UNITED STATES GEOLOGICAL SURVEY COLORADO GEOLOGICAL SURVEY R. 68 W. 505 R. 67 W. R. 67 W. 515 R. 66 W. 2 200 000 FEET 520 45' R. 66 W. R. 65 W. R. 69 W. 495 _--____ MAP SHOWING AREA OF FRONT RANGE URBAN CORRIDOR **GRAVEL STUDIES** INDEX TO SOURCES OF INFORMATION AND QUADRANGLES SOURCES OF INFORMATION 1. Finlay, G. I., 1916, Colorado Springs, Colorado: U.S. Geol. Survey Folio 203. Izett, G. A., Scott, G. R., and Obradovich, J. D., 1969, Oligocene rhyolite in the Denver basin, Colorado, in Geological Survey research 1969: U.S. Geol. Survey Prof. Paper 650-B, p. B12-B14. 2. McGrew, L. W., U.S. Geol. Survey unpub. data. 3. McGrew, L. W., and Wobus, R. A., U.S. Geol. Survey unpub. data. 4. Richardson, G. B., 1915, Castle Rock, Colorado: U.S. Geol. Survey Folio 198. 5. Scott, G. R., U.S. Geol. Survey unpub. data. 6. Scott, G. R., and Wobus, R. A., 1973, Reconnaissance geologic map of Colorado Springs and vicinity, Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-482. Sheridan, D. M., Reed, J. C., Jr., and Bryant, B. H., 1972, Geologic map of the Evergreen quadrangle, Jefferson County, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-786-A. 7. Varnes, D. J., and Scott, G. R., 1967, General and engineering geology of the United States Air Force Academy site, Colorado: U.S. Geol. Survey Prof. Paper 551, 93 p. 8. Welsh, Fred, Jr., 1969, Areal geology and cross sections of the Castle Rock area, Douglas County, Colorado: Colorado Sch. Mines unpub. M.S. thesis 1154 9. Wobus, R. A., U.S. Geol. Survey unpub. data. EL PASO CO TELLER CO SCALE 1:100:000 RESERVATION 10,000 15,000 20,000 25,000 FEET DATUM IS MEAN SEA LEVEL 300 000 Base compiled by U.S. Geological Survey in 1972 from 1:24,000 quadrangles dated 1954-1966. Limited revision from aerial photographs taken 1969 50,000-foot grid based on Colorado coordinate system, central zone 5000-meter Universal Transverse Meracator

DEPARTMENT OF THE INTERIOR

MAP SHOWING POTENTIAL SOURCES OF GRAVEL AND CRUSHED-ROCK AGGREGATE IN THE COLORADO SPRINGS-CASTLE ROCK AREA, FRONT RANGE URBAN CORRIDOR, COLORADO

grid ticks, zone 13, shown in blue

Metric elevations are shown in parentheses

Donald E. Trimble and Harold R. Fitch 1974

INTRODUCTION

Prepared in cooperation with the

Gravel and (or) crushed-rock aggregate are essential commodities for urban development, but supplies often are exhausted or otherwise eliminated by urban growth. Gravel resources may be exhausted by exploitation, covered by urban spread, or eliminated from production by zoning. This conflict between a growing need and a progressively reduced supply can be forestalled by informed land-use planning. Fundamental to intelligent decisions on land use is knowledge of the physical character, distribution, and quantity of the gravel resources of an area and of the alternative resource of rock suitable for crushing. This map has been prepared to supply data basic to land-use planning in the Front Range Urban

High-quality gravel in the Front Range Urban Corridor is restricted largely to areas beneath flood plains of major streams and to low terraces along these streams. Gravel of lower (but locally high) quality is widespread in higher terraces and on pediments (mesas or benches); the quality of stone of this gravel can be improved by washing, crushing, and grading. Cemented gravel (conglomerate), especially the less well cemented phases, also provides local sources of generally low quality gravel.

Rock suitable for processing into crushed-rock aggregate is plentiful in the older rocks of the mountains, in certain volcanic rocks of the foothills and plains, and in certain limestones, mainly in the Colorado Springs area. For many years, crushed limestone has been the chief source of concrete aggregate in the Colorado Springs area.

