANS 4162 (2) 8V--SERIES 7577

SAND, GRAVEL AND QUARRY AGGREGATE

RESOURCES MAP

STRASBURG SE QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION



- LANDFORM CODES**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (colluvial)
  - M Man-made deposits (slag, tailings, spoils, etc.)
- RESOURCE CLASSIFICATION**
- CURRENT MATERIALS**  
1. Drawn: Relatively clean and unconsolidated  
2. Drawn: Significant fines, decomposed rock, fraction not shown
- FINE MATERIALS**  
3. Sand
- UNDEVELOPED RESOURCES**  
4. Probable aggregate resource
- USE SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well-sorted debris with upper horizon thickness (ft) over sand/gravel resource thickness (ft); dashed line will have "U" indicate gravel; "M" indicates sand
  - "U" in empty space unutilized or unknown property
  - "M" denotes Colorado Geological Survey "Mineral Land and Gravel" project
  - "B" in empty space boundary, with where known or observed; dashed line approximate or indicated
- SYMBOLS LOCATED AND GEOLOGICAL DESCRIPTION BY SYMBOL**
- Overburden thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Percent sand and fines (percent of screen, 0.075 to 0.075 mm)
  - Significant amount of fines (passing 100 mesh, 0.0075 in. or 0.174 mm)
  - Significant amount of decomposed or unconsolidated
  - Significant amount of unconsolidated material
  - "U" in empty space unutilized or unknown property
  - "M" in empty space boundary, with where known or observed; dashed line approximate or indicated



- QUADRANGLE LOCATION
- NON-RESOURCE OR VETERAN AREA

**Reference:**  
Shadwin, S. A., 1971, The Big Horn Creek Dam and Reservoir of Adams and Arapahoe Counties, Colorado. Colo. Sch. Mines ER-1327.

Mapped by: Phillip C. Wicklen  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET  
DATUM IS MEAN SEA LEVEL

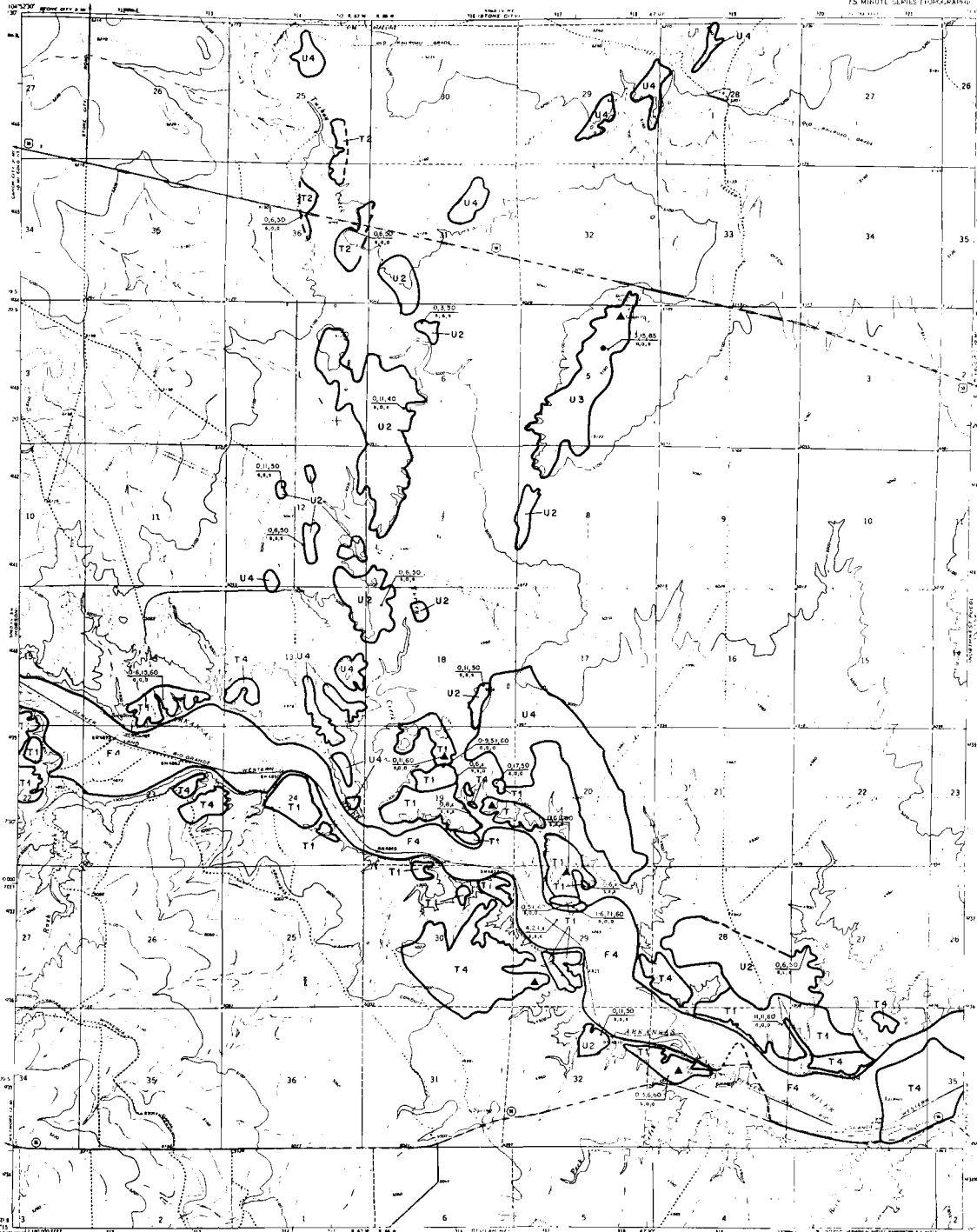
ROAD CLASSIFICATION

- Primary highway: hard surface, light-duty road, hard or unpaved surface
- Secondary highway: hard surface, unpaved road
- Interstate Route: U.S. Route: State Route

STRASBURG SE, COLO.  
82930-10418/7.5  
1969  
AND 1:10,000 SCALE SERIES 1971

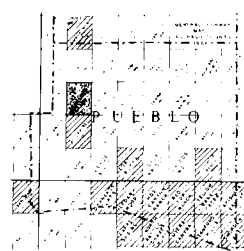
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

SWALLOWS QUADRANGLE  
 (SARAGO-PUEBLO CO)  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- SYMBOLS**
- Blank space: Unavailable
  - Blank space: Unavailable
- RESOURCE CLASSIFICATION**
- F: Floodplain deposit
  - T: Stream terrace deposit
  - V: Valley fill (F & T)
  - U: Upland deposit
  - A: Alluvial fan
  - E: Eolian deposit (sand dunes)
  - M: Marine deposit (beach, dune, etc.)
- RESOURCE CLASSIFICATION**
- 1: Gravel: relatively clean and good
  - 2: Gravel: significant fines, decomposed rock, some cobbles
  - 3: Sand
  - 4: Probable aggregate resource
- ROAD CLASSIFICATION**
- Medium duty
  - Light duty
  - Unimproved dirt
  - U.S. Route
  - State Route
- STATION LOCATION AND IDENTIFICATION OF SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Abandoned stone quarry
  - Abandoned stone quarry
  - Operating quarry aggregate resource area
  - Selected units of 3188-foot terrace with lower border (shaded) and 3188-foot terrace with upper border (unshaded) (see section 10-11-12)
  - "I" indicates gravel, "S" indicates sand
  - "A" in symbol denotes unconsolidated or alluvial deposits
  - "M" denotes (1) beach, (2) dune, (3) dune and beach, (4) dune and beach, (5) dune and beach, (6) dune and beach, (7) dune and beach, (8) dune and beach, (9) dune and beach, (10) dune and beach, (11) dune and beach, (12) dune and beach, (13) dune and beach, (14) dune and beach, (15) dune and beach, (16) dune and beach, (17) dune and beach, (18) dune and beach, (19) dune and beach, (20) dune and beach, (21) dune and beach, (22) dune and beach, (23) dune and beach, (24) dune and beach, (25) dune and beach, (26) dune and beach, (27) dune and beach, (28) dune and beach, (29) dune and beach, (30) dune and beach, (31) dune and beach, (32) dune and beach, (33) dune and beach, (34) dune and beach, (35) dune and beach, (36) dune and beach, (37) dune and beach, (38) dune and beach, (39) dune and beach, (40) dune and beach, (41) dune and beach, (42) dune and beach, (43) dune and beach, (44) dune and beach, (45) dune and beach, (46) dune and beach, (47) dune and beach, (48) dune and beach, (49) dune and beach, (50) dune and beach, (51) dune and beach, (52) dune and beach, (53) dune and beach, (54) dune and beach, (55) dune and beach, (56) dune and beach, (57) dune and beach, (58) dune and beach, (59) dune and beach, (60) dune and beach, (61) dune and beach, (62) dune and beach, (63) dune and beach, (64) dune and beach, (65) dune and beach, (66) dune and beach, (67) dune and beach, (68) dune and beach, (69) dune and beach, (70) dune and beach, (71) dune and beach, (72) dune and beach, (73) dune and beach, (74) dune and beach, (75) dune and beach, (76) dune and beach, (77) dune and beach, (78) dune and beach, (79) dune and beach, (80) dune and beach, (81) dune and beach, (82) dune and beach, (83) dune and beach, (84) dune and beach, (85) dune and beach, (86) dune and beach, (87) dune and beach, (88) dune and beach, (89) dune and beach, (90) dune and beach, (91) dune and beach, (92) dune and beach, (93) dune and beach, (94) dune and beach, (95) dune and beach, (96) dune and beach, (97) dune and beach, (98) dune and beach, (99) dune and beach, (100) dune and beach



- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



SCALE: 1" = 1 MILE  
 1" = 3280 FEET  
 1" = 1640 METERS

ROAD CLASSIFICATION  
 Medium duty ——— Light duty  
 Unimproved dirt ———  
 U.S. Route ——— State Route

SWALLOWS COLO



SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

TABLE MOUNTAIN QUADRANGLE  
COLORADO - WYOMING  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- LANDFORMS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - W Wind-deposited sand (aeolian)
  - M Man-made deposits (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
- CLASSIFICATION**  
for sand and gravel in 100-acre areas
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine tailings
  - 3 Sand
  - 4 Unavailable resource
  - 5 Potentially aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft); over sand-gravel resource thickness (ft), obtained from well logs
  - "g" indicates gravel; "s" indicates sand
  - "\*" to symbol denotes material of unknown property
  - "M" denotes Colorado Geological Survey "Man-made" and "Crest" symbols
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- STATION, LOCATION AND ORIENTAL SIMILITUDE OF SYMBOLS**
- overburden thickness (ft)
  - significant resource thickness (ft)
  - percent sand and fines (percent of sample, 0.75 to 1.0, based on wet weight)
  - significant amount of fines (percent of sample, 0.002 to 0.004)
  - significant amount of decomposed or soft rock
  - significant amount of calcine tailings (percent)
  - "\*" to symbol denotes material of unknown property
  - "M" to symbol denotes property absent or unguaranteed



QUADRANGLE LOCATION  
NON-RESOURCE OR WINDY/BLOWN AREA

**REFERENCE:**

Lowry, M.E., and Crist, M.A., 1967, Geology and ground-water resources of Larimer County, Wyoming; U. S. Geol. Survey Water-Supply Paper 1834, pl. 1.

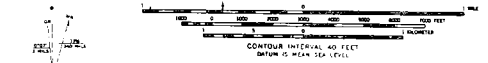
Morre, F.L., 1959, Geomorphic evolution of the east flank of the Larimer Range, Colorado and Wyoming; Div. Wyoming Geol. Ph.D. Thesis, pl. 4.

Denson, H.M., 1974, personal communication.

Veist, W.G., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colo.; U. S. Geol. Survey Water-Supply Paper 1809-1, pl. 1.

