

ENGINEERING GEOLOGY

CRESTED BUTTE HIGHLANDS

Section 16, & Portions of Sections 21 & 22  
T. 14 S., R. 85 W.

Gunnison County, Colorado

prepared for:

Crested Butte Highlands, Ltd.

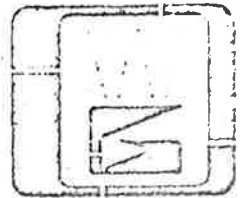
Denver, Colorado

July, 1973  
Project No. 72-031

WILLIARD OWENS  
WATER RESOURCES ENGINEERING ASSOCIATES  
ENGINEERING GEOLOGY • GROUND WATER HYDROLOGY INC  
7331 W. 38TH AVENUE • WHEAT RIDGE, COLORADO 80033 • (303) 424-5564



WILLARD OWENS  
WATER RESOURCES ENGINEERING ASSOCIATES  
ENGINEERING GEOLOGY • GROUND WATER HYDROLOGY INC  
7391 W. 38TH AVENUE • WHEAT RIDGE, COLORADO 80033 • (303) 424-5564



July 3, 1973

Mr. Jerry B. Robinson  
927 American National Bank Bldg.  
Denver, Colorado 80202

Re: Engineering Geology  
Crested Butte Highlands  
Section 16 and Portions of  
Sections 21 & 22, T. 14 S.,  
R. 85 W.  
Gunnison County, Colorado  
Project No. 72-031

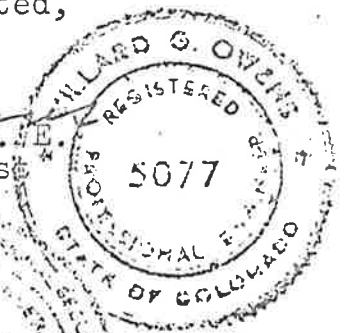
Dear Mr. Robinson:

As you requested, we studied the engineering geologic conditions of the Crested Butte Highlands, Ltd., property, east of Crested Butte, Colorado.

Please call us if you have any questions, or when you would like us to proceed with the work recommended in this report.

Respectfully submitted,

*Willard G. Owens*  
Willard G. Owens, P.E.  
Engineering Geologist



WGO:ml  
Encl.

cc: Mr. Vern Jaschke

# TABLE OF CONTENTS

	Page
INTRODUCTION	1
SUMMARY AND CONCLUSIONS	1
GENERAL GEOLOGY	3
ENGINEERING GEOLOGY	4
GROUND WATER CONDITIONS	5
Shallow Ground Water	6
Deep Ground Water	7
GEOLOGIC MAP - Plate I	

## INTRODUCTION

At the request of Mr. Jerry B. Robinson, of Crested Butte Highlands, Ltd., we studied the geologic conditions relative to the land development of Section 16 and portions of Sections 21 and 22, T. 14 S., R. 85 W., Gunnison County, Colorado. Our investigations included on-site study of the property, interpretation of geologic and topographic maps, a review of hydrologic conditions and an interpretation of aerial photographs.

The results of our investigation and recommendations on the development of the property are given in this report. The study area is shown on the attached geologic map, Plate I.

Supplemental to this report is a Soil and Capability Map prepared by the USDA - Soil Conservation Service.

## SUMMARY AND CONCLUSIONS

The results of our engineering-geologic investigation of the Crested Butte Highlands, Ltd., property disclose that residential development of the area is feasible from an engineering geologic and water supply standpoint. The geologic characteristics of the area are not expected to have an adverse impact on the proposed Crested Butte Highlands Sub-division. No engineering geologic conditions exist that should be considered hazardous.

Minor geologic problems can be anticipated where remnants of Mancos shale occur as steep slopes, but these are minor and localized.

Quantities of water that can be obtained from shallow and deep sources will require exploratory drilling and test well completion, but geologic conditions appear favorable for ground water development.

We found no evidence that the proposed subdivision is in an area of potential radiation hazards.

For central water systems exploratory-supply wells should be drilled at locations designated on Plate I as Well No. 1, Well No. 2, Well No. 3. The major springs on the property, also shown on Plate I, should be developed by backhoe trenching and test pumping to determine the manner in which a retaining system should be constructed for permanent use. However, it is apparent that flow in those springs is related to the ground water that flows at the base of the soils overlying the bedrock formations.