Potential sources of gravel or of aggregate have been grouped into eight map units-three of gravel and five of crushed-rock aggregate. A potential source of gravel, as here defined and mapped, contains 20 percent or more of granule- and pebble-size stones (smaller than 2½ in. or 6.4 cm but retained on a No. 10 U.S. Standard sieve). The minimum gravel content was placed arbitrarily at 20 percent of the deposit because this was estimated to be the most likely economic limit under the most adverse foreseeable conditions. The map units are based on differences in physical characteristics, which, in turn, determine relative quality for

SOURCES OF GRAVEL The physical characteristics used to divide the potential sources of gravel into the three groups or units shown on the map are dependent on the age of the deposits, which also primarily determines their topographic location. The highest quality gravel is the youngest, the least altered (soundest), and the least cemented and contains the least amount of calcium carbonate in the form of interstitial caliche. These are the gravel deposits of the flood plains and lower terraces of the major streams and their tributaries. The poorest quality gravel, being older and more weathered, contains an abundance of unsound stones and much calcium carbonate. This gravel forms a few high terraces, covers pediments (remnants form mesa tops, benchlands, and interstream divides less than 325 feet or 99 m above present stream level), and occurs as high-level remnants in the mountains. The oldest gravel commonly is well cemented and difficult to disaggregate and, therefore, is unlikely to be used much as a source of commercial gravel. The quality of the gravel for different uses is further determined by the types

with high-alkali cement, though others are not. Because the physical characteristics that determine relative quality for different uses are determined by source area as well as age, the gravel of units other than the cemented gravel is described by stream-valley location. The major gravelproducing streams are the Plum Creek and Cherry Creek tributaries of the South Platte River, which flow northward from the drainage divide that trends southeast from Palmer Lake, and Fountain Creek and its tributary, Monument Creek. Fountain Creek flows southward from Colorado Springs to join the Arkansas

of rock it contains. These types reflect the rocks in the source area of the stream that carried the gravel. Some rocks are more resistant to abrasion than others; some are more resistant to chemical alteration than others; and some are reactive

GRAVEL DEPOSITS UNDERLYING FLOOD PLAINS AND **TERRACES**

Plum Creek. - Plum Creek flows north to join the South Platte River south of Denver. Its East Fork heads on the north side of the South Platte-Arkansas River divide near Palmer Lake; its West Fork heads in the mountain front area west of Larkspur, with some tributaries heading in the mountains farther north. Much of the gravel along Plum Creek has been derived from the Dawson Formation, which is composed almost entirely of reworked granitic material. Gravel derived from the mountains also consists of granitic material, inasmuch as the mountainous part of the Plum Creek drainage is underlain by Pikes Peak Granite. Gravel in the area drained by the East Fork contains pebbles of rhyolitic ashflow tuff, a dense silicic volcanic rock that formerly extended across the area and that is likely to react deleteriously with high-alkali cement if used for concrete aggregate. Granule and pebble sizes compose about 50 percent of the gravel along Plum Creek. Sand composes about 50 percent. The gravel of Plum Creek commonly is 15-35 feet (4.6-11 m) thick but locally is as much as 60 feet (18 m)

Cherry Creek. - Cherry Creek also heads on the north side of the South Platte-Arkansas River divide, east of Monument, and flows northward to join the South Platte in Denver. Gravel, except for very local pockets, forms a significant part of the Cherry Creek sediments only near the north edge of the map Conglomerate, and is composed mainly of granitic fragments with only minor volcanic constituents. Although granule and pebble sizes compose about 50 percent of the Cherry Creek deposits, the gravel is predominantly in the small size ranges and is unlikely to be much utilized as a source of commercial gravel. The Cherry Creek deposits range from 20 to more than 50 feet (6-15 m) in thick-

Monument Creek and Fountain Creek. - Fountain Creek emerges from the mountains west of Colorado Springs and flows southeast through the city. Monument Creek joins from the north. The gravel deposits along both streams consist mainly of granitic material derived from the Pikes Peak Granite and the Dawson Formation. The granule and pebble fraction constitutes about 50 percent and sand, 25-40 percent, along both streams. Fines and oversize make up the remainder. The valley of Monument Creek contains little gravel north of Colorado Springs. South from Colorado Springs the gravel commonly ranges from about 10 to 50 feet (3-15 m) in thickness and locally is as much as 80 feet (24.5 m) thick. Thickest deposits are along the east side of Fountain Creek southeast of