Mapped by: Stephen D. Shuchow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



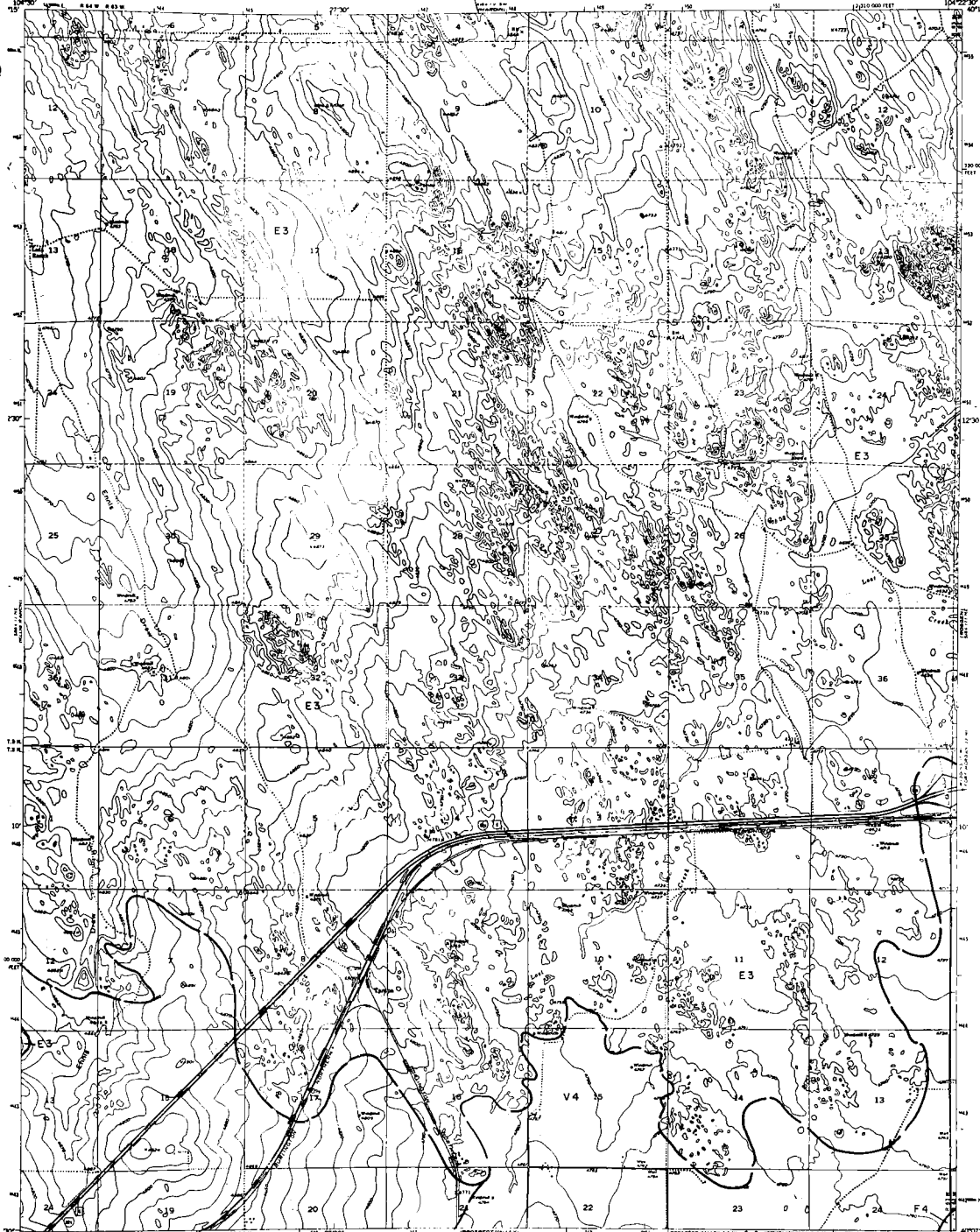
ROAD CLASSIFICATION  
Unimproved dirt

TABLE MOUNTAIN, COLO. - WYO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

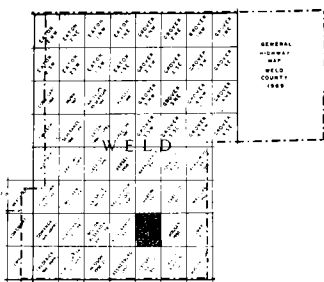
TAMPA QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

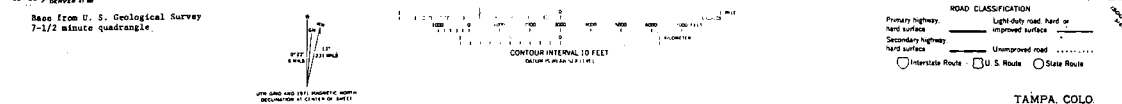
- LANDFORM UNITS**
- F Floodplain deposits
  - T Stream terrace deposits
  - V Valley fill (F & T)
  - A Alluvial fan
  - U Unfold deposits
  - E Wind-deposited sand (tuffaceous)
  - M Mudsand deposits (fine-grained, siltstone...)
- RESOURCE CLASSIFICATION**
- Class 1 (Optimal)**  
1. Gravel: relatively clean and round  
2. Gravel: significant fines, decomposed rock (mainly carbonates)  
*Note: (optimal class) showing 66 acres, 87% retained on 100 mesh, actual retention.*
- Class 2 (Potential)**  
2. Sand
- Class 3 (Probable)**  
3. Probable aggregate resource
- MAP SYMBOLS**
- Open-pit gravel and/or sand pit
  - ▭ Abandoned gravel and/or sand pit
  - ▭ Abandoned stone quarry
  - ▭ Abandoned stone quarry
  - ▭ Potential quarry aggregate resource area
  - ▭ Selected well or drill-hole location with water-bearing thickness (ft.) over sand/gravel resource thickness (ft.), obtained from well logs.
  - ▭ "x" indicates gravel; "s" indicates sand.
  - "s" in symbol denotes unconsolidated or unmineable deposits.
  - "w" denotes Colorado Geological Survey Water/Sand and Gravel projects' drill holes.
  - Landform boundary, solid where known or inferred; dashed where approximate or inferred.
- STATION, LOCATION AND ORIENTATIONAL INFORMATION**
- ▭ Sand/gravel resource thickness (ft.)
  - ▭ Selected well and flow location at bottom, 0-100 ft. small increments.
  - ▭ Significant amount of fines (passing #100 screen, 0.0075 in. or 0.274 mm.)
  - ▭ Significant amount of decomposed or weak rock
  - ▭ Significant amount of carbonates (calcite)
  - "s" in symbol denotes unconsolidated or unmineable deposits.
  - "w" in symbol denotes property, absent or foreign/lease.



- ▭ QUADRANGLE LOCATION
- ▭ NON-RESOURCE OR VETERINARY AREA

REFERENCE: Bjorklund, L.J., and Brown, R.F., 1957, Geology and ground-water resources of the lower South Platte River valley between Hardie, Colorado, and Paxton, Nebraska; U. S. Geol. Survey Water-Supply Paper 1378, pl. 1.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974



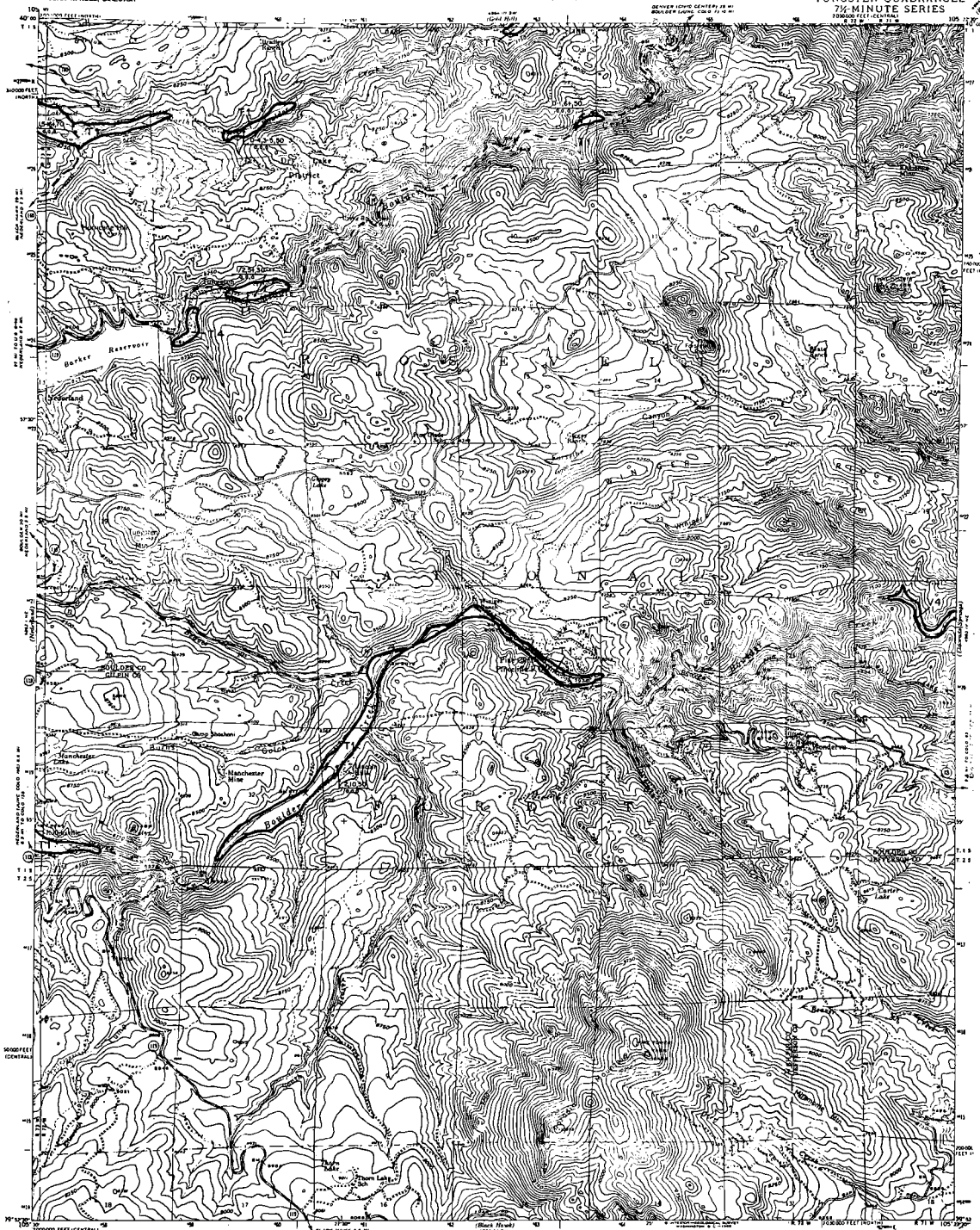
TAMPA, COLO.



**SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP**

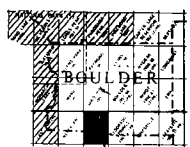
COLORADO  
**TUNGSTEN QUADRANGLE  
7 1/2-MINUTE SERIES**

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



**EXPLANATION**

- Contour unit
- Unknown classification
- LAWSON UNITS**
  - P Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (P & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
  - SAND RESOURCES**  
(at least 20,000 cu yd; 100,000 sq ft; 100,000 sq ft)
  - 1 Good: relatively level and moist
  - 2 Good: significant fines, decomposed rock, calcareous carbonate
  - GRAVEL RESOURCES**  
(at least 20,000 cu yd; 100,000 sq ft; 100,000 sq ft)
  - 1 Good
  - 2 Fair
  - Probable aggregate resource**
- ROAD SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Indicated well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well logs
  - "T" indicates gravel; "S" indicates sand
  - "I" in symbol denotes unvested or unknown property
  - "M" in symbol denotes Geological Survey Mineral Land and Gravel project area
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL SIGNIFICATION OF SYMBOLS**
  - contour interval (feet)
  - contour interval (feet) (contour interval (feet) (contour interval (feet))
  - contour interval (feet) (contour interval (feet) (contour interval (feet))
  - contour interval (feet) (contour interval (feet) (contour interval (feet))
  - "I" in symbol denotes unvested or unknown property
  - "M" in symbol denotes Geological Survey Mineral Land and Gravel project area
  - "T" in symbol denotes gravel; "S" in symbol denotes sand
  - "I" in symbol denotes unvested or unknown property

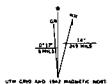


QUADRANGLE LOCATION  
NON-RESOURCE OR WITHDRAWN AREA

Reference:  
Gable, D. J., 1972,  
U. S. Geol. Survey Geol.  
Quad Map GQ-578

Mapped by: Ralph R. Shroba  
Date: June 30, 1974

Base from U. S. Geological Survey  
7 1/2 minute quadrangle



**ROAD CLASSIFICATION**  
Medium Duty      Light Duty      Unimproved Gravel      State Road

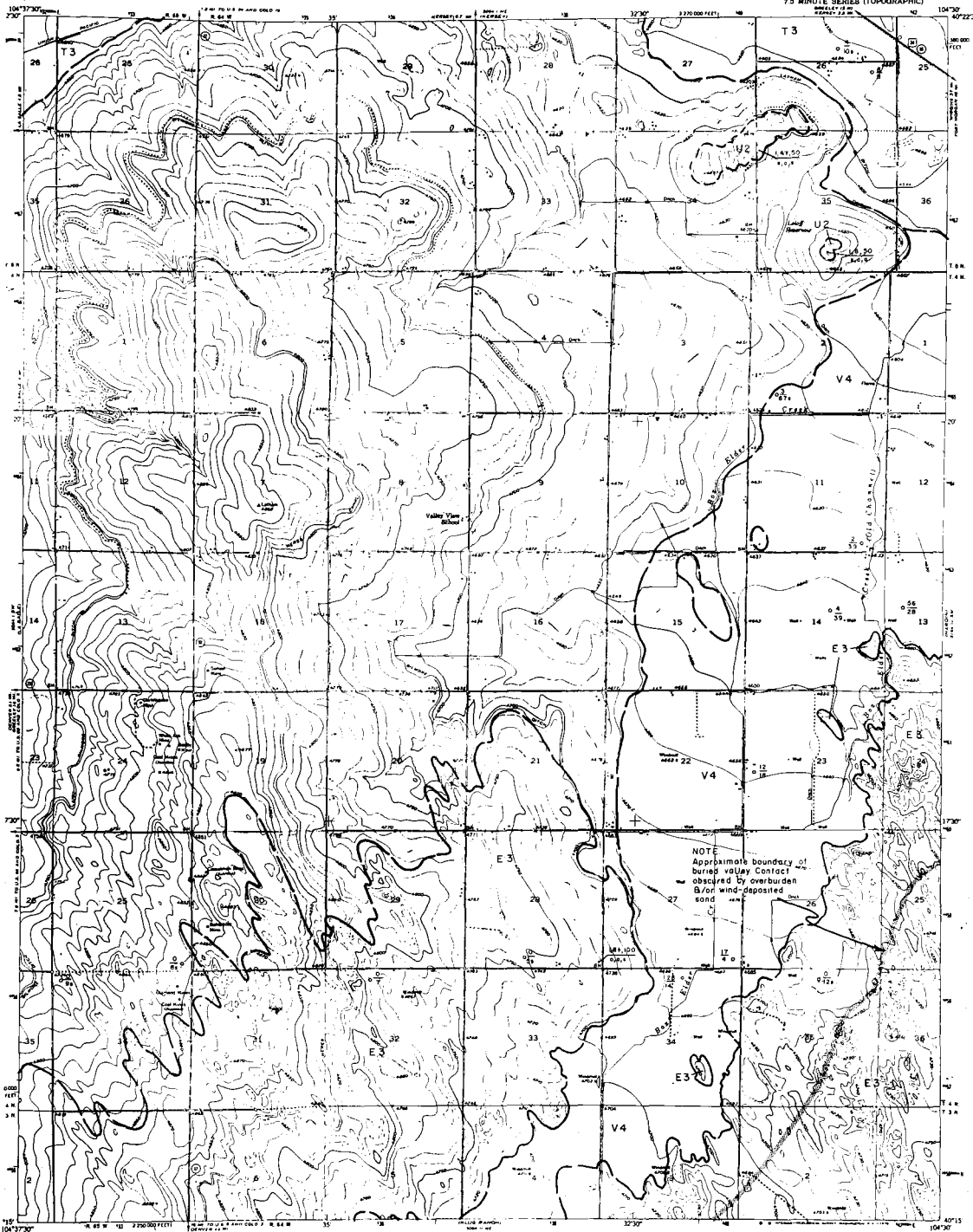
TUNGSTEN, COLO.



# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

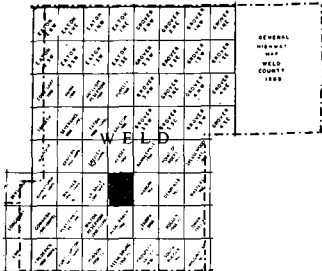
VALLEY VIEW SCHOOL QUADRANGLE  
COLORADO-WELD CO.  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Potential sand or gravel location with overburden thickness (ft) over sand/gravel resource thickness (ft); obtained from well logs.
  - " indicates gravel; " indicates sand
  - " indicates thickness overburden or unknown property
  - " indicates Colorado Geological Survey Water/land and gravel project
  - 6133 hole
  - Landmark boundary, solid where known or observed; dashed where approximate or inferred
- ROAD CLASSIFICATION**
- Hard-surface all-weather roads
  - Hard-surface all-weather roads on weather roads
  - Medium-duty
  - Loose surface graded or narrow hard surface
  - U.S. Route
  - State Route



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Reference: Saith, R. O. and others.  
 1966, U.S.G.S. Water Supply Paper:  
 1658, Plate I

Prepared by: Phillip C. Wicklin  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET  
 (EXCEPT WHERE SHOWN OTHERWISE)

UTM GRID AND STATE PLANNING MAPS  
 (EXCEPT WHERE SHOWN OTHERWISE)

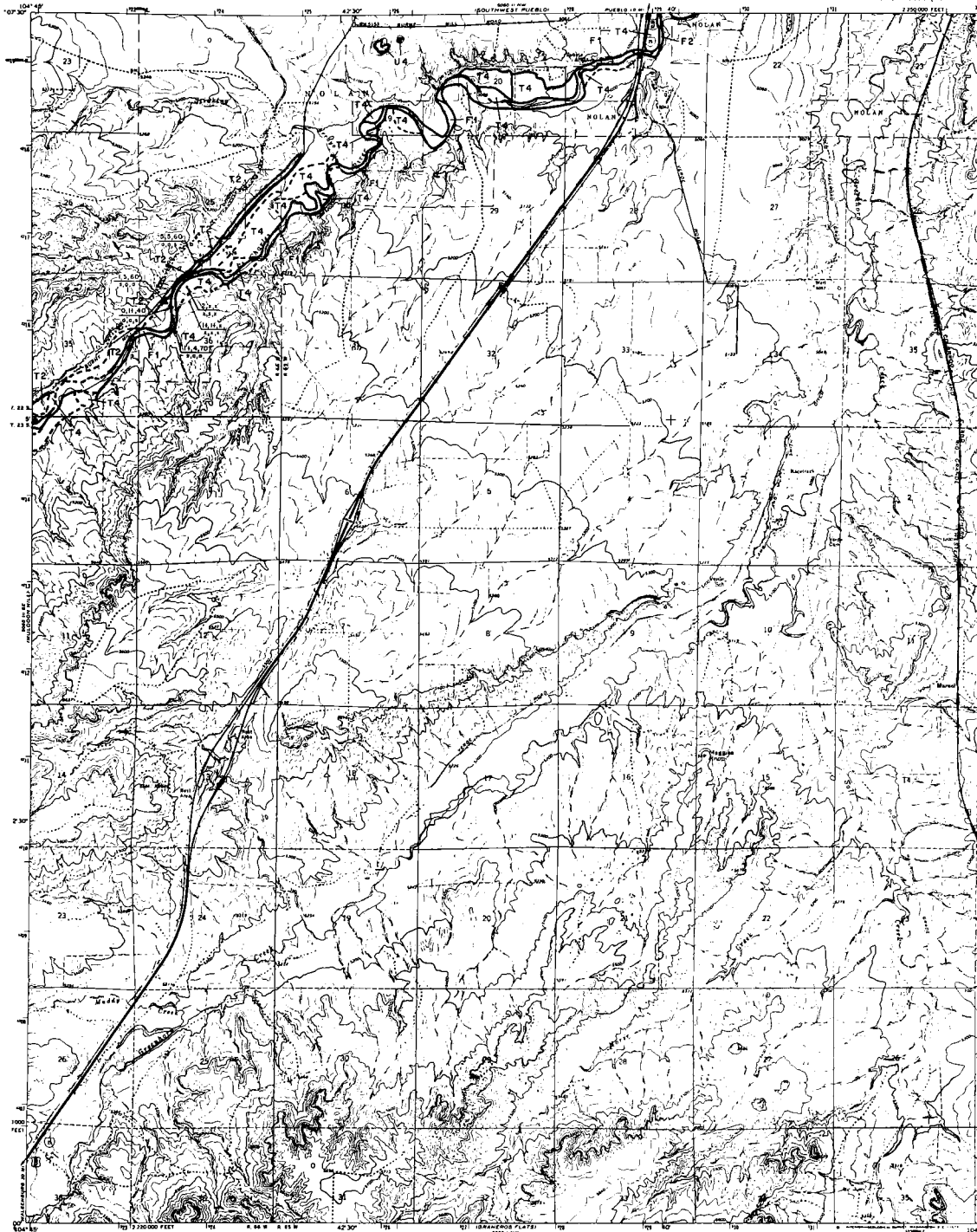
ROAD CLASSIFICATION

- Hard-surface all-weather roads
- Hard-surface all-weather roads on weather roads
- Medium-duty
- Loose surface graded or narrow hard surface
- U.S. Route
- State Route

VALLEY VIEW SCHOOL, COLO.

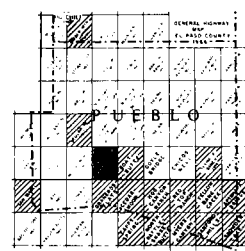
# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

VERDE SCHOOL QUADRANU  
 COLORADO-PUEBLO CO.  
 7.5 MINUTE SERIES (TOPOGRAPH)



## EXPLANATION

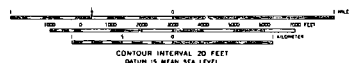
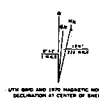
- Land on left  
 Section classification
- LANDFORMS**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils...)
- RESOURCE CLASSIFICATION**
- GRAVEL AGGREGATE**  
 or 100% or more on 40 screen, 100% or more on 20 screen
- 1 Gravel: relatively clean and sound
  - 2 Gravel: silty/clayey, decomposed rock, surface aggregate
- SAND AGGREGATE**  
 or 100% or more on 40 screen, 100% or more on 20 screen, 100% or more on 10 screen
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Selected well or fill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft) obtained from well logs.
  - "r" indicates gravel; "s" indicates sand
  - "u" in symbol denotes unutilized or unknown property
  - "wt" denotes Colorado Geological Survey Withdrawal and Grant project
  - Well hole
  - Landform boundary, solid where known or dashed where approximate or inferred
- STATION, LOCATION AND GEOLOGICAL DESCRIPTION OF DEPOSIT**
- Overburden thickness (ft)
  - unutilized resource thickness (ft)
  - percent sand and fines (percent of screen, 2.0 to 100, visual estimation)
  - 100 ft
  - Feet/percent amount of fines (percent of screen, 0.075 to 0.075 in.)
  - Feet/percent amount of decomposed or weak rock
  - significant amount of material not shown (include)
  - "u" in symbol denotes unutilized or unknown property
  - "wt" in symbol denotes property absent or withheld



■ QUADRANGLE LOCATION  
 ▨ NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Phillip C. Wickless  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle



