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THERMOCHEM INDUSTRIES LIMITED

FEASIBILITY REPORT

SULPHUR DEPOSITS
NEAR COVE FORT, UTAH

March 6, 1969

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CHAPMAN WOOD & GRISWOLD LTD.

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LIST OF DRAWINGS

CERTIFICATE

I, E. P. Chapman Jr. of North Vancouver, British Columbia, do hereby certify:

1. That I am a Mining and Geological Engineer residing at 2135 Argyle Avenue, West Vancouver, B.C.

2. That I am President of Chapman, Wood & Griswold Ltd., Consulting Mining Engineers and Geologists, with offices at 133 East 14th Street, North Vancouver, B.C.

3. That I am a registered Professional Engineer in the Province of British Columbia and in the States of Colorado, New Mexico and Texas and that I am a member of the Consulting Engineer's Division of the Association of Professional Engineers of British Columbia.

4. That I have practised my profession for more than 30 years.

5. That I am a substantial shareholder in Thermochem Industries Limited and am also an officer and director of this Company, and that the principals and a majority of the staff members of Chapman, Wood & Griswold Ltd. also own shares in this Company.

6. That I have personally visited and examined the properties near Cove Fort, Utah, on numerous occasions during 1967, 1968 and 1969 and that the work done on these properties since November 1967 has been carried out under my supervision and direction.

E. P. Chapman Jr., P. Eng.

March 6, 1969

I

INTRODUCTION

At the request of Mr. B. O. Brynelsen, Chairman of the Board of Thermochem Industries Limited, Chapman, Wood & Griswold Ltd. has been administrating a program of exploration, evaluation and development of a group of sulphur deposits situated in Beaver and Millard Counties, Utah.

The property was examined by E. P. Chapman Jr. in November, 1967. Reports by previous investigators were reviewed and reserve calculations were checked in December. In January, 1968, a program consisting of bulk sampling, trenching, seismic and ripping tests, geochemical survey, rotary drilling, aerial photography and mapping, photogeologic studies, and preliminary mining operation planning was instituted.

The program has been carried out under the general supervision of E. P. Chapman Jr. Work at the property has been directed by Geyza Lorinczi and Richard Janes of the Chapman, Wood & Griswold Ltd. staff.

A new process for recovering elemental sulphur is currently being developed and evaluated at the Colorado School of Mines Research Foundation, Inc. at Golden, Colorado, under the direction of C. W. & G. Ltd. Thermochem Industries Limited owns the rights to this process.

II

SUMMARY, CONCLUSIONS AND RECOMMI :DATIONS

1. Thermochem Industries Limited holds options on a roximately 25 square miles of properties in Beaver and Millar Counties, near the village of Cove Fort in the state of Utah.

2. Based upon revaluation of results reported for a di: ıond drilling program carried out under Clarence King in 1952 a l a rotary drilling campaign under Donald Podesta in 1967, ore reser s, classified as Drill Measured are estimated to be 1,505,000 metr tons containing 302,000 metric tons of sulphur in five deposits at a: average grade of 20.1% elemental sulphur.

3. King's reserve estimates, which can only partially : confirmed because drill logs and individual assay records are ot available, were reported as 3,900,000 short tons containing 6(,868 metric tons of sulphur at an average grade of 18.8% elemental s phur after adjusting grades apparently reported as total sulphu .

4. Eight sulphur-bearing exposures which have not bee evaluated but may contain additional reserves are known on the pr perties.

5. We consider that there is a high degree of probabilit of the presence of 2,500,000 metric tons containing 500,000 metric ns of sulphur on the Cove Fort lands and a reasonable possibility finding an additional 200,000 metric tons of sulphur.

6. A process for recoverir.g high purity sulphur from v canic and fumarolic source materials is owned by Thermocher and is in the

final stage of pilot plant testing at the Colorado School of Mines Research Foundation, Inc. at Golden, Colorado.

7. An interim report from the Research Foundation forecasts capital requirements for a plant to treat 1000 metric tons per day of Cove Fort material to be in the range of two to four million U.S. dollars, direct operating costs to be less than $2 U.S. per metric ton treated, recovery to be 94% and product grade to be 99.9% sulphur or better.

8. Although sulphur markets are currently weaker than they have been during the 1962-1968 period of acute shortage, we believe that all production from an operation at Cove Fort at the rate of 1000 metric tons per day can be sold to consumers in the Western United States at prices ranging from $35 to $45 per metric ton.

9. We estimate the cost of bringing the Cove Fort deposits into production will be approximately $5,000,000 U.S. Of this amount, three million dollars for design and construction of a 1000 MT/day plant is properly chargeable to a final stage in development of the Thermochem Process.

10. We believe that an operation at Cove Fort at the 1000 MT/day rate from estimated reserves will generate direct operating profits per metric ton of sulphur produced ranging from $18.43 at a $35 price to $28.43 at $45 before taxes and amortization.

11. We recommend that a property payment in the amount of $250,000 U.S. plus interest of approximately $61,000 both due on or before April 1, 1969 be met and that the program of preparing the properties for production at an estimated cost of $5,000,000 U.S. be implemented as soon as possible.

Respectfully submitted,

CHAPMAN, WOOD & GRISWOLD LTD.

E. P. Chapman Jr.

March 6, 1969

Distribution:
Thermochem - 8 copies

III

HISTORY

Some of the Cove Creek sulphur occurrences have been known ır over a century. Primitive mining was started in the 1870s by the Mo nons settled at Cove Fort. The elemental sulphur recovered by the formons was used for making gun powder, matches and for agricultural urposes. In 1918 a Mr. Morrissy of Salt Lake City acquired the title to ıe property.

Between 1918 and 1946 many attempts were made to operate th property on a large scale.

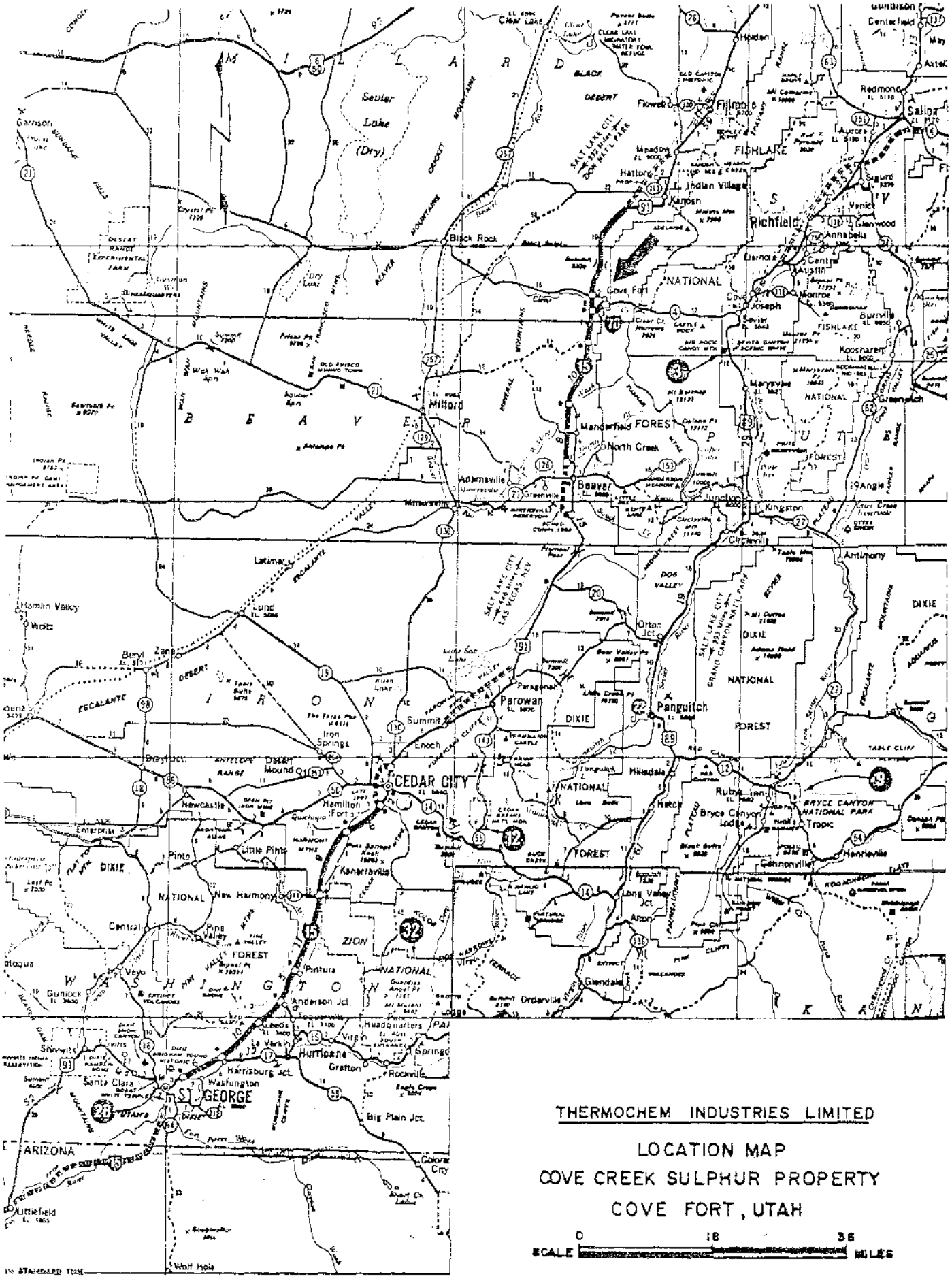
In 1950 the Chemical Corporation of America exercised an opti ı on the property from Utah Sulphur Industries.

In 1951 a flotation-type pilot mill was built near the Sulphurdal deposit; however, test results indicated that a large plant would not be onomical.

In 1951 and 1952 a systematic core drilling program was carri out under the direction of Mr. Clarence R. King, a reputable mining engi ser.

In 1967 another large scale drilling program was undertaken by he Sulphurdale Chemical Company with Mr. Donald J. Podesta as ıeir consulting geologist.

Results of King's and Podesta's programs are available. They ere the basis of early reserve calculations and served as guides in the 968 exploration program.



THERMOCHEM INDUSTRIES LIMITED

LOCATION MAP

COVE CREEK SULPHUR PROPERTY

COVE FORT, UTAH

SCALE 0 18 36 MILES

IV

LOCATION

The Cove Creek sulphur property is located in Beaver and Millard Counties, Townships 25 and 26 South, Ranges 6 and 7 West, approximately 24 miles north of Beaver, Utah.

V

PROPERTY

A. DESCRIPTION

The Cove Creek sulphur deposits are in a region of moderate relief in the foothills of the north-western part of the Tushar Mountains. The altitudes at the deposits vary from 6,100 to about 6,600 feet. Mountains southeast of the deposits rise to altitudes exceeding 12,000 feet. The climate is semiarid with pleasant summers and cold, often stormy, winters.

Juniper and piñon pine cover most of the foothills; grass and sagebrush grow in the valleys. Overburden thickness varies greatly throughout the property.

A total of approximately 16,120 acres (25.2 square miles) comprises the property controlled by Thermochem under option agreements. Of this ground approximately 5,720 acres, including about 187 acres of patented mining claims and fee lands, lie in Beaver County. The remaining 10,400 acres, including 330.8 acres of patented lode mining claims, are situated in Millard County. The relationships of fee lands to unpatented claims and of land boundaries to known sulphur deposits are shown on Drawing No. 1061 accompanying this report.

A description of these lands together with an inventory of Personal Property to be conveyed if the option agreement is exercised is reproduced below from the list appended to the Contract of Sale.