A deep exploratory well should be constructed at Well Site No. 4 to determine the water yielding characteristics of the Dakota and Entrada sandstones. The results of the exploratory drilling at that point will determine feasibility of additional well sites.

In summary, the hydrogeologic conditions of the area and the substantial surface drainage areas suggest that ample shallow and deep ground water supplies can be developed to serve residential development of the area. Our experience in other areas

has been that the Dakota and Entrada sandstones are good aquifers which yield 25 to 150 gallons of water per minute. However, actual quantities available can be determined only by the proper construction, development and testing of wells completed in these formations.

#### GENERAL GEOLOGY

The Crested Butte Highlands, Ltd., property is located on moderate to steep slopes which face the valley of East and Slate rivers. As shown on Plate I, most of the property is underlain by the Dakota formation, (Kd), which is made of massive sandstone which dips toward the west. The easternmost extreme of the property is underlain by the red to green siltstones of the Morrison formation (Jm), under which lies the Entrada sandstone (Je). The southwestern extremity of the property is underlain by the siltstone to claystone shale of the Mancos formation (Kmc). These bedrock formations underlie soils which range from clay to gravelly sand.

Soils are well developed throughout most of the area and support vegetation ranging from prairie grass to aspen and evergreen trees. A few springs and intermittent streams occur in Section 16 and Section 22. Surface water drainage areas which support those springs and intermittent streams are shown on Plate I.

The elevation of the land surface ranges from about 8680 feet in the southwest corner of the property to 10,040 feet at the

northeast corner of Section 22. Surface water channels within and above the property are poorly developed, with the intermittent streams disappearing into the terrace and flood plain gravels along the northeast edge of the East River, which is a tributary to Slate River. The occurrence of gravelly materials in the soils which overlies much of the area and the poorly developed surface water drainage suggests that shallow ground water flows beneath the soils and on top of the sandstone and shale of the Dakota and Mancos formations.

#### ENGINEERING GEOLOGY

Our investigations disclosed no geologic conditions which could be considered hazardous from an engineering geologic standpoint. The relatively smooth slopes of the area parallel the general dip of the formations, which is toward the west. The Dakota sandstone underlies the soils throughout most of the area and forms a stable bedrock formation. The Dakota sandstone forms a prominent northeast-southwest ridge through the central portion of Section 22. The Entrada sandstone forms a stable, erosion-resistant rim along the north eastermost edge of the property.

A few remnants of the Mancos shale formation occur in much of the area, but engineering geologic problems such as local soil creep in those areas can be expected to be minor. We do not anticipate unusual road and other type excavation except in the exposures of the Dakota sandstone.

Because of the drainage areas within and above the property we recommend that natural drainageways be kept open and free from restrictions during seasonal runoff and flood flow periods. Residential development of the area can be expected to increase surface water runoff and we recommend that planning and engineering of the area include provisions for such runoff across the property to the south and into Slate River or Cement Creek.

#### GROUND WATER CONDITIONS

The average annual precipitation within the area is 20 to 25 inches, of which approximately 9 inches occur during the months of May through September. The average annual precipitation is considerably higher than this above 10,000 feet in the upper portions of the drainage areas shown on Plate I.

The poorly developed surface drainage system suggests that much of the snowmelt and rainfall soak through the soils and recharge the underlying bedrock formations. Also, much of the rainfall and snowmelt flows on top of the bedrock formation, through the sandy and gravelly soils and southwestward to form the springs and intermittent streams where the water evaporates, is used by plants, or disappears into the gravelly materials in the flood plain of Slate River and East River.

The sources of water supplies within the property are:

1. The shallow water in the soils above bedrock and
2. Ground water in the Dakota and Entrada sandstone which lie beneath the property.



## Shallow Ground Water

The shallow ground water which issues to the surface in the form of springs, creates local wet areas that will require drainage. The portion of this water that is not consumed by plants and evaporation is tributary to the surface and subsurface system of Slate River. The development of this water would entail salvage of consumed water and perhaps water rights on the property or on other properties which could be transferred to the property.

Since a central water system is planned for a portion of the property, exploratory drilling should be done to develop shallow ground water at locations designated on Plate I as Well 1, Well 2 and Well 3. The purpose of test wells will be to determine the quantity of water that can be developed from the sand and gravel soils on top of the Dakota sandstone bedrock. Filing on springs in the area, as surveyed by Jaschke Engineering, were submitted to the Colorado Division of Water Resources in order to claim use of such water within the proposed residential development.