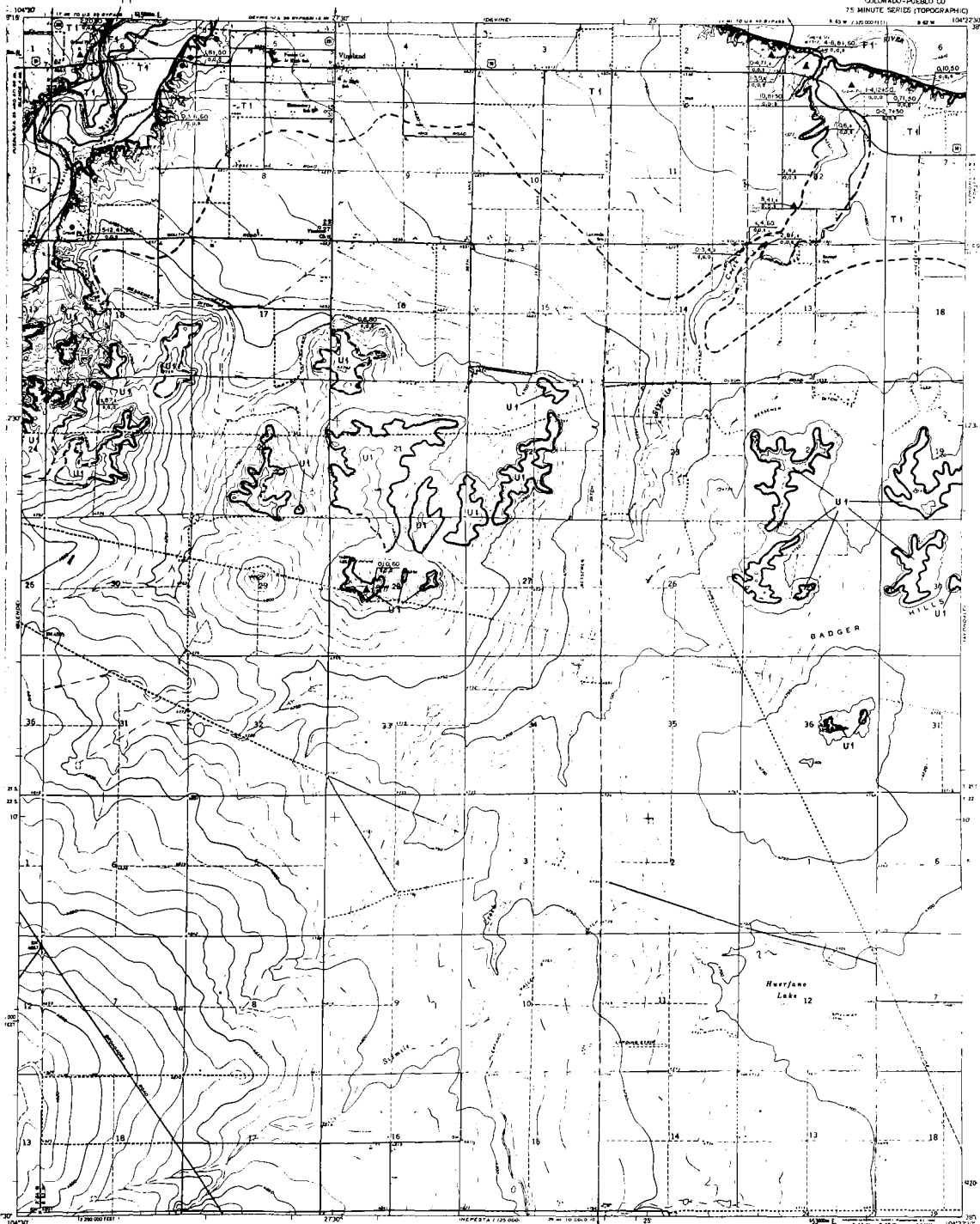
- ROAD CLASSIFICATION**
- Primary highway: Light-duty road, hard or hard surface
  - Secondary highway: Unimproved surface
  - Interstate Route: U S Route
  - State Route: State Route

VERDE SCHOOL, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

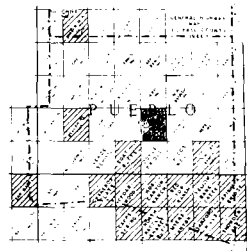
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. ROLLA, DIRECTOR

VINELAND QUADRANGLE  
COLORADO-PUEBLO CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- Landform units
- Resource class/function
- LANDFORM UNITS**
  - F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unconsolidated deposit
  - A Alluvial fan
  - E Non-deposited sand (alluvial)
  - M Man-made deposit (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
  - 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, and/or carbonaceous
  - 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel surface and pit
  - Abandoned gravel surface and pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Probable quarry aggregate resource area
  - Selected well or drill-hole location with associated lithologic log (if any) and/or gravel resource thickness (ft); obtained from well logs
  - "I" indicates gravel; "S" indicates sand
  - "\*" to symbol denotes unreported or unknown property
  - "m" denotes Colorado Geological Survey field-based and direct projection
  - Drill hole
  - Landform boundary, solid where known or reported; dashed where approximate or inferred
- STATION LOCATION AND ORIENTATION**
  - Interurban sidewalk (1/2")
  - Commercial/Industrial sidewalk (1/2")
  - Unimproved road and/or fence (spacing 40' common, 2 to 10', usual distribution)
  - Significant amount of fines (spacing 1/2 to 1/4 inch, 0.025 to 0.015 inch)
  - Significant amount of material (nonporous material)
  - "m" to symbol denotes unreported or unknown property
  - "U" to symbol denotes property shown on map/county



QUADRANGLE LOCATION

NON-RESOURCE OR WITHDRAWN AREA

Mapped by: Stephen D. Schuchow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



ROAD CLASSIFICATION

Heavy-duty Light-duty

Medium-duty Unimproved dirt

U.S. Route State Route

VINELAND COLO



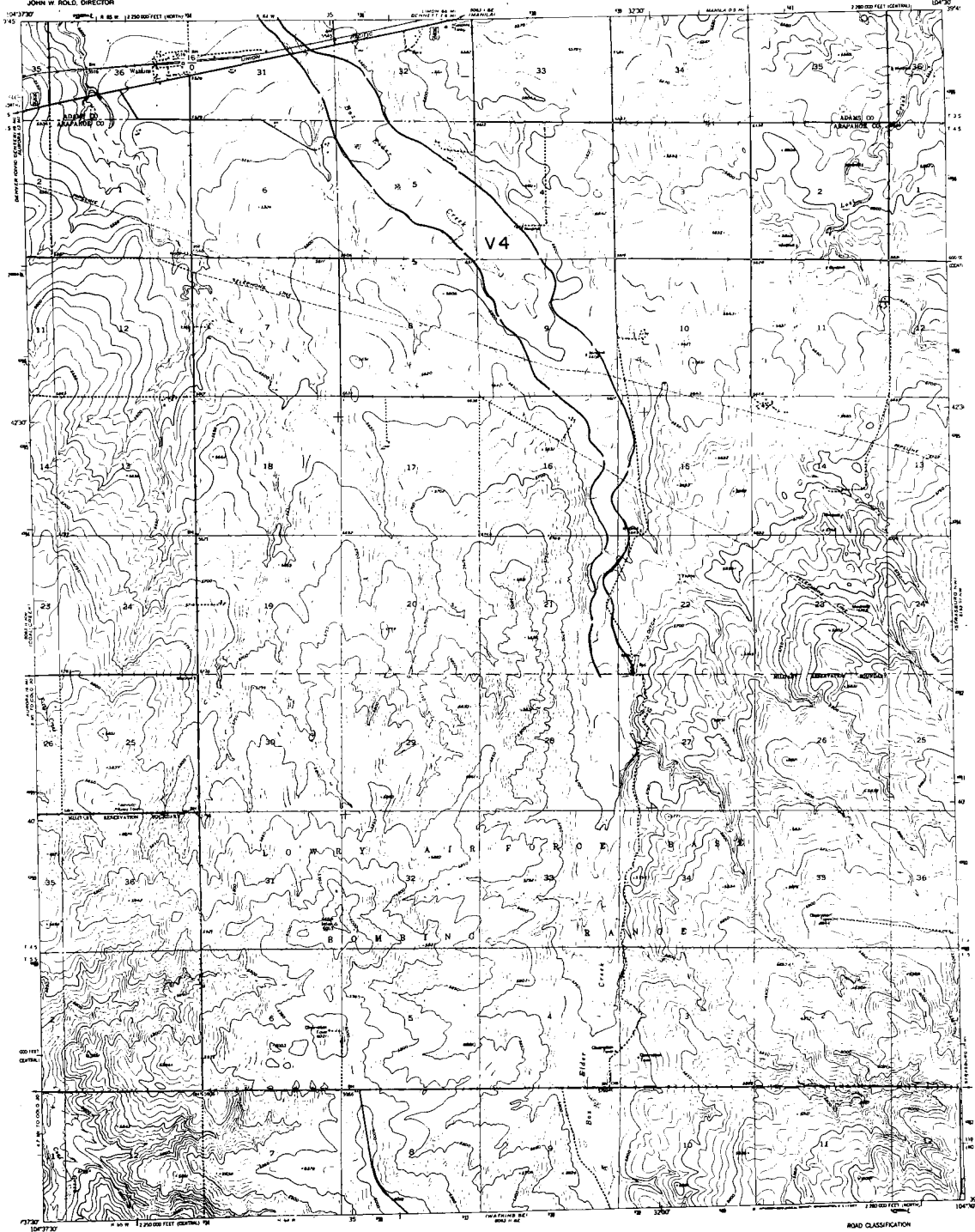


# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

WATKINS QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
PROBATION (20) CONTAINS

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

## EXPLANATION



**EXPLANATION**

**LAPORAL UNITS**

- F Floodplain deposit
- T Tuvon terrace deposit
- V Valley fill (F & T)
- U Upland deposit
- A Alluvial fan
- E Vial-deposited sand (alluvial)
- M Nonvial deposits (slag, tailings, spalls...)

**RESOURCE CLASSIFICATION**

**Class Aggregate**  
for 100,000 cu yd. or more.

- 1 Gravel: relatively clean and sound
- 2 Gravel: significant fines, decomposed rock calcite interstices

**Fill Aggregate**  
for 100,000 cu yd. or more, 75% material in 20-mesh screen, 100% retained in 40-mesh screen.

- 3 Sand
- 4 Probable aggregate resource

**MAP SYMBOLS**

- Operating gravel mill/road pit
- Abandoned gravel mill/road pit
- Operating stone quarry
- Abandoned stone quarry
- Potential quarry aggregate resource area
- Selected well or wide-hole location with over-burden thickness (ft) over sand/gravel resource
- Abandoned (ft), selected from well logs
- "r" indicates gravel; "s" indicates sand
- "a" in symbol indicates abandoned or unknown resource
- "m" denotes Colorado Geological Survey mechanical and gravel projects
- Grill hole
- Landform boundary, solid where known or observed; dashed where approximate or inferred

**SYMBOL, LOCATION AND ORIGIN/CLASSIFICATION OF SYMBOL**

Symbol	Location	Origin/Classification
(Symbol with 'r')	Overburden thickness (ft)	Aggregate resource information (ft)
(Symbol with 's')	Gravel and sand resource (ft)	Aggregate resource information (ft)
(Symbol with 'a')	Abandoned resource	Aggregate resource information (ft)
(Symbol with 'm')	Significant amount of fines (finning 1000 screen, 0.075 mm, or 0.075 mm)	Aggregate resource information (ft)
(Symbol with 'd')	Significant amount of decomposed or weak rock	Aggregate resource information (ft)
(Symbol with 'c')	Significant amount of calcite cementation (calcite)	Aggregate resource information (ft)
(Symbol with 'u')	Not an aggregate property (quarry or mill)	Aggregate resource information (ft)

Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol
Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol
Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol
Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol	Symbol

