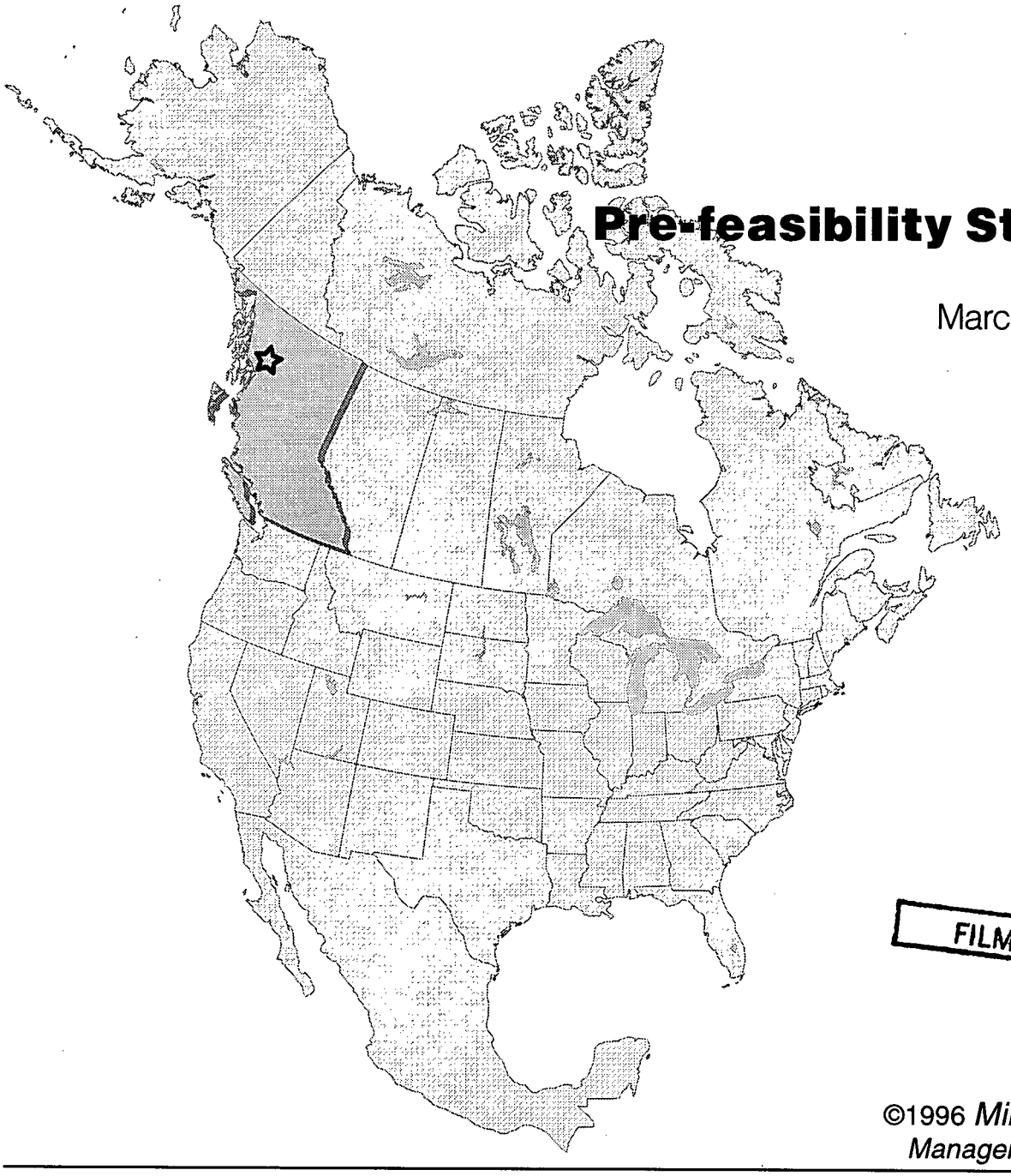
ISK Wollastonite

- northwest British Columbia

Super Twins Resources Ltd



Pre-feasibility Study

March, 1996

MineStart™
Management Inc.

27 March, 1996

Super Twins Resources Ltd
612-475 Howe Street
Vancouver
BC V6C 2B3

Attn: Mr. Allen W. Achilles, President

Dear Mr Achilles,

WOLLASTONITE PROJECT – PRE-FEASIBILITY

We are pleased to forward your pre-feasibility report on the ISK Wollastonite project.

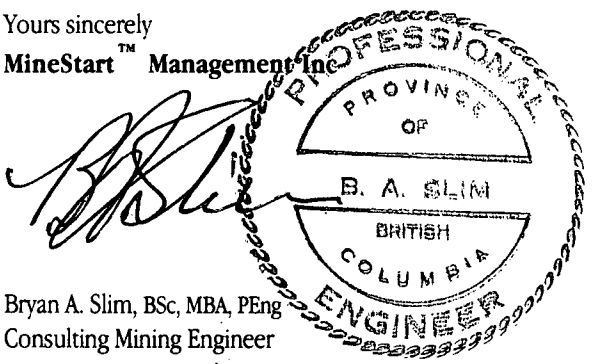
Given the study findings of high grade raw wollastonite, beneficiation by standard technology to yield grades typical of commercial products and grinding trials giving high aspect ratio material the indications are that ISK Wollastonite could cover the full market requirements.

ISK Wollastonite is confirmed from professional engineering work to be benign in not being soluble in water, not having leachable metallics and incapable of causing acid rock drainage. An economic analysis of a proposed simple but elegant production concept indicates profit potential.

Based on the above and the findings of this study as documented here it is our professional opinion that the next stage of development of ISK Wollastonite should proceed and we look forward to the confirmation following further field work that the project is recognised as world class.

We thank you for the opportunity be of assistance and offer our professional services for the ongoing development.

Yours sincerely
MineStart™ Management Inc



Bryan A. Slim, BSc, MBA, PEng
Consulting Mining Engineer

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Attach.

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CONCLUSIONS

CONCLUSIONS

Based on our five weeks site work in July and August, 1995, sampling as carried out under our direction, professional laboratory testing, examination of company files, discussions with company principals and other as noted, secondary data sources, experience and our professional engineering and marketing judgement it is the opinion of MineStart™ Management that:

- samples from one deposit –the Cliff – at ISK wollastonite indicates the existence of 75 to 80% pure wollastonite
- beneficiation trials show this can be concentrated and recovered by standard magnetic separation and flotation to give 96% wollastonite with a brightness of at least 87% ISO
- grinding trials have yielded acicular material of which 50% has an aspect ratio greater than 15:1
- there is an inferred two million raw tonnes of wollastonite above ground in the Cliff Deposit; two much larger deposits have been identified which also indicate high grade raw material
- a production concept of simple bench mining, slurry pipeline transport of the crushed raw wollastonite to the tidal Stikine River and then barging to a suitable port is proposed
- ISK wollastonite is insoluble in water, does not contain leachable metallics and incapable of causing acid rock drainage; the immediate environment does not indicate sensitivities
- the above factors all combine to indicate ISK Wollastonite can meet all market specifications and offer the opportunity for a profitable commercial operation and be confirmed in due course to be a world class deposit

and

- detailed work is now justified to establish the environmental and infrastructure baselines and continuity of wollastonite quality in the deposits in anticipation of a bulk sampling programme as a prelude to application for a mining lease

RECOMMENDATIONS

RECOMMENDATIONS

The positive indications in this report on the pre-feasibility study as summarised in the conclusions justify the continuation of the studies.

It is our professional recommendation to implement the development programme of § 8 which covers the following:

- the technical aspects of environmental and infrastructure baselines
- detailed sampling by core drilling and trenching
- investigations for a slurry pipeline and a riverside landing
- a cadastral survey
- continuation of market development
- detailed beneficiation trials to confirm quality and develop a flow-sheet
- examination for ports and beneficiation plant location

SUMMARY

SUMMARY

The ISK Wollastonite project is situated in north-western British Columbia some 240 km north west of the town of Smithers and about 70 km northeast of Wrangell, Alaska. Super Twins Resources Ltd Resources Ltd presently holds 170 modified mineral claim units covering about 4 250 hectares; further staking is underway.

Initial field work in 1993 identified two wollastonite deposits and a 1995 field programme by Super Twins Resources Ltd confirmed the 1993 deposits, discovered a further two deposits and a probable fifth. Of these three occur as above ground abutments. 1995 samples from one deposit –the Cliff – indicates the existence of 75 to 80% pure wollastonite and for which a preliminary estimate allows for an inferred two million raw tonnes of wollastonite above ground. The two other abutments deposits are much larger.

Beneficiation trials show the Cliff raw wollastonite can be concentrated and recovered by standard magnetic separation and flotation to give 96% wollastonite with a brightness of at least 87% ISO. Grinding trials have yielded acicular material of which 50% has an aspect ratio greater than 15:1

ISK Wollastonite sow far tested is insoluble in water, does not contain leachable metallics and is incapable of causing acid rock drainage; the immediate environment does not indicate sensitivities.

A production concept of simple bench mining, slurry pipeline transport of the crushed raw wollastonite to the tidal Stikine River and then barging to a suitable port is proposed.

The tests and analysis of the ISK Wollastonite to-date collectively indicate a the potential for market type products which can meet all market specifications. An economic analysis shows a good profit potential and thus the project offers the opportunity for a profitable commercial operation and to be confirmed in due course to be a world class deposit.

A development programme is proposed to gather detailed site information and provide samples for additional testing to confirm feasibility all n anticipation of a bulk sampling programme for market trials as a prelude to an application for a mining lease.

TABLE OF CONTENTS

TABLE OF CONTENTS

1 INTRODUCTION

1 INTRODUCTION

1.1 THIS REPORT

111 TERMS OF REFERENCE

Super Twins Resources Ltd Resources Ltd is in the exploration stage of developing its ISK Wollastonite project situated in north western British Columbia and have retained MineStart Management Inc to :

- design and direct a sampling programme
- arrange for appropriate laboratory testing
- develop a conceptual project outline and
- provide an initial economic evaluation.

