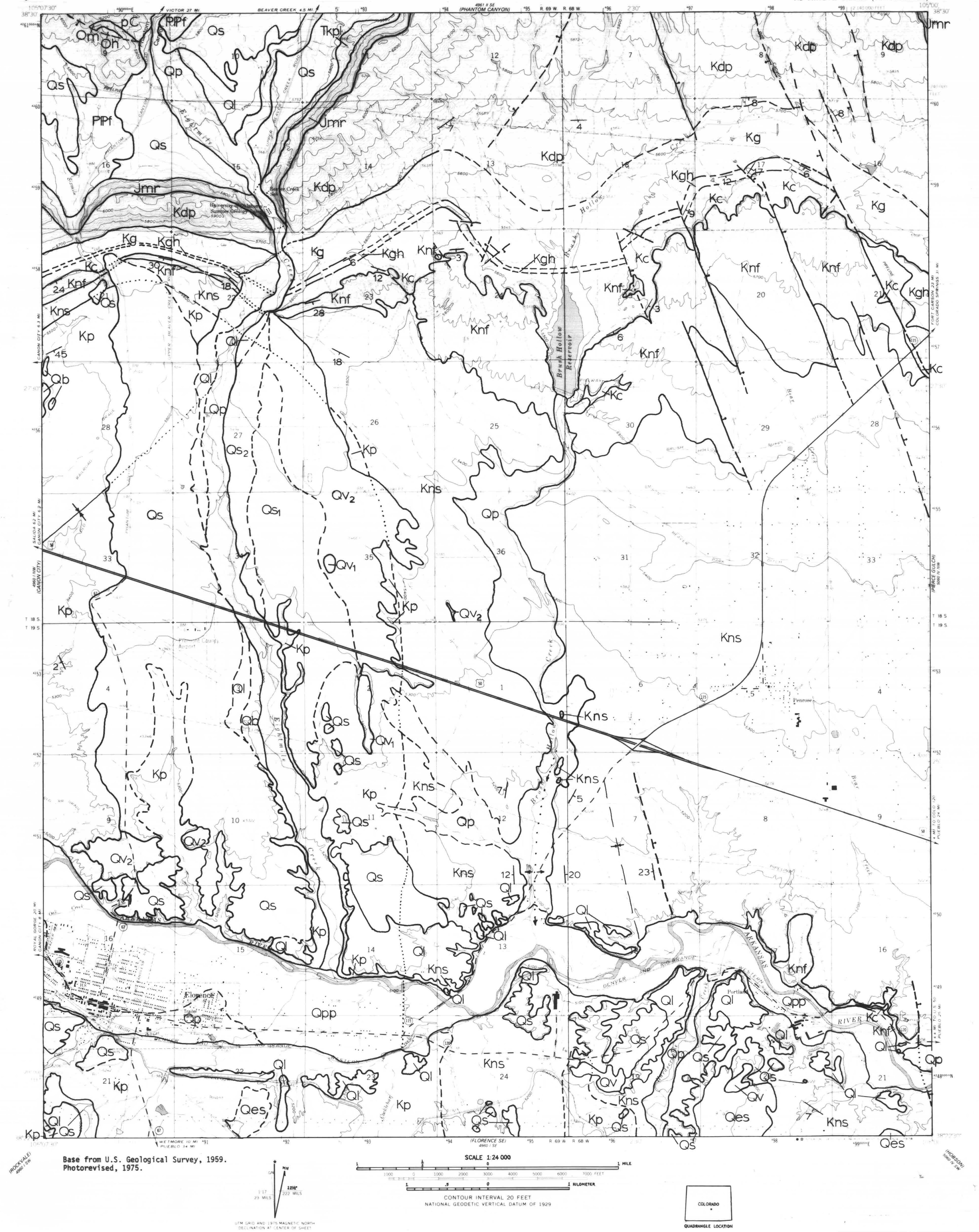
COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

FLORENCE QUADRANGLE
COLORADO—FREMONT CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



RECONNAISSANCE GEOLOGIC MAP OF THE FLORENCE QUADRANGLE

by Bruce W. Beach

This Reconnaissance Geologic Map of the Florence 7 1/2-minute Quadrangle was prepared as part of Colorado School of Mines Thesis T-2532 with support of the Colorado Geological Survey. As an open-file map it should be considered preliminary to a subsequent formal publication which will be edited and redrafted. In addition the formal publication will include an extensive explanatory text based on the thesis.