The construction of Well No. 1, Well No. 2 and Well No. 3 is expected to require a cable tool drill rig to penetrate the anticipated gravel, cobbles and perhaps boulders in the lower portion of the soil profile. The development of the springs in the area can be done using a backhoe and installing a concrete or galvanized steel retainer to collect and store the water. We recommend that the construction of the wells and development of the springs be done under the direct supervision of an engineering geologist experienced in the development of ground water supplies.

Deep Ground Water

We recommend the construction of a deep water well through the Dakota and Entrada sandstones at the location designated on Plate I as Well No. 4 (deep). We anticipate that this well can be drilled by a standard rotary, direct circulation drilling rig although it might be necessary to use a cable tool to penetrate the gravelly soil overlying the bedrock. The depth to the bottom of the Dakota and the Entrada sandstones at Well No. 4 (estimated 400 to 600 feet) will provide information on anticipated depths through these aquifers in other portions of the area. If the results of Well No. 4 are favorable, a similar well should be constructed at the location shown on Plate I as Well No. 5 (deep).

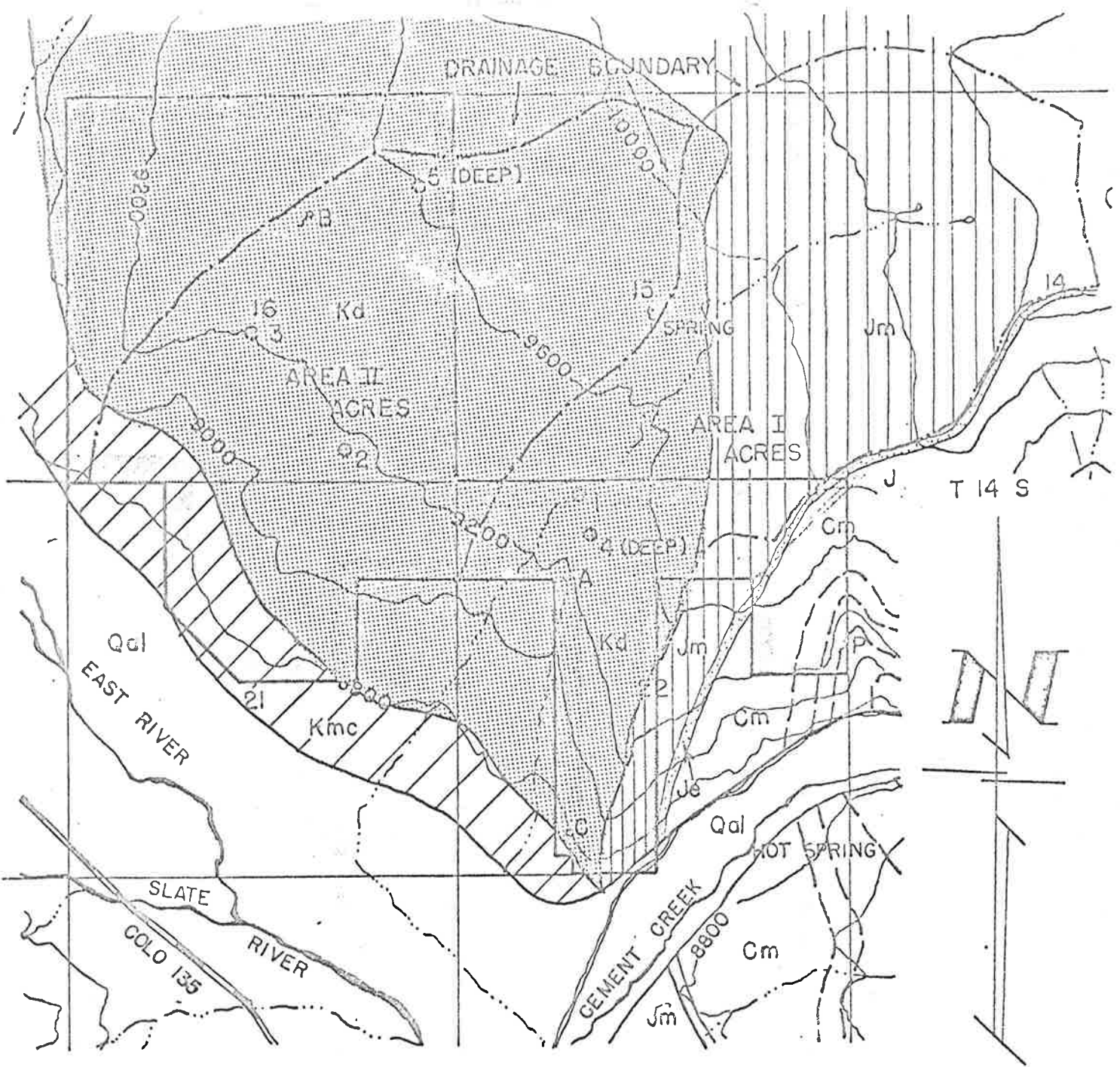
Please call us if we can be of further assistance on the final engineering geologic or water development stages of this project.

