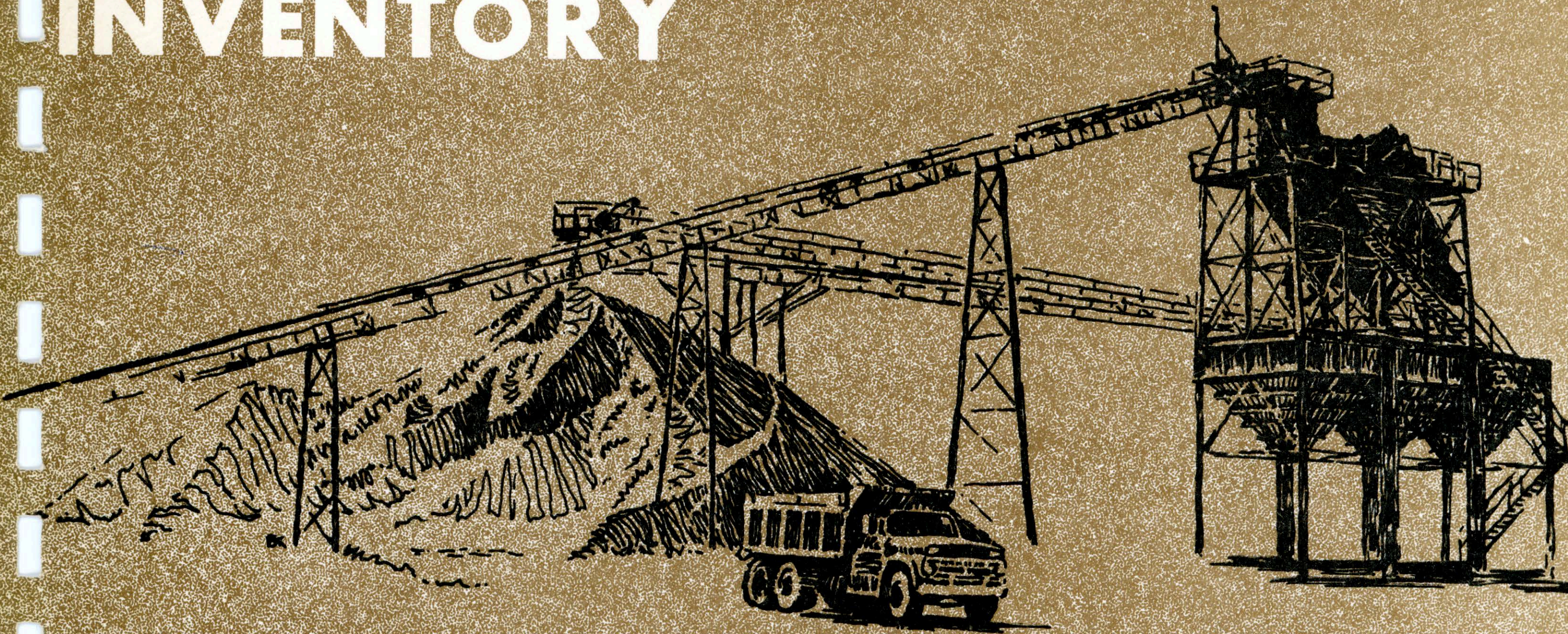
Environmental Geology Section

REPORT NO. 14

CONSTRUCTION MATERIALS INVENTORY



MORTON COUNTY, KANSAS

STATE HIGHWAY COMMISSION OF KANSAS

State Highway Commission of Kansas
Location and Design Concepts Department
Planning and Development Department

CONSTRUCTION MATERIALS INVENTORY OF MORTON COUNTY, KANSAS

by

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Photo Interpretation Section

Prepared in Cooperation with the
U. S. Department of Transportation
Federal Highway Administration

1971

Construction Materials Inventory Report No. 14

the **WHY ?**

WHAT ?

HOW ?

of This Report

This report was compiled for use as a guide when prospecting for construction material in Morton County.

> *Construction material includes all granular material, consolidated rock, and mineral filler suitable for use in highway construction.*

Known open and prospective sites, both sampled and unsampled, and all geologic deposits considered to be a source of construction material are described and mapped.

> *Prospective sites are select geologic locations where construction material may be found.*

The diagram opposite shows how the MATERIALS INVENTORY SECTION may be used to evaluate and locate <u>mapped sites</u>.

The individually mapped sites certainly do not constitute the total construction material resources of the county. And, the data outlined in the diagram may be used for purposes other than the evaluation and location of these sites.

Beginning on page 5 is a section explaining the geology of the county. This information (along with the maps, descriptions, and test data) provides the means of evaluating and locating additional construction material sources in the geologic units throughout Morton County.

TO LOCATE AND EVALUATE

A MAPPED SITE OF CONSTRUCTION MATERIAL IN MORTON COUNTY

TURN TO THE MATERIALS INVENTORY SECTION

See
TABULATION OF CONSTRUCTION MATERIALS
Figure 7, Page 15

for material
BY TYPE
USE COLUMN 1

For Quality Data
See Figure 12
Page 23

for material
BY INTENDED USE
USE COLUMN 2

for **DESCRIPTION** of material

Column 3 gives page of DESCRIPTION which includes engineering characteristics, approximate locations and references to materials map.

for **AVAILABILITY** of material

Column 4 gives relative amounts available, general location, and references to materials map.

MATERIALS MAP

SEE PINK SHEET, PAGE 25

Material source units, as well as all open sites, are mapped. Each site is referenced to an individual data form.

SITE DATA FORMS

OPEN SITES; NOT SAMPLED	GREEN SHEET, PAGE 27
OPEN SITES; SAMPLED	GREEN SHEET, PAGE 47
PROSPECTIVE SITES; SAMPLED	GREEN SHEET, PAGE 59
PROSPECTIVE SITES; NOT SAMPLED	GREEN SHEET, PAGE 63

Each site data form includes a map for site location, and provides information concerning landownership, material quality (if available), geologic age, and site accessibility.

CONTENTS

PREFACE

This report is one of a series compiled for the Highway Planning and Research Program, "Materials Inventory by Photo Interpretation." The program is a cooperative effort of the Federal Highway Administration and the State Highway Commission of Kansas, financed by highway planning and research funds. The objective of the project is to *provide a statewide inventory of construction materials*, on a county basis, to help meet the demands of present and future construction needs.