DESCRIPTION OF MAP UNITS

Quaternary

Post Piney Creek Alluvium (Qpp)
Brownish-gray, poorly sorted, gravelly sand about 2-3 feet (1m) above modern drainages. Source of excellent quality aggregate.

Piney Creek Alluvium (Qp)
Grayish-brown, poorly sorted, silty gravel with humus. Terrace is about 20 feet (6m) above the Arkansas River and is mapped in broad upland valleys. Weakly developed soil. Source of excellent quality gravel.

Eolian Sand (Qes)
Light-brown to yellow, well-sorted, cross-bedded, non-cemented sand. Moderately developed soil and unit is about 10-20 feet (3-6m) thick.

Broadway Alluvium (Qb)
Yellowish-brown, bouldery gravel about 40 feet (12m) above the Arkansas River. Terrace has moderately well developed soil and is about 10 feet (3m) thick. Source of good quality gravel.

Louviers Alluvium (Ql)
Yellowish-gray, cobbly gravel, poorly sorted, poorly stratified about 80 feet (24m) above the Arkansas River. Terrace is about 20 feet (6m) thick and has a well developed soil. Good source of aggregate.

Slocum Alluvium (Qs)
Yellowish-red to grayish-orange, well stratified, poorly sorted gravel with reworked shale. Usually covered by light brown silt or clayey sand, occurs at two terrace levels, 120 feet (36m) and 170 feet (52m), above drainages. Unit can be very poorly sorted, clay- or silt-rich. Well developed soil on units about 5-10 feet (2-6m) thick.

Verdos Alluvium (Qv)
Yellowish-brown to grayish-brown, coarse sand and gravel, well rounded, weathered clasts. Two levels, 180-230 feet (55-70m) and 290 feet (88m) above the Arkansas River. Units about 20 feet (6m) thick with well developed soils.

Upper Cretaceous — Pierre Shale (Kp)
Dark-gray, olive-gray to black clayey, silty, and sandy shale, containing bentonite beds and several zones of marine fossils (Scott and Cubban, 1975); thickness varies from less than 100 feet (30m) to over 4000 feet (1200m) in the Canon City-Florence Basin, contains cone in cone structures and limonitic concretions.

Upper Cretaceous — Smoky Hill Shale (Kns)
Light-gray, yellowish-brown, calcareous, fissile shale, chalk, and limestone; about 570 feet (171m) thick, top of unit is set at the orange weathering chalky ledge.

Upper Cretaceous — Fort Hays Limestone (Knf)
Light-gray, fine-grained, hard, fossiliferous limestone, interbedded with thin, calcareous shale; 30-40 feet (9-12m) thick, formerly named Timpas Limestone, forms a ledge or hogback with underlying Codell Sandstone and Juana Lopez calcarenite.

Upper Cretaceous — Carlile Shale (Kc)
Juana Lopez Member, brown, fossiliferous calcarenite, 3 feet (1m) thick; Codell Sandstone Member, light-brown to gray, fine-grained, calcareous sandstone, 30 feet (10m) thick; Blue Hill Shale Member, dark-gray to black, fissile, noncalcareous shale, 100 feet (30m) thick; Fairport Chalky Shale Member, yellowish-brown to black, fissile, calcareous shale, 100 feet (30m) thick; mostly non-resistant, forming minor valley between the Greenhorn and Fort Hays Limestones.

Upper Cretaceous — Greenhorn Limestone (Kgh)
Bridge Creek Limestone Member, bluish-gray, thin-bedded, dense, hard, limestone interbedded with thick, gray, calcareous shale, 40 feet (13m) thick; Hartland Shale Member, dark-gray, calcareous shale, 60 feet (20m) thick; Lincoln Limestone Member, dark-gray calcareous shale and thin-bedded calcarenite, 40 feet (13m) thick; limestones vertically jointed, unit forms a low hogback.