A preliminary report was issued in November, 1995 which provided a project overview.[1] The report in presenting initial evidence of high purity wollastonite amenable to concentration led to a professional opinion that the project had merit and further work was justified.

112 REPORT STRUCTURE

This report is structured to progressively examine the success contingent components of the project. The foundation of any mining project is the joint need for an adequate resource which is amenable for processing to yield potential commercial products – this is reviewed in § 3 – Wollastonite Potential.

With this foundation established it is important to examine the project's site environment – § 4 which serves to allow for the development of the production concept – § 5. By combining §'s 4 & 5 the various ecological issues can be reviewed – § 6 which will either indicate the need for further field investigations or revisions to the concept. With a nominal fit then and only then is it justified to consider the profit potential; this is carried out in § 7 – Project Economics.

Finally in § 8 the development programme is proposed for the development needed in 1996. These findings, collectively, will thus serve as a pre-feasibility study.

A re-examination of the concepts can then, from feed back, be carried out to identify improvements while maintaining a balance with the environment for an improved commercial opportunity.

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[1] Slim, B.A.; "ISK Wollastonite ,Super Twins Resources Ltd Preliminary Evaluation, " MineStart Management Inc (Nov 1995).

113 UNITS OF MEASUREMENT

Unless otherwise stated the units of measurement in this report conform to SI metric measurements[2] as adopted by Canada in the Weights and Measures Act of 1971. Reference to these measurements in the text is by use of the approved international symbols and spellings with one exception and that is use of the period to signify the decimal point – see Table 1-1. Given both the international aspects of this project and the current ambiguities in the use of English the use, meaning and spelling of words are intended to conform to the Oxford English Dictionary.

Table 1-1 SI symbols

Quantity	Name of unit	Symbol
length	metre	m
mass	kilogram	kg
time	second	s

Units specific to the mining industry

mass	tonne	t
volume	cubic metre	m^3
land area	hectare	ha

The name of the unit is not used except in text when there is no associated numeral. The symbols should be separated from the numeral and usually take the lower case form; upper case is only used when it relates to a unit named after a person or to avoid ambiguity.

Decimal multiples and sub-multiples should be in increments of 1 000 with separation by spaces and can take prefixes to the unit names eg:

giga	G	1 000 0000 000	10^9
mega	M	1 000 000	10^6
kilo	k	1 000	10^3
milli	m	0.001	10^{-3}
micro	μ	0.000 001	10^{-6}

The prefix is directly attached to the unit symbol to form a new unit symbol. Digits of large numbers should be separated by spaces into groups of three. As examples:

2M t = two million metric tonnes. 1 t = 1 000 kg = 1k kg = 1M g

[2] international symbol for Système International d'Unités, now commonly referred to as the metric system

1.2 WOLLASTONITE

Wollastonite, named after W.H. Wollaston. an English chemist and mineralogist, is a calcium metasilicate having the chemical formula $CaSiO_3$ and has the stochiometric composition of 48.3% CaO and 51.7% SiO_2. Wollastonite is chemically inert but can be digested in concentrated hydrochloric acid.

Although having a short history of industrial use Wollastonite is the only naturally occurring, non-metallic, white acicular mineral. Because of its unique cleavage properties wollastonite breaks down during crushing and grinding into lath-like or needle-shaped particles of varying acicularity This particle morphology imparts high-strength and is, therefore, of considerable importance in many markets including replacement for short-fibre milled fibreglass and short-fibre asbestos and as a reinforcing filler. Wollastonite is used in applications ranging from ceramic tile to vehicle brake-pads, from bowling-balls to car bumpers and from thermal insulation board to paints and protective industrial coating.

The combination of high brightness and low gas release when heated creates a major demand in the ceramics industry and the brilliant whiteness and a reported natural high paste pH of 9.9 are of major importance to its use in the coatings industry and filler markets.

1.3 ACKNOWLEDGEMENTS

The study embodied in this report reflects the contributions of many people and companies and specifically we acknowledge the assistance and support of the directors and staff of Super Twins Resources, Dr John Payne for mineralogy, Hosokawa Micron Ltd for use of their grinding facilities, Jeff Austin PEng for advising on beneficiation, Cal Kilby PGeo for guidance, Dr Paul Rusanowski on ecological points, Richard Kopchynski of KWH Pipe (Canada) Ltd, Peak Computing Services and the staff of various laboratories including Acme Analytical Laboratories Ltd, ASL Ltd, Econotech Services Ltd, Cominco Research Labs, PRA Ltd, Vancouver Petrographics Ltd. Lastly but by no means least we thank Dave Barr PEng for sharing his vast knowledge on the Stikine.

2 PROPERTY

2 PROPERTY

2.1 PREAMBLE

Section 2 – Property describes the claims, location and access, topography and infrastructure.

2.2 CLAIMS

221 THE CLAIMS

Ten 4 post claims encompass the project area with a nominal 170 units covering 4 250 ha; details are presented in Table 2-1 below and Plate 2-1 shows the claims on a background of the NTS topography. Further claims are being staked to enlarge the holdings.

Table 2-1 Mineral Claim Data

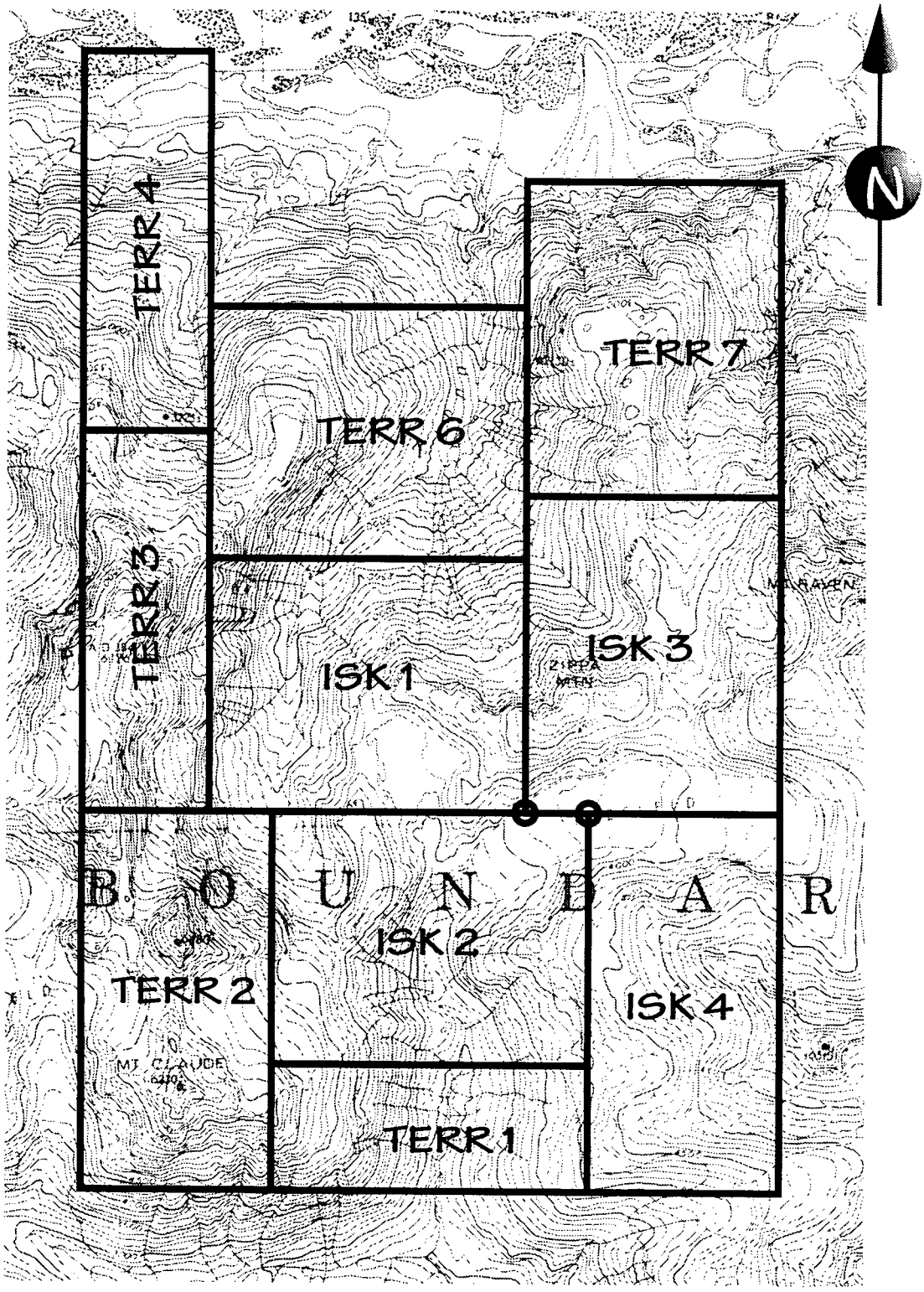
Claim Name	Tenure No	Units
ISK 1	334360	4N x 5W
ISK 2	334361	4S x 5W
ISK 3	334362	5N x 4E
ISK 4	334363	6S x 3E
TERR 1	342169	2N x 5E
TERR 2	342170	6N x 3W
TERR 3	341965	6S x 2E
TERR 4	341966	6N x 2E
TERR 6	342171	4S x 5E
TERR 7	342172	5S x 4E

222 OWNER

The claims are registered 100% in the name of Super Twins Resources Ltd Resources Ltd.[3] Production revenue is subject to a 20% npi with an option for buy out of 10% of the npi for $1 million.[4]

[3] Mineral Titles office, Vancouver

[4] as advised B. A. Lueck, Director ,Super Twins Resources Ltd



ISK WOLLASTONITE
Super Twins Resources Ltd

Claim blocks on NTS base

Base:	NTS	Scale:	1:50 000
Region:	Iskut, BC	Date:	Nov 1995
M.D.:	Liard	Plate:	2-1

2.3 LOCATION AND ACCESS

231 LOCATION

The property is located in the Iskut region of north-west British Columbia about 240 km north-west of Smithers BC – report cover. The approximate latitude is 56° 39′ 10″ N and longitude 131° 18′ 37″ W at about 14 km due west of the Bronson airstrip and the Snip gold mine and some 75 km west of the Stewart Cassiar highway.