GRAVEL DEPOSITS OF PEDIMENTS (MESA TOPS) AND UPLAND TERTIARY REMNANTS IN THE MOUNTAINS The gravel deposits of this unit lie mostly on broad flats 80-100 feet (24.5-30.5 m) or more above stream level east of the mountain front. A few patches of older gravel in the mountains along West Monument Creek are several hundreds of feet above stream level. Most of the gravel of this unit was deposited by streams emerging from the mountains, shifting from side to side and probably merging laterally. These deposits, therefore, are composed mainly of Pikes Peak Granite. The deposits contain little oversize material and generally more than 50 percent of granule and pebble sizes. They commonly contain large amounts of chalky calcium carbonate, especially in the upper few feet, and they commonly are downgraded physically and chemically by the processes of weathering. The deposits generally are 10-20 feet (3-6 m) thick. Despite their inferior qualities, the gravel deposits of this unit have been used extensively in the Colorado Springs

CEMENTED GRAVEL (CONGLOMERATE) Cemented gravel (conglomerate) is a generally inferior source of gravel in

the Front Range Urban Corridor. A very well cemented conglomerate, the Castle Rock Conglomerate, underlies upland areas and caps mesas and buttes north of the South Platte-Arkansas River drainage divide. This conglomerate is generally less than 50 feet (15 m) thick. The most abundant pebbles are granite, gneiss, quartzite, and white vein quartz. There are some chert pebbles and rhyolitic ash-flow tuff pebbles (Richardson, 1915). Although the deposit contains some boulders 1 foot (30.5 cm) or more in diameter, pebbles slightly larger than 2 inches (5 cm) are most common. The sandy matrix of the conglomerate is cemented by silica; hence, most of the formation would have to be quarried and crushed for reduction to aggregate. Locally, however, the basal part of the deposit is less well cemented than elsewhere and, hence, is more

SOURCES OF CRUSHED-ROCK AGGREGATE Five broad categories of rocks are potential sources of crushed-rock aggregate:

(1) Limestone and dolomite, (2) fine-grained igneous rocks, (3) coarse-grained igneous rocks, (4) foliated metamorphic rocks, and (5) sandstone and quartzite. Coarse-grained igneous rocks and foliated metamorphic rocks are present only in the mountains. Sandstone, quartzite, limestone, and dolomite occur both in the mountains and along the mountain front. Fine-grained igneous rocks are present only east of the mountains.

LIMESTONE AND DOLOMITE

Limestone and dolomite are currently being quarried as excellent sources of crushed-rock aggregate in the Colorado Springs area. A sequence of Paleozoic marine carbonate formations overlies the Cambrian Sawatch Sandstone (Scott and Wobus, 1973). Directly overlying the sandstone is 40 feet (14 m) of darkred finely to coarsely crystalline thin-bedded dolomite (Peerless Dolomite) overlain by about 185 feet (47 m) of reddish-gray limestone (Manitou Limestone). These carbonate rocks are separated from about 130 feet (40 m) of overlying dark-gray dense limestone (Leadville and Williams Canyon Limestones) by about 65 feet (20 m) of sandstone and shale (Harding Sandstone). All these formations together form a generally northeast-trending belt of outcrop from west of Manitou Springs to north of the Garden of the Gods. Large quarries in these rocks north of the Garden of the Gods supply most of the aggregate presently required by the building industry in the Colorado Springs area.

FINE-GRAINED IGNEOUS ROCKS

Light-gray fine-grained volcanic rock, classified as rhyolitic ash-flow tuff and containing 74-percent silica, locally forms a caprock on buttes and mesas or underlies Castle Rock Conglomerate that, in turn, caps buttes, mesas, and divides northward from a point a few miles north of Monument. Most of the rock is composed of devitrified glass shards; it is likely to be reactive in concrete and, therefore, would be unsuitable as concrete aggregate unless special low-alkali cement is used. The rock has been quarried extensively for use as crushed rock for road metal and, to a lesser extent, as building stone. This rock is part of a once-continuous ash-flow sheet probably less than 50 feet (15 m) thick (Izett, Scott, and Obradovich, 1969).