Upper Cretaceous — Graneros Shale (Kg)
Light- to dark-gray, argillaceous, fissile, noncalcareous shale, minor clay beds and limestone layers; 115 feet (24m) thick, with cone in cone structures in the lower 60 feet (20m).

Lower Cretaceous — Dakota Group (Kdp)
Dakota Sandstone, light-tan to yellowish-brown, fine- to medium-grained, friable, massive- to thin-bedded, cross-bedded, sandstone; with minor shale, claystone, and conglomerate; 80-100 feet (25-30m) thick, forms distinctive, massive hogback. Glencairn Shale, tan to brown, thin-bedded, fine- to medium-grained sandstone with gray to black, sandy, fissile shale and clay; 80 feet (25m) thick;
Lytle Sandstone, white medium- to coarse-grained, cross-bedded sandstone, conglomerate and variegated clays; 40-110 feet (15-33m) thick.

Upper Jurassic — Morrison Formation (Jmr)
Gray, maroon, red and green sandstone, siltstone, lenticular limestone and shale with minor conglomerates; 300-350 feet (110-115m) thick, commonly displays landslide deposits.

Upper Jurassic — Ralston Creek Formation (Jmr)
Greenish-gray siltstone, claystone, shale and evaporite (gypsum), arkosic sandstone and conglomerate, mostly in the southwestern map area; 20-50 feet (7-16m) thick, ledge and slope former with the Morrison.

Triassic-Permian — Lykins Formation (Tkpl)
Red shale and siltstone overlain by wavy bedded gray limestones with red and purple shales; about 100 feet (30m) thick, non-resistant to erosion, valley and lower slope former.

Permian-Penn. — Fountain Formation (PPf)
Red, arkosic, cross-bedded, conglomerate and sandstone, siltstone and dark reddish-brown shale, minor lenticular limestones; 1000-1400 feet (300-430m) thick, valley former with lower section forming resistant 'flat-irons.'

Lower Ordovician — Harding Sandstone (Oh)
White to pink, thin-bedded, fine-grained sandstone with interbedded gray to red shale; about 100 feet (30m) thick.

Lower Ordovician — Manitou Limestone (Om)
White to pink, coarsely crystalline limestone with bedded chert, weathers to dark red color, about 20-40 feet (6-12m) thick.

Precambrian — Idaho Springs Formation (pC)
Light-gray to white, fine-grained, dense quartzites; red to gray, coarse-grained Pikes Peak granite; biotite-plagioclase-rich gneiss; dense, hard, and fractured.

SYMBOLS

Contact - Dashed where approximately located, dotted where concealed.

Fault trace - Ball on downthrown side. Dashed where approximately located, dotted where concealed.

Anticline - Arrow in direction of plunge. Dotted where concealed.

Syncline - Arrow in direction of plunge. Dotted where concealed.

ATTITUDE OF BEDDING

16 Inclined

Vertical

REFERENCES

Gerhard, L.C., 1961, Geology of the lower Phantom Canyon area, Fremont County, Colorado: Unpubl. M.S. Thesis, University of Kansas.

Mann, C.J., 1957, Geology of the Chandler Syncline, Fremont County, Colorado: Unpubl. M.S. Thesis, University of Kansas.