Topographic maps references, for the Cliff Deposit, are:

NTS 1:50 000 series 104B/11 - Craig River	– NAD 27,UTM 9 – 359372E, 6280881N
TRIM 1:20 000 series 104B.064 digital	– NAD 83,UTM 9 – 359265E, 6281079N.

232 ACCESS

Access to the region is by charter flight with fixed wing landing available at Bronson Creek airstrip (nominal 1 500 m runway) at

UTM 9 – NAD 27	372903E	6284170N
UTM 9 – NAD 83	372796E	6284362N
Lat/Long	56° 41′ 16″ N	131° 16′ 23″ W

From here a helicopter is essential to get to the property. Winter snows are probably heavy and access should be considered for only the summer months of July to September.[5,6] Low cloud can restrict the access in summer because of the prevailing winds from the north-west.

The only alternative access to Bronson Creek is by boat along the Iskut river. This is a braided river and very shallow and has many bars which are continually shifting and may not be navigable except for shallow draught boats for most months of the year either because of ice or too low a water level. We note that the Snip gold mine uses a hovercraft, excluding the winter months when a DC4 plane is employed, for transporting gold and concentrates to and fuel oil from Wrangell, Alaska.

2.4 PHYSIOGRAPHY

The claim blocks cover a variety of glaciers, mountains, alpine meadows and ice fields where the relief is about 800 m ranging from 1 000 to 1 800 m ASL. Regional elevation highs are probably about 2 200 m. Plate 2-2 shows this area in

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[5] The nearest reporting weather station is Bronson Creek but no reports have been made since 1992, the next nearest is Bob Quinn but at about 1 000 m lower elevation and 75 km to the E. NE

[6] Kerr in his 1948 report advises mid October as a final date for work in the region but was, presumably, referring to the lower river valleys

100 ft contours (ex NTS). The terrain can best be described as extremely rugged and, apart from a small area on the south flanks of the Iskut river, is all above the tree line – see Plates 4-4, 4-6 to 4-9.

The tree line in this region and on the claims seems to be at about 1 000 m. Although the lower parts of the Glacier deposit are below this elevation the combination of north facing aspect and the lateral moraine has precluded the growth. In general vegetation is grass, pink and white heathers and various small alpine plants and shrubs none more than 150 to 300 mm high.

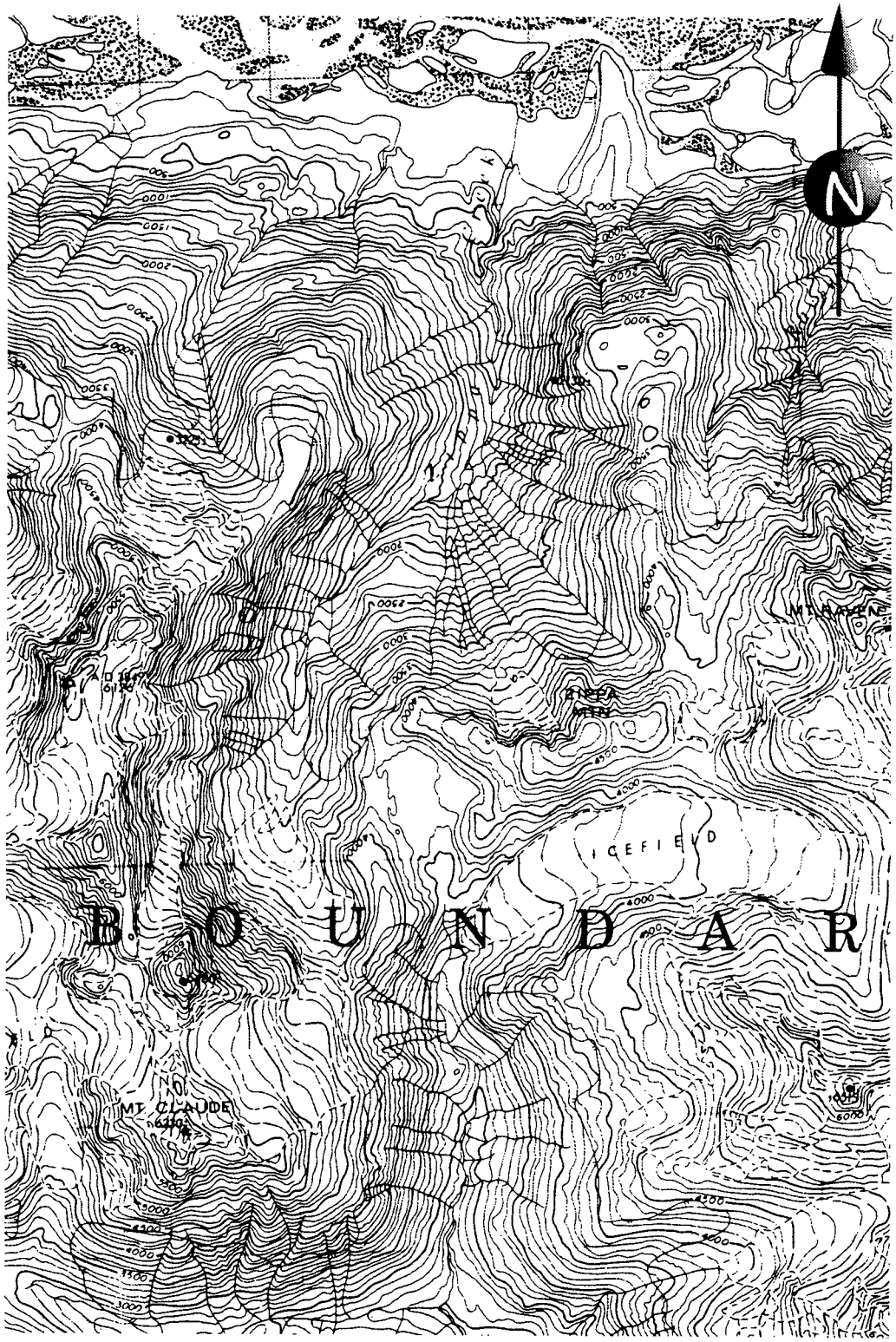
Care should be exercised using the topographic maps as we note that glaciers have receded as much as 200 m[7] or more since the base data was collected for TRIM in 1982 and that the time base for the NTS is 1965.

2.5 INFRASTRUCTURE

The claims have no road access and the nearest public services are at Wrangell Alaska about 65 km or 20 minutes flying time to the southwest. Apart from the landing facilities at Bronson Creek airstrip there is the Snip and Pamicon camps and Snip mining operation.

Nearest regional road access at the Eskay Creek mine and the alternative of the Stewart -Cassiar highway at Bob Quinn lake about 20 minutes flying time for a helicopter at 75 km to the east-northeast.

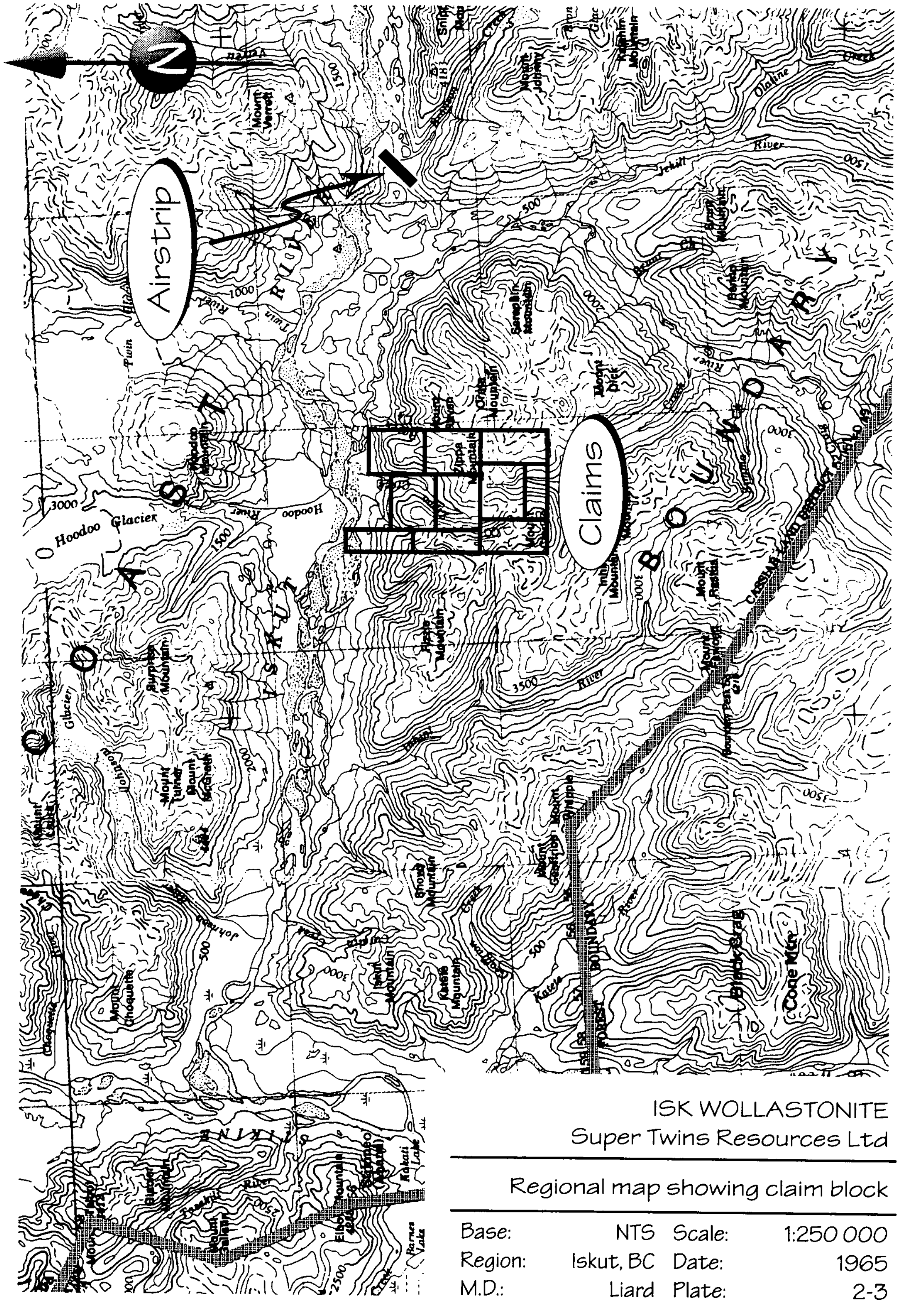
[7] eg the glacier on the south-west flank of Mount Raven the toe of which covers part of the probable BryS deposit