Three geologic investigations, "Geology and Ground-water Resources of Morton County" (1942) by T. G. McLaughlin, "Geologic Studies in Southwest Kansas" (1940) by H. T. U. Smith, and "Pleistocene Geology of Kansas" by J. C. Frye and B. A. Leonard, provide basic geologic information for this report. Detailed geologic and soil data were obtained from soil surveys and centerline geologic profiles prepared for design of major highways in the county by the State Highway Commission.

Appreciation is extended to Mr. G. B. Sigsbee, Sixth Division Materials Engineer and Mr. Roy Brown, Morton County Engineer for verbal information concerning construction materials in the area.

This report was prepared under the guidance of J. D. McNeal, State Highway Engineer, the project leader, R. R. Biege, Jr., Engineer of Location and Design Concepts; and G. M. Koontz and A. H. Stallard of the Location and Design Concepts Department.

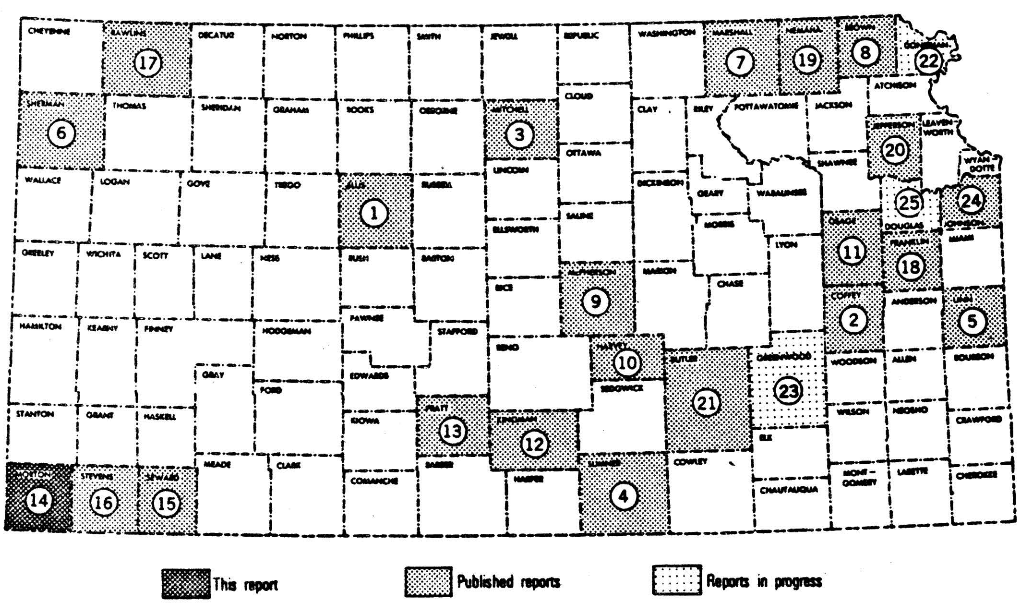


Figure 1. Index map of Kansas showing the location of Morton County along with the report number and location of other counties for which reports have been or are being completed.

ABSTRACT

Morton County lies in the High Plains physiographic division of Kansas in the extreme southwest corner of the state. The topography is flat to gently rolling, with the Cimarron River being the major drainage channel. Some of the drainage, especially in the Dune Sand and Loess-covered areas, is internal.

Material resources in Morton County consists of the Ogallala, Grand Island, and Sappa Formations, Dune Sand, and Alluvium and Terrace Deposits. Only sand and gravel from the Ogallala Formation, Grand Island Formation, and Alluvium and Terrace Deposits have been utilized for material purposes. Older consolidated bedrock units are exposed in small areas but have no material significance.

Because of the semi-arid climate and the granular nature of the surface material, geo-engineering problems are not severe except along the Cimarron River. During flood stage this river migrates widely and scours deeply in its channel sometimes washing out bridges and fills. Also, wind erosion may occur during dry seasons as a result of sparse vegetation cover on the sloping surfaces adjacent to a roadway.

Most ground-water contains a considerable amount of mineralization. Tests should be taken on all water prior to use in Portland Cement concrete.