COLORADO GEOLOGICAL SURVEY
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OPEN FILE 83-5
PLATE-2

FLORENCE QUADRANGLE
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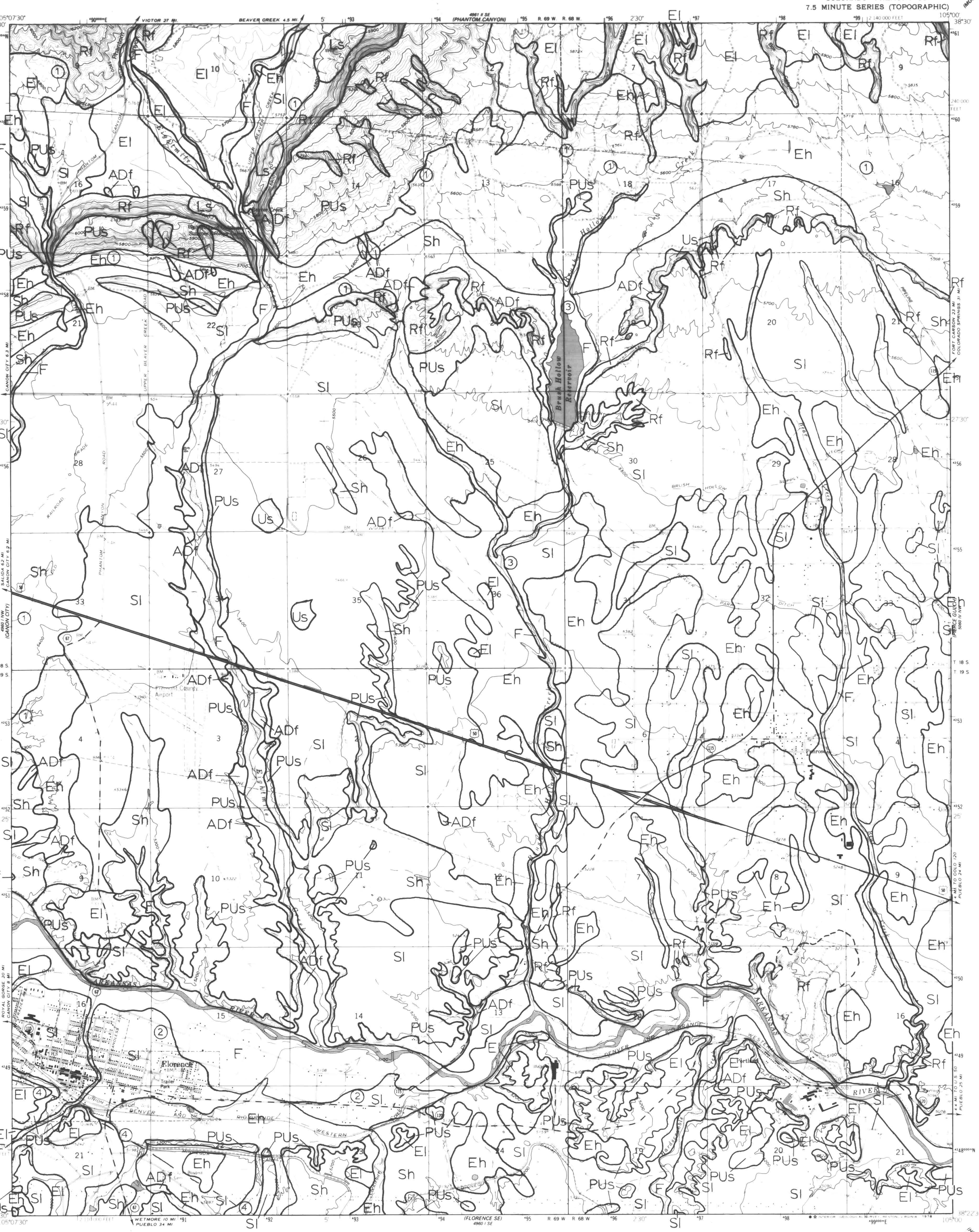

Base from U.S. Geological Survey, 1959.
Photorevised, 1975.

REFERENCES

Lampiris, N., Unpubl. maps, Geologic hazards and natural resources of Fremont County, Colorado: available from County Land-Use Board, Canon City, Colo.

Rogers, et al., 1974, Guidelines and criteria for identification and land-use controls of geologic-hazard and mineral resource areas: Colo. Geol. Survey Spec. Paper 6, 146 p.

NOTES

1. Numerous small alluvial/debris fan areas occur at the base of most slopes.
2. Corrosive soils.
3. Flood hazard difficult to evaluate because of dam and/or housing construction.
4. Ground subsidence hazard may exist south of this line.

GEOLOGIC-HAZARD MAP OF THE FLORENCE QUADRANGLE

by Bruce W. Beach

This Geologic Hazards Map of the Florence 7 1/2-minute Quadrangle was prepared as part of Colorado School of Mines Thesis T-2532 with support of the Colorado Geological Survey. As an open-file map it should be considered preliminary to a subsequent formal publication which will be edited and redrafted. In addition the formal publication will include an extensive explanatory text based on the thesis.