ISK WOLLASTONITE
Super Twins Resources Ltd

Area Topography

Base:	NTS	Scale:	1:50 000
Region:	Iskut, BC	Date:	1965
M.D.:	Liard	Plate:	2-2



ISK WOLLASTONITE
Super Twins Resources Ltd

Regional map showing claim block

Base:	NTS	Scale:	1:250 000
Region:	Iskut, BC	Date:	1965
M.D.:	Liard	Plate:	2-3

3 WOLLASTONITE POTENTIAL

3 WOLLASTONITE POTENTIAL

3.1 PREAMBLE

Section 3 – Wollastonite Potential describes and analyses the resource, discusses some typical commercial supplies and postulates potential market opportunities for the Isk wollastonite and then reviews the resource potential and ranks the deposits for development.

3.2 ISK MINERAL RESOURCE

321 SOURCE

The wollastonite occurs in a skarn round the pyroxenite margins of the Mount Zippa pluton which forms an elliptical laccolith of about 3.5 x 5 km with an area of 14 km^2.[8,9] Plate 3-1 shows the sites of the deposit outcrops found to-date.

322 MINERALISATION

The four definite and one probable deposit found to-date all exhibit similar characteristics as shown from mineralogical examination and point counts: that of predominant wollastonite with minor garnet and clinopyroxene. The calcite concentration is low and appears to be typically less than three or four percent; some K-feldspar, sphene and plagioclase is noted as well as trace quartz.[10]

From field observations the wollastonite is seen as being extensive and continuous within the deposits with cleanly delineated dykes and pods. This is clearly seen in the Cliff deposit – Plate 3-2.[11] This means selective mining of the wollastonite should limit dilution.

In Table 3-1 we present a summary of the mineralogy of the raw wollastonite showing the majority minerals as determined by point counts. Sample V is a composite of in-situ panel sampling and sample S a composite of selective scree sampling over 200 m at the base of a deposit – see also § 332.2. In both cases we believe

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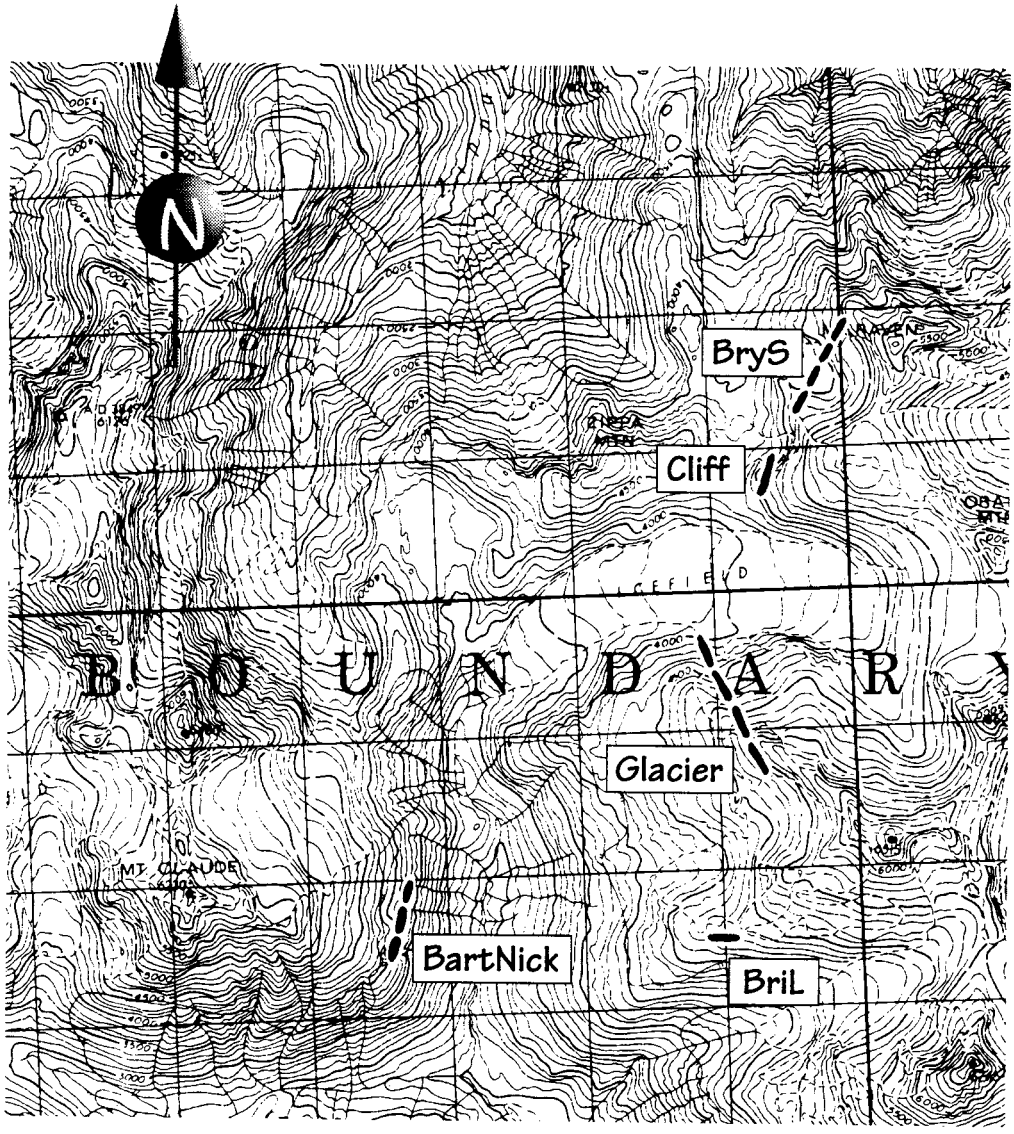
8 Lueck, B.A.; "Geological evaluation of a wollastonite resource: geological report for the ISK 1-4 claims". private report. (1 Apr 1995)

9 Slim, B.A.; "ISK Wollastonite ,Super Twins Resources Ltd Preliminary Evaluation, " MineStart Management Inc (Nov 1995).

10 summary of various mineralogical reports by J.G. Payne ,Ph.D of Vancouver Petrographics Ltd

11 photograph taken mid July 1995



ISK WOLLASTONITE
Super Twins Resources Ltd

Wollastonite deposits so far discovered

Base:	NTS	Scale:	sketch
Region:	Iskut, BC	Date:	Sep 1995
M.D.:	Liard	Plate:	3-1

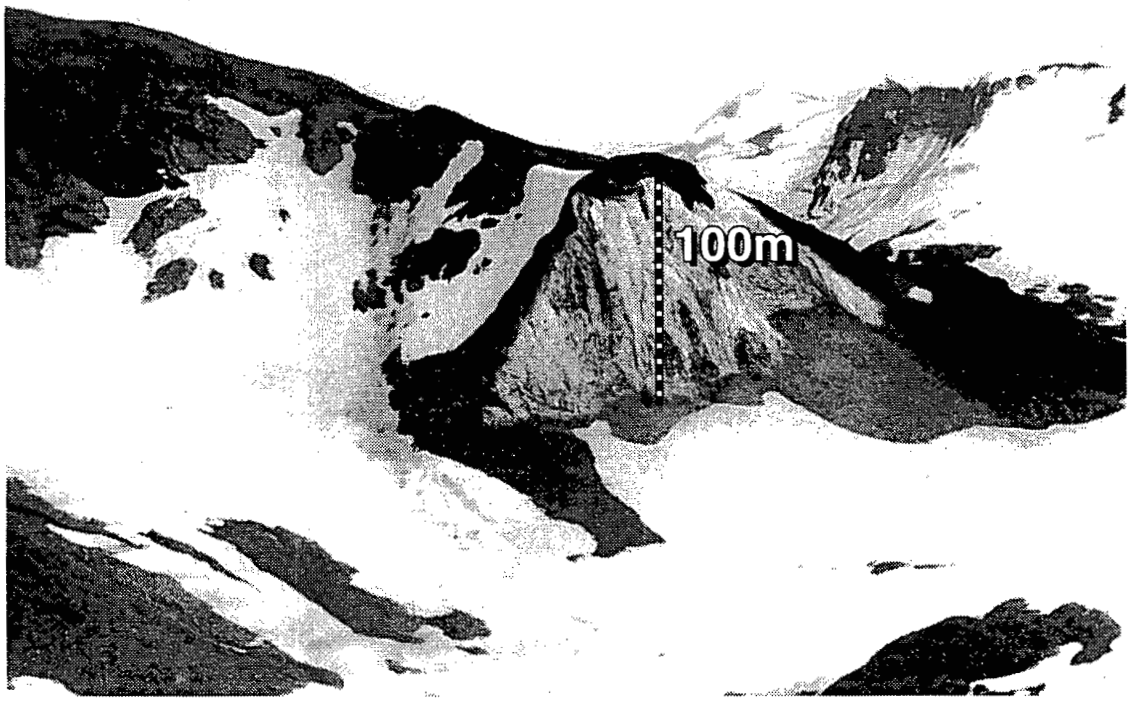


Plate 3-2 Cliff deposit showing the dykes

the sampling technique reasonably duplicated a selective mining approach.[12] The lower calcite content in the S sample may arise from weathering dissolution by acid rain/snow.