GENERAL INFORMATION SECTION

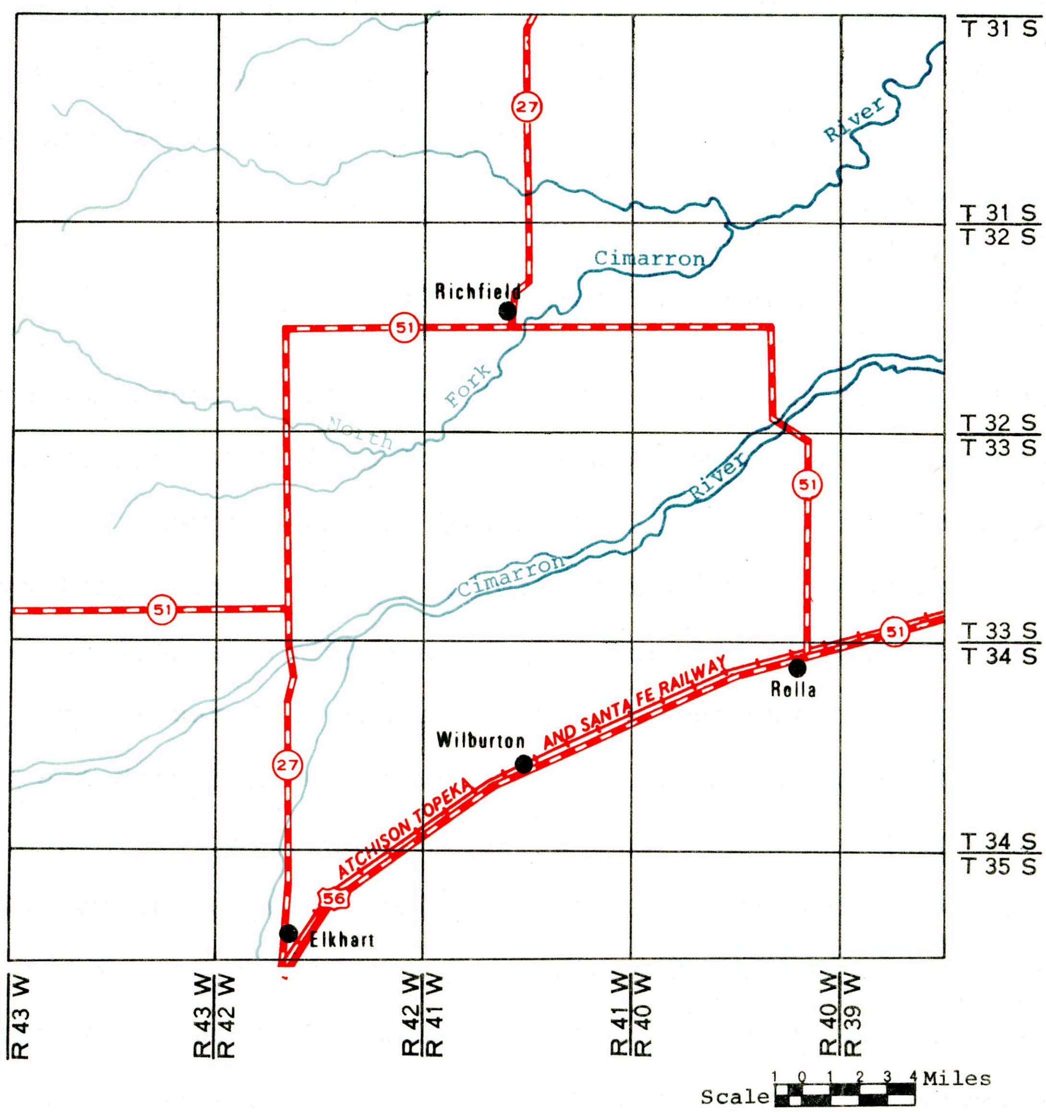


Figure 2. Drainage and major transportation facilities in Morton County.

FACTS ABOUT MORTON COUNTY

Morton County has an area of 733 square miles and a population of 3,576, according to the Bureau of the Census in 1970. Of the total population, 2,089 live in Elkhart, the county seat and principal city. The county lies in the High Plains physiographic division of Kansas in the extreme southwest corner of the state. Figure 2 illustrates drainage, railroads, and major highway locations.

METHODS OF INVESTIGATION

Investigation and preparation of this report consisted of three phases: (1) research and review of available information, (2) photo interpretation, and (3) field reconnaissance.

During phase one, relevant information concerning geology, soils, and construction materials of the county was reviewed and the general geology was determined. Quality test results of samples taken in Morton County were then correlated with the various geologic units and unconsolidated deposits.

Phase two consisted of study and interpretation of aerial photographs taken by the Kansas Highway Commission at a scale of one inch equals 2,000 feet. Figure 3 illustrates aerial photographic coverage of Morton County. Geologic source beds and all open materials sites were mapped and classified on aerial photographs. All materials sites were then correlated with the geology of the county.