COARSE-GRAINED IGNEOUS ROCKS Coarse-grained igneous rocks, mostly granitic in composition, are distributed widely in the mountains. In the map area they consist mostly of Pikes Peak Granite and its lithologic variations, although Silver Plume Quartz Monzonite and Boulder Creek Granodiorite crop out in the southern part. The Silver Plume commonly is the best source of crushed-rock aggregate among the coarse-grained

These coarse-grained igneous rocks commonly are weathered or decomposed by chemical alteration to depths of tens of feet in many places beneath ridgelines and upland surfaces. In the canyon walls and the valley bottoms, the rocks tend to be less altered. The decomposed rock consists largely of separated but nearly unaltered mineral grains and is, in effect, simply a disaggregated granite. In places, however, the mineral constituents are altered to clay. Disaggregated granite has been used extensively in some parts of the mountains as road-surfacing material. On crushing, some of the coarser grained igneous rocks break along mineral boundaries and, hence, lack sufficient toughness to make good crushed-rock aggregate. Laboratory tests, therefore, may be needed to verify potential aggregate sources in these rocks. Most of the Pikes Peak Granite is pink to reddishtan medium- to coarse-grained granitic rock, but fine- to medium-grained phases are present locally. The coarse grain of much of the granite facilitates mechanical and chemical disintegration and renders the rock generally unsuitable as a source of crushed-rock aggregate. The naturally disintegrated Pikes Peak Granite, though, is well suited for surfacing material on secondary roads and has been used exten-

The Silver Plume Quartz Monzonite underlies a few square miles at the south end of the mountainous area of the Corridor. The rock is gray to pinkish buff and commonly medium grained, but locally grades from fine to coarse grained (Sheridan, Reed, and Bryant, 1972) and generally has tightly interlocked crystals. In parts of the rock, planar arrangements of feldspar crystals form vague to pronounced foliation. The Boulder Creek Granodiorite forms a rather broad band of outcrop at the

south end of the main body of Pikes Peak Granite. The Boulder Creek is darkgray medium-crystalline to coarsely crystalline granodiorite and quartz diorite and is generally gneissic. The Boulder Creek ranks generally below the Silver Plume in quality as a potential source of crushed-rock aggregate from coarsegrained igneous rocks, but some parts will provide crushed rock of high quality. METAMORPHIC ROCKS Metamorphic rocks, mostly gneisses and schists, compose those parts of the

mountains not formed of igneous rocks. The metamorphic rocks here occur

mainly as small masses lying between the major intrusive bodies of coarse-grained igneous rocks. Biotite gneiss predominates—a gray foliated rock composed mainly of quartz, plagioclase, and biotite. Subordinate types include hornblende gneiss and other variants. Most of these rocks probably were derived by reconstruction of older sedimentary rocks. Similar gneissic rocks are being quarried near Denver as a source of crushed-rock aggregate and riprap. SANDSTONE OR OUARTZITE

In the Colorado Springs area about 25 feet (7.5 m) of Cambrian sandstone or quartzite (Sawatch Sandstone or Sawatch Quartzite) rests on a nearly planar surface on the Pikes Peak Granite. This sandstone or quartzite is reddish brown, white, or green, fine to coarse grained, and locally very hard. Similar sandstone or quartzitic sandstone fills fractures as much as 30 feet (9 m) wide in the Pre-

EXPLANATION OF MAP UNITS

104°37′30″

GRAVEL DEPOSITS UNDERLYING FLOOD PLAINS AND TER-RACES - Source of best quality gravel for concrete aggregate and road metal. Pebbles generally well rounded and sound; gravel contains little interstitial lime (CaCO₃). Pebble composition reflects kinds of bedrock exposed in source area; granite, gneiss, pegmatite, and quartzite are most common. Little or no reactive constituents, except for silicic ash-flow tuff in deposits of Plum Creek and Cherry

GRAVEL DEPOSITS OF PEDIMENTS (MESA TOPS) AND UPLAND TERTIARY REMNANTS IN THE MOUNTAINS – Generally poor quality for concrete aggregate; locally useful as a source of road metal or subgrade material. Cobbly and bouldery near the mountains; pebbly to sandy farther east. Many unsound stones. Much caliche lime (CaCO₃) as cement and as coatings on stones CEMENTED GRAVEL (CONGLOMERATE) — Castle Rock Conglomerate commonly is very well cemented, in part by siliceous cement, but locally its base is only slightly cemented. Contains stones of volcanic, quartzitic, and crystalline rocks. Difficult to disaggregate for use as gravel.