Table 3-1 Mineralogy summary – raw wollastonite

Sample	Wollast %	Calcite %	Garnet %	Cl. pyroxene %	K-spar %
V- raw	75.1	5.8	2.2	10.5	1.8
S - raw	80.5	2.7	2.7	11.7	1.7

323 WOLLASTONITE QUALITY

Table 3-1 shows high-purity wollastonite in both sample composites and thus reflect the potential for a high purity deposit.

[12] panel sampling, where a sequence of areas are sampled, is the preferred technique as it recognises the area as being more representative than a line as in channel sampling

3.3 RESOURCE INVESTIGATION

331 FIELD INVESTIGATION

.1 1995 Field Programme

The 1995 field work focused on two aspects – sampling and geological mapping.

.2 Sampling

Sampling for the Cliff deposit was limited by the vertical face which, because of weathering, presented a safety risk – Plate 3-2. Sample V was a near vertical in-situ sampling of 1 x 1 m panels over 16 m in the S-W top corner beneath the dyke. Sample composite S was a systematic and selective sampling across the scree base which was still mostly covered by snow when the photograph in Plate 3-2 was taken.

The selective sampling approach for S was intended to avoid the dyke and other waste material in the scree and thus represent selective mining intended to minimise dilution. Because the weathering had penetrated in parts up to 10 m or more into the face it is felt that the scree sampling was partially a three dimensional sampling Sample V was a true panel sample of all the material in the panels and typically at 4-5 kg per panel.

A later sampling programme at the Cliff, again in the scree, followed a panel approach but included samples of all the material including the dyke rock. Our testing showed that with about a 70% wollastonite concentration that the trial beneficiation could still provide a concentrate. Below this level additional beneficiation is necessary. This then signals the need for the selective mining as probably being more efficient.

.3 Mapping

Mapping of both the Cliff and Glacier deposits was carried out. The maps are included in the November preliminary evaluation.[13]

332 LABORATORY INVESTIGATIONS

.1 General

Laboratory investigations must focus on deposit purity, amount and type of wollastonite recoverable - yield, and potential product characteristics.

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[13] Slim, B.A.; "ISK Wollastonite ,Super Twins Resources Ltd Preliminary Evaluation, " MineStart Management Inc (Nov 1995).

Since there is not direct assay for wollastonite the purities have to be estimated. Beneficiation to provide a concentrate with XRF analysis and mineralogical point counts is appropriate to provide the mineralogical and chemical data.

Specific details of the testing are not presented in the interests of preserving what may become proprietary technology.

.2 Testing

A combination of magnetic cleaning and flotation work on the samples described in § 322 provided two initial concentrates whose mineralogical purity is given in Table 3-2.

Table 3-2 Mineralogy of initial concentrates

Sample	Wollast %	Calcite %	Garnet %	Cl.pyroxene %	K-spar %
V- con	95.9	1.9	0.3	0.8	.3
S - con	95.7	0.3	0.6	1.6	1.2

The chemical composition of the S concentrate is given in Table 3-3 and as a reference we also include a specification of a Nyco product.[14]

Table 3-3 Chemical purity comparison

	Sample S %	Nyco %
CaO	46.17	47.50
SiO_2	51.54	51.00
Fe_2O_3	0.45	0.40
MgO	0.30	0.10
Al_2O_3	0.41	0.20
TiO_2	0.04	0.02
LoI	0.50	na

For an initial beneficiation test the composition for sample S is excellent given that the analysis for Nyco is for the finished product. The sample S concentrate is interpreted as about 96% wollastonite – which agrees with the point count – with low calcite and iron which would meet commercial market requirements.

[14] data taken from a Nyco specification sheet

.4 Aspect Ratio

Preliminary grinding trials on samples were carried out at various mill settings and in Figure 3-1 we present a summary of a better result and to illustrate the significance we include the ratios measured before grinding – see 1995 report.

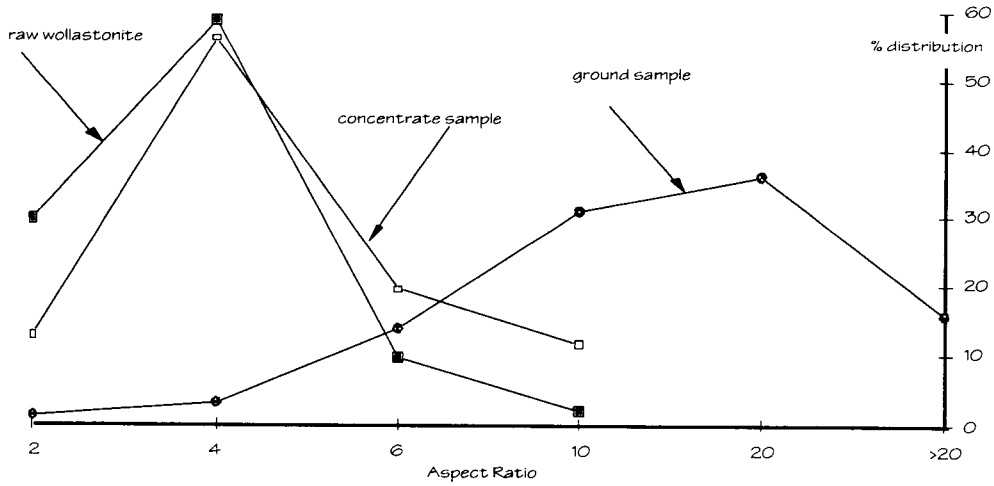


Figure 3-1: Aspect Ratios, progress from raw material to preliminary grind trials

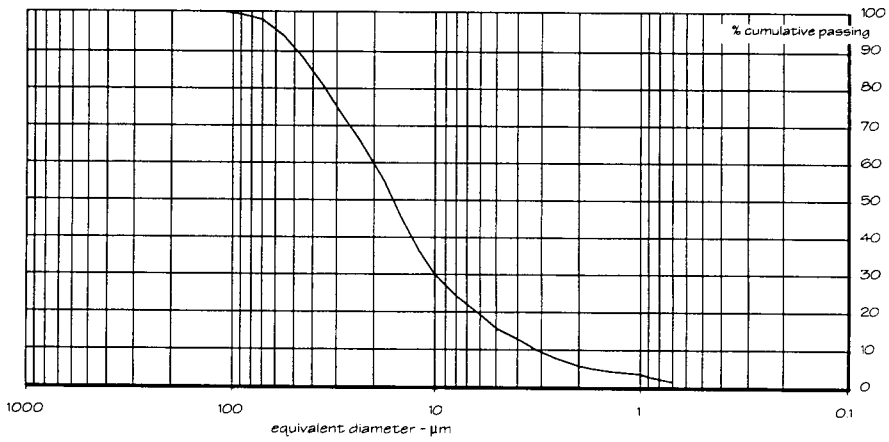


Figure 3-2: Particle size distribution for preliminary grind

3.3 COMMERCIAL SPECIFICATIONS

As a preliminary guide to the market demand we provide in Table 3-4 specification of some current commercial products. The data is taken from specification sheets published by the various producers. The gaps in the information indicate no information was given.

3.4 ISK POSSIBLE MARKETS

From the testing and analysis to-date we believe the results indicate that ISK wollastonite can cover all market demand areas. In Table 3-4 we demonstrate this by providing summary data for ISK S. This data should be compared with the other specifications. We stress that ISK data is not a description of a product but rather the non optimised results from our preliminary qualifying trials.

		NYAD 1250	NYAD G	Vansil W-30	Wolcron 200	Kemolit A60	FW 200	Wicroll 40	LWIEC H-100F	ISK S
Chemical Properties	unit									
CaO		47.00	47.00	44.04	36.60	48.02	43.50	44.70	45.42	46.17
SiO2	%	50.00	50.00	50.05	50.50	48.77	53.00	52.50	50.60	51.54
Fe2O3	%	1.00	0.50	0.26	0.25	0.43	0.25	0.20	0.10	0.45
Al2O3	%	1.00	1.00	1.75	0.77	0.66	1.00	0.80	0.40	0.41
MnO	%	0.10	0.10	0.02	-	0.29				
MgO	%	0.30	0.30	1.48	4.80	0.06	0.80	0.50	0.86	0.30
TiO2	%	0.05	0.05	-	-					0.04
Na2O	%	-	-	0.22	0.03	trace				
P2O5	%	-	-	-	0.20					
LOI	%	0.80	0.80	2.18	7.00	1.68	1.20	1.20	2.00	0.50
SUM	%	100.25	99.75	100.00	100.15	99.91	99.75	99.90	99.38	99.41
Physical Properties										
brightness	GE %	94	85	87						
brightness	ISO %					96-98	84	88		87.3
aspect ratio	length/diameter	3:1				20:1	3:1	6:1	15:1	15:1
<75 um	%				95		98		94	100
< 30um	%	100					78			
< 10 um	%	96		83			32			
bulk density						0.86	0.97	0.49	0.97	
– loose	lbs/cu ft	30			44-49					
– tapped	lbs/cu ft	50			94-96					
mol. weight	g/mole	116.0	116.0	116.0	116.0	116.0	116.0	116.0	116.0	116
relative density		2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
pH	10% paste	9.9	9.9	9.8	9.9	9.0	10.5	10.2		10.8

Table 3-4: Summary of various commercial wollastonites plus ISK S

3.6 RESOURCE ESTIMATE

361 TERMINOLOGY

A reserve for any industrial mineral in general and wollastonite in particular must recognise that the description applies to "*...those minerals or parts of the deposits which have been demonstrated by sales contracts as having a market demand.*"

To generate this sales contract it follows that there must have been sufficient deposit investigations to understand the locations and continuity in-situ and mineral characterisation to describe the mineralogy, chemistry and various physical attributes. Beneficiation testing is essential to demonstrate amenability for concentration to market standards.[15]

362 THE DEPOSITS

Analytical work on samples from the deposits all show high-grade wollastonite. However, to be attractive for production the deposit must be suitable for easy mining, provide good access for operation and removal of raw wollastonite. In this respect we provide a preliminary ranking in Table 3-5 for these features.