Phase three was conducted after initial study of aerial photo-

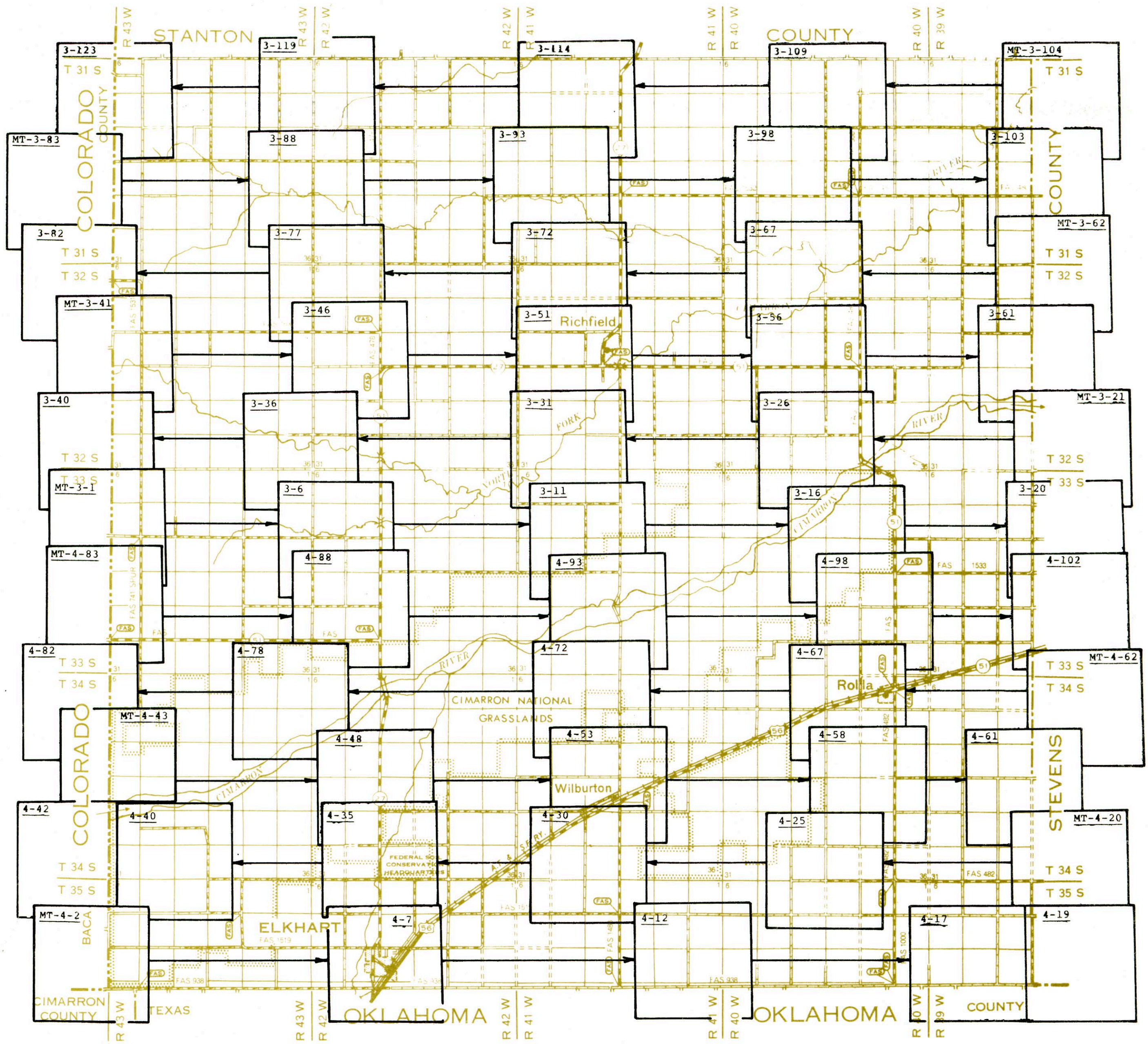
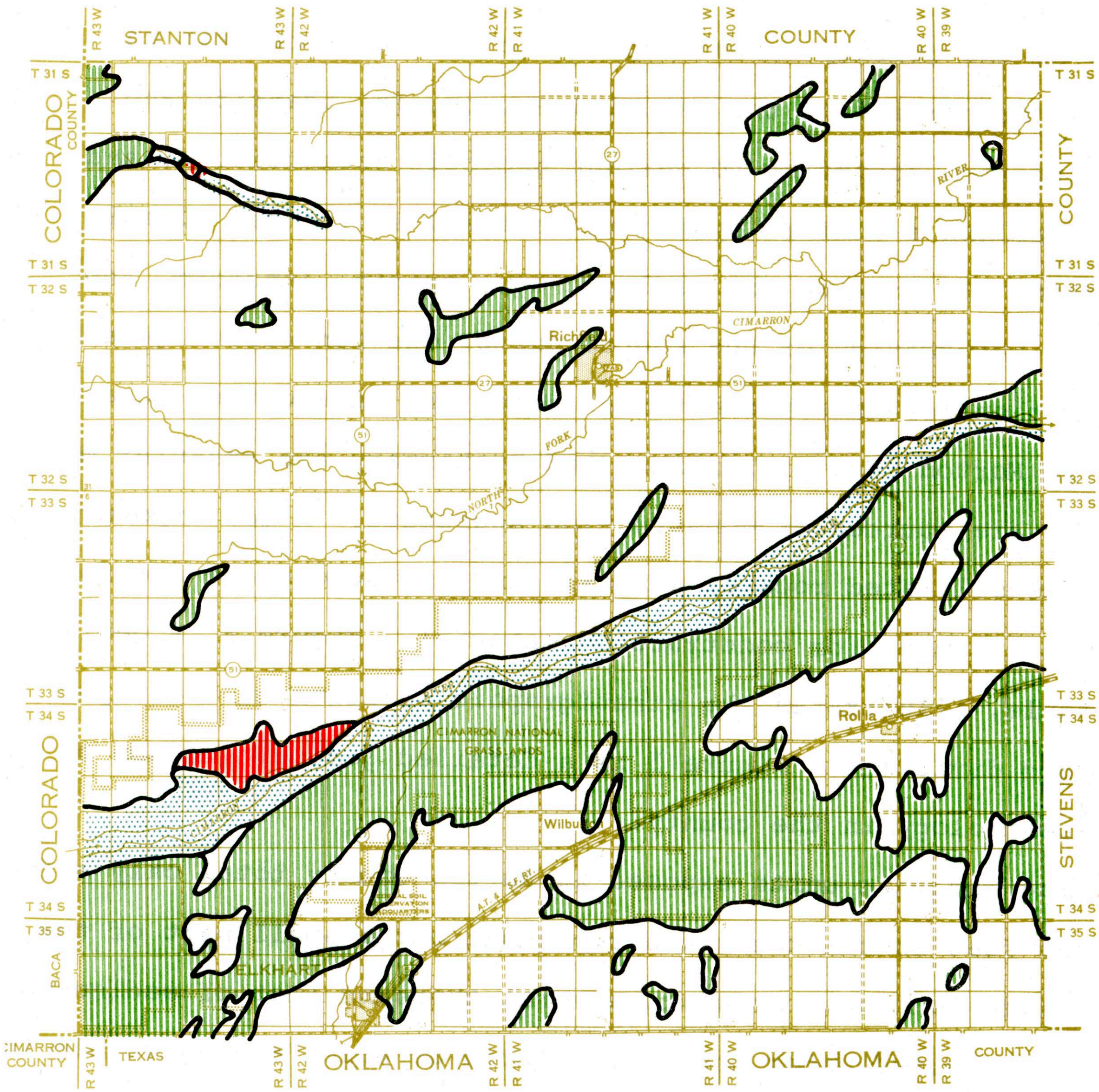


Figure 3. AERIAL PHOTOGRAPHIC COVERAGE MAP for Morton County. The numbers refer to photographs taken by the Photogrammetry Section, State Highway Commission of Kansas, on November 2 and 3, 1965 at a scale of 1" = 2000'. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.

graphs. A field reconnaissance was conducted by the author to examine construction materials, to verify doubtful mapping situations, and acquire supplemental geologic information. Geologic classification of open sites was confirmed and prospective sites were observed.

GEOLOGY SECTION



LEGEND

Alluvium and Terrace Deposits

Loess

Dune Sand

Ogallala, Sappa and Grand Island Formations

GENERAL GEOLOGY

GEOLOGY is the basis for this materials inventory. Knowledge of the geology makes it possible to: (a) ascertain the general properties of the material source, (b) identify and classify each according to current geologic nomenclature, and (c) establish a uniform system of material source bed classification. By knowing the geologic age, origin, landform, and quality information of the source units, one can derive general information for untested material sites and prospective locations.

In Morton County, Tertiary and Quaternary age granular materials are sources of construction aggregate. A few exposures of older consolidated rock of Jurassic and Cretaceous age are found but are not used for construction material. Figure 4, a geologic timetable, illustrates the stratigraphic position of the major geologic divisions. Figure 5 is a detailed geologic column of the surface geology in the county.

The geologic units exposed in Morton County total only a few hundred feet in thickness and represent but a small part of the total rock section. However, several thousand feet of sedimentary rocks are buried under the county, much of which are Paleozoic in age.

The oldest buried rock in Morton County is comprised in the Pre-Cambrian basement complex of igneous and metamorphic origin. Most Pre-Cambrian history can be interpreted only from scattered information obtained from drill logs.