INTRODUCTION

Geologic hazards are related to normal geologic processes. Hazards result from the adverse interaction between the geologic/physiographic conditions and man. The purpose of this hazard study is to identify problem areas, to prevent the creation of new hazard areas or increasing the risk associated with existing areas, and to assist planners in making rational land-use decisions. Mapping units used in this study generally conform to the definitions provided by Rogers, et al. (1974). More information on geologic hazard identification and mitigation procedures can be found in the same reference.

Designation as a 'geologic hazard area' does not necessarily mean that development can not take place or that high risks are implied. Identification only means that the probability exists that conditions in the area could have an adverse impact on land-use. The mapping scale limits the size of identifiable hazard areas, some areas will contain small zones of other hazards. More than one hazard commonly occur together, but for map clarity only the most predominant hazard is designated. The user should investigate every project on a site-specific basis with full appreciation of the overlap and gradational nature between hazard areas. Every hazardous process should be reviewed during an investigation in any one geologic hazard area.

This map and legend were designed as reference material for county planners and only as guides for more detailed site-specific studies. These products represent generalized conditions over a broad zone and serve only to familiarize the site planner with the types and extent of hazardous processes that he might encounter. Information provided in these products should not be used as the basis for engineering design but only as information that should be included in a review of proposed land-use changes.

HAZARD DESCRIPTION

LANDSLIDE AREA

Ls

Areas where active slope failures can be identified. Evidence for slope movement includes both geologic and physiographic features. Hummocky terrain, steep scarps, disrupted vegetation, and deranged drainage patterns might be present. Slope aspect, gradient, ground moisture conditions, and vegetation all affect landslide activity.

Boundaries are generally distinct. Conditions leading to landsliding can occur outside the areas and are influenced by both natural processes and man. Risks resulting from landslides include damage to housing, utilities, and lines of communication.

UNSTABLE-SLOPE AREA

Us

Slope areas that have been failure zones in the recent geologic past, possibly under different climatic conditions. Evidence for present day activity is missing or uncertain. Physiographic features are similar to those in landslide areas but more subdued. The same surficial processes and conditions that influence landsliding also influence unstable slope areas.

Boundaries are generally easy to identify. These areas can be considered in 'metastable equilibrium' and any changes in present conditions, either natural or man-made, can reactivate failure activity.

POTENTIALLY-UNSTABLE SLOPE AREA

PUs

Areas with all the same geologic and physiographic characteristics of areas that have failed but that show no sign of past or present failure activity. Soil creep might be the only activity recognized. Slope aspect and angle, composition, moisture conditions, vegetation, etc. all influence the stability of these areas.

Boundaries are difficult to choose. Areas were outlined based on an understanding of the causes of mass wasting and instability. Risks are uncertain in these areas, slight changes in conditions could be catastrophic or cause only minor damage. The slope conditions give no indication of what to expect.

ROCKFALL AREA

Rf

Areas where free-falling, rolling, sliding, or bounding rocks from cliffs, steep slopes, or overhangs can occur. Individual rockfalls occur very rapidly, are nearly unpredictable, and affect only limited areas per each event. Talus at the base of fractured or jointed bedrock cliffs is an indication of rockfall activity.

The lower boundary on these areas is difficult to pick. The rollout zone for rockfalls is a function of relief, slope shape and gradient, type of materials on slope, size and shape of blocks, and the presence of obstructions. The risks in these areas involve impact from the moving rocks to structures. Mitigation procedures are usually expensive and not completely safe.

FLOOD AREA

F

Areas where future flooding can be expected. Criteria used for identification included evidence of past floods, vegetation and drainage development. Climatic conditions, the type and frequency of storms and their intensity and duration, as well as geomorphic conditions influence the flood hazard.

Boundaries are generalized, especially in areas where the land surface has been disturbed by construction or agriculture. Risks associated with flooding include inundation, sediment deposition, channel erosion, and possibly shifts in channel positions. All minor drainages are potential areas for flash floods. Individual mitigation procedures are usually ineffective, flood-control structures are more efficient.