Respectfully submitted,





*Willard G. Owens*  
Willard G. Owens, P.  
Engineering Geologist

WGO:ml





**EXPLANATION**

- Qal ALLUVIUM
-  Kmc MANCOS SHALE
-  Kd DAKOTA SANDSTONE
-  Jm MORRISON FORMATION
-  Je ENTRADA SANDSTONE
- Cm MAROON CONGLOMERATE
- P PALEZOIC UNDIVIDED

- q A SPRING
- o 2 PROPOSED TEST WELL LOCATION

SCALE 1" = 2000'

GEOLOGIC MAP  
 CRESTED BUTTES HIGHLANDS,  
 LTD. PROPERTY  
 GUNNISON COUNTY, COLORADO



WILLARD OWENS  
 ASSOCIATES  
 INC  
 PROJECT NO 72-031

8 | 9

9 | 10

17 | 18

16 | 15

LOCATIONS VERIFIED IN FIELD  
 AND BY AERIAL PHOTOGRAPHS  
 BY *Willard G. Owens*  
 WILLARD G. OWENS, P.E.

SPRING 16-8 (4 GPM)  
 $S 78^{\circ} 51' 47'' W 944'$

SPRING 16-1 (3 GPM)  
 $S 8^{\circ} 53' 22'' W 1286.42'$

SEC. 16  
 648.77 AC



SPRING 16-2 (2 GPM)

SPRING 16-6 (2 GPM)

SPRING 16-5 (2 GPM)

16-3 (6 GPM)

SPRING 16-7 (4 GPM)  
 $N 69^{\circ} 22' 09'' E 1952.19'$

SPRING 16-4 (20 GPM)  
 $N 73^{\circ} 52' 38'' E 1432.43'$

SPRING 16-4A (14 GPM)  
 $N 76^{\circ} 40' 18'' E 1364.86'$

$N 51^{\circ} 27' 19'' E 3299.58'$

$N 60^{\circ} 36' 48'' E 1567.49'$   
 $N 66^{\circ} 12' 37'' E 2665.40'$

$N 51^{\circ} 55' 53'' W 2820.57'$

17 | 16

16 | 15

20 | 21

21 | 22

SPRING LOCATIONS  
 CRESTED BUTTE HIGHLANDS, INC.  
 SEC. 16, T14S, R 85W OF THE 6<sup>th</sup> P.M.  
 GUNNISON COUNTY, COLORADO