Sedimentary limestone, shale, and sandstone of Paleozoic age

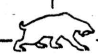
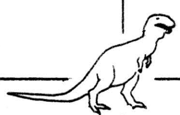
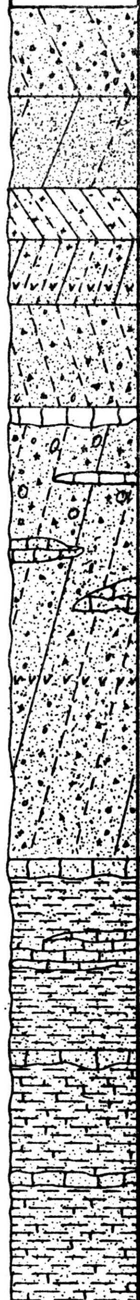
ERAS	PERIODS	ESTIMATED LENGTH IN YEARS	TYPE OF ROCK IN KANSAS	PRINCIPAL MINERAL RESOURCES
CENOZOIC	QUATERNARY (PLEISTOCENE) 	1,000,000	Glacial drift; river silt, sand, and gravel; dune sand; wind-blown silt (loess); volcanic ash.	Sand and gravel; volcanic ash; agricultural soils; water.
	TERTIARY	59,000,000	Silt, sand, and gravel; fresh-water limestone; volcanic ash; bentonite; diatomaceous marl; opaline sandstone.	Sand and gravel; volcanic ash; diatomaceous marl; water.
MESOZOIC	CRETACEOUS 	70,000,000	Chalky shale, dark shale, vari-colored clay, sandstone, conglomerate; outcropping igneous rock.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; ceramic materials; water.
	JURASSIC	25,000,000	Sandstone and shale, chiefly subsurface.	
	TRIASSIC	30,000,000		
PALEOZOIC	PERMIAN 	25,000,000	Limestone, shale, evaporites (salt, gypsum, anhydrite), red sandstone and siltstone, chert, and some dolomite.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; natural gas, salt, gypsum, water.
	PENNSYLVANIAN 	25,000,000	Alternating marine and non-marine shale; limestone, sandstone, coal, and chert.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and limestone and shale for cement; ceramic materials; oil, coal, gas, and water.
	MISSISSIPPIAN 	30,000,000	Mostly limestone, predominantly cherty.	Chat and other construction materials; oil, zinc, lead, and gas.
	DEVONIAN	55,000,000	Subsurface only. Limestone and black shale.	Oil.
	SILURIAN	40,000,000	Subsurface only. Limestone.	Oil.
	ORDOVICIAN	80,000,000	Subsurface only. Limestone, dolomite, sandstone, and shale.	Oil, gas, and water.
	CAMBRIAN 	80,000,000	Subsurface only. Dolomite and sandstone.	Oil.
PRE-CAMBRIAN	(Including PROTEROZOIC and ARCHEOZOIC ERAS)	1,600,000,000 +	Subsurface only. Granite, other igneous rocks, and metamorphic rocks.	Oil and gas.

Figure 4. Geologic timetable.



Graphic Legend	Thickness	System	Series	Stage	Formation	Generalized Description	Construction Material
	0 to 75'	Quaternary	Pleistocene	Wisconsinan and Recent	Alluvium and Terrace Deposits	Fine, medium and coarse sand with arkosic gravel and some silt; tan-brown in color.	Concrete Aggregate Bituminous Aggregate Base Course Aggregate Shoulder Material Light Type Surfacing
	0 to 75'				Dune Sand	Fine to medium sand with minor amounts of silt and clay; tan-brown in color.	Base Course Binder
	0 to 15'			Illinoisan Sangamonian and Wisconsinan	Loess	Clayey silt, tan in color with zones and nodules of caliche.	Embankment Subgrade and Slope Material
	0 to 100'			Kansan and Yarmouthian	Sappa Formation	Clayey silt and fine sand with caliche, tan-brown in color. May contain irregular beds of Pearlette volcanic ash.	Possible Light Type Surfacing (Caliche Gravel) Possible Mineral Filler (Volcanic Ash)
					Grand Island	Fine, medium and coarse sand and arkosic gravel with minor amounts of silt and clay; tan-brown in color.	Concrete Aggregate Bituminous Aggregate Base Course Aggregate Shoulder Material Light Type Surfacing
	0 to 600'	Tertiary	Pliocene		Ogallala Formation	Fine, medium and coarse sand and arkosic gravel with some cobbles, silt, clay and caliche; tan-brown to near white in color. Contains irregular calcium cemented zones termed mortar bed. Also contains some thin algal limestone and volcanic ash.	Concrete Aggregate Bituminous Aggregate Base Course Aggregate Shoulder Material Light Type Surfacing Building Stone (Cobbles)
	0 to 150'	Cretaceous	Lower Cretaceous		Dakota Formation	Only dark brown iron cemented sandstone found exposed, but the unexposed portions undoubtedly contain varicolored silty shales.	None
	300'±	Jurassic	Upper Jurassic		Undifferentiated Jurassic	Exposed portion composed of tan-brown and red sandstone and red silty shale.	None

Figure 5. Generalized geologic column of the surface geology in Morton County.

overlie the Pre-Cambrian. In early Paleozoic time (except possibly the Silurian and Devonian Periods) sediments were laid down in seas which covered a large part of western Kansas including Morton County. However, most deposits were removed during the Mississippian erosional cycle. Subsequently, marine limestone, shale, and some sandstone of Mississippian, Pennsylvanian, and early Permian age were deposited. Near the middle of the Permian, evaporites were formed in isolated basins caused by a general withdrawal of the seas. Later, continental red beds were deposited on broad mud flats and shallow basins.

The first half of the Mesozoic Era was characterized mostly by a continental environment in which erosion took place; however, red beds and sandstone were deposited during this time. Some of these deposits which belong in the Jurassic System are exposed near *Point Rock*, a few miles north of Elkhart.

In Cretaceous time, marine conditions returned to Morton County and the Cheyenne Sandstone was deposited. Later the dark gray Kiowa Shale was laid down, followed by sandstone and clay shale of the Dakota Formation. The Dakota Formation is exposed in a few places along the Cimarron River in Morton County.

Uplift of the Rocky Mountains ended the Mesozoic and the Cenozoic Era began. Most sediments of this era are unconsolidated clays, silts, sands, and gravels, but some cemented zones may be found, especially in the oldest deposits. The Cenozoic Era is divided into two systems, the Tertiary and Quaternary. The oldest Cenozoic deposits of Morton County were laid down during the Pliocene Epoch of the Tertiary Period. This unit, termed the Ogallala Formation, is a large alluvial fan extending out from the Rocky Mountains.

Cooler climatic conditions marked the end of the Tertiary and the beginning of the Quaternary Period. The Pleistocene Epoch of the Quaternary represents times of repeated glacial and interglacial cycles. Figure 6 is a geologic timetable of the Quaternary Period that shows the names and approximate length of each division. The glacial ages (Nebraskan, Kansan, Illinoisan, and Wisconsinan) represent times of advancement and retreat of glaciers. The three interglacial ages (Aftonian, Yarmouthian, and Sangamonian) were times of relative geologic stability. Although glaciation was restricted to the northeast part of the state, the sequence of glaciation played a controlling role in the development of Pleistocene nomenclature and the classification of deposits in Morton County.