**QUADRANGLE LOCATION**

**NON-RESOURCE OR WETLANDS AREA**

Base from U. S. Geological Survey 7-1/2 minute quadrangle

CONTOUR INTERVAL 10 FEET  
SHOWS 8-MIN. INTERVAL

ROAD CLASSIFICATION

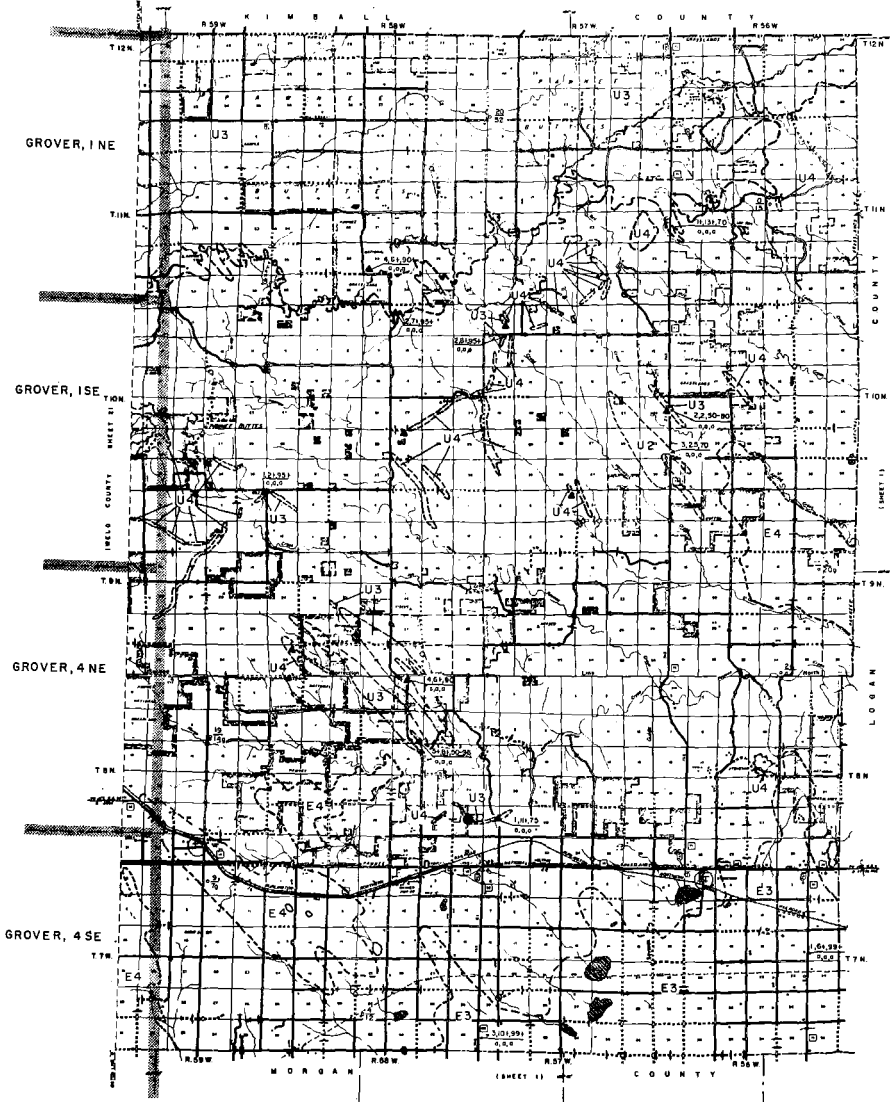
- Heavy-duty
- Medium-duty
- U. S. Route
- Light-duty
- Unimproved dirt
- State Route

WATKINS, COLO.  
K30373--W10430/75  
1954  
JOB 5003 & RE-ACKED VERT

Map by: R. H. C. Wickland  
Date: June 30, 1974

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

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



## EXPLANATION

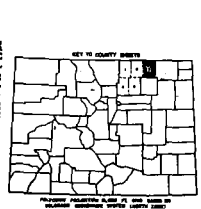
- Legend for the Sand, Gravel, and Quarry Aggregate Resources Map.
- LAPOINTE UNIT**
    - F Fluvial deposit
    - T Stream terrace deposit
    - V Valley fill (F & T)
    - U Upland deposits
    - A Alluvial fan
    - E Wind-deposited sand (eolian)
    - M Man-made deposits (e.g., roadbeds, spalls...)
  - RESOURCE CLASSIFICATION**
    - COARSE GRAVELS** (as input for processing in 60 screen, 20/40 classification)
      - 1 Gravel: relatively clean and sand
      - 2 Gravel: significant fines, decomposed rock, lacustrine carbonates
    - FINE GRAVELS** (as input for processing in 20 screen, 40/60 screen, 60/100 screen, 100/200 screen)
      - 3 Sand
    - Unutilized Resource**
      - 4 Potential aggregate resource
  - NOT SYMBOL**
    - Abandoned gravel and/or sand pit
    - Abandoned stone quarry
    - Abandoned stream quarry
    - Potential quarry aggregate resource area
    - Isolated well or drill-hole location with overburden thickness (see map and gravel) summary (thickness 100), obtained from well logs.
    - "X" indicates gravel; "E" indicates sand
    - "U" in symbol denotes unutilized or unknown property
    - "M" in symbol denotes Geological Survey Department and Geology projects
    - "R" in symbol denotes resource
    - Location boundary, solid where known or dashed, dashed where approximate or inferred
  - SECTION, LOCATION AND GEOLOGICAL CHARACTERIZATION OF DEPOSIT**
    - Numbered thickness (ft)
    - Numbered resource thickness (ft)
    - Percent sand and gravel (grading to 20 mesh, 20/40 mesh, 40/60 mesh)
    - Significant amount of fines (grading 200 mesh, 20/40 mesh, or 40/60 mesh)
    - Significant amount of decomposed or well rock
    - Significant amount of lacustrine carbonates (includes)
    - "U" in symbol denotes unutilized or unknown property
    - "M" in symbol denotes property absent or unutilized



- QUADRANGLE LOCATION**
- NON-RESOURCE OR WITHDRAWN AREA**

**REFERENCE:**  
 Haskin, M. D., Jr., 1965, Reconnaissance of ground-water resources in parts of Larimer, Logan, Morgan, Sedgewick, and Weld Counties, Colorado. U. S. Geol. Survey, Water-Supply Paper 1500-L, p.11.  
 Damon, H.H., 1974, personal communication.

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974



**GENERAL LEGEND**

	Road
	Stream
	Boundary
	Well
	Quarry
	Deposit
	Resource Area
	Section Number
	Township and Range
	Scale
	North Arrow

GENERAL HIGHWAY MAP  
**WELD COUNTY**  
 COLORADO

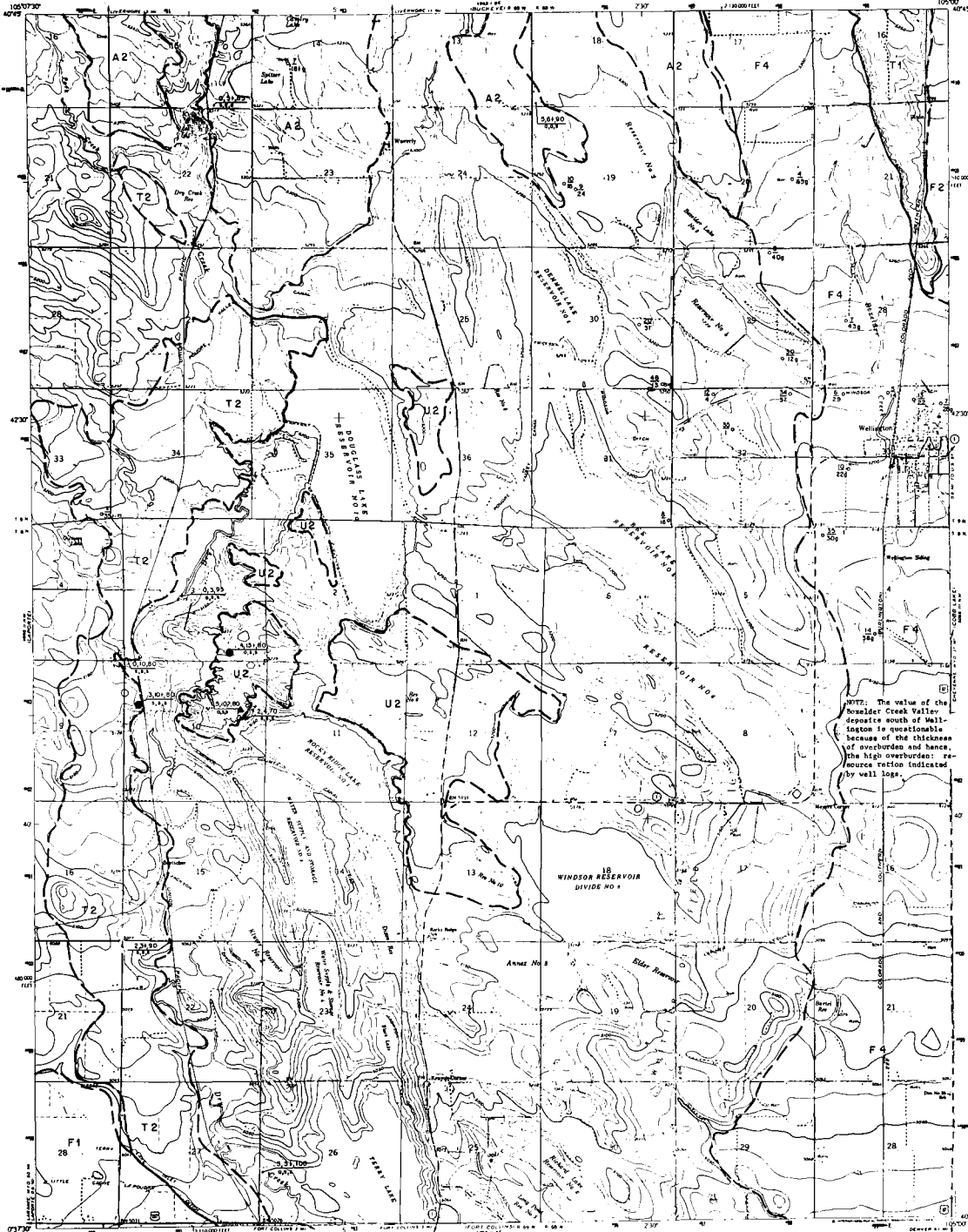
STATE DEPARTMENT OF HIGHWAYS  
 DIVISION OF HIGHWAY SURVEY OF COLORADO  
 COLORADO STATE ENGINEERING SOCIETY  
 U. S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL GENERAL DEVELOPMENT

1969

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

WELLINGTON QUADRANGLE  
COLORADO - LARIMER CO  
7.5 MINUTE SERIES (TOPOGRAPHIC)  
NEW-FORM COLLENS D. QUADRANGLE

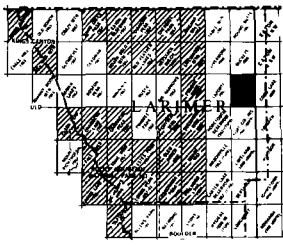
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HULL, DIRECTOR



## EXPLANATION

- LANDFORMS**
- F Floodplain deposit
  - T Terrace terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoil, etc.)
- AGGREGATE CLASSIFICATION**
- Coarse Aggregate**  
1" (25.4 mm) or larger
- 1 Gravel: relatively clean and sound
  - 2 Gravel: significant fines, decomposed rock, calcine cementation
- Fine Aggregate**  
No. 20 (75 microns) or larger
- 3 Sand
  - 4 Probable aggregate resource
- QUARRY TYPES**
- A Operating gravel and/or sand pit
  - B Abandoned gravel and/or sand pit
  - C Operating stone quarry
  - D Abandoned stone quarry
- Other Symbols**
- Potential quarry aggregate resource area
  - Potential well or drilling location with overburden thickness (ft) and sand/gravel resource thickness (ft) obtained from well logs
  - "s" indicates gravel; "m" indicates sand
  - "x" in symbol denotes unmineralized or unknown contents
  - "u" denotes Colorado Geological Survey (1972) data and "c" denotes Colorado Geological Survey (1972) data
  - Landform boundary, solid where known or observed, dashed where approximate or inferred
- PLATON LOCATION AND TOPOGRAPHIC INDICATIONS OF ELEVATION**
- overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - percent sand and fines (percent of coarse, 2.0 to 2.0 in., visual estimation)
  - significant amount of fines (percent of coarse, 2.0 to 2.0 in., visual estimation)
  - significant amount of decomposed or weak rock
  - significant amount of material unsuitable for use
  - "u" in symbol denotes unmineralized or unknown property
  - "x" in symbol denotes property absent or insignificant

**NOTE:** The value of the Boulder Creek Valley deposits south of Wellington is questionable because of the thickness of overburden and hence, the high overburden: resource fraction indicated by well logs.