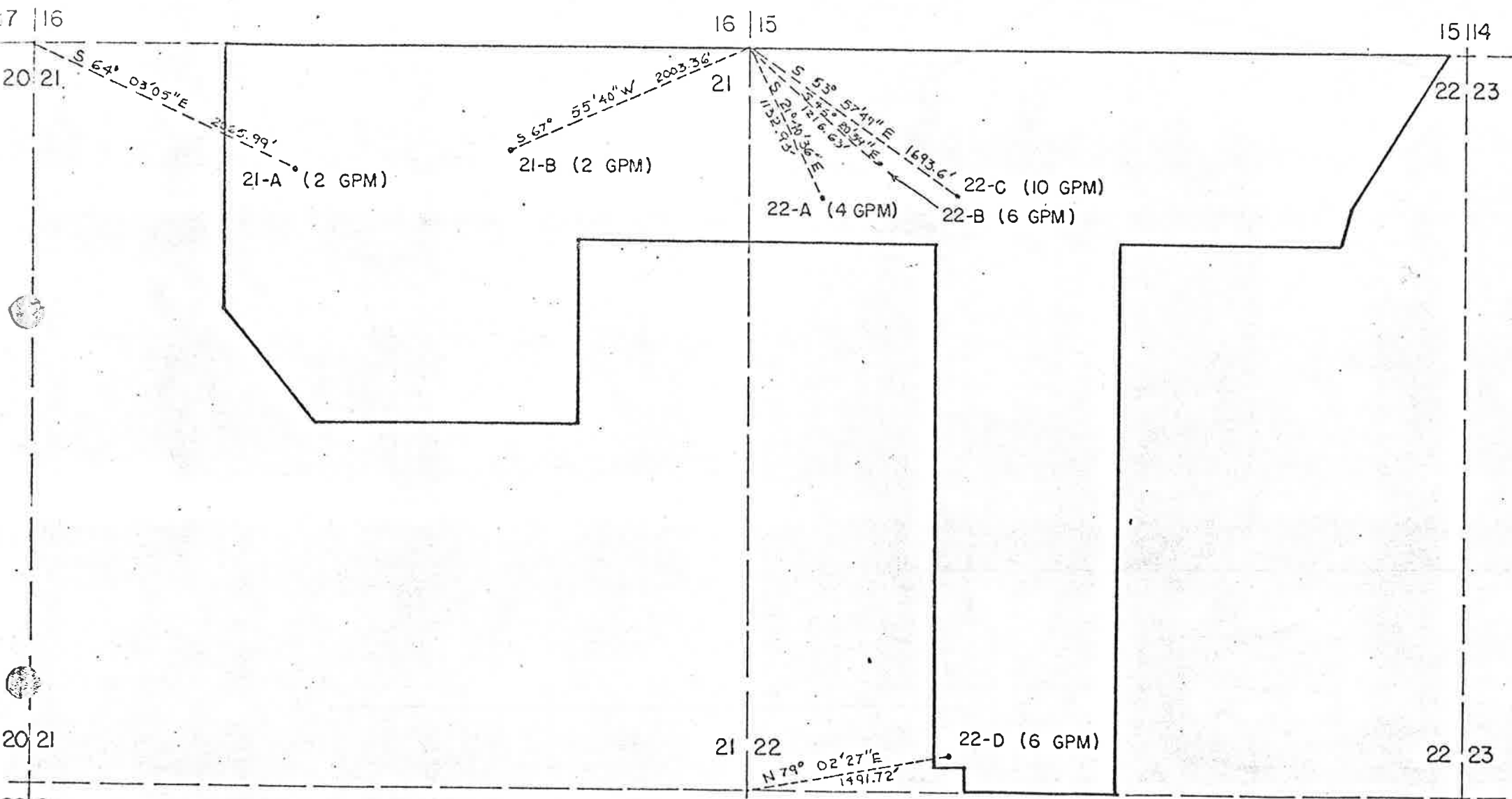
0 500 1000  
 SCALE

WILLARD OWENS  
 ASSOCIATES  
 INC

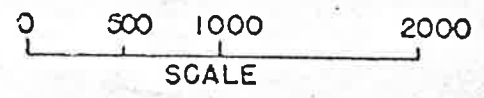


COE, VAN LOO AND JASCHKE ENG. INC.  
 SURVEYED BY: 1990 S. GARRISON, LAKEWOOD, COLO.

PROJECT NO.72-031



SPRING LOCATIONS  
 CRESTED BUTTE HIGHLANDS, INC.  
 SEC. 21 & 22, T14S, R85W OF THE 6<sup>th</sup> P.M.  
 GUNNISON COUNTY, COLORADO



LOCATIONS VERIFIED IN  
 FIELD AND BY AERIAL  
 PHOTOGRAPHS BY *Willard G. Owens*  
 WILLARD G. OWENS, P.E.