ALLUVIAL/DEBRIS-FAN AREA

ADf

Areas subject to normal stream deposition and deposition from infrequent debris/mudflow events. Generally a triangular shaped landform, located in drainages where the gradient is reduced and the transporting fluid can't carry its sediment load. Areas were outlined based on their shape, position in drainages, and by the type of material present. Fan areas need a source of sediment, usually from high erosive soils, a drainage pathway, and the reduction in gradient on that pathway.

Boundaries are distinct, with a small section of the contributing drainage included with each area. Risks involve frequent inundation, at the least minor depositional damage, and possibly major damage from the impact of moving debris. Some mitigation methods can reduce the risks.

EROSIVE-SOILS AREA

Eh

El

Areas where surficial materials are susceptible to erosion. Several variables affect erosion potential including: (1) soil type; (2) rainfall intensity and duration; (3) infiltration rates; (4) length of slope; (5) angle of slope; and (6) surface roughness (vegetation, construction, etc.). These areas were subdivided into high and low erosion-susceptibility areas.

High erosive soils were evaluated by the presence of rills and gullies and by high K values (>.25), given to each soil type by the U.S. Soil Conservation Service (U.S.S.C.S.). Slope angle and vegetation were also subjectively considered. Risks from these areas include loss of topsoil, dissected terrain, and increased sediment loads in streams.

Low erosive-soils areas are either underlain by thin soils, by resistant materials, or are areas of deposition. Areas in floodplains can receive sediment during flooding. The flat-topped mesas usually are protected by erosion resistant gravels. Thin colluvial soils over indurated bedrock show a low erosion potential. Risks related to low erosive soils include excavation problems, drainage problems, high water tables, and possibly flooding.

Boundaries for erosive-soils areas are very generalized, usually overlapping with swelling-soils areas. Generalization is necessary because erosion is related to how much man disturbs the environment. Climate, topography, vegetation, and land-use are the major controls on erosion hazards.

SWELLING-SOILS AREAS

Sh

Sl

Areas underlain by soils or soft bedrock which experience change in volume, either swelling or shrinking, with changes in moisture conditions. Certain clay minerals, like montmorillonite, are very susceptible to swelling and units composed primarily of this mineral can have very high swelling potentials. Gypsum and other sulfates also experience volume changes and are considered in this hazard category. The amount and type of mineral present, the soil type, initial density, changes in moisture content, the load on the soil, and time all affect the amount of possible swelling. Two subareas are identified.

High swell-potential areas were chosen based on information from U.S.S.C.S. mapping, bedrock units that are known to have swelling problems, and are areas of popcorn texture or deep desiccation cracking. Areas where damage was due to swelling pressures were also included. Percent swell is usually greater than 5 percent. Severe damage to all structures can result if these areas are not investigated.

Low swell-potential areas were outlined mainly from U.S.S.C.S. mapping and information in other sources. Percent swell is less than 5 percent. Risks include minor cracking of roads, sidewalks, plaster walls, and possibly misfit of doors and windows.

Boundaries for swelling soils areas are very general and should not be considered precise. Swelling soils and erosive soils commonly exist together, with slope conditions and vegetation controlling which hazard is more severe. Identification and proper engineering design usually can minimize the risks in swelling-soils areas.

HAZARD MATRIX

HAZARD AREAS (columns) / LAND USE ACTIVITY (rows)