Table 3-5 Deposit ranking

Deposit	Mining	Rank
Cliff	surface	1
BartNick	surface	2
BriL	surface	3
Glacier	u/g	4
BryS	u/g	5

363 ESTIMATE

At this stage it is not possible to provide a resource estimate for the various deposits with the exception of the Cliff which, because of the portion above ground and our initial measurements, we estimate at a preliminary 2M t. However, based on the size of the pluton and areas so far explored it is reasonable to contemplate 40M t potential at this stage.

15 Slim, B.A.; "Economics of various industrial minerals for the pulp and paper industry" , – BC EMPR, Industrial Minerals "95, Vancouver . (Oct 1995)

4 PROJECT SITE ENVIRONMENT

4 PROJECT SITE ENVIRONMENT

4.1 PREAMBLE

Section 4 - Project Site Environment describes the various components of the site internal environment. In Figure 4-1 we show these environmental components and their links.

First the mineralogy is described and this is followed by preliminary notes on the geomorphology and climate. Then the technical components of geochemistry, hydrology and geohydrology are reviewed and this section is concluded with the ecology.

4.2 INTERNAL VS EXTERNAL ENVIRONMENT

The distinction between the *internal* and *external environments* must be understood for it is the internal area exclusively that is affected by the project.

The *internal environment* is the area bounded by the mineral claims and includes any transport corridors which could be established and thus expected to have some disturbances. In contrast the *external environment* can only be affected by the project if there is any form of discharge into it from the project lying within the internal environment.

4.3 GEOLOGY

431 GENERAL

The property is dominated by the Mount Zippa Pluton, an elliptical laccolith about 14 km^2 in area comprising three main rock types: pyroxenite, syenite and mela-syenite – Plate 4-1. The pluton is zoned from a pyroxenite border phase to mela-syenite and to trachytic K-feldspar syenite in the core. The silicic undersaturated nature of the pluton is manifest in abundant and widespread vishnevite-cancrinite[16] and melanite garnet showing strong oscillatory zoning.[17]

The pyroxenite forms an inwardly-dipping marginal phase which grades through mela-syenite to the core syenite . The most extensive rock type is syenite which commonly shows a strong planar alignment of platy K-feldspar. The planar alignments of K feldspar and acicular pyroxene define a concentric, inward-dipping

[16] by XRD

[17] by optical microscope

foliation that shallows towards the interior of the intrusion. Large-scale petrological zoning, small scale mineral layering and a clear and distinct igneous foliation suggest that the dominant influence in rock formation was gravitational settling of minerals crystallising from a strongly undersaturated alkaline magma.

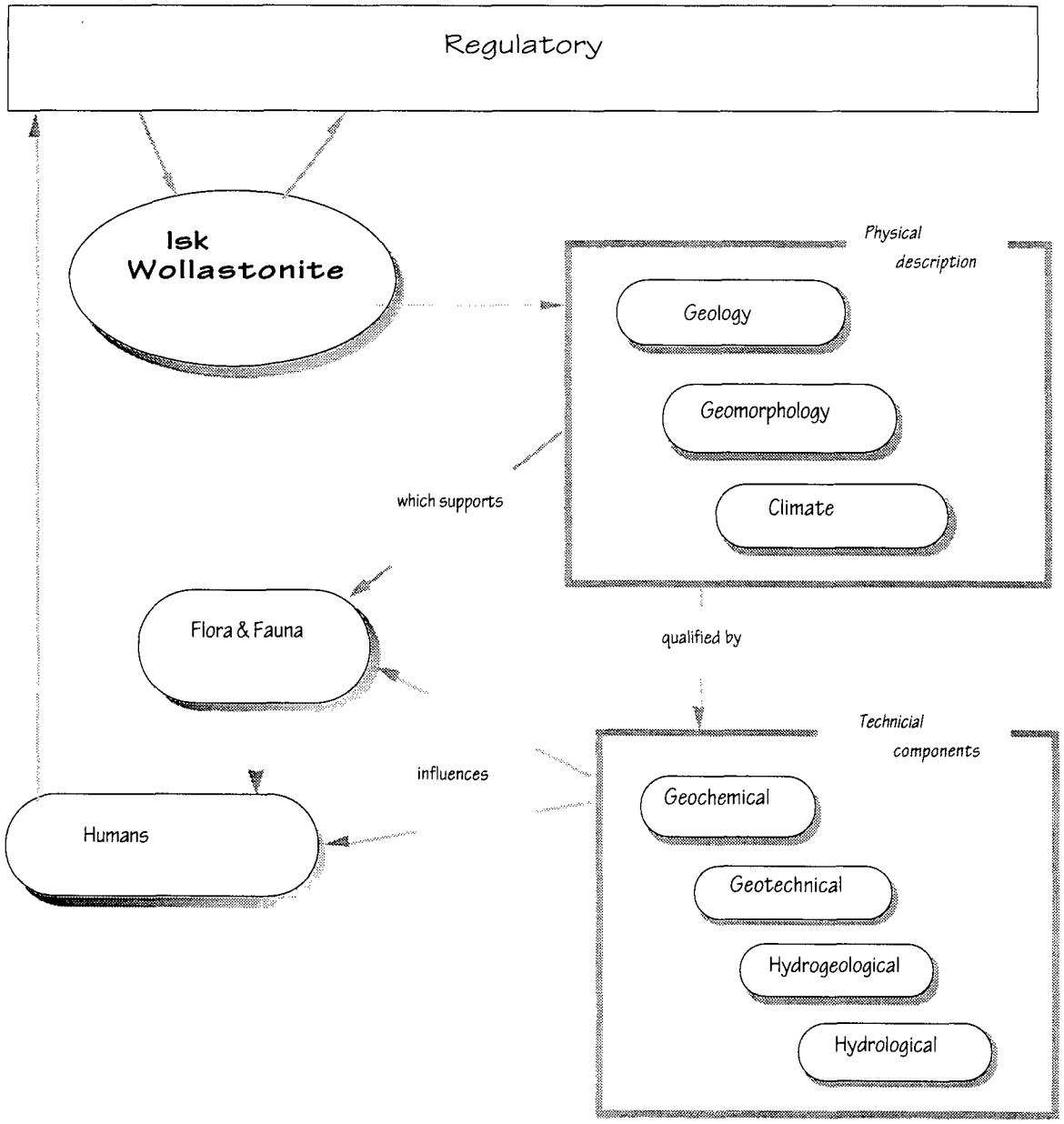
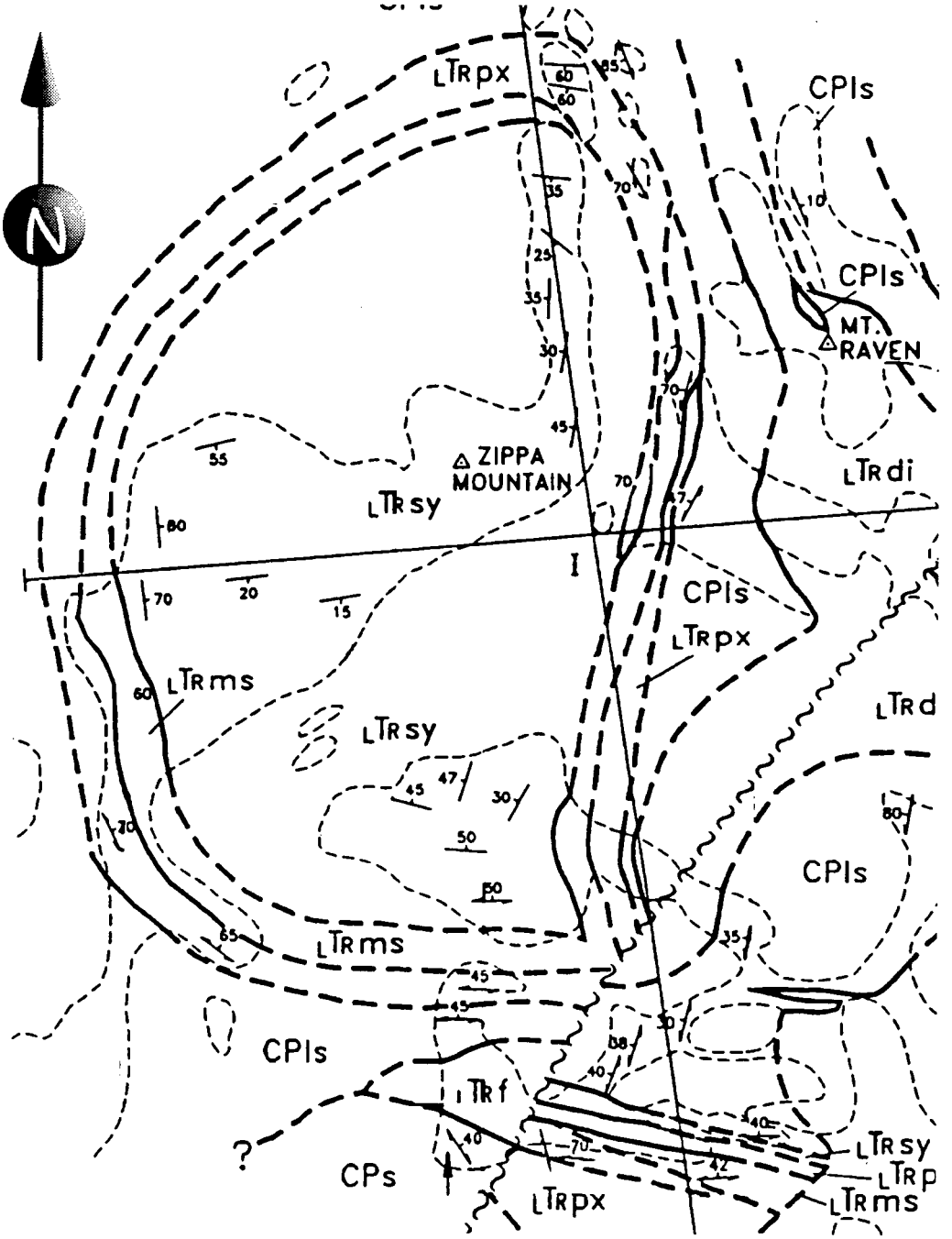