PERSONAL PROPERTY

1. 2 1/3 HP lighting mixers
2. 2300 Gram Denver pulp scale and bucket
3. TD-18 Cat Int'l tractor with 12 foot dozer
4. 1957 Reo Dump truck
5. 5 state hoist for truck
6. 2 GE transformers 250 KW
7. D-4 Caterpillar tractor with front end loader
8. Scoop-mobile
9. D-8 Caterpillar tractor and can
10. Le Roix Portable air compressor
11. 1953 Chevrolet $\frac{1}{2}$ ton pickup truck
12. Space heater
13. Cement mixer $\frac{1}{2}$ SK
14. Road grader
15. NW shovel with Cat 4600 engine
16. Case tractor with Hough front end loader
17. Clark fork lift
18. Ripper
19. Extra rods for rod mill
20. Approximately 5000 paper bags
21. Miscellaneous tools
22. Miscellaneous furniture
23. Miscellaneous office equipment
24. Miscellaneous pipes, valves and fittings

REAL PROPERTY

Located in Beaver County, State of Utah:

(Patented Lode Mining Claims and Fee Lands)

Lot 4 and NE$\frac{1}{4}$NW$\frac{1}{4}$ Sec. 12, T 26 S, R 7 W, SLB&M (87 acres)

Lots 3 and 4, Sec. 7, T 26 S, R 6 W, SLB&M (80 acres)

Washington Lode Mining and Mill Site Claim, designated by Surveyor General Lot No. 57 and 57B

Newark Lode Mining Claim, designated by Surveyor General Lot No. 58

(The above patents are recorded in the office of the Beaver County Recorder in Book Z-4, commencing on pages 440 and 443, to which reference is hereby made.)

Located upon and attached to the above described claims and properties are various improvements including houses and other buildings (Log house and apartment, Shop-office building, Green apartment building, metal storage building, etc.) and a mill for the processing of sulphur ore. Said mill includes the following component parts:

1. Allis Chalmers ball mill (5x10)
2. 12 Float cells
3. 6 Float cells
4. Rod mill - complete with liners
5. Aluminum and steel storage building - at plant
6. Byron-Jackson 14" pump
7. 15x20 jaw crusher
8. 2 Trommel screens
9. Pan feeder
10. 12" Craftsman lathe
11. 12 Amp Mullenbach power panel
12. 238' conveyor
13. Sterling 3 HP motor
14. 2 285 BBL. 8900 gallon tank
15. 450' conveyor
16. Reeves motor
17. Single stage Cyclone classifier (Krebbs)
18. 3 GE transformers
19. 200 HP Cyclothern boiler
20. 5 pumps, 3 motors and starters
21. Thickener with motor and tank
22. 10,000 grinding balls
23. Denver sampler machine
24. Reagent feeders SS bank of 4
25. Sytron with controls - V-200-25 Amps
26. SS pressure tank 4x22
27. Air compressor
28. Weinman pump and misc. equipment
29. 12'x16' steel bin with 7' collector and exch.
30. Union stitching machine and screw conveyor and bagger
31. $1\frac{1}{4}$" Aqua-Vel water conditioner
32. 150 Ga. SS kettle
33. #800 Cherry Burrell high pressure pump
34. Ingersol Rand portable air compressor
35. 5"x5" Denver SRL sand pump
36. SS tank 4'x16' (1400 gal.)
37. 2 11,000 gallon tanks
38. 1 22,000 gallon tank with pump
39. Mill building
40. Switch house and switches
41. 10' lathe
42. Grissley
43. Conditioner tank
44. Shriver pump with motor
45. 120 foot SS heat exchanger

(Unpatented Placer Mining Claims)

Sulphurdale Mining Company Claims No. 12 to 22 inclusive (approx. 1720 acres)

KAP No. 20 ($SW\frac{1}{4}$ Sec. 12, T 26 S, R 7 W, SLB&M, 160 acres)
KAP No. 21 ($NW\frac{1}{4}$ Sec. 12, T 26 S, R 7 W, SLB&M, 160 acres)
KAP Nos. 24, 25 and 26 (approximately 400 acres)

Morrissey Claims Nos. 1 to 7 inclusive (approximately 942 acres)
Morrissey Claims Nos. 32 to 42 inclusive (approximately 1680 acres)

(Unpatented Placer Claims located partly in Beaver County and partly in Millard County, State of Utah)

KAP No. 22 ($N\frac{1}{2}NE\frac{1}{4}$ Sec. 12, and $S\frac{1}{2}SE\frac{1}{4}$ Sec. 1, T 26 S, R 7 W, SLB&M, approximately 160 acres

Morrissey Claims Nos. 8 and 9 (approximately 320 acres)
Sulphurdale Mining Company Claims Nos. 24 and 26 - (approximately 320 acres)

Located in Millard County, State of Utah:

(Patented Lode Mining Claims)

Conqueror Sulphur Lode, designated by Surveyor General as Lot No. 46 (20.66 acres)
The Victor Sulphur Mine, Lot No. 51(a) (20.66 acres)
Mayme Hinckley Lode Mining Claim, Lot No. 56 (20.66 acres)
Emperor Lode Mining Claim, Lot No. 52 (20.66 acres)
Boston Sulphur Mine, Lot No. 42 (20.58 acres)
Utah Lake Lode Mining Claim, Lot No. 53 (16.44 acres)
West Mariposa Lode Mining Claim Lot No. 55 (13.62 acres)
New York Sulphur Mine, Lot No. 47 (20.66 acres)
Philadelphia Sulphur Mine, Lot No. 49 (20.66 acres)
Salt Lake Lode Mining Claim, Lot No. 54 (18.64 acres)
Sulphur King Lode, Lot No. 44 (20.66 acres)
Excelsior Lode, Lot No. 38 (20.66 acres)
Mammoth Mine, Lot No. 37 (20.66 acres)
Utah Sulphur Lode, Lot No. 45 (20.42 acres)
Mariposa Mine, Lot No. 43 (19.50 acres)
Queen Victoria Lode Mining Claim, Lot No. 50 (15 acres)
Prince Albert Mine, Lot No. 42 (20.66 acres)

(The above patents are recorded in the office of the Millard County Recorder in Book A of Mining Deeds, pages 94 to 142, to which reference is made.)

(All in Sections 10, 17, 18, 19, 20 and 24, T 25 S, R 6 W, SLB&M - 307.80 acres, except for overlaps of some of the claims on others.)

(Unpatented Placer Mining Claims)

KAP No. 1 ($SW\frac{1}{4}$ Sec. 32, T25S, R6W, SLB&M, 160 acres)
KAP No. 2 ($S\frac{1}{2}NW\frac{1}{4}$ and $W\frac{1}{2}NE\frac{1}{4}$ Sec. 32, T25S, R6W, SLB&M, 160 acres)
KAP No. 3 ($SE\frac{1}{4}$ Sec. 31, T25S, R6W, SLB&M, 160 acres)
KAP No. 4 ($SW\frac{1}{4}$ Sec. 31, T25S, R6W, SLB&M, 160 acres)
KAP No. 5 ($SE\frac{1}{4}NW\frac{1}{4}$ and $S\frac{1}{2}Ne\frac{1}{4}$ Sec. 31, T25S, R6W, SLB&M, 120 acres)
KAP No. 6 ($SE\frac{1}{4}$ Sec. 30, T25S, R6W, SLB&M, 160 acres)
KAP No. 7 ($N\frac{1}{2}SW\frac{1}{4}$ and $SE\frac{1}{4}SW\frac{1}{4}$ Sec. 30, T25S, R6W, SLB&M, 120 acres)
KAP No. 8 ($N\frac{1}{2}SE\frac{1}{4}$ Sec. 29, T25S, R6W, SLB&M, 80 acres)
KAP No. 9 ($N\frac{1}{2}SW\frac{1}{4}$ Sec. 29, T25S, R6W, SLB&M, $SW\frac{1}{4}SW\frac{1}{4}$ Sec. 29, T25S, R6W, SLB&M, 120 acres)
KAP No. 10 ($NE\frac{1}{4}$ Sec. 8, T25S, R6W, SLB&M, 160 acres)
KAP No. 11 ($NW\frac{1}{4}$ Sec. 8, T25S, R6W, SLB&M, 160 acres)
KAP No. 12 ($SE\frac{1}{4}$ Sec. 8, T25S, R6W, SLB&M, 160 acres)
KAP No. 13 ($SW\frac{1}{4}$ Sec. 8, T25S, R6W, SLB&M, 160 acres)
KAP No. 14 ($NW\frac{1}{4}$ Sec. 7, T25S, R6W, SLB&M, 160 acres)
KAP No. 15 ($NE\frac{1}{4}$ Sec. 7, T25S, R6W, SLB&M, 160 acres)
KAP No. 16 ($SE\frac{1}{4}$ Sec. 7, T25S, R6W, SLB&M, 160 acres)
KAP No. 17 ($SW\frac{1}{4}$ Sec. 7, T25S, R6W, SLB&M, 160 acres)
KAP No. 18 ($E\frac{1}{2}NE\frac{1}{4}$ Sec. 32, $NW\frac{1}{4}NW\frac{1}{4}$ Sec. 33, $SW\frac{1}{4}SW\frac{1}{4}$ Sec. 28, all in T25S, R6W, SLB&M, 160 acres)
KAP No. 23 ($S\frac{1}{2}NE\frac{1}{4}$ and $N\frac{1}{2}SE\frac{1}{4}$ Sec. 1, T26S, R7W, SLB&M, 160 acres)
(Total 2840 acres)

Morrisey Claims Nos. 10 to 31 inclusive (approximately 3560 acres); Reference is made to Book 6, pages 134 to 143 and pages 223 and 224 in the office of the Millard County Recorder.

Sulphurdale Mining Company Claims 1 to 4 inclusive, 7, 9, 10, 11, 23 to 34 inclusive (approximately 3920 acres); Reference is made to Book 16, pages 194-207 in the office of the Millard County Recorder.

(Unpatented Lode Mining Claims)

Neale Fluorspar Lode Mining Claims Nos. 1 to 10 inclusive (approximately 206.61 acres); Reference is made to Book 16, page 191 and Book 15, pages 345 to 349 in the office of the Millard County Recorder.

(Fee Land)

$E\frac{1}{2}NW\frac{1}{4}$; $SW\frac{1}{4}$ Sec. 1, T26S, R7W, SLB&M; Less 8.71 acres for State Road; (231.29 acres, about 40 acres of which is located in Beaver County)

WATER RIGHTS

The following described water rights are appurtenant to and used in connection with the above described real property:

South Fork of Spring Creek in Beaver County for domestic and mining purposes
Jan. 1 to Dec. 31, Certificate of Appropriation No. 1750

North Fork of Spring Creek in Beaver County for domestic and mining purposes
Jan. 1 to Dec. 31, Certificate of Appropriation No. 1750

Willow Springs in Beaver County for domestic and mining purposes,
Jan. 1 to Dec. 31, Certificate of Appropriation No. 1750

Application for Appropriation from Underground Well located N 1870 feet, E 760 feet from the SW corner of Sec. 7, T 26 S, R 6 W, SLB&M, Application No. 33246, Extension granted to December 31, 1966 and applied for beyond that date, but no word has been received - it is assumed to have been extended.

The following mining claims contain title defects as set forth:

1. Lots 3, 4, $SE\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}NE\frac{1}{4}$, T25S, R6W, S.L.M. May be subject to lease obtained from State of Utah on sulphur and sulphur dioxide gas.

2. KAP Claims Nos. 14, 15, 16, 17 and Sulphurdale Mining Claims Nos. 1 and 2 and parts of Neale Fluorspar Claims Nos. 5, 7 and 8 may be invalid due to lack of mineral reservation in patent.

3. Morrissey Claims Nos. 23, 25, 29 and 30 are clouded by patents without mineral reservations, but probably valid.

4. Claims filed after 1954 do not include oil, gas, coal or certain other leaseable minerals.

B. TITLE

Titles to the sulphur properties near Cove Fort, together with a description of the various agreements through which ownership will pass from the present owners to Thermochem are subjects covered in a separate report prepared by solicitors for Thermochem.

Documents certifying that sufficient work was performed to serve as annual assessment required under the laws of the United States and of the State of Utah for the assessment year 1967-1968 were filed in the County Seats of Beaver and Millard Counties, Utah, over the sworn signatures of Carl Wight and Geyza Lorinczi on August 14, 1968. The unpatented mining claims which form a major portion of the properties near Cove Fort are thus in good standing through September 1969.

C. TERMS OF CONTRACT TO PURCHASE

The option agreements covering the right of Thermochem to purchase the Cove Fort sulphur properties contain terms and obligations which must be considered in any assessment of the feasibility of bringing the deposits into production. These are summarized below:

1. Total consideration is $2,030,175.00 payable as follows:
   a) $30,175 payable on execution of Modification of Contract of Sale dated December 26, 1967. This has been paid.
   b) $250,000 payable on or before April 1, 1968. This also has been paid.

c) $250,000 payable on or before April 1, 1969 together with interest to that date at the rate of 6% from December 26, 1967 on the unpaid portion of the $1,000,000 part of the total consideration covered by fixed payment schedules.

d) $500,000 payable on or before December 1, 1969 together with interest accrued to that date.

e) $1,000,000 payable as a charge of $2.00 per long ton for the first 500,000 long tons of sulphur "produced and sold from said assigned and conveyed premises."