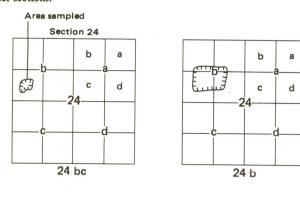
Less well cemented phases have been used locally as road metal LIMESTONE AND DOLOMITE – Excellent source of crushed-rock aggregate occurring only in the Colorado Springs area. The unit includes the Peerless Dolomite and the Manitou, Williams Canyon, and Leadville Limestones, which are quarried extensively for use as crushed-rock aggregate. The Peerless Dolomite (Upper Cambrian) and the Manitou Limestone (Lower Ordovician) together are about 225 feet (69 m) thick. The Harding Sandstone (Middle Ordovician), about 65 feet (20 m) thick, separates them from the overlying Williams Canyon and Leadville Limestones (Mississippian), together about 130 feet (40 m) thick. The Williams Canyon and Leadville Limestones are hard, dense, dark-gray limestones. The Niobrara Formation and Greenhorn Limestone of Cretaceous age and the Lykins Formation of Triassic(?) and Permian age all contain limestone along much of the mountain front in the Front Range Urban Corridor, but these limestone units are rel-

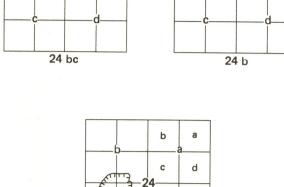
atively thin and contain much interstratified shale and, therefore, are

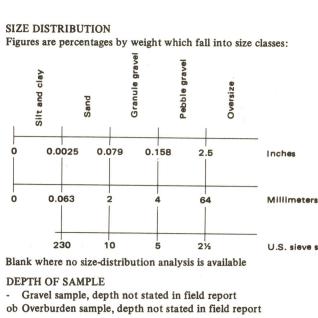
not shown on the map

EXPLANATION OF TABLE

SAMPLE LOCALITY Sample localities are listed by the section in which they lie, under the heading of township and range. Within the section, localities are listed by quarter section and quarter-quarter section. Quarter sections are lettered a, b, c, d, counterclockwise, beginning with the northeast quarter. Within quarter section, the quarter-quarter sections are lettered in the same manner (as 24 bc). Where only one letter is listed (as 24 b), the area sampled lies within more than one quarter-quarter section. Where two letters are listed, separated by a comma (as 24 b, c), the area sampled lies in both quarter sections.







DEPTH TO WATER TABLE Not stated in field report ? Stated in field report as unknown

system of county and pit number

ject. Numbers refer to indexing system of quadrangle and sample V, S Varnes, D. J., and Scott, G. R., 1967, General and engineering geology of the United States Air Force Academy site, Colorado: U.S. Geol. Survey Prof. Paper 551, 93 p.

Sample has been combined with samples from nearby localities

for representation on the map as a composite sample.