Land Use Activity	Landslide Area	Unstable-Slope Area	Potentially Unstable-Slope Area	Rockfall Area	Flood Area	Alluvial Debris-Fan Area	Erosive Soils: High Erosion Area	Erosive Soils: Low Erosion Area	Swelling Soils: High Swell Area	Swelling Soils: Low Swell Area
Residential Development, High Density	3 / A B C D E F H Mitigation is expensive. Maintenance costs high.	3 / A B C D F H Careful siting and engineering can reduce risk.	3 / A B C D F Design and site investigations can reduce risk.	3 / A B C D E F Mitigation can be expensive.	3 / B E F G Very low slopes (<3%) have poor drainage.	3 / A B E F G H Extensive work and mitigation can reduce risk.	2 / B C D E F G H Good drainage design will reduce risk.	1 / B C E F Excavation might be expensive and difficult.	3 / D E H Proper design construction can reduce risk.	2 / D E H Proper care and maintenance can reduce risk.
Residential Development, Low Density	3 / A B C D E F H Good engineering can help reduce risk.	2 / A B C D F H Remedial construction and engineering may be necessary.	2 / A B C D F Site investigations required.	3 / A B C D E F Selective siting can reduce risk.	3 / B E F G Very low slopes (<3%) have poor drainage.	3 / A B E F G H Costly mitigation necessary.	2 / B C D E F G H Good drainage design can reduce risk.	1 / B C E F May be subject to flooding near flood areas.	3 / D E H Proper design and construction can reduce risk.	2 / D E H Proper care and maintenance can reduce risk.
Roads	3 / A B C D E F H Costs increase for design and construction.	3 / A B C D F H Proper design and maintenance can reduce risk.	2 / A B C D F Good planning can reduce risk.	3 / A B C D E F Engineering and design can reduce risk.	2 / B E F G Good drainage structures can reduce risk.	2 / A B E F G H High maintenance costs.	1 / B C D E F G H Drainage design and maintenance can reduce risk.	1 / C E F H Subject to floods if located near flood area.	2 / D E H High maintenance costs.	1 / D E H Minor damage, road cracking.
Utilities	2 / A B C D E F H Occasional damage. Good design can reduce risk.	1 / A B C D F H Engineering and design can reduce risk.	1 / A B C D F H Good planning can reduce risk.	2 / A B C D E F Careful siting can reduce risk.	1 / B E F G Leaks in water lines can increase risk.	2 / A B E F G H High maintenance costs.	2 / B C D E F G H High maintenance costs.	2 / B C D E F H May be difficult and expensive to excavate.	2 / D E H Good design reduces risk.	1 / D E H Few problems.
Open Space Recreation	1 / A B E H Minor problems.	1 / A B F No problems.	0 / A B F No problems.	1 / A B E F Selective siting of buildings can reduce risk.	1 / B E G Minor problems.	2 / A B E G H Risk must be evaluated for potential losses.	1 / B E G H Recreational uses can be affected by rill and gully erosion.	0 / B F G H Off-road use by vehicles can increase risk.	1 / E H Light-weight structures can be dangerous.	0 / E H No problems.
Industrial and Commercial Development	3 / A B C D E F H Mitigation is expensive but may make project possible.	3 / A B C D F Engineering and design should be required.	2 / A B C D F Maintenance and good design can reduce risk.	2 / A B C D E F Maintenance cost may be high.	2 / B E F G High maintenance costs. Design can reduce risk.	2 / A B E F G H High maintenance costs.	2 / B C D E F G H Drainage design and maintenance can reduce risk.	0 / B C F H Few problems.	2 / D E H Good engineering and design can reduce risk.	0 / D E H Minor problems.
Agriculture	1 / A B D E F H Minor problems. Irrigation canals and fence lines offset.	1 / A B D F H Irrigation can increase risk.	0 / A B D F Minor trouble on steeper ground.	1 / A B D E Minor problems.	0 / B D E F G Larger areas can be affected by flooding from canals.	0 / B E F G H Few problems.	1 / B C D E F G H Gullying and loss of topsoil can reduce yields.	0 / B C D E F G H Few problems. Occasional flooding.	1 / D E H Light-weight structures can be damaged.	0 / D E H No problems.

Degree of Risk

Degree	Value
High	3
Moderate	2
Low	1
Very Low	0

Cell key: Risk | Factors that influence hazards; Comments

Conditions and factors that influence hazards

A. Local relief can affect hazard.
B. Degree of slope (angle) affects hazard.
C. Oversteeping or loading slope can increase risk.
D. Changing ground moisture conditions affect the hazard.
E. Hazard can vary with the seasons.
F. Removing vegetation can increase risk.
G. Drainage density and development affects hazard.
H. Composition and texture of surficial materials affects hazard.