While the above payment schedule differs in due dates but not in total amounts from that set forth in the formal contracts available to us, we have been advised by solicitors for Thermochem that agreement in principle has been reached between all parties on the terms cited herein.

The remaining fixed payments required will therefore be approximately as follows:

April 1, 1969 - Principal sum	$250,000	
Interest on $1,000,000 - Dec. 26, 1967 - April 1, 1968	15,738	
Interest on $750,000 - Apr. 1, 1968 - April 1, 1969	45,000	
Total payment		$310,738
December 1, 1969 - Principal sum	$500,000	
Interest on $500,000 - April 1 - Dec. 1, 1969	20,055	
Total payment		$520,055

All sums are in U.S. dollars.

VI

ACCESS, FUEL, POWER AND WATER

All of the presently known Cove Fort sulphur deposits are with two miles to U.S. Highway 91 and/or Interstate 70, which is presently be g built (see Drwg. No. 1075).

Black Rock, which is a Union Pacific railhead, is 24 miles wes of Cove Fort.

A natural gas line and a high-tension power line run near the p: perty to provide possible sources of fuel and power.

The following described water rights are appurtenant to and us l in connection with the claim block:

South Fork of Spring Creek, North Fork of Spring Creek a: Willow Springs, all in Beaver County, for domestic and mi ng purposes. Jan. 1 to Dec. 31, Certificate of Appropriation No. 1750.

Application for Appropriation from Underground Well locat l N 1870 feet, E 760 feet from the SW corner of Sec. 7, T26 R6W, SLB&M, Application No. 33246. Extension has been applied for but no reply has been received.

(For creek and well locations see 1" = 1000' topographic m).

VII

GEOLOGY AND MINERALIZATION

The Cove Fort sulphur deposits occur along a strong system of faulting having a generally north-south trend, a maximum width of some two miles in an east-west direction and a known linear extent of approximately eight miles (see Drawing No. 1075). Within this major fault zone numerous cross fractures have cut the ground into irregular blocks of widely varying shape and dimension. Sub-soil rocks range from intermediate to acid flows of middle to late Tertiary age to earlier limestone and quartzite sediments.

The fracture system has provided passageway for solutions and gases carrying sulphur in the form of H_2S and SO_2 along with carbon dioxide. The acid created by these compounds has attacked all of the rocks adjacent to vents and passageways resulting in intense alteration and bleaching.

Sulphur in elemental form and as sulphides, principally pyrite, as well as the hydrous calcium sulphate, gypsum, has been deposited at numerous points along this plumbing system. In places where shallow topographic basins have formed concentrations of sulphur occur in a gangue of water lain tuff, fault breccia, a sandy conglomerate or a combination of these materials. Where porosity is high and the formation has not been previously sealed by silica, elemental sulphur has almost completely filled all available void spaces. The general odor of hydrogen sulphide in the Cove Fort area, the presence of gas bubbling through the pond in the bottom of the Sulphurdale pit and the encountering of sulphur-bearing gas in a number of drill holes indicate that deposition of sulphur is still going on.

VIII

RESERVES

Reserves of the various known Cove Fort sulphur deposits have been estimated by various authorities during the past seventeen years. After studying the reports and data available to us, we have concluded that the work of two men, supported by the program of bulk sampling and limited drilling carried out under our supervision, forms a reliable basis for calculating the minimum tonnages and grades which can be taken as assuredly present in these deposits.

In 1952 a comprehensive diamond drilling program was carried out on the property under the direction of Clarence R. King, a highly respected and well known mining engineer. An interim report by Mr. King dated October 24, 1952 and plans and sections for three of the deposits, Sulphurdale, Victor-Conqueror and Sulphur King are available and have been reviewed. Unfortunately, drill logs and individual assays are not available and Mr. King passed on several years ago. Results can therefore be compared with work done by others only on an overall basis. Nevertheless, the description given by King of the sampling and analytical techniques used and the good correlation between his statements and conditions as we observe them lead us to conclude that his work was the best yet done on the properties and that his results are generally acceptable. Pertinent data from the King report are summarized below:

Type of drilling	-	Core
Size of hole	-	BX
Total Footage drilled	-	6,316
Average depth of hole	-	60 feet
Drill grid spacing	-	100 feet
Average overburden to ore thickness ratio	-	0.65

In May and June of 1967 a program of pneur tic rotary drilling was carried out on the properties under the supervision f Mr. Donald J. Podesta, Consulting Geologist from Miami, Florida. The purpose of this work was to check King's results and to explore some a as in which King inferred extensions might be present. A total of apj oximately 8,400 feet in 120 holes was drilled in this project. Podesta's grad s averaged about two units of sulphur lower than those of King. Podesta fers that this difference is caused by loss of sulphur in recovery of dr cuttings from the air stream.

Reserves as estimated by King, Podesta an by Chapman, Wood & Griswold Ltd. are shown in Table I.

We have classified our estimated reserves "Drill Measured" since they are based upon drill results verified in part y bulk sampling and trenching. We have used assay data from both Podesta nd King and reduced the area of mineable reserves to eliminate peripher material at grades we consider to be sub-economic. We believe that our fi res represent a safe minimum in tonnage and grade of what can be extracte in mining the deposits.

Bulk samples from the Sulphurdale Deposit id observations made during mining tests indicate that the grade is proba ly closer to 20% than to the 15.9% calculated from Podesta's drilling. though insufficient data is available to us to support Mr. King's inferr l tonnages, examination of the deposits involved indicate that his tonnage fi ures seem high based upon the data available to us. However, considering he eight deposits upon which very little work has been done, it is our con idered opinion that there is a high degree of probability of the presence of 2,500,000 metric tons containing 500,000 metric tons of elemental sulphu and that there is a reasonable possibility of finding an additional 200,000 r tric tons of sulphur.

TABLE I

COVE FORT RESERVE ESTIMATES

Deposit	Class	KING*** Metric Tons Ore	%S*	Metric Tons S	PODESTA** Metric Tons Ore	%S*	Metric Tons S	C. W. & G. LTD. Metric Tons Ore	%S*	Metric Tons
Sulphurdale	Proven	817,000	18.3	149,511	1,373,800	15.9	218,550			
	Drill Measured							594,600	20.0	118,7(
Victor-Conqueror	Proven	907,000	15.0	136,000	648,648	18.6	120,880			
	Inferred	907,000	15.0	136,000						
	Drill Measured							558,000	18.3	102,0(
Sulphur King	Proven	181,500	28.5	51,727	181,730	26.3	47,800			
	Drill Measured							205,000	26.0	53,30
Prince Albert	Proven				56,812	18.4	10,450			
	Drill Measured							78,800	18.9	14,9(
Excelsior	Proven				93,530	16.3	15,240			
	Inferred	181,500	20.0	36,300						
	Drill Measured							68,600	19.1	13,1(
East Purgatory-Beehive	Inferred	363,000	30.0	108,900						
Black Mine and Wildcat Areas	Inferred	181,500	25.0	45,400						
TOTALS	Proven	1,905,500	17.7	337,238	2,354,520	17.5	412,920			
	Inferred	1,633,000	20.0	326,600						
	Drill Measured							1,505,000	20.1	302,0(
	All Classes	3,538,500	18.8	663,838	2,354,520	17.5	412,920	1,505,000	20.1	302,0(

* Elemental Sulphur

** Podesta does not define ore classification but his text implies equivalent of proven

*** Assays adjusted from total S to elemental S

IX

METALLURGY

Since early in the twentieth century sulphur deposits of the volcanic or hot spring type have been of little economic interest as no recovery method had been found which would produce high quality sulphur from such deposits at a cost competitive with prices based on Frasch process sulphur.

In 1967 a Vancouver-based group obtained rights to a process which shows promise of producing a 99.5+ percent elemental sulphur product at an estimated cost which would be competitive with Frasch sulphur. The process has been under development by the Colorado School of Mines Research Foundation, Inc. at Golden, Colorado, under the direction of Chapman, Wood & Griswold Ltd.

In February, 1968, a small pilot plant with a feed capacity of 6 to 8 pounds per hour was completed and started operating to produce high quality sulphur on a continuous basis from raw materials. In March the mini-plant was operated for a total of 470 hours using Sulphurdale Stockpile and Victor Conqueror Pit material as feed with very encouraging results.

A larger pilot plant designed to treat 1,000 pounds of feed per hour went on stream during November 1968. An interim letter report from the Research Foundation dated February 19, 1969, gives the current status of development of the process. A reproduction of this letter in full follows.

COLORADO SCHOOL OF MINES RESEARCH FOUNDATION, INC.

GOLDEN, COLORADO 80401

Office of the Director

February 21, 1969

Refer to

Mr. E. P. Chapman, Jr.
President
Chapman, Wood and Griswold Ltd.
133 East 14th Street
North Vancouver, B.C.
Canada

Dear Mr. Chapman:

This letter concerns the current status of your organization's sulfur recovery work at the Colorado School of Mines Research Foundation, Inc. We are phrasing this letter in such a way that any of your interested associates who may not be as current on this subject as you, may better understand our position in this development and the conclusions we have arrived at thus far with reference to the potential of your organization's sulfur recovery process.

The process which is commonly referred to as the "Champagne" process is a relatively uncomplicated process for recovering sulfur which occurs as elemental sulfur in deposits which are not amenable to the well-established and conventional Frasch process for elemental sulfur recovery. In essence, the Champagne process contacts the sulfur bearing material with hot trichloroethylene, a non-explosive, non-flammable organic liquid into which the sulfur dissolves, and after the sulfur solution of hot trichloroethylene is separated from the undissolved matter, the trichloroethylene solution is cooled to allow the sulfur to crystallize out of solution as a very pure marketable sulfur product. This product is separated from the cold trichloroethylene which is then heated and recycled to the sulfur dissolving step of the process. As we have already advised you, we have been researching sulfur recovery processes for the past 12 years and the Champagne process is the most technically and economically promising process of which we are aware.

When you commissioned our organization to determine the economics of this process, and to obtain engineering design data for a possible commercial operation, we first re-examined the process at the bench-scale laboratory level. This work confirmed Mr. Champagne's findings and resulted in the filing of a second patent application in addition to the one initially filed by Mr. Champagne. In essence, we established that the technology of the process was in accordance with Mr. Champagne's claims; the laboratory work revealed no significant

technical problems and our contacts with the suppliers of the solvent, trichloroethylene, indicated the reagent to be widely used commercially for other purposes, available in ample quantities and with indication that its price would work downwards (subsequently confirmed).

On the basis of our findings, we therefore moved to the operation of a small pilot plant commonly referred to as a "miniplant" in order to gather information on the basis of which a decision concerning the operation of a large pilot plant could be made. The principal purpose of the miniplant has been to establish the loss of solvent per short ton of sulfur produced as the result of the chemical breakdown of the solvent during the recycle between the hot and cold steps of the process; and, of equal importance, to determine the behavior of a variety of elemental sulfur bearing ores in the Champagne process. As a matter of record, we have been dependent upon others for the selection of these sulfur-bearing materials. We received the individual samples you submitted and treated these in the miniplant for a sufficient length of time to obtain meaningful data on each sample.

With no exceptions or reservations, the data arising from the operation of the miniplant has been encouraging with respect to the economic potential of the process. We brought to bear the most exacting means at our command to determine the chemical breakdown of the solvent, while, at the same time, obtaining as much data as possible on potential corrosion problems, the optimum size to which the ore should be reduced, the purity of the sulfur product (grade) and percent sulfur recovered from the samples. This encouraging data which is already tabulated and discussed in reports you have received from us, may be recapitulated as follows:

Geographic Origin Sample Material	Percent Sulfur in Material (Dry Basis)	Percent Sulfur Recovered	Analysis of Sulfur Recovered	Chemical Loss of Solvent Per Ton* of Sulfur Product	Total Loss of Solvent Per Ton* of Sulfur Product
Wyoming	33.2	80.	99.4	$ 0.93	$ 6.55
California	31.9	94.	99.3	0.75	5.68
Utah	21.2	80.	97.7	0.35	9.55
Guatemala	73.6	89.	99.5	1.62	not determined
Bolivia	52.8	83.	99.4	1.05	8.50
Philippines	29.8	91.	99.5	0.51	6.72
Costa Rica	24.4	90.	99.7	1.94	8.95
			Average	$ 1.02	

*2000 lbs.