**QUADRANGLE LOCATION**

**NON-RESOURCE OR WETLAND AREA**

**REFERENCE:**

Retaby, L.A., and Schneider, P.A., Jr., 1972. Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map T-687.

Swan, F. B., III, 1973. Map of surficial geology of part of the Wellington quadrangle, second mapping for Colorado Geol. Survey Windsor Environmental Geology Project, open-file map.

Mapped by: Stephen D. Schenckow  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

- Heavy duty Light duty
- Medium duty Unimproved dirt
- U.S. Route State Route

CONTOUR INTERVAL: 20 FEET  
ELEVATION IN FEET

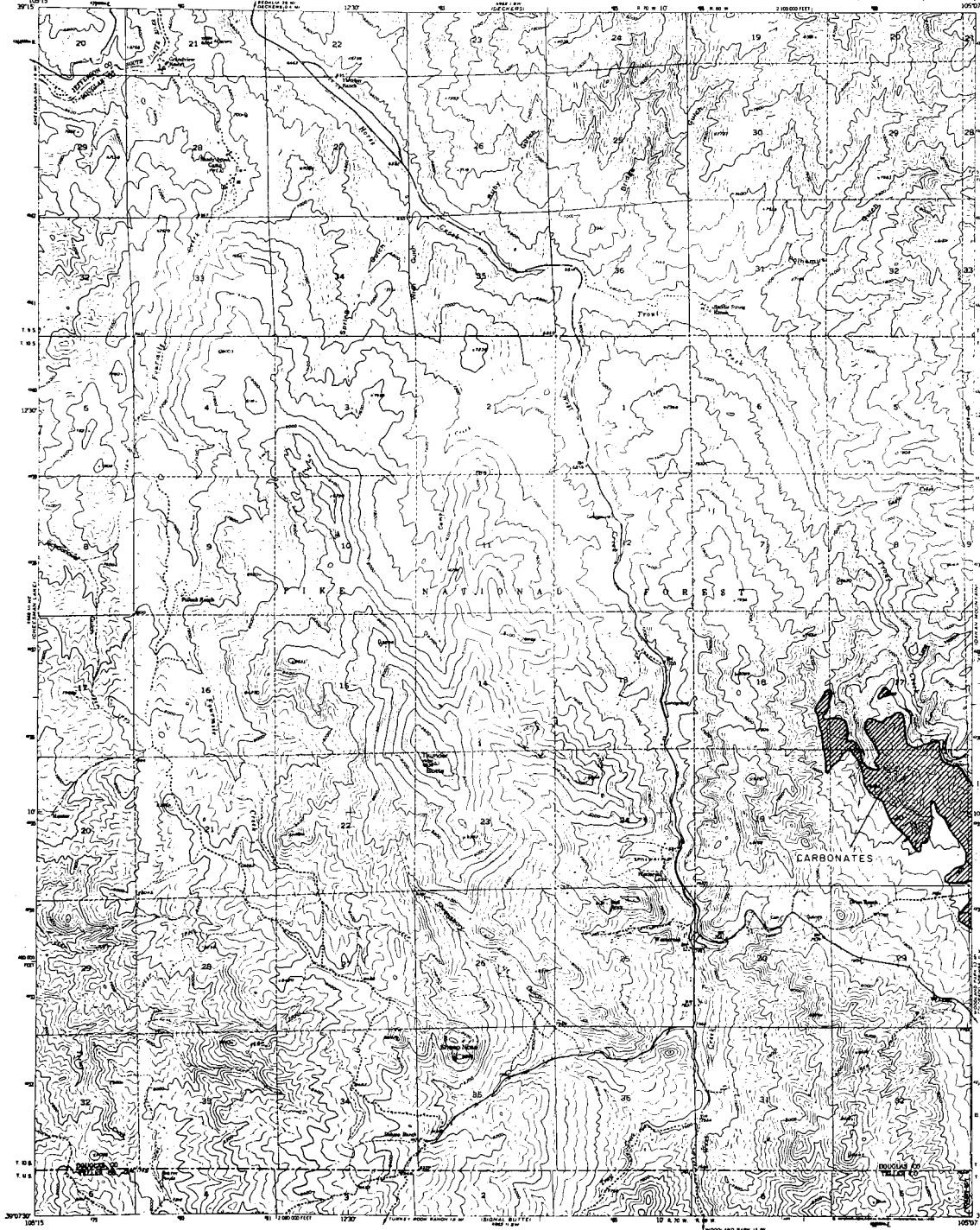
WELLINGTON, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

WESTCREEK QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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

## EXPLANATION



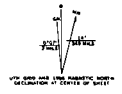
- LEGEND**
- AGGREGATE TYPES**
- F Floodplain deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Erosion-deposited sand (contour)
  - M Man-made deposits (lake, tailings, spoil, etc.)
- PROBABLE QUANTITY**
- 1 Good: relatively clean and well sorted
  - 2 Good: slightly finer, decomposed rock, calcareous carbonate
  - 3 Fair
  - 4 Poor: aggregate resource
- MAP SYMBOLS**
- Operating gravel sand and pit
  - Abandoned gravel sand and pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Prospect quarry aggregate resource area
  - Selected well or drill-hole location with overburden thickness (ft) over sand/gravel resource thickness (ft), obtained from well log
  - "S" indicates gravel; "G" indicates sand
  - "X" in shaded denotes unoperational or unknown property
  - "G" source: Colorado Geological Survey geotechnical and mineral properties file
  - Landmark boundary, well where known or observed; dashed where approximate or inferred
- STATUS, LOCATION AND CONDITIONAL RESTRICTION OF PROPERTY**
- Private land (shaded)
  - Public land (unshaded)
  - Right-of-way (dashed line)
  - Significant amount of forest covering 1000 acres, 5000 ft or more
  - Significant amount of decomposed or weak rock
  - Significant amount of incision (erosion) on known property
  - "X" in shaded denotes property absent or unoperational
- DOUGLAS**



Geology Modified after:  
Horne, J.C., 1951. Structural geology of the eastern flank of the southern Front Range, Colorado: University of Colorado Ph.D. Thesis, 121 p., 3 pls.

Mapped by: Phillip C. Micklin  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



CONTOUR INTERVAL 40 FEET  
OTHER @ MEAN SEA LEVEL

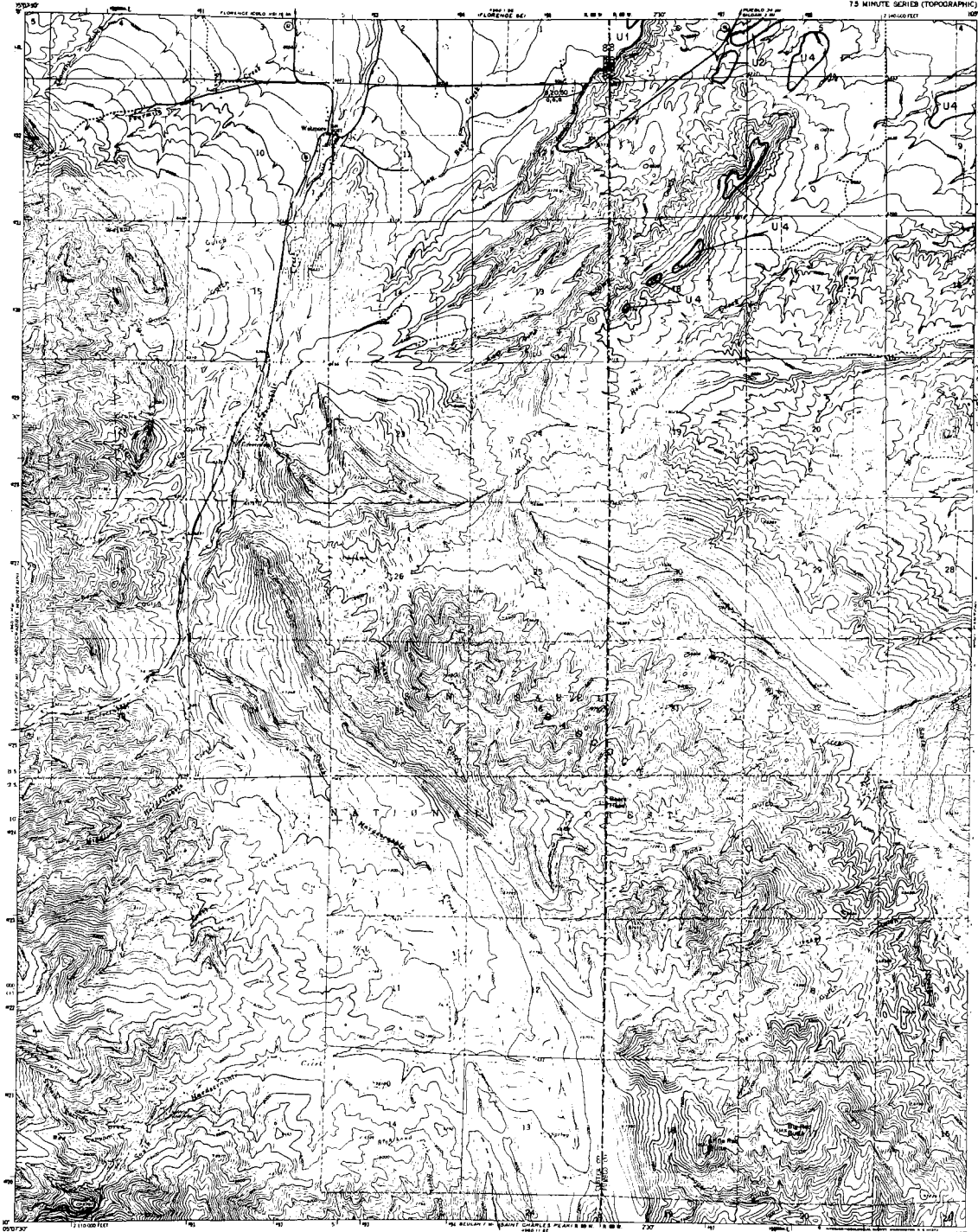


WESTCREEK, COLO.



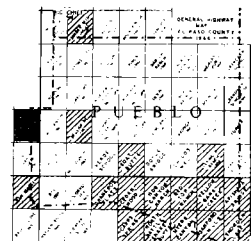
SAND, GRAVEL AND QUARRY AGGREGATE  
 RESOURCES MAP

WETMORE QUADRANGLE  
 COLORADO  
 7.5 MINUTE SERIES (TOPOGRAPHIC)



EXPLANATION

- Landform unit
- Resource class/formation
- LANDFORM UNITS**
  - F Fluvial deposit
  - T Tress terrace deposit
  - V Valley fill (F & T)
  - U Upland deposits
  - A Alluvial fan
  - E Eolian-deposited sand (alluvial)
  - M Metamorphic deposits (slates, shales, gneisses, etc.)
- RESOURCE CLASSIFICATION**
  - Coarse Sand/Gravel** (at least 50% retained on #40 screen, visual estimation)
    - 1 Gravel: relatively clean and sound
    - 2 Gravel: significant fines; decomposed rock, calcareous cementation
  - Fine Sand/Gravel** (greater than 70% passing #40 screen, visual estimation)
    - 3 Sand
    - 4 Probable aggregate resource
- MAP SYMBOLS**
  - Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Truncated quarry aggregate resource area
  - Isolated well or drill-hole location with measured thickness (ft) obtained from well logs
  - "m" indicates gravel; "s" indicates sand
  - "c" is symbol denoting unconsolidated or cohesionless property
  - "m" denotes Colorado Geological Survey "underground and gravel production" drill hole
  - Landform boundary, solid where known or observed; dashed where approximate or inferred
- SYMBOL LOCATION AND DIMENSIONAL INFORMATION OF SYMBOLS**
  - overburden thickness (ft)
  - sand/gravel resource thickness (ft)
  - current sand and gravel (passing #40 screen, 7.5 in. x 1, visual estimation)
  - sign/foot amount of fines (passing #100 screen, 0.075 in. or 0.075 mm.)
  - sign/foot amount of decomposed or weak rock
  - sign/foot amount of cohesionless materials
  - "c" or "m" symbol denoting unconsolidated or cohesionless property
  - "m" or "c" symbol denoting property absent or unapplicable

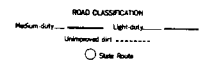
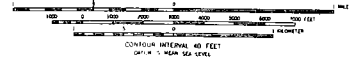
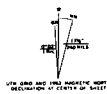


- QUADRANGLE LOCATION
- NON-RESOURCE OR WITHDRAWN AREA

Geology modified after Taylor, R. S., and Escher, G. S., 1973, U. S. Geological Survey Map MF-548.