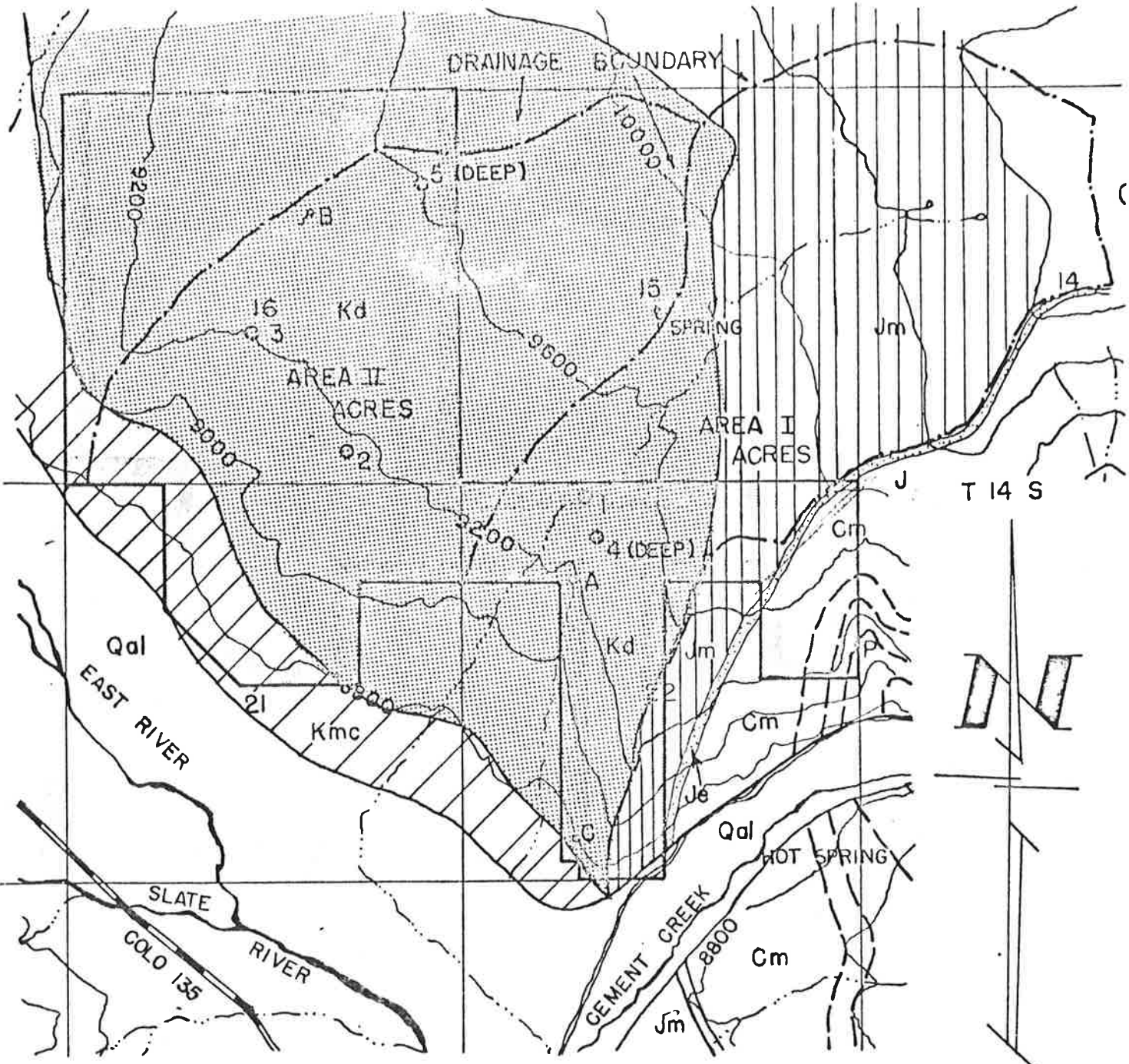
WILLARD OWENS  
 ASSOCIATES  
 INC  
 PROJECT NO. 72-031







SURVEYED BY: COE, VAN LOO AND JASCHKE ENG. INC  
 1990 S. GARRISON, LAKEWOOD, COLORADO

R 85 W

DRAINAGE BOUNDARY



### EXPLANATION

- Qal ALLUVIUM
-  Kmc MANCOS SHALE
-  Kd DAKOTA SANDSTONE
-  Jm MORRISON FORMATION
-  Je ENTRADA SANDSTONE
- Cm MAROON CONGLOMERATE
- P PALEZOIC UNDIVIDED

- q A SPRING
- 2 PROPOSED TEST WELL LOCATION

SCALE 1" = 2000'



WILLARD OWENS  
ASSOCIATES  
INC  
PROJECT NO 72-031

GEOLOGIC MAP  
CRESTED BUTTES HIGHLANDS,  
LTD. PROPERTY  
GUNNISON COUNTY, COLORADO

PLATE I