With reference to the above recapitulation, and as more fully explained in reports you already have from us, the miniplant was not designed to minimize the loss of solvent other than the chemical loss, and hence the column reflecting total losses is relatively meaningless as far as extrapolation to a commercial situation is concerned. Losses, other than chemical, were entirely mechanical (leaks, spillage, vapors, etc.) and should be minimal in a properly designed commercial plant. Likewise, the purity of the sulfur from the miniplant could not be as desired because the miniplant was essentially constructed of common steel which experienced a small amount of corrosion in a few areas and thus some corrosion products reported with the sulfur product as impurities. In addition, the miniplant was not designed to achieve maximum sulfur recovery. However, in view of the encouraging data arising from the miniplant operations, you authorized us to proceed to design, install, and operate a large pilot plant utilizing "off-the-shelf" equipment which could be readily scaled up for a commercial design if the data arising from this larger operation continued favorable.

As of the date of this letter, this prototype plant, piloting the Champagne process, is on stream and has been operated intermittently since November, 1968. Without meaning to be presumptuous, we hope that all concerned are pleased with the fact that the continuing development of this process resulted in an operating prototype plant within 11 months from the time you first discussed this job with us. This pilot plant has been designed to accommodate up to 1,000 lbs. of feed material per hour on a continuous around-the-clock basis. You requested us to incorporate into this plant a sufficient variety of equipment so that any system demands could be met. The operating programs to establish the merit of various combinations of equipment have been the cause for intermittent operations since it has been necessary to shut the plant down from time to time to test alternate equipment and flow schemes.

We emphasize this point so that all concerned will be aware of why we are not yet ready to offer you a final technical and economical appraisal. However, concerning our experience with this prototype plant to date, we can state without reservation that:

1. We have processed more than 100,000 lbs. of Utah material.

2. Highest sulfur recovery on the Utah material has been 95% with an average recovery of 84%.

3. Chemical degradation (loss) of the trichloroethylene solvent appears no more than that obtained during miniplant operations.

4. No important corrosion problem has been uncov ed and it appears that much of the stainless steel construction of t prototype plant could be replaced with common steel, or at leas with materials less expensive than stainless steel.

5. The sulfur product recovered is bright yellow ar has analyzed as high as 99.98% sulfur and at no time has it anal ed less than 99.85% sulfur (this is a rubber grade premium purity).

6. We have encountered no unexpected technical pr lems with the operation of the Champagne process. It is now obvious th some of the equipment in the prototype plant may be over-designed and at a commercial plant using this process would be of a relatively simpl design.

7. Our present thinking is that in a typical commer al plant to which sized feed material is being delivered, not more han three operators per shift would be necessary.

8. Operations have revealed no air or water polluti problems in connection with the process, other than the control of d t from sizing the ore if the ore is extremely dry.

9. Toxicity or related hazards with reference to the se of the trichloroethylene solvent are literally negligible as far as he operation of a properly designed plant is concerned. (It is true hat reckless exposure to the solvent or to its vapor is hazardous.)

With reference to capital required for a 1,000 ton per da plant located at Sulphurdale, Utah, processing ore containing 20% by we t recoverable sulfur, our calculations indicate a capital investment ranging fr \$2,000,000 to $4,000,000, exclusive of mining equipment. The actual gure will depend upon the final choice of equipment and materials of constructi as may appear most desirable as the result of our continuing pilot plant expe nce. Due to the continuing simplification of required equipment for the p cess, our feeling is that the actual capital requirement for the proposed com rcial plant will be on the lower side of this range. This estimated capital r quirement covers the ore size reduction, the chemical processing plant and ma ntenance shop, but does not include any other applicable capital costs.

With reference to direct chemical processing costs on a ort ton of sulfur product, and based on a 1,000 ton per day plant at Sulph dale, Utah, utilizing a grade of ore averaging 20% recoverable sulfur, our pr ection is as follows:

1,000 short tons of feed x 20% sulfur x 94% recovery = 188 short tons sulfur per 24 hour day

Average chemical solvent loss from miniplant runs... $1.02 per ton of sulfur (Table - page 2)

Operating labor

First shift -	1 superintendent 1 chemist 1 secretary 2 maintenance 1 foreman 2 operators	= 64 hours
Second shift -	1 foreman 2 operators 1 analyst 1 janitor	= 40 hours
Third shift -	1 foreman 2 operators 1 janitor-sampler	= 32 hours

Recapitulation manhours = 136 x $3.00 per hour	=	$ 408.00
Overhead on labor	=	408.00
Fuel per 24 hour day	=	340.00
Power per 24 hour day	=	75.00
Supplies per 24 hour day	=	20.00
Reagent $1.02 x 188 ton	=	192.00
Maintenance items per 24 hour day	=	220.00
Total		$1663.00
$1663 Daily operating Cost ÷ 188 tons S	=	$ 8.85

We realize the foregoing projected $8.85 direct operating cost will be influenced by any mechanical loss of solvent resulting from improper plant design or improper plant operation. To allow for this contingency, therefore, it seems reasonable to double the solvent loss cost to provide for such items as leaks and mechanical spillage. In other words, by adding another $1.02 to the foregoing $8.85 figure, our projected operating cost, based on the

assumptions as indicated, is $9.87. To be more conservative, we state that our projected operating cost, based on the foregoing qualifications, is under $10.00 per 2,000 lb. (short) ton of sulfur produced.

With reference to the foregoing brief summary of our opinion, I trust this conveys to you and your associates that we believe that future operations of your prototype plant here will confirm that the economics of the process are favorable. At this time, and based on our total experience with this development for you, we have no reason to believe that the economics of the process will not be favorable.

Sincerely yours,

E. H. Crabtree
Director

C. J. Lewis
Director of Research
Chemical Division

EHC/arh
enc extra copies

cc: Mr. Roy Hickman

X

EXPLORATION AND DEVELOPMENT PROGRAM

During the period January 8 to August 16, 1968, a field program of exploration and evaluation was carried out at the property. Evaluation and development planning has been conducted in our Vancouver office since December, 1967.

This program of exploration, evaluation and development comprised trenching, bulk sampling, seismic and ripping tests, geochemical survey, rotary drilling, aerial photography and mapping, photogeologic studies and preliminary mining operation planning.

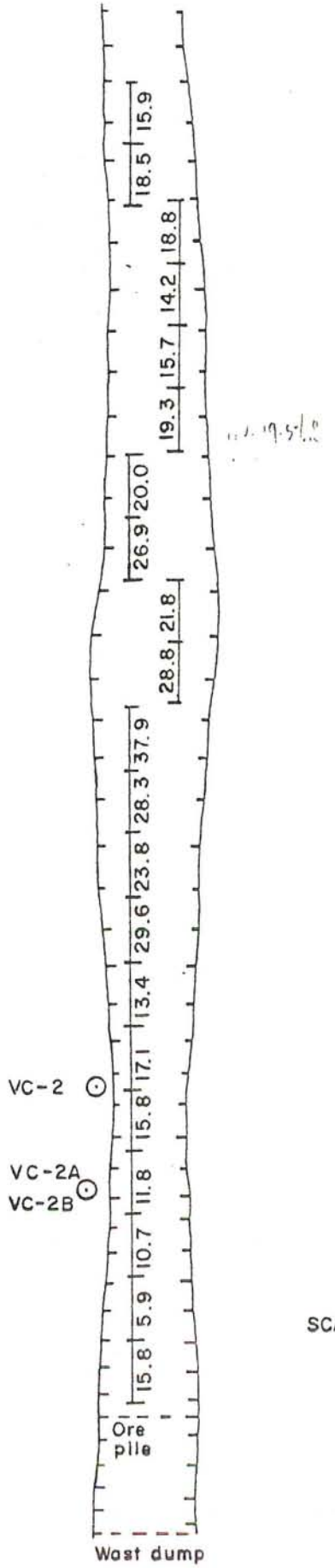
A. TRENCHING

A trench, with dimensions 360x25x14 feet, was dug by a D-8 caterpillar in the centre of the Victor-Conqueror deposit. The purpose of this trench was twofold; to check the continuity and grade of sulphur mineralization, and to determine rippability of the host rock.

The bottom of this trench was sampled in 15-foot increments. Channel locations and assay results are shown in Drawing No. 1029. Average grades of these samples are tabulated below:

Interval*	Length Feet	Grade % Elemental Sulphur
0 - 90	90	17.07
90 - 210	120	27.14
210 - 315	105	12.93
0 - 315	315	19.52

*From north end of pit



LEGEND

APPROXIMATE TRENCH OUTLINE

21.8 CHANNEL LOCATION, LENGTH AND PERCENT ELEMENTAL SULPHUR.

⊙ ROTARY HOLE LOCATION

NOTE: AVERAGE TRENCH DEPTH IS 14 FEET.

THERMOCHEM INDUSTRIES LIMITED

VICTOR-CONQUEROR DEPOSIT
MAP SHOWING HORIZONTAL CHANNEL SAMPLE LOCATIONS

SCALE 0 40 80 120 FEET

CW & G LTD. DRWG.NO. 1029 APR., 1968

Although the grade of the material exposed in this trench is not directly comparable to the grade of the Victor-Conqueror deposit as a whole, it is interesting to note that the estimated grade of this body based on drill results is 19.5% elemental sulphur.

B. BULK SAMPLING

Approximately 120 tons of Victor-Conqueror material averaging 14.7 percent elemental sulphur was mined, crushed and hauled to Golden for metallurgical testing.

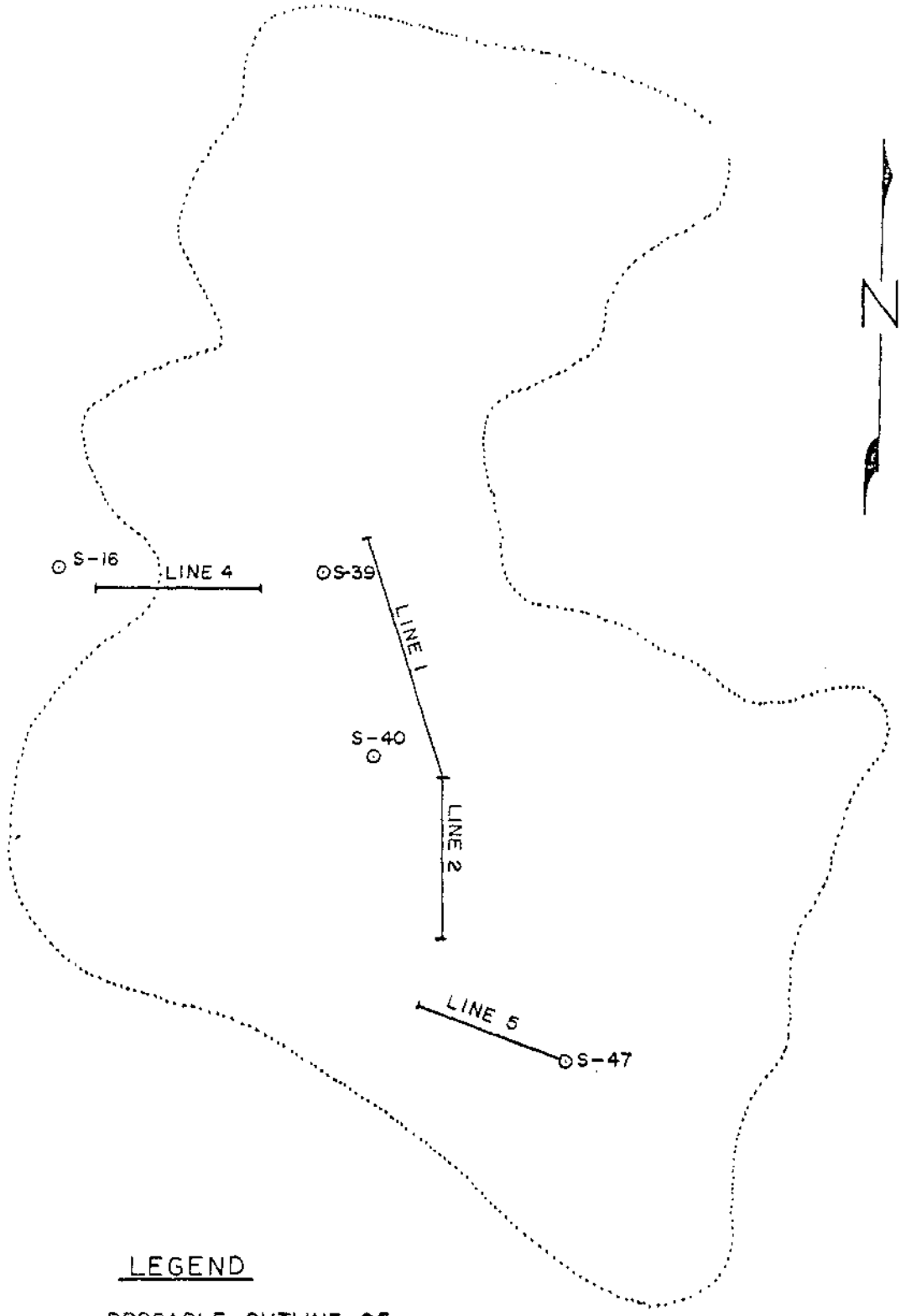
This sample was taken from a trench dug between drill holes V-38 and V-39 (for location refer to Drawing No. 1077). The sulphur-bearing horizon was drilled, blasted, broken up and moved with an old D-7 and loaded with a one-yard bucket front-end loader, then hauled about six miles to the Sulphurdale plant site for crushing.