Figure 4-1 Isk Wollastonite – environmental components



LEGEND

- LTrg — Seraphim pluton: equigranular biotite-hornblende granite
- LTrdi — Mt. Raven pluton: equigranular or hornblende feldspar porphyritic diorite; local gabbro
- LTrf — felsic syenite: equigranular syenite with little or no mafic minerals
- LTrsy — Zippa Mtn. K-feldspar syenite: layered and trachytic syenite and vishnevite-cancrinite pegmatite
- LTrms — Zippa Mtn. mela-syenite: syenite with >40% mafic minerals: pyroxene, melanite and biotite
- LTrpx — Zippa Mtn. pyroxenite: equigranular to pegmatitic aegirine-augite pyroxenite
- Trv — Stuhini Group: layered tuffaceous volcanic rocks and pyroxene porphyritic flows
- CPIs — limestone, calc-silicate rocks, shale, thinly laminated calc-silicate and recrystallized limestone with interbedded calcareous shale
- CPs — chert, shale, graphitic shale with interbedded, massive chert
- CPsc — schist, phyllite derived from CPs; mica schist at margin of Seraphim pluton

SYMBOLS

- cumulate layering
- transposed layering, schistosity
- mineral lineation
- fault
- geological contact: defined, approximate
- limit of outcrop

ISK WOLLASTONITE
Super Twins Resources Ltd

Local geology

Base:	B. Lueck	Scale:	sketch
Region:	Iskut, BC	Date:	Sep 1995
M.D.:	Liard	Plate:	4-1

432 MINERALISATION

The wollastonite occurs as skarn formations round the margins of the Mount Zippa pluton – see Plate 4-1.

A mineralogical description says, in part, :

> "Samples have a moderately variable texture and mineralogy between fragments. Mineral intergrowths are best seen in the two coarser fractions; the -48 fraction is mainly of single grains. Many fragments are dominated by wollastonite with minor to moderately abundant clinopyroxene and minor garnet. A few fragments are dominated by clinopyroxene and a few by garnet-(calcite). A few fragments are dominated [by] one or more of calcite, K-feldspar and quartz. Minor minerals include sphene, plagioclase, and opaque. Opaque probably is mainly pyrite, which was identified in the offcut block of samples S3 (+20) and S1 (-48). Carbonate occurs in two main textures. Calcite with low relief forms replacement patches and veinlets. Carbonate with high relief occurs in extremely fine grained aggregates in part with garnet, possibly as a replacement of other silicates. In the modal analyses, this carbonate was not distinguished from calcite.
>
> Coarser size-fractions tend to have more abundant clinopyroxene, garnet and feldspars than finer fractions, whereas wollastonite increases in abundance with increasing fineness. This is probably because wollastonite was more readily fractured than the other minerals, and therefore it would be concentrated in the finer fractions."[18]

4.4 GEOMORPHOLOGY

The Wollastonite deposits so far found all lie at elevations ranging from 1 200 to 1 500 m in the Boundary Ranges of the Coast Mountain – Plate 2-2 shows the relief. Some 5 km kilometres to the north of the Cliff and 1 100 m lower lies the braided Iskut river flowing from east to west to join up with the Stikine some 25 km to the west. As the map shows the best description of the area is rugged and a large portion of the land is covered by ice-fields or glaciers.

Scree and talus is fairly common arising from the weathering factor of freeze-thaw and geological weaknesses typically in the steeper areas.

The direction of facing is critical in determining the permanency of the snow and ice versus the degree of thaw and melt and avalanches or cornice failures– see § 4.5 & 4.6.

4.5 CLIMATE

There appear to be no weather records for the immediate area. Winter snows are probably heavy and the summer months are characterised by low clouds and rain related to the prevailing north-west winds.

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18 Payne, J.G.; "Wollastonite – analyses of samples S1 to S4". (Sep 1995)

Bob Quinn Lake was the nearest reporting weather station – at 75 km to the E.NE and about 1 000 m lower elevation – and the 15 year (1977-92) means for precipitation and snowfall are given in Table 4-1 and monthly data in Appendix A.[19]

Table 4-1 15 year precipitation annual means

	Precipitation mm	Snowfall cm
mean	604	177
high	733	260
low	489	83

4.6 GEOTECHNICAL

We are not aware of any previous geotechnical investigations made on the site. The terrain of the immediate areas of interest, although steep, is not believed to pose avalanche threats so much as cornice collapses in permanent ice-field areas.[20] During the 1995 field programme several of the latter collapses were seen on the ridge above and to the south of the Glacier deposit, all during late July.

The Cliff area at 1 200 m ASL is relatively low and, being south facing, has no permanent snow field immediately above the deposit – as shown in Plate 3-2, taken in late July 1995. In contrast about 0.5 km to the north of the Cliff lies the Bry deposit which is partially covered by the toe of a glacier – Plate 2-2. see also § 482.1

This suggests that a transport corridor for a pipeline could follow the crest of the north facing ridge above the Iskut and slowly descend along the contours as it approaches the Stikine.

4.7 GEOCHEMISTRY

471 GENERAL

Apart from our 1995 sampling and laboratory programmes we are not aware of any investigations into the geochemistry of the wollastonite deposits.

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19 Bob Quinn has not reported since 1992

20 General examination of the area appears to show no typical avalanche evidence such as avalanche paths

At this stage we have concentrated on the whole rock analysis, acid based accounting and mineral solubility.

472 ACID GENERATION POTENTIAL

All the test results clearly show that neither the wollastonite nor associated dyke rocks pose an acid generation threat.

Of the six samples submitted for ABA[21] only four were found to have any detectable sulphur with values ranging from 0.03 to 0.05% with corresponding sample paste pH's 10.8 to 11.4. Net neutralisation potential (NNP) ranged from a low 166 to a high of 573. The variability reflects the concentration of wollastonite and calcite.

473 SOLUBILITY

Neither the wollastonite nor associated dyke rocks are soluble as defined and described by the special waste extraction procedure – *SWEP.* [22]

Two samples previously tested for acid based accounting were also tested for solubility for the metals only. Being mineral samples the organic and anion tests were deemed not necessary. Table 4-2 shows the results for total metal for those elements detected with the corresponding SWEP maximum where such a limit has been proscribed.

Table 4-2 SWEP test results

		A mg/L	B mg/L	SWEP max mg/L
Barium	T-Ba	3.20	1.19	100.00
Calcium	T-Ca	1 520.00	2 210.00	-
Copper	T-Cu	0.18	0.12	100.00
Iron	T-Fe	0.89	<0.115	-
Magnesium	T-Mg	4.79	2.84	-
Manganese	T-Mn	10.90	7.51	-
Potassium	T-K	44.50	22.00	-
Silicon	T-Si	41.70	62.50	-
Strontium	T-Sr	7.37	10.90	-
Zinc	T-Zn	0.23	0.05	500.00

21 EPA 600/2-78-054, pp 45-55. (1978)

22 Waste Management Act. Special Waste – Schedule 4 [am BC Reg 132/92 s 36]

4.8 HYDROLOGY & HYDROGEOLOGICAL

481 GENERAL

The following is a preliminary observation as we are not aware of information on either the hydrology or hydrogeology of the land area.

482 HYDROLOGY

.1 Land

It is probable for at least eight months of the year that the areas of interest at the Cliff and other deposits are under snow. From our experience in 1995 while we found the Cliff deposit was uncovered – Plate 3-2 there was only limited ground exposure at the base of the north facing Cliff and also the Glacier in late July and most of the snow melt occurred in early to mid August.

At the Cliff area the land above the crest is south facing and snow there will melt earlier than round the toe which is north facing and in the shadow of the hillside until quite late in the day. Snow melt forms the ephemeral Raven Creek which in due course drains into the Iskut – Plates 4-2 & 4-3.[23] The aerial photography used for the TRIM maps for the plate was taken in July 1982 and since then the toe of glaciers appears to have retreated to the east as much as 200 m from the position shown on the map.

..2 Rivers

Initial drainage of the snow melt and summer rains form ephemeral water courses draining to the Iskut to the north.

Both the Iskut and Stikine rivers clearly carry a heavy load of particulate matter. Some sampling for the Stikine reports the pH less than 6 up-stream from the Iskut junction.[24]

482 HYDROGEOLOGY

Given the mountain terrain with an expected shallow soil at the higher elevations in the deposits areas ground water could be none existent to limited.