USGS U.S. Geological Survey, sampling for the purpose of this pro-

CDH Colorado Division of Highways. Numbers refer to their indexing

SOURCES OF INFORMATION

TABLE OF CAMBLE DATA

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3 ba	66	23 34 36	29 23	0	0 - 9 0 - 2 2 - 4.5 4.5- 9 1 SOUTH, R	1.4-2.7 ANGE 65 WES		USGS 8-1		2 cb	11 5 12 5 12	84 63 1 83 60 2			5 SOUTH, RAN 0 - 5 5 - 15 0 - 7.5 7.5- 19 0 - 8		?	?	CDH 4-88
6 da + cd	9	51 59 60 70	10 61 6 12 18 14 19 11 14 13	0 0 0 0	ob 0 - 5.5 5.5- 9 9 - 15 0 - 7	ob 0 -1.7 1.7-2.7 2.7-4.6	? ?	CDH 4-61 CDH 4-46		3 ca	14	35 1 80 45 1 34 2 32 48 1 39 1	0 31 5 5 3 25 5 30	0 7 0 14 12 0 0	8 -15.4 0 - 13 0 - 2 2 - 13 0 - 12 0 - 5 0 - 1	2.4-4.7 0 -4.0 0 -0.6 0.6-4.0 0 -3.7 0 -1.5 0 -0.3 0.3-3.7			CDH 4-37
5 da	5 3 6 3	86 57 66 72	7 7 7 15 15 6 5 15 22 18 13 10 3 22 12	0 0 0 0	2 SOUTH, R 0 - 2 2 - 11 1.3- 6 1.7- 4.5 3 - 12	0 -0.6 0.6-3.4 0.4-1.8 0.5-1.4 0.9-3.7	20 6.1	CDH 4-66		23 bc 29 c,d	15 57 6 52	28 1 32 1 47 1 32 1	8 9 2 38 5 41 6 28 4 41 4 2	2 0 7 7 2 7 0	1 - 8.5 0 - 1 1 - 5 5 - 13 0 - 0.5 0.5- 13 0 - 1	0.3-2.6 0 -0.3 0.3-1.5 1.5-4.0 0 -0.2 0.2-4.0 0 -0.3	90 2	?	CDH 4-92
9 cc D ad P bc ca	5 0 11 8 18 2	94 67 65 61 61 60	1 0 20 13 20 4 26 5 12 9 27 11 21 11	0 0 0 0	2 - 11 6 -10.5 3 - 11 4 - 20 4 - 5 9 - 10 0 - 8 5 - 20	0.9-3.4 -1.2-6.1 1.2-1.5 2.7-3.0 0 -2.4 1.5-6.1		V,S B-62 V,S B-54* V,S TP-3* V,S TP-1*		30 d 31 b 36 b	56 8 88 5 8 17 3 20 6	34 30 12 36 1 33 1 24 1 35 1 45	5 5 0 36 0 0 3 29 3 43 3 24	0 16 0	0 - 5 5 - 20 0 - 2 2 - 10 2 - 19 0 - 2.5 2.5 - 12 1 - 12	0 -1.5 1.5-6.1 0 -0.6 0.6-3.0 0.6-5.8 0 -0.8 0.8-3.7 0 -0.3	? 60]	? L8.3	CDH 4-12 CDH 4-57 CDH 4-20
5 bb	6 8 7 8	38 38 44 36	22 37 28 28 27 27 26 22 24 33	0 0 0 0 0	4.5- 11 11 - 13 15 - 20 5.5- 8 8 - 11 11 - 14 6 - 11	1.4-3.4 3.4-4.0 4.6-6.1 1.7-2.4 2.4-3.4		V,S TP-2		36 da	37 57 5	51 35 25	TOWNSH 5 7 5 3 5 36 TOWNSH	0 0 0 29	5 SOUTH, RAN 0 - 4 0 - 4 2 - 32	0 -1.2 0 -1.2 0.6-9.8	?	?	CDH 4-36
ó ac	7 7 4 25 13 22 30	41 37 38 43 56 47 53 34	24 28 37 19 28 30 12 20 15 16 15 16 6 11 16 38 4 36 5 22	0 0 0 0 0 0 0 10 30 33	11 - 14 1 - 4.5 3.5- 5.5 4 - 6 0 - 1 1 - 12 1 - 12 1 - 12 3 SOUTH, RA	0.3-1.4 1.1-1.7 1.2-1.8 0 -0.3 0.3-3.7 0.3-3.7	70 21.3	CDH 4-8		7 ac	20 14 30 4 11 72 5	47 2 41 1 38 1 27 35 1 37 31 1 43 21 27 1	3 32 3 22 7 32 6 33 9 24 5 43 7 27 5 27 5 10	0 4 10 0 14 2 0 7 12 0	0 - 2 2 - 10 1.5- 9.5 0 - 3.5 3.5- 6 6 - 24 0 - 1 1 - 26 9 - 15 0 - 5	0 -1. 5	10 50 1		CDH 4-23 CDH 4-24 CDH 4-84
5 bd	10 26 10 10 6	44 2 74 48 2 46 2 63 3	0 0 4 0 29 14 29 17 0 0 27 15 27 17 19 12	0 0 0 0 0 0 0	0 - 3 3 - 11 11 - 19 19 - 25 1 - 12 12 - 20 20 - 22 0 - 12	0 -0.9 0.9-3.4 3.4-5.8 5.8-7.6 0.3-3.7 3.7-6.1 6.1-6.7 0 -3.7	? ?	CDH 4-38*		l aa	73 33	26 30 44 20 36	2 2 3 1 8 38 4 3 5 23 TOWNSH		4 - 28 0 - 4 12 - 15 15 - 31 0 - 11 11 - 14 SOUTH, RAN			0.5	April -
5 ad	10	47 2	15 9 27 16 TOWNSH		0 - 12 0 - 12 3 SOUTH, RA	0 -3.7 0 -3.7 NIGE 66 WES		CDH 4-7		22 da	3	40 19		27	0 - 2 0 - 6 SOUTH, RANGE 1.5- 12 1.5- 12	0 -0.6 0 -1.8 GE 67 WES 0.5-3.7 0.5-3.7		?	CDH 4-18 CDH 4-52