Although Nebraskan glaciation indirectly caused some stream deposition in Morton County, the deposits were removed and (or) reworked by Kansan stream action.

The oldest Quaternary bed found in the county is the Kansan aged Grand Island Formation. This unit is composed mostly of silt, sand, and gravel. Later in the age, as stream velocities became slower, the Sappa Formation was deposited over the Grand Island. During deposition of the Sappa, volcanic activity in the Rocky Mountain area was the source of the wind-deposited *Pearlette Ash* zone.

During Illinoisan and Sangamonian time, barren stream valleys provided a source of Loess that blankets upland areas.

In Wisconsinan and Recent time, many topographic features

Divisions of the Quaternary Period

Period	Epoch	Age	Estimated length of age duration in years	Estimated time in years elapsed to present
Quaternary	Pleistocene	Recent		10,000
		Wisconsinan Glacial	45,000	55,000
		Sangamonian Interglacial	135,000	190,000
		Illinoisan Glacial	100,000	290,000
		Yarmouthian Interglacial	310,000	600,000
		Kansan Glacial	100,000	700,000
		Aftonian Interglacial	200,000	900,000
		Nebraskan Glacial	100,000	1,000,000

Figure 6. Geologic timetable of the Quaternary Period.

had developed into their present form. Sand dunes developed and low terraces were formed on both sides of the Cimarron River floodplain. In Recent time, undrained depressions have become prominent on the Dune Sand and Loess-covered terrain.

GEO-ENGINEERING

This section is a general appraisal of the material available in Morton County for use in highway construction. Potential ground-water problems and the quality of water available for concrete are briefly reviewed. *Detailed field investigations may be* *necessary to ascertain the severity of specific problems and to make recommendations in design and construction procedures.*

All geologic units except bedrock formations have been utilized for road construction purposes. Loess may have high plasticity indices, but this is not detrimental because of low annual precipitation. If granular material is disturbed during construction, erosion from wind and water will result.

Dunes are the most frequent erosional problem in road construction. When dunes are not stabilized by vegetation, it may be necessary to coat backslopes with asphalt to prevent erosion.

The Ogallala is the principal water bearing formation in Morton County. Other productive units include the Permian and Jurassic siltstones and sandstones, Cheyenne Sandstone, Dakota Formation, Grand Island Formation, and Alluvium and Terrace Deposits. Most ground-water contains a considerable amount of mineralization. Tests should be taken on all water prior to use in Portland Cement concrete.

Flood water of the Cimarron River is an age old problem. During flood stage the river scours both horizontally and vertically causing rapid meandering and deep erosion. On several occasions bridges and fills have been washed out. To help prevent loss of bridges, H-beam piling should be used because it generally will penetrate deeper into the unconsolidated material. A stream migration study, by use of aerial photographs, should be helpful in locating the most stable crossing area.

MATERIALS INVENTORY SECTION

GENERAL INFORMATION

Material resources of Morton County are restricted to the Ogallala, Grand Island, and Sappa Formations, Dune Sand, and the Alluvium and Terrace Deposits. Only sand and gravel from the Ogallala and Grand Island Formations, and the Alluvium and Terrace Deposits have been utilized in Morton County. The Sappa Formation may contain scattered zones of volcanic ash useful for mineral filler. Also, caliche laded zones in the Sappa are a possible source of low quality gravel. Select areas in the Dune Sand may yield a high plasticity index silt that is useful for base course binder.

Most material is produced from areas in and (or) near the Cimarron River valley. Away from the major drainage, thick Loess and (or) Dune Sand overburden prevent feasible recovery.

CONTENTS OF CONSTRUCTION
MATERIALS INVENTORY SECTION

TYPE and geologic source	USE	DESCRIPTION page	AVAILABILITY
Sand and Gravel Ogallala Formation	Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material. Riprap. Building stone.	16	Mostly found in the northern two-thirds of the county along the north side of the Cimarron River valley and at various points along the North Fork of the Cimarron River. Unit is shown on all materials map plates.
Grand Island Formation	Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material	17	Mostly found along the north side of the Cimarron River near the stream. Unit shown on all materials map plates in conjunction with the Ogallala Formation.
Alluvium and Terrace Deposits	Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material	19	Lies in a narrow band in the immediate area of the Cimarron River. The river traverses the central portion of the county from southwest to northeast. Unit shown on plates III, IV, and V.
Mineral Filler and(or) Caliche Gravel Sappa Formation	Economic material sources not recognized at present time in Morton County; however, if found, caliche gravel may be used for light type surfacing and volcanic ash for mineral filler.	20	Most likely found near the major drainage. The map unit is shown on all materials map plates in conjunction with the Ogallala and Grand Island Formation.
Clay-bound Silt Loess	Embankment, subgrade, and slope material.	21	Mostly found in the southern one-third of the county south of the Cimarron River. Unit is shown on all materials map plates.
Binder Soil Dune Sand	Base course binder.	22	Mostly in the southern one-third of the county south of the Cimarron River. Unit is shown on all materials map plates.

Figure 7. Tabulation of the construction material types and their availability in Morton County.

DESCRIPTION OF CONSTRUCTION MATERIALS

Sand and Gravel

Ogallala Formation

The Ogallala Formation, which may be as much as 600 feet thick, consists of tan and locally white colored clay, silt, sand, gravel, and cobbles (figure 7). Nodules and thin veins of caliche are scattered throughout the formation. The coarse material contains pieces of granite, lava, sandstone, siltstone, and limestone. Secondary calcium carbonate coats the coarser grains in some areas. Some material, cemented with calcium carbonate, forms weather-resistant outcrops termed *mortar bed*. Also, fresh water *algal limestone* is found at scattered localities.

Figure 7. Coarse gravel and cobbles in the Ogallala Formation, NW¼, sec. 20, T31S, R39W.

Quality test data on the Ogallala show a Los Angeles wear range of 29.1 to 32.8 percent and a soundness loss ratio value of 0.97 to 0.98. The absorption on one sample was 1.88 percent. Additional test information is shown in figure 12, page 23. The material may be used for concrete and bituminous aggregate, base course, shoulders, and light type surfacing. A limited amount of cobbles have been used for ornamental building purposes and for erosional protection in gullies and on steep slopes.