Approximately 180 tons of Sulphurdale material averaging 21.1 percent elemental sulphur was crushed and hauled to Golden for metallurgical testing. This material had been stockpiled near the crusher by operators who had been mining the Sulphurdale deposits prior to 1960.

C. SEISMIC TESTS

In order to determine the rippability of the sulphur-bearing rocks seismic tests were conducted over the Sulphurdale, Victor-Conqueror and Sulphur King deposits. This work, concurrent with the ripping tests, was carried out by Gibbons & Reed Company of Salt Lake City.

In general, seismic tests aid in obtaining information about rippability by applying the principle that the velocity of shock waves is proportional to the density of medium in which the waves are transmitted. A model



LEGEND

PROBABLE OUTLINE OF OREBODY

DRILL HOLE LOCATIONS

SEISMIC TEST LINE

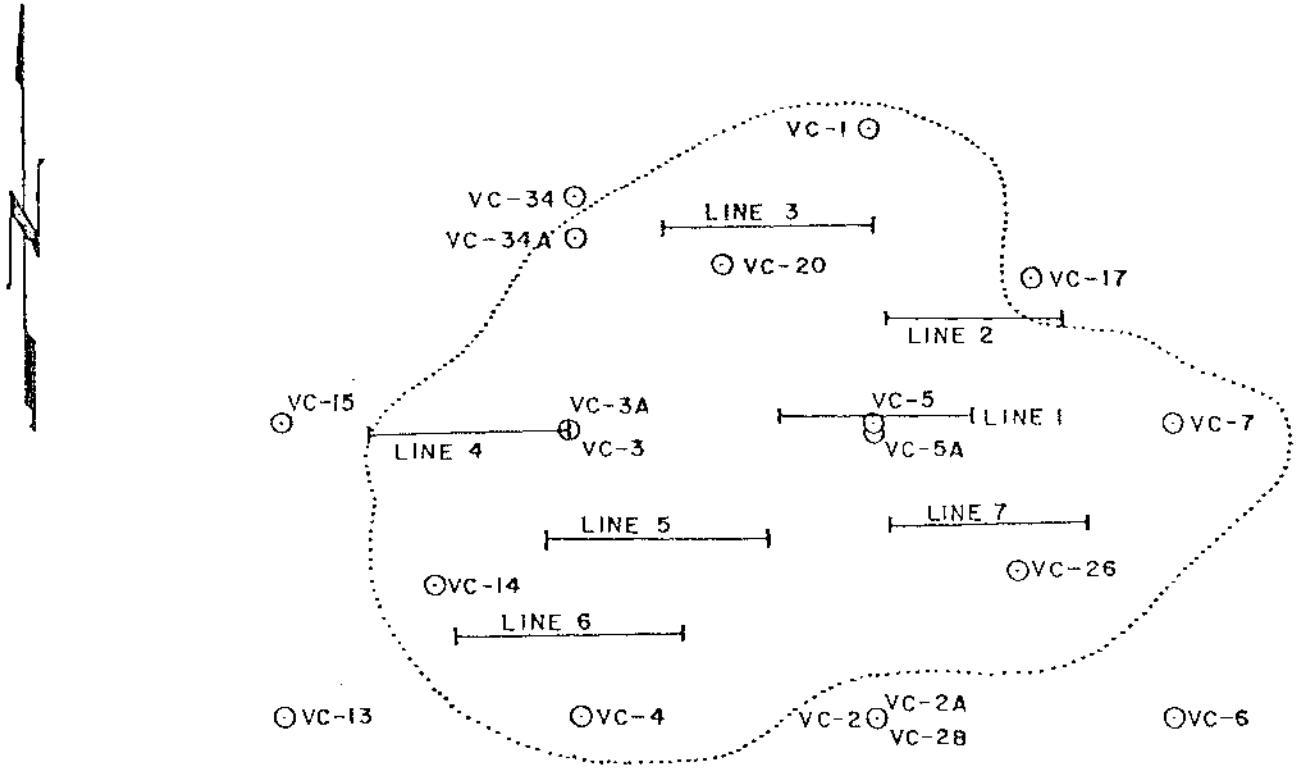
THERMOCHEM INDUSTRIES LIMITED

SULPHURDALE DEPOSIT

SKETCH SHOWING SEISMIC TEST LINE LOCATIONS

SCALE 0 200 400 600 FEET

CW & G LTD. DRWG NO. 1030 MAY, 1968



LEGEND

- DRILL HOLE LOCATIONS
- PROBABLE OUTLINE OF OREBODY
- SEISMIC TEST LINE

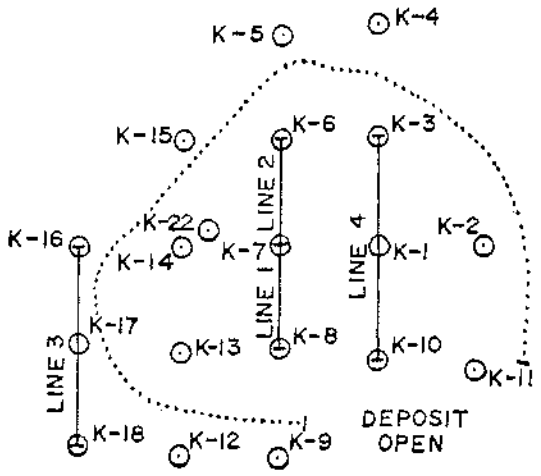
THERMOCHEM INDUSTRIES LIMITED

VICTOR-CONQUEROR DEPOSIT

SKETCH SHOWING SEISMIC TEST LINE LOCATIONS

SCALE 0 200 400 600 FEET

CW & G LTD. DRWG. NO. 1032 MAY, 1968



LEGEND

- ⊙ DRILL HOLE LOCATIONS
- PROBABLE OUTLINE OF OREBODY
- SEISMIC TEST LINE

THERMOCHEM INDUSTRIES LIMITED

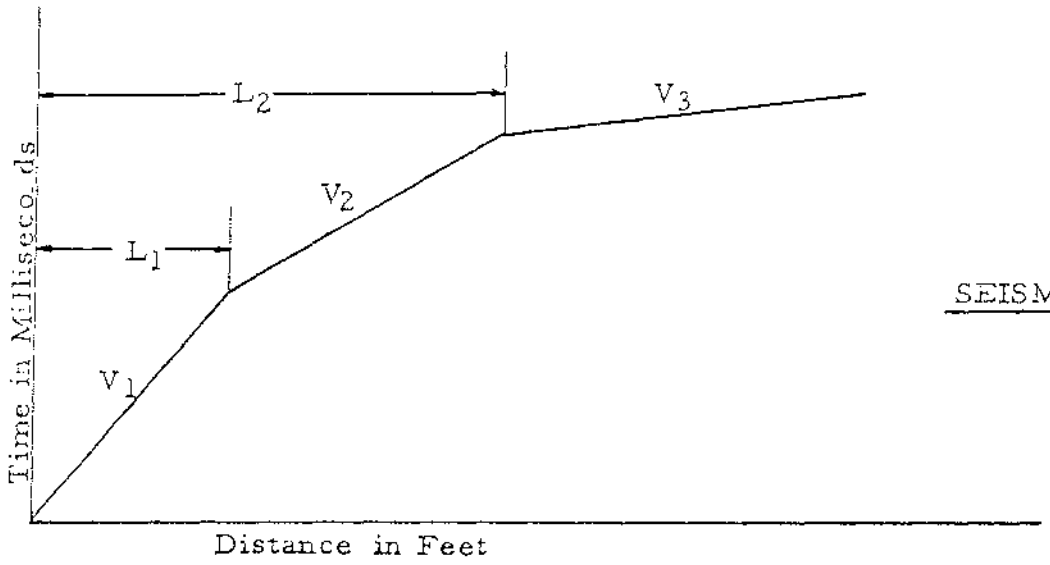
SULPHUR KING DEPOSIT

SKETCH SHOWING SEISMIC TEST LINE LOCATIONS

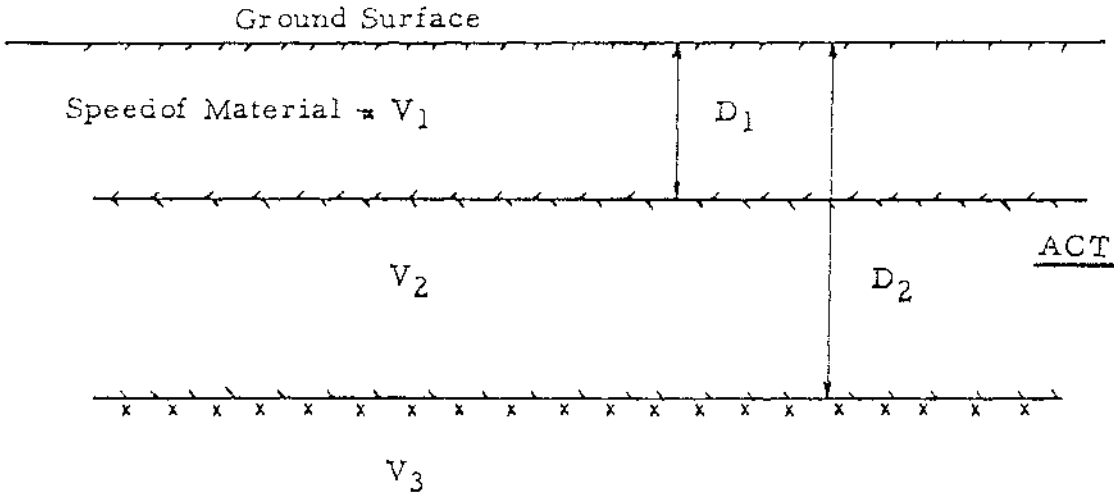
SCALE 0 200 400 600 FEET

CW&G LTD. DRWG. NO. 1033 MAY, 1968

Figure I



SEISMIC CURVE



ACTUAL GROUND

V = Velocity of shock wave through material in ft/sec.