Mapped by: Ralph R. Shroba  
 Date: June 30, 1974

Base from U. S. Geological Survey  
 7-1/2 minute quadrangle

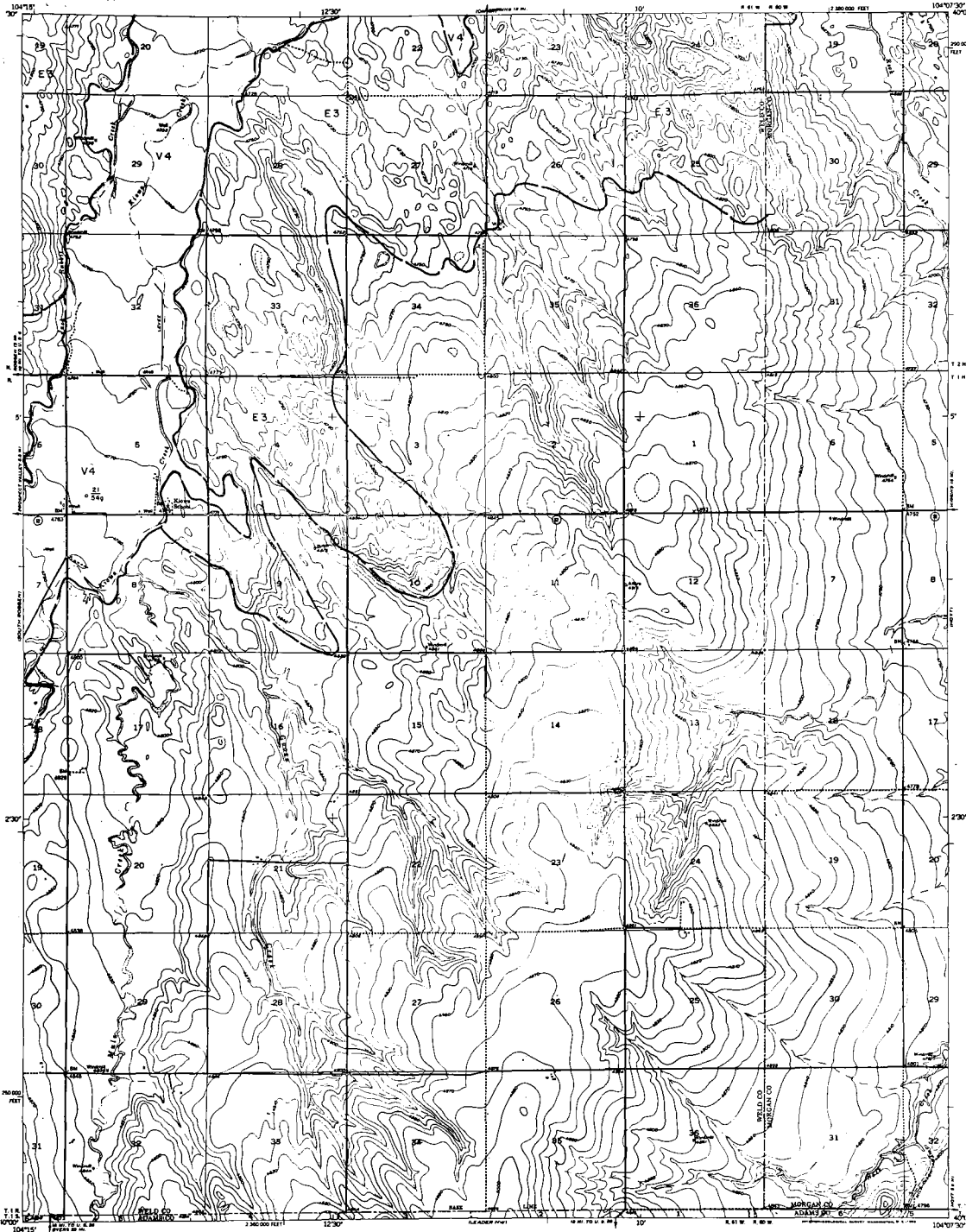


WETMORE, COLO.

SAND, GRAVEL AND QUARRY AGGREGATE  
RESOURCES MAP

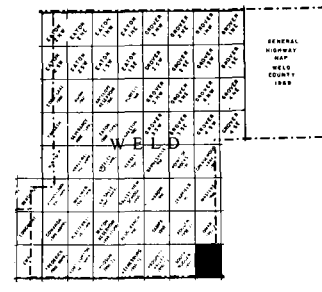
WIGGINS SW QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)

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



EXPLANATION

- Legend**
- Topographic unit
  - Resource classification
- LAPIDARY UNITS**
- F Fluvial deposit
  - T Stream terrace deposit
  - V Valley fill (F & T)
  - U Unaltered deposit
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Man-made deposits (slag, tailings, spoils, ...)
- RESOURCE CLASSIFICATION**
- Coarse Aggregate**  
(See Table 1, Appendix A for details, "usual" abbreviations)
- 1 Gravel: medium to fine and sand
  - 2 Gravel: significant fines, decomposed rock, calcium carbonate
- Fine Aggregate**  
(See Table 2, Appendix A for details, "usual" abbreviations)
- 3 Sand
  - 4 Probable aggregate resource
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Proposed quarry aggregate resource area
  - Selected well or drill hole location with overburden thickness (ft) and underlying resource thickness (ft), omitted from well logs
  - "\*" indicates gravel, "s" indicates sand
  - "x" in symbol denotes unvalued or unknown property
  - "w" denotes Colorado Geological Survey "Water/land and gravel projects" (WLL) well
  - Landform boundary, solid where known or inferred; dashed where approximate or inferred
- STATION, LOCATION AND CORRELATION DESCRIPTION OF SYMBOL**
- overburden thickness (ft)
  - underlying resource thickness (ft)
  - percent sand and fines (based on screen, 0.30 mm), initial estimation
  - significant amount of fines (based on 1000 screen, 0.075 in. or 0.075 mm)
  - significant amount of decomposed or weak rock
  - significant amount of calcium carbonate (carbonate)
  - "\*" in symbol denotes unvalued or unknown property
  - "s" in symbol denotes property absent or insignificant

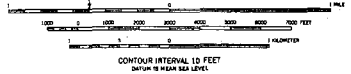


■ QUADRANGLE LOCATION  
▨ NON-RESOURCE OR MINOR AREA

REFERENCE: Bjorklund, L.J., and Brown, S.P., 1957, Geology and ground-water resources of the lower South Platte River valley between Hardin, Colorado, and Paxton, Nebraska: U. S. Geol. Survey Water-Supply Paper 1376, p. 1.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Base from D. S. Geological Survey 7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

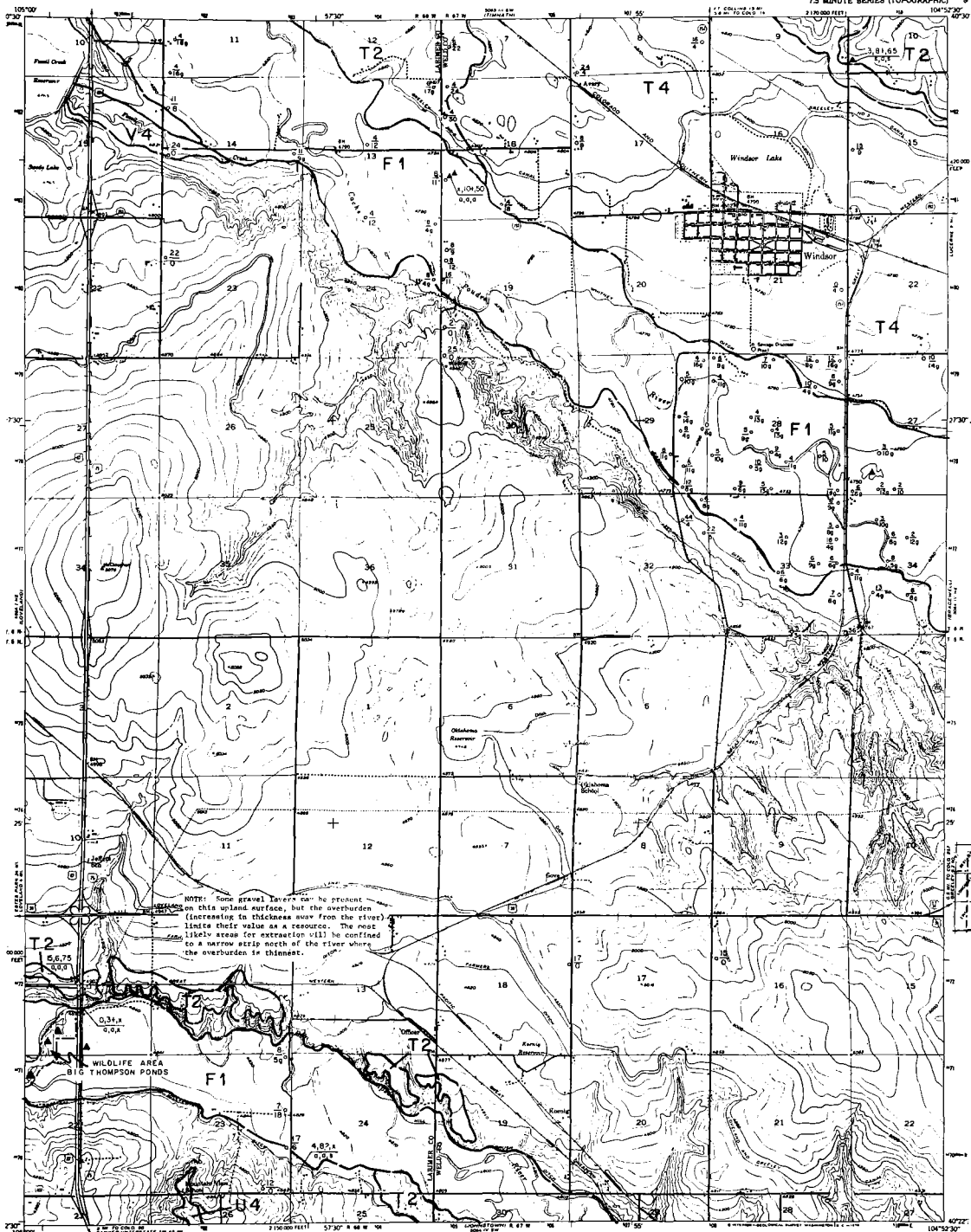
- Heavy duty: Limited
- Medium-duty: Limited
- Unimproved dirt: Limited
- U.S. Route: Limited
- State Route: Limited

WIGGINS SW, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

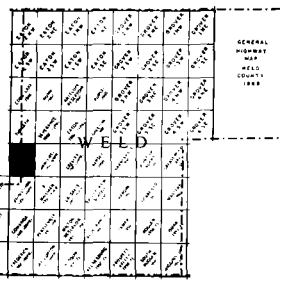
DEPARTMENT OF NATURAL RESOURCES  
COLORADO GEOLOGICAL SURVEY  
JOHN W. HOLL, DIRECTOR

WINDSOR QUADRANGLE  
COLORADO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



## EXPLANATION

- LITHOLOGICAL UNITS**
- T Fluvio-lacustrine deposit
  - T2 River terrace deposit
  - V Valley fill (F & T)
  - U Upland deposit
  - A Alluvial fan
  - E Wind-transported sand (eolian)
  - M Man-made deposit (slag-tailings, spoil, etc.)
- RESOURCE CLASSIFICATION**
- 1 Gravel: relatively clean and round
  - 2 Gravel: significant fines, decomposed rock, various colors
  - 3 Sand
  - 4 Probable aggregate resource
- QUARRY SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
- STATION LOCATION AND ORIOLOGICAL INFORMATION**
- North-south thickness (ft)
  - East-west thickness (ft)
  - Approximate sand and gravel thickness in overburden (ft)
  - Indicates gravel "G" indicates sand "S" in (small) denotes unclassified or unknown resource
  - "us" American Geological Survey Windsor Sand and Gravel Prospector's drill hole
  - Indicates thickness of acid drain holes or observed, dashed shows approximate or inferred



NOTE: Some gravel layers may be present on this upland surface, but the overburden (increasing in thickness away from the river) limits their value as a resource. The most likely areas for extraction will be confined to a narrow strip north of the river where the overburden is thinnest.