Although the Ogallala underlies most of the county, it is exposed mostly along the north side of the Cimarron River valley and at various places along the North Fork of the Cimarron. Only where *mortar bed* and (or) *algal limestone* are found does the formation make a prominent outcrop (figure 8). Except for the cemented phase, it is difficult to distinguish between the Ogallala Formation and the younger Sappa and Grand Island Formations. Thus, the units were mapped together as the Ogallala and Sappa-Grand Island Formation map unit (To & Qsgi symbol). This unit is shown on all six materials map plates.

Grand Island Formation

The Grand Island Formation is composed of tan-colored silt, sand, and arkosic gravel (figure 9). This formation, which may be as much as 100 feet thick, differs from the Ogallala in that it contains less calcium carbonate coating on the grains, little or no cementation, and no cobbles.

It should be noted that material may be produced from both the Grand Island and Ogallala Formations at one location. For example an operation may start in the Grand Island, then extend

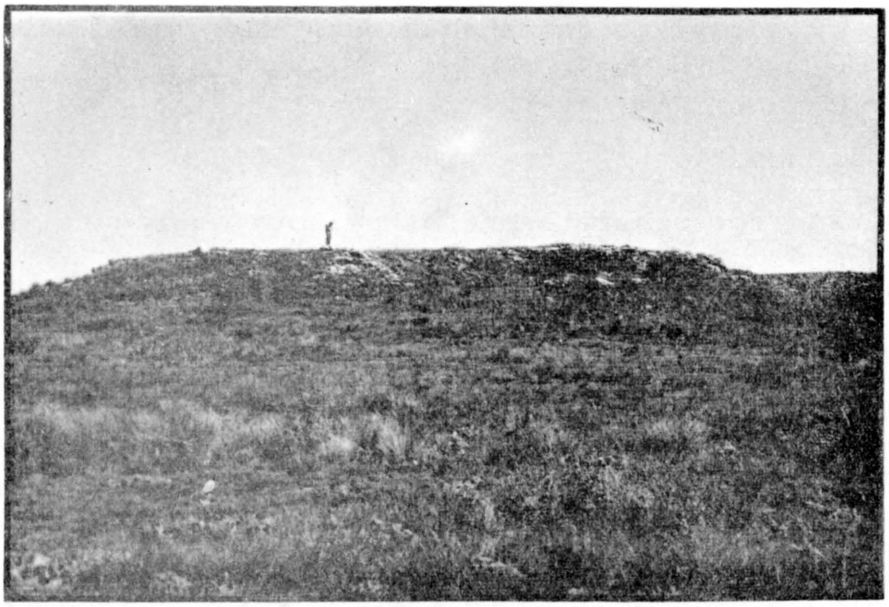


Figure 8. Mortar bed in the Ogallala Formation along the Cimarron River in southwest Morton County, SE¼ sec.33, T33S, R42W.

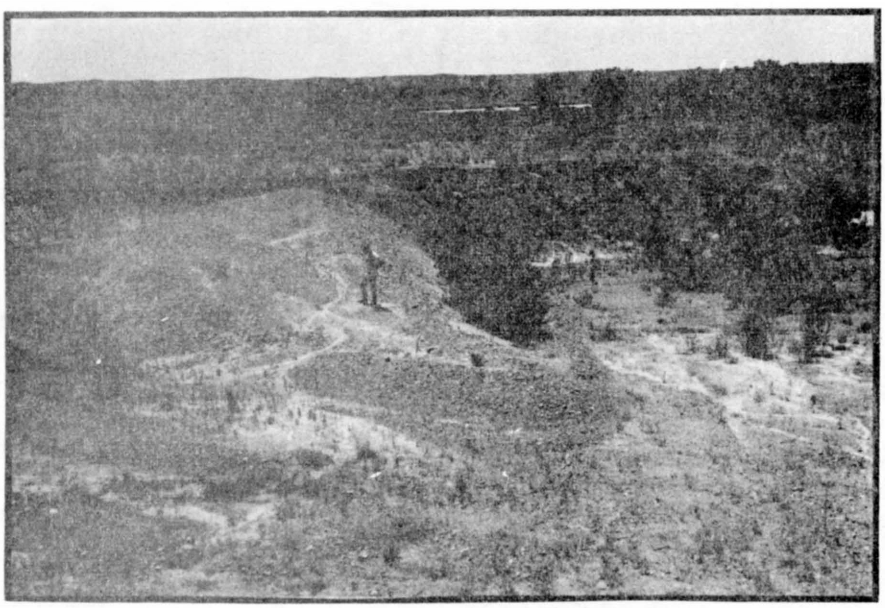


Figure 9. Pit in the Grand Island Formation, SW¼ sec.2, T33S, R4W.

into the Ogallala.

The Grand Island is probably the best quality material found in Morton County, though relatively little testing has been conducted. Material from this unit has been used for concrete and bituminous aggregate, base course, shoulder material, and light type surfacing material.

The formation is exposed in a narrow band on the north side of the Cimarron River. It is shown on all materials plates as the Ogallala Formation and Sappa-Grand Island Formation map unit (To & Qsgi symbol).

Alluvium and Terrace Deposits

Only the Alluvium and Terrace Deposits in the Cimarron River valley contain construction material. The unit is a tan-colored silt, sand, and gravel (figure 10). Maximum thickness is estimated to be 75 feet.

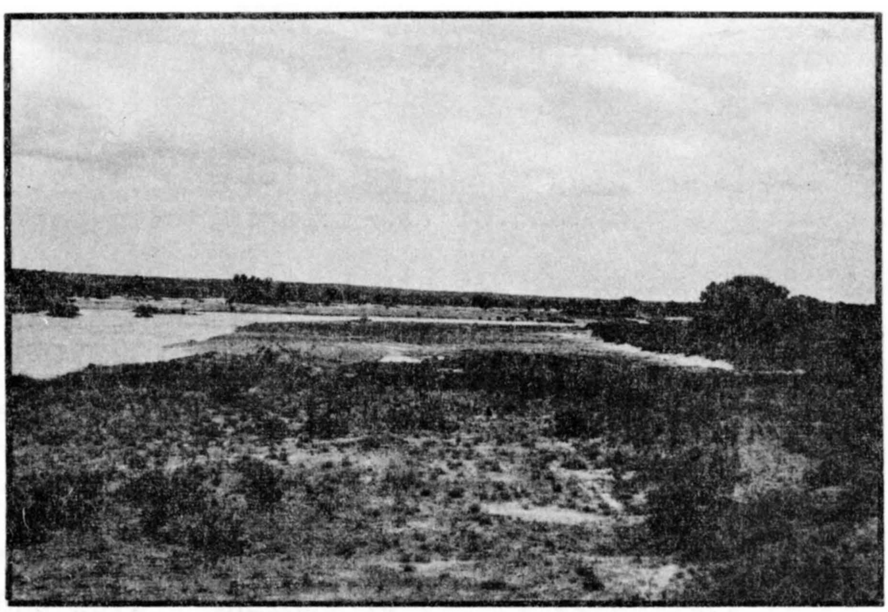


Figure 10. Alluvium and Terrace Deposits in the Cimarron River valley.