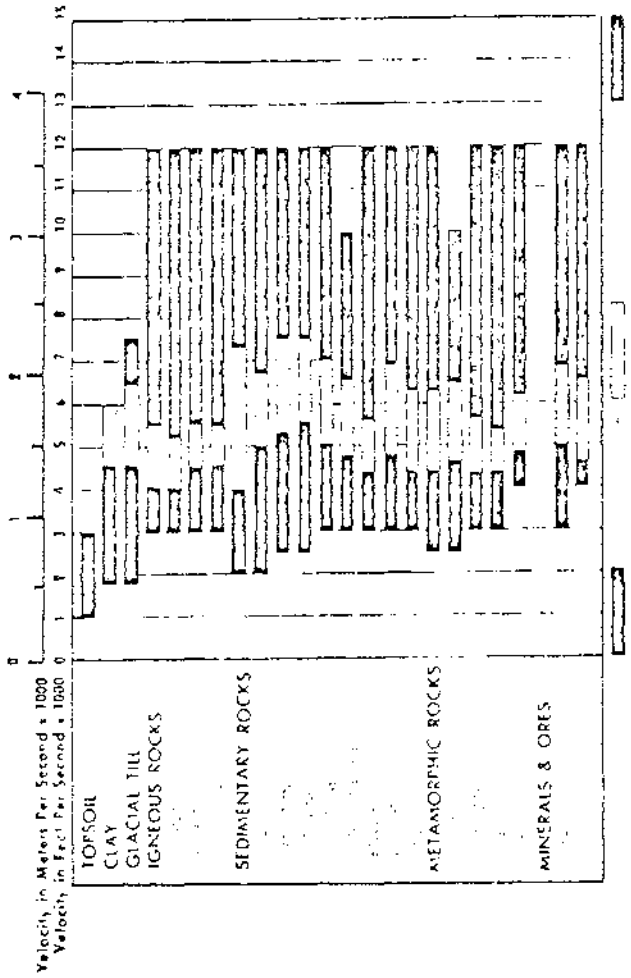
= $\frac{\text{Dist. in ft.}}{\text{Time in milliseconds} \times 1000}$

$D_1 = \frac{L_1}{2}\sqrt{\frac{V_2 - V}{V_2 \quad V_1}}$ = depth to interface of different velocity materials in feet

$D_2 = D_1 + \frac{L_2}{2}\sqrt{\frac{V_3 - V_2}{V_3 \quad V_2}} - RD_1$

Production

D8H. (235 H.P.) - NO. 6 RIPPER PERFORMANCE AS RELATED TO SEISMIC WAVE VELOCITIES HINGE TYPE RIPPER



Production

D9G. (385 H.P.) - NO. 9 RIPPER PERFORMANCE AS RELATED TO SEISMIC WAVE VELOCITIES HINGE TYPE RIPPER

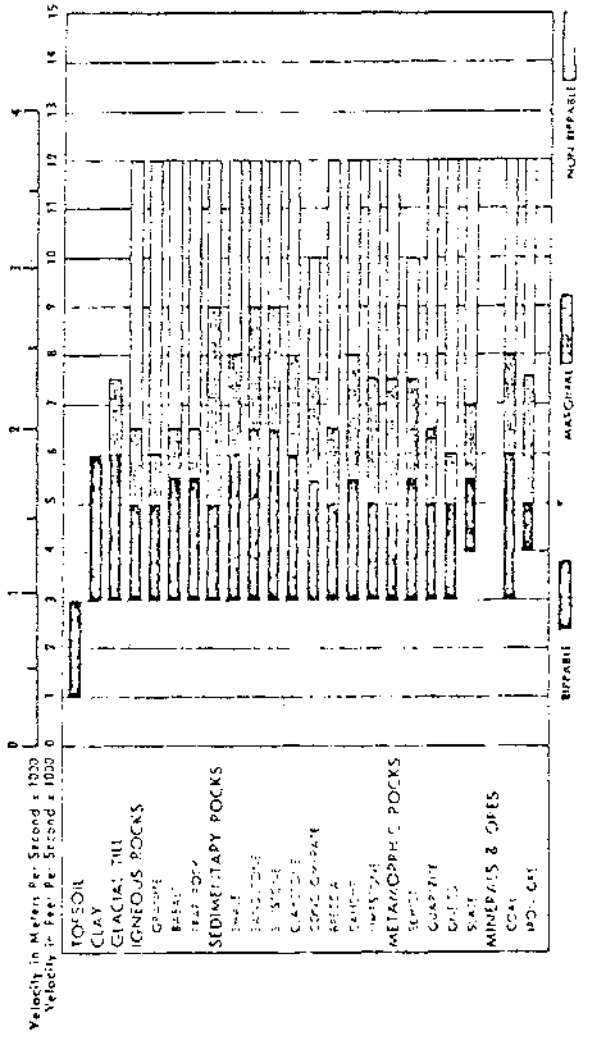
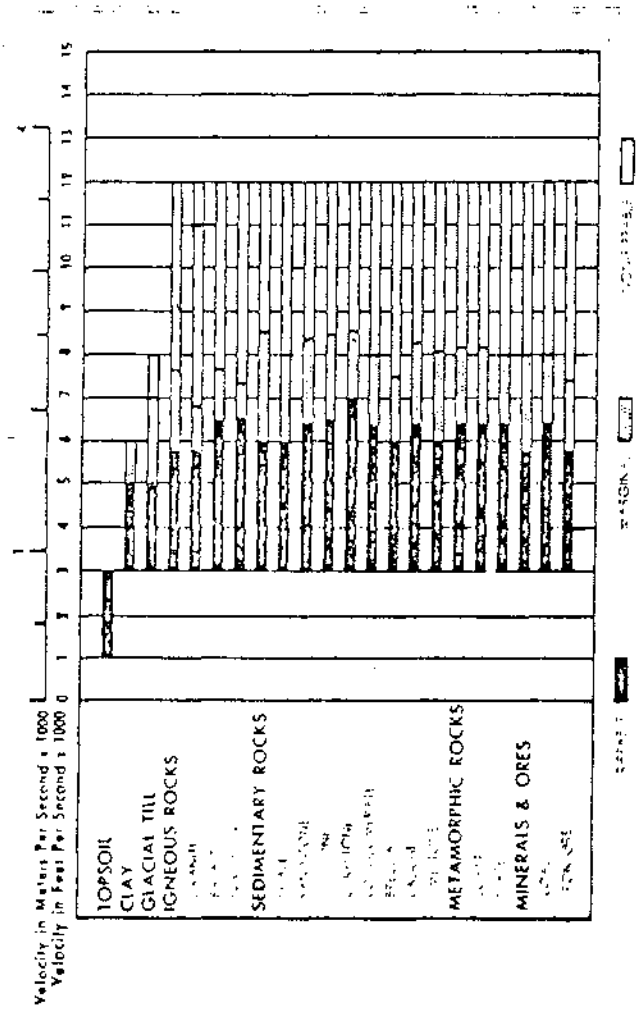


FIGURE 2

Production

D8H. (235 H.P.) - NO. 8 SERIES B - MULTI AND SINGLE SHANK PARALLELOGRAM TYPE RIPPER RIPPER PERFORMANCE AS RELATED TO SEISMIC WAVE VELOCITIES



Production

D9G. (385 H.P.) - NO. 9 SERIES B - MULTI AND SINGLE SHANK PARALLELOGRAM TYPE RIPPER RIPPER PERFORMANCE AS RELATED TO SEISMIC WAVE VELOCITIES

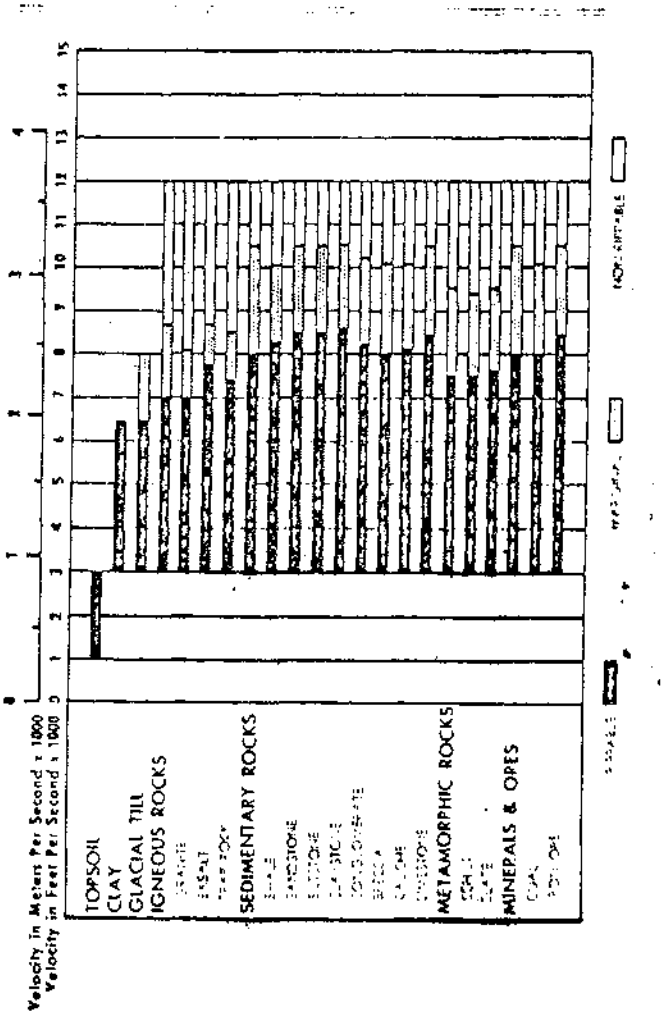


FIGURE 3

of depth and velocity calculations is given in Figure 1.

There are three basic assumptions involved in the calculation of depth and velocity. Firstly, the material in any given layer is assumed to be homogeneous; if the material is heterogeneous the average velocity obtained may be misleading. Secondly, it is assumed that layers with different velocities have uniform thickness, otherwise the accuracy of calculations will be affected. Finally, the seismograph works on the principle that rock density increases with depth; therefore, if a soft stratum underlies a hard layer the former might remain undetected.

Figures 2 and 3 show ranges of shock wave velocities in a number of rock types which are expected to be ripped by D-8 and D-9 tractors. The economics of such ripping is not considered in these graphs.

A total of 15 lines was run over the three major deposits. Line location sketches and depth-velocity graphs accompany this report.

A comparison of seismic results with the Caterpillar charts (Figures 2 and 3) suggests that the sulphur-bearing horizon and the waste necessary to be removed can be ripped with a D-9 equipped with a hinge-type ripper. There were two layers detected having velocities in excess of 5,700 feet per sec, both of which are believed to be below the sulphur horizon.

D. RIPPING TESTS

In April of 1968 a D-8 Caterpillar equipped with a hinge-type hydraulic ripper was used in conducting tests on the Sulphurdale and Victor-Conqueror deposits.

Trenches were dug in rocks of measured shock wave velocities of 5,700 ft/sec and 3,900 ft/sec in the Sulphurdale and Victor-Conqueror areas, respectively (for trench locations see Drawing Nos. 1076 and 1077). These velocities represent rock densities that are well in excess of the average measured densities for the three major deposits.

The results indicated but did not conclusively demonstrate that the deposits could be economically mined using a tractor equivalent to a Caterpillar D-9. Since ripping and scraping is a method of exploitation which can be carried out at substantially lower costs than can be realized by drilling and blasting followed by loading and hauling in trucks, a second series of tests using a D-9 tractor and motorized scrapers was started in February 1969 by Gibbons and Reed. Work on the Sulphurdale body was completed with favorable results on February 21st. The test program on the Victor-Conqueror is proceeding satisfactorily. In our opinion there is now no doubt that the Cove Fort sulphur deposits can be mined by inexpensive ripping and scraping techniques.

E. GEOCHEMISTRY

In April, 1968 a soil pH orientation survey was undertaken in the Victor-Conqueror deposit area.

The survey was initiated on the anticipation that soils over sulphur-bearing rocks would contain abnormal concentrations of sulphuric acid liberated during the redox processes of elemental sulphur.

Twenty-nine samples were collected over near-surface sulphur-bearing and barren rocks for free-acidity determinations.

The results of this preliminary orientation survey indicated a sufficient contrast between pH values obtained over the two different types of ground (see Drawing No. 1034 and table below) to provide a relatively inexpensive reconnaissance exploration method in the Cove Fort area.

Over near-surface sulphur-bearing rocks:

Sample	pH
V-1	6.21
V-2	6.95
V-3	7.30
V-4	7.32
V-9	5.62
V-16	7.22
V-19	6.51
V-20	6.37
V-21	6.31
V-22	6.38
V-23	6.65
V-28	6.49
V-38	5.63
V-39	6.67
V-40	6.55
V-41	6.25
V-42	6.51
VC-2A	5.70
*HK-7	7.60
*HK-8	8.02
Arithmetic mean pH	6.48

Over drilled or assumed barren rocks:

Sample	pH
B-1	7.98
B-2	7.60
B-3	7.73
B-4	7.97
V-10	6.40
V-12	7.22
V-30	6.70
V-31	7.46
V-32	7.11
Arithmetic mean pH	7.35

*Samples taken in different soil environment - not included in arithmetic mean

pH determinations of the orientation samples were carried out by the Research Foundation in Golden.