FINE-GRAINED IGNEOUS ROCKS – Light-gray rhyolitic ash-flow tuff as much as 15 feet (4.6 m) thick. Locally underlies the Castle Rock Conglomerate and caps buttes or mesas from Castle Rock southward to a point a few miles north of Monument. This rock has been quarried both as building stone and as a source of crushed aggregate for road metal, but its suitability for concrete aggregate is diminished by reactive constituents

Rc COARSE-GRAINED IGNEOUS ROCKS – Crop out widely within the mountains. These rocks, with the probable exceptions of the Pikes Peak Granite and the pegmatites, are potential sources of high-quality crushed-rock aggregate. The Pikes Peak Granite is a nearly homogeneous pink granite or quartz monzonite that forms most of the mountainous area north of Little Fountain Creek. The Silver Plume Quartz Monzonite is a gray to pink rock that forms the southern part of the mountainous area. The Boulder Creek Granodiorite forms a belt of outcrop between the Pikes Peak Granite and the Silver Plume Quartz Monzonite METAMORPHIC ROCKS - Foliated biotite gneiss forms small bodies in the southern part of the mountainous part of the area. These rocks generally are not as good a source of crushed-rock aggregate as the

utilized near Denver

SANDSTONE OR QUARTZITE - The Sawatch Sandstone (Cambrian), which is about 25 feet (7.5 m) thick in the Colorado Springs area, and quartzitic sandstone fracture fillings (sandstone dikes) of similar material locally may constitute a source of crushed-rock aggregate

igneous rocks, but some of the gneissic rocks are presently being so

SHEAR ZONE — Crushed or broken rock along a major fault; generally much altered. Undesirable as a source of crushed-rock aggregate but sometimes excavated for road subgrade material or backfill

BOUNDARY OF DEPOSIT OR LINE OF CONTACT BETWEEN DE-

LARGE GRAVIEL PIT

ROCK QUARRY - Either operating or abandoned

DISTRIBUTION OF GRAIN SIZES IN GRAVEL DEPOSIT. IN PER-CENT BY WEIGHT - Diagram indicates analysis of a sample that contained 15-percent clay and silt, 35-percent sand, 30-percent granules and peblbles, and 20-percent oversize material (cobbles and boulders). Location is center of circle unless leadered to a point. Some sampled localities are indicated where extent of gravel-bearing part of formation is not known or where areal extent is too small to be shown

are sectional subdivisions. Numerical data are found in accompanying ABBREVIATED LOG OF DEPOSIT - From data furnished by Colorado Division of Highways and U.S. Geological Survey. Thicknesses shown

on the map. Number adjacent to diagram is land-net location: first

number is township, second number is range, third is section, and letters

cl Clay ss Sandstone st Silt 20 THICKNESS OF GRAVEL DEPOSIT – In feet

For sale by U.S. Geological Survey

Denver, Colo. 80225 and Reston, Va. 22092, price \$1.00