Material has been produced by pumping at several locations along the Cimarron River; however, these operations have not proven feasible largely because of the abundance of fine sand and thin clay lenses. According to the county engineer, pumping operations are hindered at some locations by large cobbles. Where cobbles are encountered, the operation has undoubtedly extended through the Alluvium and penetrated the Ogallala Formation.

One quality test showed a Los Angeles wear value of 34.8 percent. Although soundness and absorption values were not available, they are probably similar to the Ogallala and (or) Grand Island Formation from which it was derived. Gradation information is shown in figure 12 (page 23). Material from this unit may be used for concrete and bituminous aggregate, base course, shoulder aggregate, and light type surfacing material. It is shown on materials map plates III, IV, and V (Qal symbol).

Mineral Filler and (or) Caliche Gravel

Sappa Formation

The Sappa Formation is composed of tan-colored, clay-bound silt with accumulations of *caliche*. It has limited exposure, except in certain areas along the Cimarron River. In Grant, Seward, and Meade counties the formation can be identified by the presence of the *Pearlette volcanic ash* zone.

Material has not been utilized from this unit in Morton County. However, it is a possible source of caliche gravel and volcanic ash. Caliche can be used for light type surfacing and the ash is an important source of mineral filler. Caliche accumulations are not as extensive in Morton County as those found to the east in Seward County.

Test information is not available on the Sappa Formation in this County. However, data from other areas show that ash in the pure state has a plasticity index of zero and the caliche gravel is generally soft and of poor quality. The Sappa is shown on the materials map in conjunction with the Ogallala and Grand Island Formations (To & Qsgi symbol).

Clay-Bound Silt

Loess

Much of the upland stream divide areas, especially north of the Cimarron River, is covered by a thin layer of clay-bound silt. This wind-deposited material termed *Loess* generally does not exceed 15 feet in thickness. Typical of the Loess-covered area is a nearly flat terrain that is usually the best farm land in the county. Loess may thinly veneer many areas; however, it is shown as a map unit only where a substantial thickness has accumulated.

Although Loess is normally not considered a material source, it is included in this inventory mainly because of its large areal extent.

On road construction projects that traverse the Loess, it is used for embankment and subgrade. Since it supports vegetation relatively well, it is useful for slope material.

No quality information is available on this material. Loess is shown on all materials map plates (Ql symbol).

Dune Sand

Dune Sand topography is prominent in the southern one-third of the county south of the Cimarron River with small scattered areas to the north (figure 11). The thickness of this material probably does not exceed 75 feet.

Figure 11. Dune Sand topography in eastern Morton County.

Dune Sand has not been utilized in Morton County for material purposes, however, *select* sites in other Kansas counties provide a source of a high plasticity index silt that is useful for base courses.

Gradation information on some Dune Sand is shown in figure 12, page 23. Dunes are shown on all materials map plates (Qds symbol).

Site No.	Material Type	Percent Retained 1½	3/4	3/8	4	8	16	30	50	100	Wash	G.F.	P.I.	L.L.	Sp.Gr. Wet	Sp.Gr. Dry	Wt/Cu. Ft.	LA Wear	Soundness	Absorption	Source of Data
Source of Material: Ogallala Formation To-Qsgi																					
SG+20	Sand & Gravel	--	3	9	14	19	27	48	86	97	3.0	3.05	17	0	2.61	---	117.2	32.8(B)	0.98	----	Av. 4 samples, SHC Form 619 No. 65-1
SG-25	Sand & Gravel	--	9	17	26	34	42	60	88	97	3.0	3.73	16	1	2.55	---	119.1	30.0(B)	0.98	----	Av. 4 samples, SHC Form 619 No. 65-3
SG-18	Sand & Gravel	5	18	31	39	43	57	70	91	98	1.0	4.52	--	-	2.62	---	125.3	32.1(B)	0.98	----	SHC Form 633, Lab. No. 66383
SG-21	Sand & Gravel		11	18	25	31	--	--	--	92	4.8	3.42	--	-	2.59	---	------	-------	----	----	SHC Form 245, Lab. No. 22480
SG+24	Sand & Gravel	9	19	30	40	47	54	67	84	92	8.0	4.42	--	-	2.59	2.54	116.12	29.1(C)	0.97	1.88	SHC Form 633, Lab. No. 65-350
Source of Material: Grand Island Formation To-Qsgi																					
SG-23	Sand & Gravel	--	2	12	19	27	39	58	83	94	4.0	3.34	--	-	2.58	2.56	116.0	31.9(C)	0.98	----	SHC Form 633, Lab. No. 36308
SG+19	Sand & Gravel	--	--	14	32	44	55	69	87	96	4.0	3.97	--	-	----	----	-----	------	----	----	SHC Form 633, Lab. No. 42779
SG-22	Sand & Gravel	--	--	2	6	17	37	71	95	99	1.0	3.27	--	-	----	----	-----	------	----	----	SHC Form 245, Lab. No. 15242
Source of Material: Dune Sand Qds																					
SI-28	Silt	0	0	0	0	0	2	6	18	40	60.0	----	--	-	2.63	----	77.6	------	----	----	SHC Form 623, Lab. No. 53885
SI-27	Silt	0	0	0	0	0	0	1	5	19	75.0	----	--	-	2.63	----	84.9	------	----	----	SHC Form 623, Lab. No. 53884
Source of Material: Alluvium Qal																					
SG+26	Sand & Gravel	0	0	7	10	35	46	65	98	99	4.8	3.60	--	-	----	----	-----	34.8(B)	----	----	SHC Form 633, Lab. No. 42149

Figure 12. Results of tests completed on samples of material from geologic source beds in Morton County.