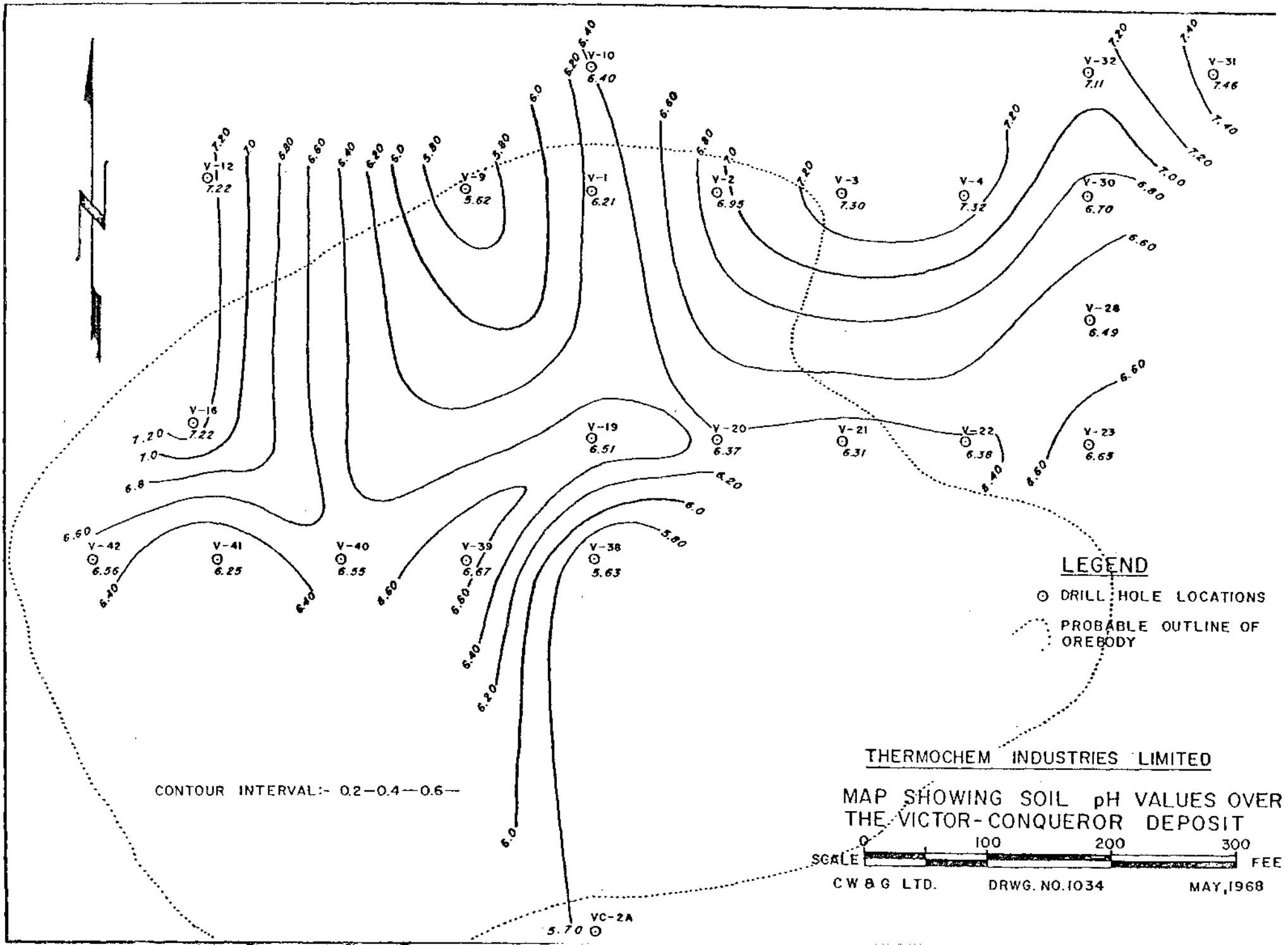
In an attempt to pinpoint new exploration targets in the claims area a total of 61 soil samples were collected in the months of July and August. Sample sites were selected by utilizing preliminary photogeologic structural interpretation of the Cove Fort area. Sample locations and corresponding pH values are shown on Drawing No. 1309.

pH 7.00 was determined to be threshold; therefore, all values below this must be investigated.

For field determinations a portable Metrohm E-280A pH meter was used. Glass-calomel electrodes and buffer solutions for standardization were provided with this unit. The following sample preparation procedure was applied: 5.0 grams of -20 mesh soil was weighed into a 50 ml culture tube (with stopper), 5 ml A.R. grade methyl alcohol and 5 ml demineralized water were added to it. The tube was shaken well, then set aside to settle for ten minutes. pH of liquid phase was measured to an accuracy of $\pm$ 0.05.

It should be noted that the pH decreases as the hydrogen ion concentration (acidity) increases. Due to the logarithmic nature of pH a small decrease in pH corresponds to a large increase in hydrogen ion concentration.

A few values lower than pH 7.00 were encountered but in most instances these were close to known deposits. Research in geochemical techniques is continuing at the property under the direction of Richard Janes of the C.W.&G. Ltd. staff. Encouraging progress is reported in refinement of both sampling and analytical methods. When the snow which now


V-1 6.21
V-2 6.95
V-3 7.30
V-4 7.32
V-5 5.62
V-9 5.62
V-10 6.40
V-12 7.22
V-16 7.22
V-19 6.51
V-20 6.37
V-21 6.31
V-22 6.36
V-23 6.65
V-28 6.49
V-30 6.70
V-31 7.46
V-32 7.11
V-38 5.63
V-39 6.67
V-40 6.55
V-41 6.25
V-42 6.56
VC-2A 5.70
LEGEND
DRILL HOLE LOCATIONS
PROBABLE OUTLINE OF OREBODY
CONTOUR INTERVAL:- 0.2—0.4—0.6—
THERMOCHEM INDUSTRIES LIMITED
MAP SHOWING SOIL pH VALUES OVER THE VICTOR-CONQUEROR DEPOSIT
0 100 200 300
SCALE FEE
CW & G LTD. DRWG. NO. 1034 MAY, 1968

covers the property is gone within the next few weeks, a program of broad geochemical coverage of the Cove Fort area is planned.

F. AERIAL PHOTOGRAPHY AND MAPPING

At the request of Chapman, Wood & Griswold Ltd. the following work has been completed by Intermountain Aerial Surveys of Salt Lake City, Utah:

1. Setting panels and ground control survey prior to flying the claims area.

2. Preparation of one stereo set black and white at 1" = 1000', one set black and white at 1" = 2000', and one set infrared at 1" = 2000' covering the claims area.

3. Preparation of a photo mozaic for the same.

4. Preparation of 5-foot contour interval maps for the Sulphurdale, Victor-Conqueror and Sulphur King pit areas.

5. Preparation of one 20-foot contour map for the northern half of claims area.

6. Enlargement of a 40-foot contour interval map of the claims area.

These maps are being used as a base for mine planning and exploration and development work. Copies are appended to this report.

XI

MARKETS

Sulphur markets are currently in a somewhat confused state as a result of the ending in the last half of 1968 of a six-year period of acute sulphur shortage. In February 1969 quoted prices f.o.b. Gulf ports dropped $2 per long ton - the first official break in prices in 10 years - to $39 per long ton for dark and $40 per long ton for bright. Various authorities predict a surplus in sulphur supply over demand lasting through 1975.

Both supply and demand projections for sulphur are subject to tremendous uncertainties. Despite enormous expenditures, the search for new deposits amenable to recovery by the Frasch Process has been largely unsuccessful. Availability of Polish sulphur, a prime factor in European markets, is undeterminable. Estimates of the potential quantity which will come on stream from high cost sources such as plants recovering sulphur from sour gas, gypsum, pyrites and thermal powder station waste gases vary widely. Demand is closely tied to the markets for phosphatic fertilizer which in turn are profoundly influenced by free world foreign aid programs and the availability of hard currencies to underdeveloped countries.

During 1968 sulphur consumption in non-Communist countries grew 3.8% to 26.9 million long tons. From 1962 through 1967 the annual consumption growth rate averaged about 7%.

Estimates of demand growth rates through 1975 range from 4% to 8% per year. In a report on a study made for Thermochem, Hedlin Menzies predicts an annual increase in demand of 6%. Estimates of available supply

average about 35 million long tons by 1970 and 40 million tons by 1975. Drawing No. 1312 shows free world consumption projected at growth rates of 4, 6 and 8%. It appears that there will be a substantial surplus through 1970 but that if the 6% annual growth can be achieved supply and demand would be in balance by mid 1973.

No pricing structure exists for sulphur equivalent to that for metals such as lead, zinc and copper. Quoted prices are nominal to a varying degree and most sales are made on long term contracts or on a spot basis. Unfortunately sales agreements cannot be negotiated until production plans have been completed and availability of supply can be forecast with reasonable accuracy. However, Cove Fort is favorably situated in comparison to major suppliers of sulphur to consumers whose requirements exceed any projected rate of production from the deposits.

The best markets for sulphur produced from the Cove Fort properties appear to be:

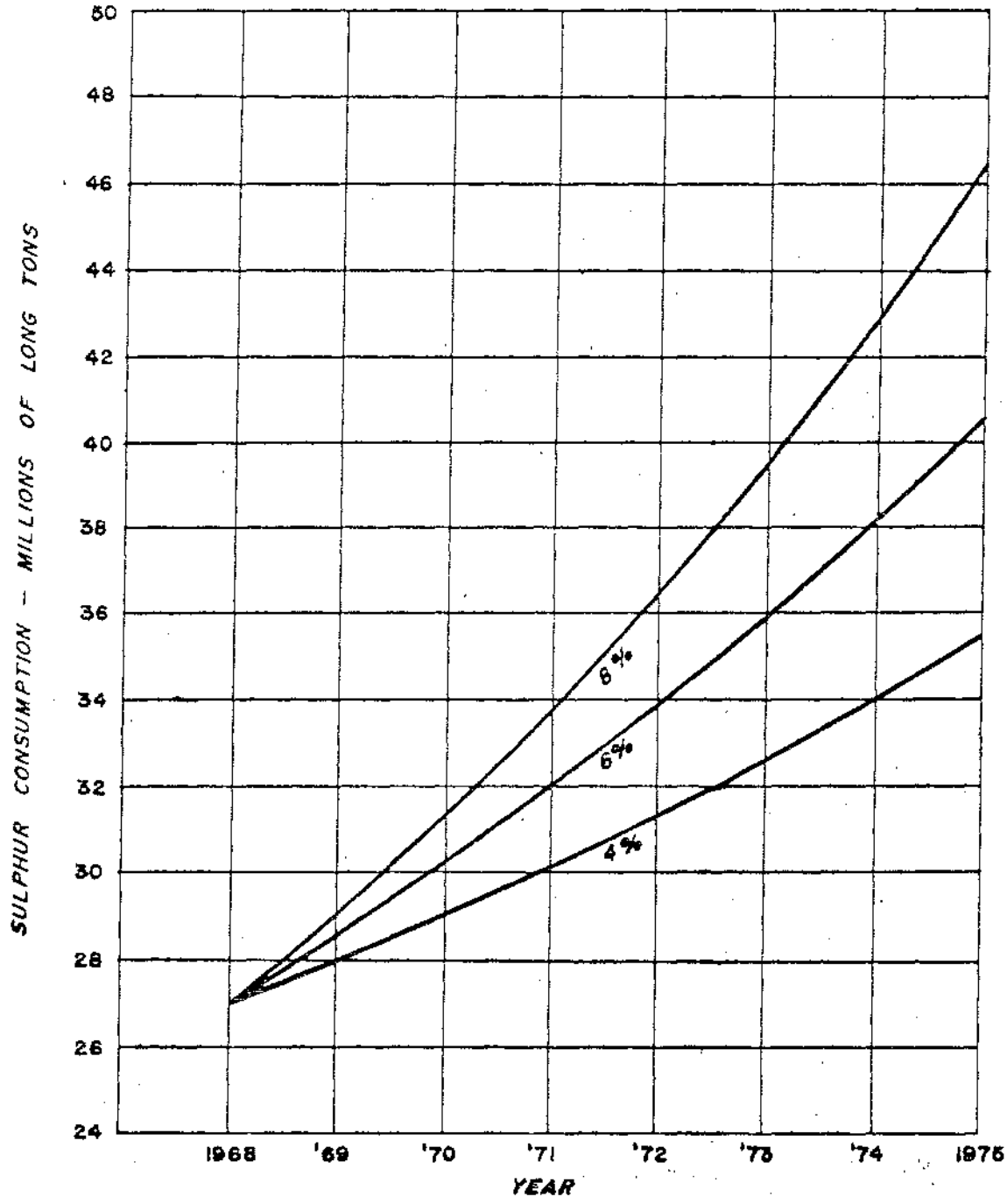
1. Brush Beryllium Company's planned beryllium plant near Milford, Utah, approximately 45 miles by highway from Cove Fort. Requirements are estimated to be 60 to 100 long tons of sulphur per day.