- ROAD CLASSIFICATION**
- Heavy-duty
  - Medium-duty
  - Intermittent Route
  - Light-duty
  - Unimproved dirt
  - U.S. Route
  - State Route
- QUADRANGLE LOCATION**
- NON-RESOURCE OR WITHDRAWN AREA
- REFERENCE:**
- Swan, P. H., III, 1972. Map of surficial geology of part of the Windsor quadrangle: Recon. mapping for Colorado Geol. Survey Windsor Environmental Geology Project, open-file map.
  - Hershey, L.A., and Schneider, P.A., Jr., 1972. Geologic map of the lower Cache La Poudre River basin, north-central Colorado: U. S. Geol. Survey Misc. Geol. Inv. Map I-687.
  - Shelton, D.C., 1974. personal communication.
  - Ching, P.W., 1972. Economic gravel deposits of the lower Cache La Poudre River: Colorado State Univ. Unpub. Master Sci. Thesis.
- Geology modified after: Colton, R.B. and Pritch, W.R., 1974. Map showing potential sources of gravel and crushed-rock aggregate in the Boulder-Fort Collins-Clearwater Area, Front Range Urban Corridor, Colorado: U. S. Geol. Survey Map I-855 D.
- Mapped by: Stephen D. Schuchow  
Date: June 30, 1974
- Prepared in cooperation with the  
U. S. Geological Survey.

Base from U. S. Geological Survey  
7 1/2 minute quadrangle



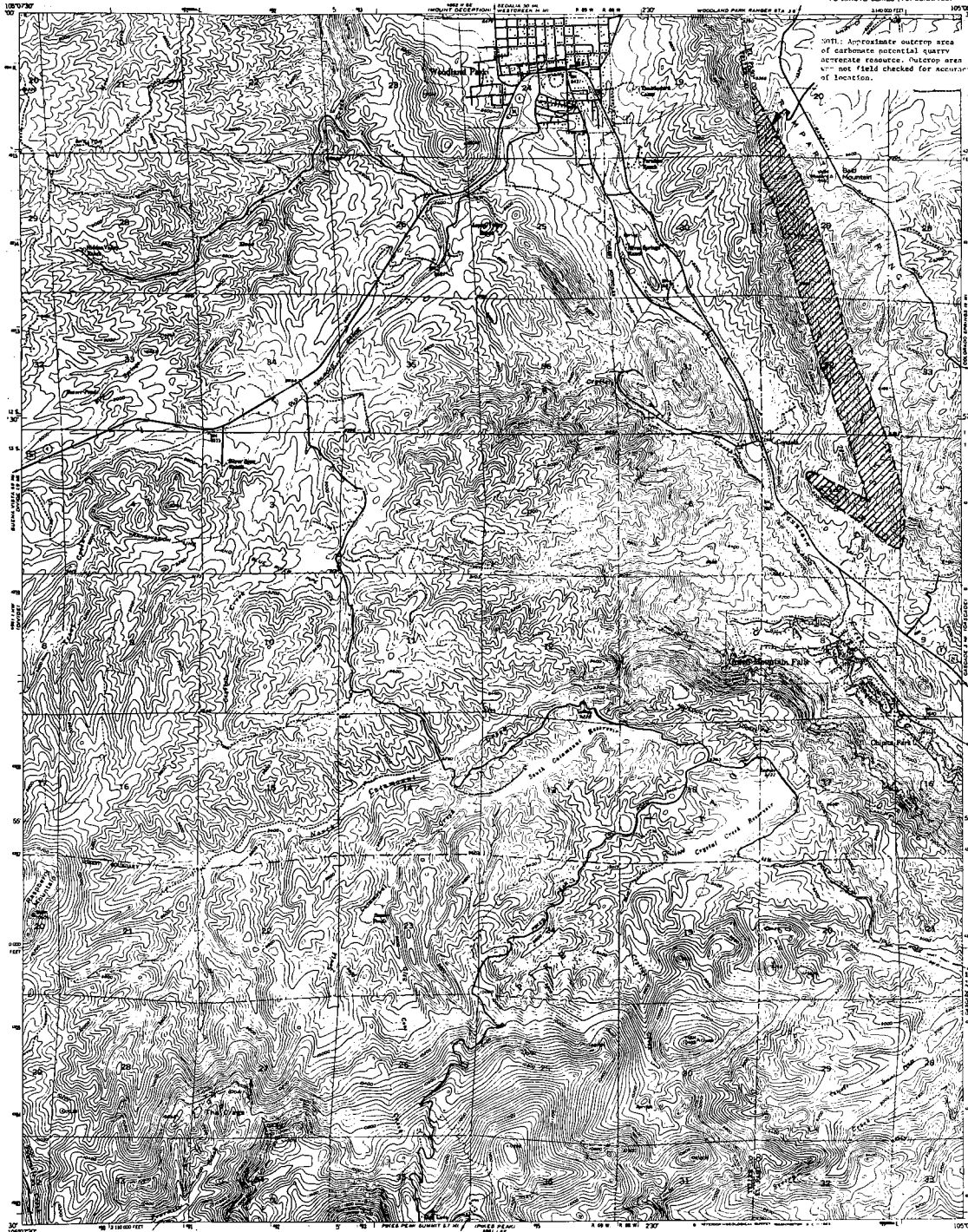
CONTOUR INTERVAL 10 FEET

WINDSOR, COLO.

# SAND, GRAVEL AND QUARRY AGGREGATE RESOURCES MAP

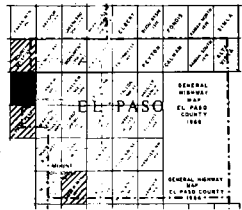
WOODLAND PARK QUADRANGLE  
COLORADO  
75 MINUTE SERIES (TOPOGRAPHIC)

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



## EXPLANATION

- LANDFORM UNITS**
- F Floodplain deposit
  - T Tertiary terrace deposit
  - V Valley fill (F & T)
  - U Wind deposits
  - A Alluvial fan
  - E Wind-deposited sand (eolian)
  - M Non-mud deposits (sand, silt, gravel, etc.)
- RESOURCE CLASSIFICATION**
- 1 Class 1: 500-1000 sq ft on 40 acres, actual outcrop
  - 2 Class 2: 1000-5000 sq ft on 40 acres, actual outcrop
  - 3 Class 3: 5000-10000 sq ft on 40 acres, actual outcrop
  - 4 Class 4: 10000-50000 sq ft on 40 acres, actual outcrop
  - 5 Class 5: 50000-100000 sq ft on 40 acres, actual outcrop
  - 6 Class 6: 100000-500000 sq ft on 40 acres, actual outcrop
  - 7 Class 7: 500000-1000000 sq ft on 40 acres, actual outcrop
  - 8 Class 8: 1000000-5000000 sq ft on 40 acres, actual outcrop
  - 9 Class 9: 5000000-10000000 sq ft on 40 acres, actual outcrop
  - 10 Class 10: 10000000-50000000 sq ft on 40 acres, actual outcrop
  - 11 Class 11: 50000000-100000000 sq ft on 40 acres, actual outcrop
  - 12 Class 12: 100000000-500000000 sq ft on 40 acres, actual outcrop
  - 13 Class 13: 500000000-1000000000 sq ft on 40 acres, actual outcrop
  - 14 Class 14: 1000000000-5000000000 sq ft on 40 acres, actual outcrop
  - 15 Class 15: 5000000000-10000000000 sq ft on 40 acres, actual outcrop
  - 16 Class 16: 10000000000-50000000000 sq ft on 40 acres, actual outcrop
  - 17 Class 17: 50000000000-100000000000 sq ft on 40 acres, actual outcrop
  - 18 Class 18: 100000000000-500000000000 sq ft on 40 acres, actual outcrop
  - 19 Class 19: 500000000000-1000000000000 sq ft on 40 acres, actual outcrop
  - 20 Class 20: 1000000000000-5000000000000 sq ft on 40 acres, actual outcrop
  - 21 Class 21: 5000000000000-10000000000000 sq ft on 40 acres, actual outcrop
  - 22 Class 22: 10000000000000-50000000000000 sq ft on 40 acres, actual outcrop
  - 23 Class 23: 50000000000000-100000000000000 sq ft on 40 acres, actual outcrop
  - 24 Class 24: 100000000000000-500000000000000 sq ft on 40 acres, actual outcrop
  - 25 Class 25: 500000000000000-1000000000000000 sq ft on 40 acres, actual outcrop
  - 26 Class 26: 1000000000000000-5000000000000000 sq ft on 40 acres, actual outcrop
  - 27 Class 27: 5000000000000000-10000000000000000 sq ft on 40 acres, actual outcrop
  - 28 Class 28: 10000000000000000-50000000000000000 sq ft on 40 acres, actual outcrop
  - 29 Class 29: 50000000000000000-100000000000000000 sq ft on 40 acres, actual outcrop
  - 30 Class 30: 100000000000000000-500000000000000000 sq ft on 40 acres, actual outcrop
  - 31 Class 31: 500000000000000000-1000000000000000000 sq ft on 40 acres, actual outcrop
  - 32 Class 32: 1000000000000000000-5000000000000000000 sq ft on 40 acres, actual outcrop
  - 33 Class 33: 5000000000000000000-10000000000000000000 sq ft on 40 acres, actual outcrop
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  - 42 Class 42: 100000000000000000000000-500000000000000000000000 sq ft on 40 acres, actual outcrop
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  - 49 Class 49: 500000000000000000000000000-1000000000000000000000000000 sq ft on 40 acres, actual outcrop
  - 50 Class 50: 1000000000000000000000000000-5000000000000000000000000000 sq ft on 40 acres, actual outcrop
- MAP SYMBOLS**
- Operating gravel and/or sand pit
  - Abandoned gravel and/or sand pit
  - Operating stone quarry
  - Abandoned stone quarry
  - Potential quarry aggregate resource area
  - Related well or drill-hole location with core-log thickness (ft) and sand/gravel resource thickness (ft), indicated from well logs
  - "S" indicates gravel, "G" indicates sand
  - "L" symbol denotes unmineralized or unknown property
  - "M" denotes Colorado Geological Survey Water/Soil and Ground projects
  - "H" symbol denotes unmineralized or unknown property
  - "N" in symbol denotes property absent or undeveloped
- ROAD CLASSIFICATION**
- Heavy-duty
  - Light-duty
  - Overlapped dirt
  - U.S. Road
  - State Road
- STATION, LOCATION AND INDUCED UNDEVELOPMENT OF RESOURCES**
- Suburban thickness (ft)
  - Sand/gravel resource thickness (ft)
  - Gravel and/or sand resource thickness (ft)
  - Significant amount of sand (spacing 1000 ft, 2000 ft, or 3000 ft)
  - Significant amount of gravel or sand rock
  - "L" symbol denotes unmineralized or unknown property
  - "N" in symbol denotes property absent or undeveloped



**QUADRANGLE LOCATION**

**NON-RESOURCE OR WITHDRAWN AREA**

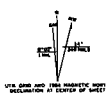
**REFERENCE:**

Crosby, W.D., 1899, Archean-Cambrian contact near Manitou: Geol. Soc. Am. Bull., v. 10, p. 161-164, Pl. 14, 1:160,000.

Cross, W., 1894, Pike's Peak Folds, Colorado: U. S. Geol. Survey Folio no. 7.

Mapped by: Phillip C. Wicklein  
Date: June 30, 1974

Base from U. S. Geological Survey  
7-1/2 minute quadrangle



**ROAD CLASSIFICATION**

Heavy-duty

Light-duty

Overlapped dirt

U.S. Road

State Road

WOODLAND PARK, COLO.