2. J. R. Simplot Co. at Pocatello, Idaho.

3. Uranium mills in Utah, Colorado and Wyoming.

4. Oxide copper leaching plants in Utah and Arizona.

5. Users in the San Francisco and Fresno areas of California.



THERMOCHEM INDUSTRIES LIMITED

FREE WORLD SULPHUR CONSUMPTION
PROJECTED TROUGH 1975

AT GROWTH RATES OF 4, 6 & 8 PERCENT

DRWG Nº 1312 C. W. & G. LTD MARCH, 1969

Sulphur produced by the Thermochem process will be of high purity and suitable for any end use. With favorable freight differentials in the proposed marketing area, we believe that up to 200 metric tons of sulphur per day can be sold over the next five years at prices at Cove Fort ranging from $35 to $40 per metric ton (2204 lbs.) or long ton (2240 lbs.).

XII

MINING PLAN

In July 1968, Gibbons & Reed Company, contractors with offices in Salt Lake City, Utah, submitted an estimate of the cost of mining and transporting ore from the Cove Fort sulphur deposits to a plant located near the Sulphurdale deposit.

The estimates were based upon the following assumptions:

A. Mining by conventional methods involving drilling, blasting, shovel loading and truck haulage.

B. Production rate at 1000 metric tons of ore and 700 metric tons of overburden plus waste per day.

The estimates were as follows:

"1. Haul 1000 tons of ore 1000 feet to plant and waste 700 tons of overburden per day. Estimated cost: $0.65 per ton moved = $1.105 per ton of ore."
(This figure would apply to the Sulphurdale pit.)

"2. Haul ore approximately five (5) miles at 1000 tons per day and waste 700 tons of overburden per day within 2000 feet of the pit. Estimated cost: $0.85 per ton moved = $1.445 per ton of ore hauled to the plant.

"The above price does not include the cost of a bridge over the freeway or the haul road to the plant. A hard surfaced, all weather haul road would cost approximately $20,000 per mile."
(This figure would apply to all other presently known Cove Fort deposits.)

Preliminary analysis indicated that if the deposits could be mined by stripping and scraping methods, substantial savings could be realized over the Gibbons & Reed estimates. Mining tests currently being carried out have progressed far enough in our opinion to demonstrate that the deposits can be mined by such methods.

Detailed studies involving different types of equipment, cycle times, operating and capital costs have been conducted by Simon Malone, mining engineer on C.W.&G. Ltd.'s staff. A summary of Mr. Malone's findings appears below:

Several different equipment and costing combinations were used in attempting to find the most economic mining method. These included tractor scrapers, front end loaders and bulldozers costed on a contractural and outright purchase basis. The two most economic methods appear to be

a) The use of a D9 for ripping combined with a 621 Tractor Scraper for mining and moving the ore to a dumping point close to the mill. The D9 would rip 3 hours/day and push the remainder of the day.

b) Using a D9 for ripping combined with a large front end loader for moving the ore to the millsite or adjacent dumping point.

These two methods were costed on the bases

i) Contractor charging out full owning and operating costs on all equipment for mining purposes without imposing an 8-hour shift limitation but guaranteeing 1400 tons ore per day.

ii) The contractor charging for 8 hours equipment usage per day regardless of optimimum utilization.

iii) The operating company purchasing the equipment and reselling it at the completion of the operation. On costing this, the capital equipment cost could be a deductible item for taxation purposes in which case no ownership costs pertain.

Both variations are shown in the table below.

	(i) Contractor moves ore without time limitation		(ii) Contractor paid for equipment on shift basis (8 hrs)		(iii) Purchase and resale of equipment	
	Cost per ton (cents)		Cost per ton (cents)		Cost per ton (cents)	
	Ore+Waste	Ore	Ore+Waste	Ore	Ore+Waste	Ore Only
621 + D9	20¢	33	19	31	15(11)*	26(17)*
Michigan 475 + D9	20	34	24	41	16(10)*	28(17)*

*Cost of mining if capital cost is not applied to the mining cost

Conclusions and recommendations:

It appears that the purchase and resale of equipment and an operation by the company would be a practical and economic solution.

The combination recommended is that of a large front end loader combined with a D9 for ripping purposes. The front end loader has these advantages over the tractor scraper.

a) It is highly mobile compared to the tractor scraper.

b) It is independent of the bulldozer for production purposes.

c) It could be used for the handling of concentrates.

d) The hourly operating cost is $24.10 compared to $21.98 for the 621 tractor scraper. The $2.12 difference is significant but in terms of operating costs the cost per ton of material is 17¢ in both cases.

e) The front end loader could be used for grade control.

f) The total hourly equipment usage will be roughly 25% less if a front end loader is used as the D9 would be required only half a shift daily compared to a full shift on the tractor scraper.

Although the final cost per ton of ore is 2 cents per ton higher and amounts to $60,000 over the operating life of the two pits, it is felt that the flexibility offered by the front end loader is desirable and that an evaluation of possible tax benefits be carried out.

Based on the above the final mining costs are:

Capital Cost $185,300 and Operating Cost 17¢/ton ore, less resale value

This could also be expressed as a final cost of 28¢/ton ore including capital at presently indicated ore reserve estimates.

Hauling costs based on use of two 45-ton trucks, a highway speed of 35 mph and 85% availability are estimated to be 23¢ per ton moved or 39¢ per ton of ore.

Total mining and hauling costs are thus estimated to be $0.28 + $0.39 or $0.67 per ton of ore.

XIII

ECONOMIC CONSIDERATIONS

Detailed estimates of the capital requirements to place the Cove Fort sulphur deposits into production and of accurate operating costs must await completion of test work being carried out at the Thermochem pilot plant in Golden, Colorado and design work being performed by Lakeside Engineering and The Galigher Company in Salt Lake City, Utah. However, the tone of the letter dated February 19, 1969 from the Colorado School of Mines Research Foundation, Inc. and examination of the data upon which the economic projections contained therein are based leads us to conclude that these projections can be used for order of magnitude analysis with a reasonable degree of safety.

While the preliminary nature of the following figures should be clearly understood, we believe them to be conservative.

Capital Requirements:

1000 metric ton per day Thermochem Plant, including design, engineering and installation		$3,000,000.00
Pre-production		
Stripping and mining test	$60,000	
Drilling and sampling	50,000	
Haulage road	100,000	
Water	40,000	
Tailings disposal	20,000	
Property supervision	30,000	300,000.00
Working Capital		400,000.00
Property Payments	$750,000	
Interest	81,000	831,000.00
Contingency		469,000.00
Total		$5,000,000.00

(Mining equipment is assumed to be on lease-purchase and is included in operating costs.)

Operating Costs:

	Per metric ton - Plant Feed -
Treatment	
Per C.S.M.R.F. letter, $1663/d + $192/d/1000	$1.86
Mining and hauling	0.67
Overhead and administration	0.25
Total	$2.78

Since the estimated grades of the various deposits are not the same, the cost per metric ton of sulphur produced will vary. The following table shows this estimated cost for each deposit using the 95% recovery figure predicted by the C.S.M.R.F.

Deposit	Grade % S	Concentrate Ratio	Cost/MT Sulphur Produced	Property Payment	Total Cost $/MT S
Sulphurdale	20.0	5.26	14.62	2.00	16.62
Prince Albert	18.9	5.63	15.65	2.00	17.65
Excelsior	19.1	5.57	15.48	2.00	17.48
Victor-Conqueror	18.3	5.75	15.98	2.00	17.98
Sulphur King	26.0	4.05	11.26	2.00	13.26
Total Average	20.1	5.24	14.57	2.00	16.57

This table clearly demonstrates the profound effect of grade on operating costs.

If prices in the range of $35-$45 per metric ton are realized, direct operating profits will be as follows:

Property	Sales Price per Metric Ton Sulphur		
	$35	$40	$45
Sulphurdale	$18.38	$23.38	$28.38
Prince Albert	17.35	22.35	27.35
Excelsior	17.52	22.52	27.52
Victor-Conqueror	17.02	22.02	27.02
Sulphur King	21.74	26.74	31.74
Total Average	18.43	23.43	28.43

The total reserves of 302,000 metric tons of contained sulphur at 95% recovery would produce 286,900 metric tons of 99.982% sulphur product and generate operating profits ranging from $5,288,000 at the $35 price to $8,157,000 at $45 per ton before amortization and taxes. At our estimated ore reserve figures, the operation would have a life of four and one quarter years, as a minimum would fully return the required investment and would at best generate a modest profit.

However, a number of factors could substantially improve the minimal situation reported above. For example, if King's tonnage and grade figures could be substantiated, the operating life would more than double, the $2 per metric ton property payment would be terminated in 7.4 years when the one half million metric tons production figure had been reached and the operating profits would range from $12,297,000 to $18,933,000.

The normal procedure in development of a mining property would be confirmation of reserves prior to reaching a production decision. However, to Thermochem Industries Limited the installation of a commercial scale plant utilizing their sulphur recovery process at the earliest possible time is a vitally important step in development of the process. The Company is completing licensing arrangements with the owners of several large, high grade native sulphur deposits which have been delineated and prepared for production. Samples from these deposits have been successfully treated in the Thermochem miniplant and tests in the large pilot plant are scheduled to follow completion of work now being carried out on material from the Cove Fort area. Final acceptance of the licensing agreements and the decision to use the process are contingent both upon results of these tests and upon the availability of engineering design and installation details for a

commercial scale plant. The licensing agreement if implemented would be very profitable to Thermochem.

Under these circumstances it is proper to consider the capital cost of installing a commercial scale plant at Cove Fort to be the next stage of development of the Thermochem process. If this amount, estimated to be $3,000,000, is not charged against these deposits, the indicated minimum profit margins are more than sufficient to justify placing the properties into production.

XIV

RECOMMENDED PROGRAM

The following program is designed to prepare the Cove Fort properties for production at the earliest possible date, delineate the major deposits to the point that better defined tonnages and grades can be determined and detailed pit designs made and investigate markets and negotiate sulphur sales contracts.

Project	Time	Supervisor	Cost U.S. Dollars
Mining Test	March	Janes	$ 30,000
Plant Site Preparation	Mar. - Apr.	Hickman	*
Crushing Plant and Ore Storage, design and installation	Apr. - May	Hickman	*
Drilling - Sulphurdale and Victor-Conqueror	Apr. - May	Janes	20,000
Geochem and Exploration	Apr. - Sept.	Janes	25,000
Market Studies	Apr. - May	McKenzie	5,000
Plant Design	Apr. - Aug.	Hickman	*
Plant Construction	June - Sept.	Hickman	*
Water and Tailings Disposal	July - Sept.	Hickman	60,000
Pit Preparation	July - Sept.	Janes	30,000
Exploration Drilling	June - Sept.	Janes	30,000
Haulage Road	Aug. - Nov.	Janes	100,000
Property Payment and Interest	March	Austin	311,000
*Lumped under Plant Cost			3,000,000
			$3,611,000

With provisions for a property payment and interest in the amount of $770,000, working capital in the amount of $400,000 and contingencies, the total comes to $5,000,000.

To implement this program, Thermochem should register its U.S. subsidiary, Thermochem Industries, Inc. to do business in Utah and take the steps necessary to conform to the state and federal regulations relative to hiring of labor, entering into contracts and other business functions. The study of markets and negotiations of sulphur sales contracts should start immediately.

Mr. Roy Hickman, President of Lakeside Engineering and officials of the Galigher Company believe that if data development from the pilot plant test program becomes available on schedule, construction of the plant near Cove Fort can be completed by the end of September 1969. We consider this to be optimistic, but do believe that it can be installed and operating before the end of this year.

We estimate that sufficient data will be at hand to permit submission of a final feasibility report by mid-June.

We recommend that this program be adopted and that the funds required for its implementation be provided.