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[23] TRIM map 104B.064

[24] BC & Yukon Chamber of Mines Resources/Infrastructure Map (20 Sep 1995) with acknowledgements to D.A. Barr ,PEng

Plate 4-2 Raven Creek looking north

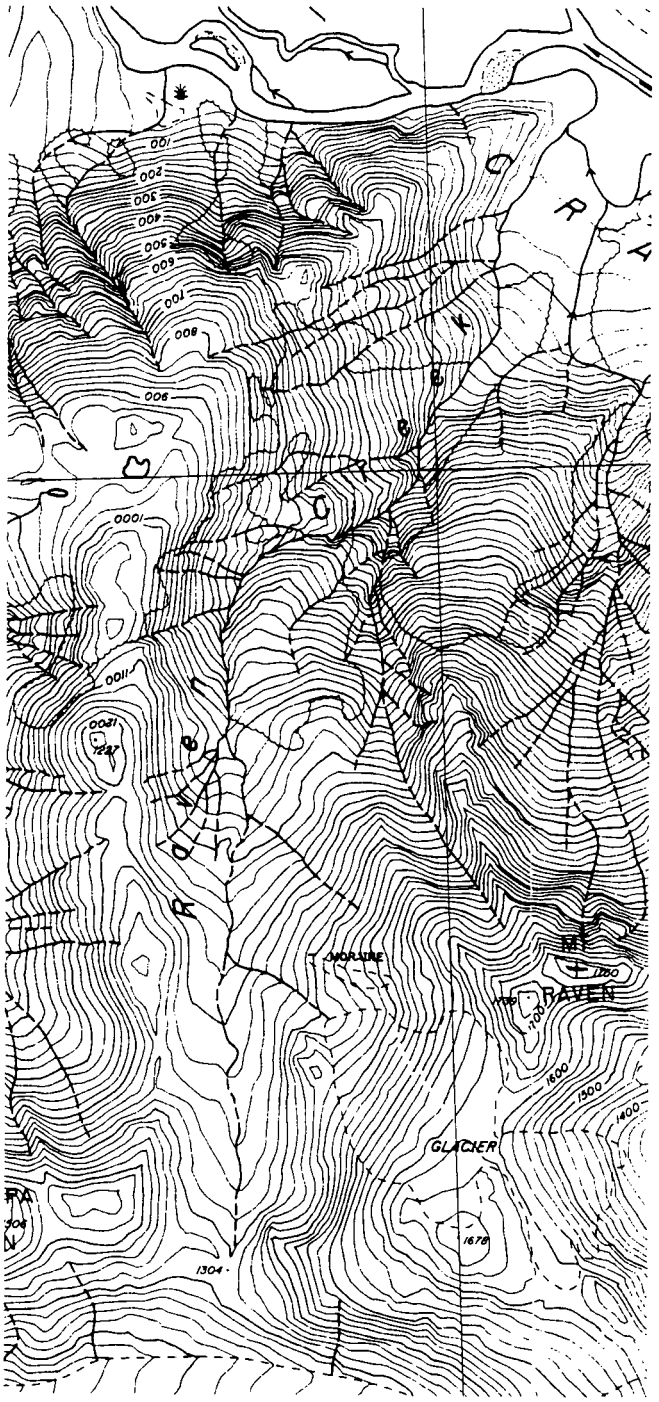
4.9 ECOLOGICAL

491 GENERAL

There are probably no documented studies of the ecological conditions in the immediate area of interest. As such the following is intended to provide a preliminary description.

492 FLORA AND FAUNA

The Cliff area is the only one so far examined which has some adjoining grass land see also § 482.1. At the toe either the scree has covered what could have been grass land or snow covers the remaining area. The tree line appears to lie at about 1 000 m although the influence at higher elevations is the depth of soils. At the Glacier area, which is north facing and immediately below a steep snow covered ridge and above a glacier, has no observed plant life – in fact parts of the deposit are only visible as nunatuks.



ISK WOLLASTONITE
Super Twins Resources Ltd

Topography of Raven Creek

Base:	TRIM	Scale:	1:20 000
Region:	Iskut, BC	Date:	1982
M.D.:	Liard	Plate:	4-3

Animal life appears to be very sparse – as is to be expected with no suitable plants. Over the space of six weeks only two bears were noted. Marmots were occasionally heard and one ptarmigan was seen above the Glacier deposit.

493 HUMAN

We have no knowledge of anybody living in the area – with the exception of the Snip mine operation some 14 km to the east and the operators of the fishing company on the west bank of the Stikine River some 35 km to the west of the site.[25]

[25] personal discussion with Trapper Dave who lives close to the Snip operation

5 PRODUCTION CONCEPT

5 PRODUCTION CONCEPT

5.1 PREAMBLE

Part 5–Production Concepts sets out the approach to the development of the ISK wollastonite project based on the preceding analyses.

With the concept described a comparison can then be made with the environmental description – § 4, to examine for areas of sensitivity – this forms § 6 Ecological which examines issues and paves the way for identifying the next stage of development. This in turn allows for examining the impact on the internal and external environments. Prudent field work and engineering can then be expected to lead to a design which satisfies the corporate needs without creating an imbalance in the environment during construction and operations and allows for a "walk-away shut-down".

5.2 DEVELOPMENT STRATEGY

521 BASIS

The ISK wollastonite project needs both investigations in the field and detailed laboratory work for beneficiation testing and product development. With the site described a review of alternatives can then be made and this followed by development of the traditional full feasibility study.

As such we present, as part of Super Twins business plan, a three-stage development strategy which applies professional technical judgement to reflect management needs.

522 STRATEGY

.1 Short Term

The short term covers the 1995 field work, preliminary investigations and technical due diligence. The investigations for and preparation of this report and opinion constitutes the preliminary investigations and due diligence.

.2 Detail Phase

This continues on from the initial stage and covers the detailed field investigations for selecting a preferred deposit for start up, transport route and defining the site internal environment to gather

data for commercial design which is in ecological balance. Non-field investigations cover markets and detailed beneficiation trials.

End product of this stage would be the feasibility examination followed by the production decision.

.3 Implementation

This is the stage when the project is started up and commences with the detailed design following project confirmation for the issuing of permits by the British Columbia government.

523 EXPLOITATION OF NATURAL ENVIRONMENT

The Cliff deposit by virtue of being above ground and forming one end of a large hillside offers an easy aspect for mining with blasted rock falling to the toe. In turn the rivers allow for simple barge transport with the rock gravity fed from minesite to a riverside landing. The BartNick and BriL appear to offer similar opportunities.

Clearly these indications for simplicity of mining and transport must be exploited.

5.3 PROJECT CONCEPT

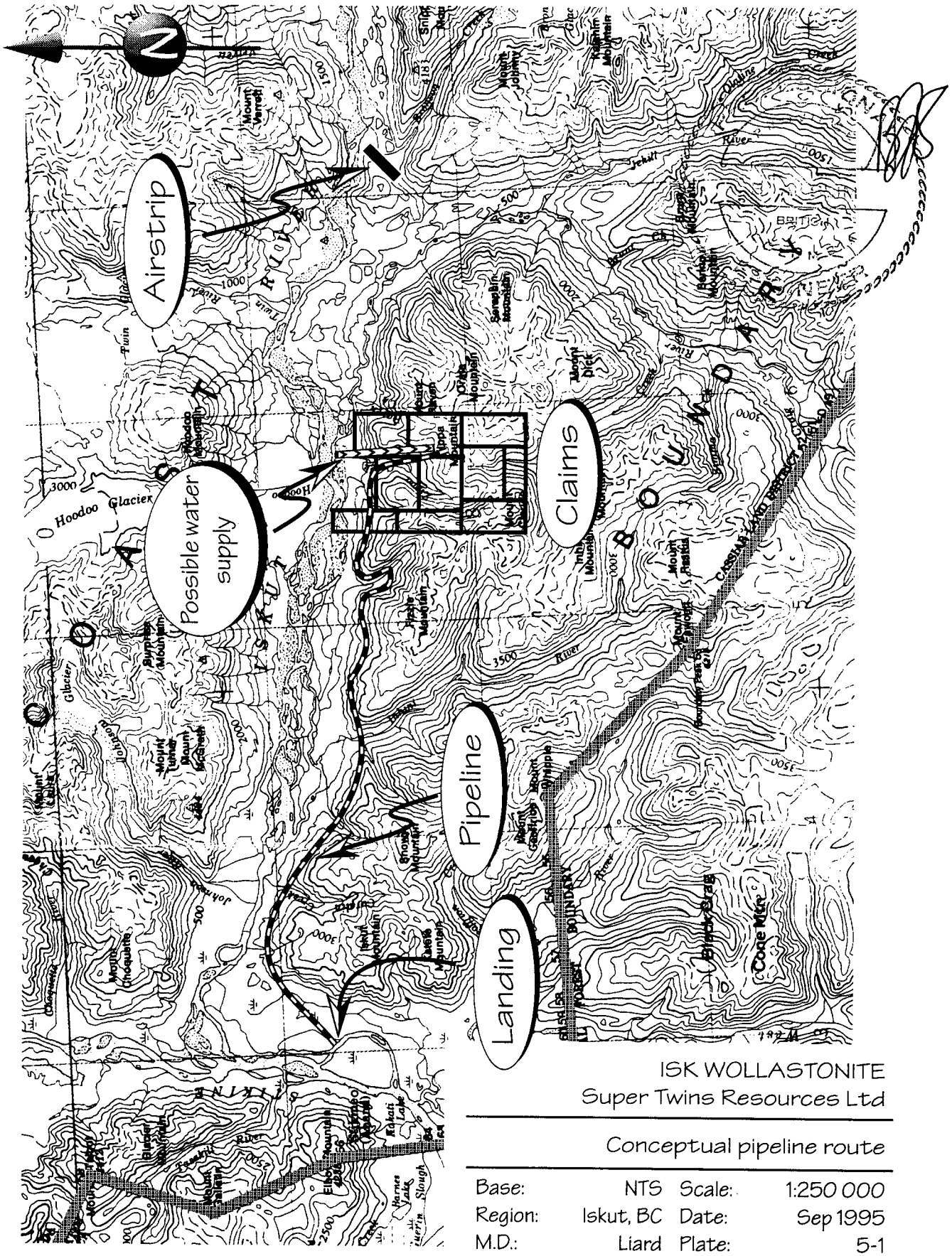
531 OVERVIEW

Proposed is a simple, seasonal surface mining operation at a deposit with the raw wollastonite transported by a gravity pipeline to the Stikine river for barge shipping to a port where beneficiation and market preparation would be carried out, this is illustrated in Figure 5-1.

532 OPERATIONS

.1 Mining

From our knowledge so far, the Cliff deposit – and other deposits with similar geometry – offers the opportunity for a simple mining operation by successive bench blasting. The broken rock would accumulate at the Cliff bottom in the same way that the scree now exists. A front end loader or



ISK WOLLASTONITE
Super Twins Resources Ltd

Conceptual pipeline route

Base:	NTS	Scale:	1:250 000
Region:	Iskut, BC	Date:	Sep 1995
M.D.:	Liard	Plate:	5-1

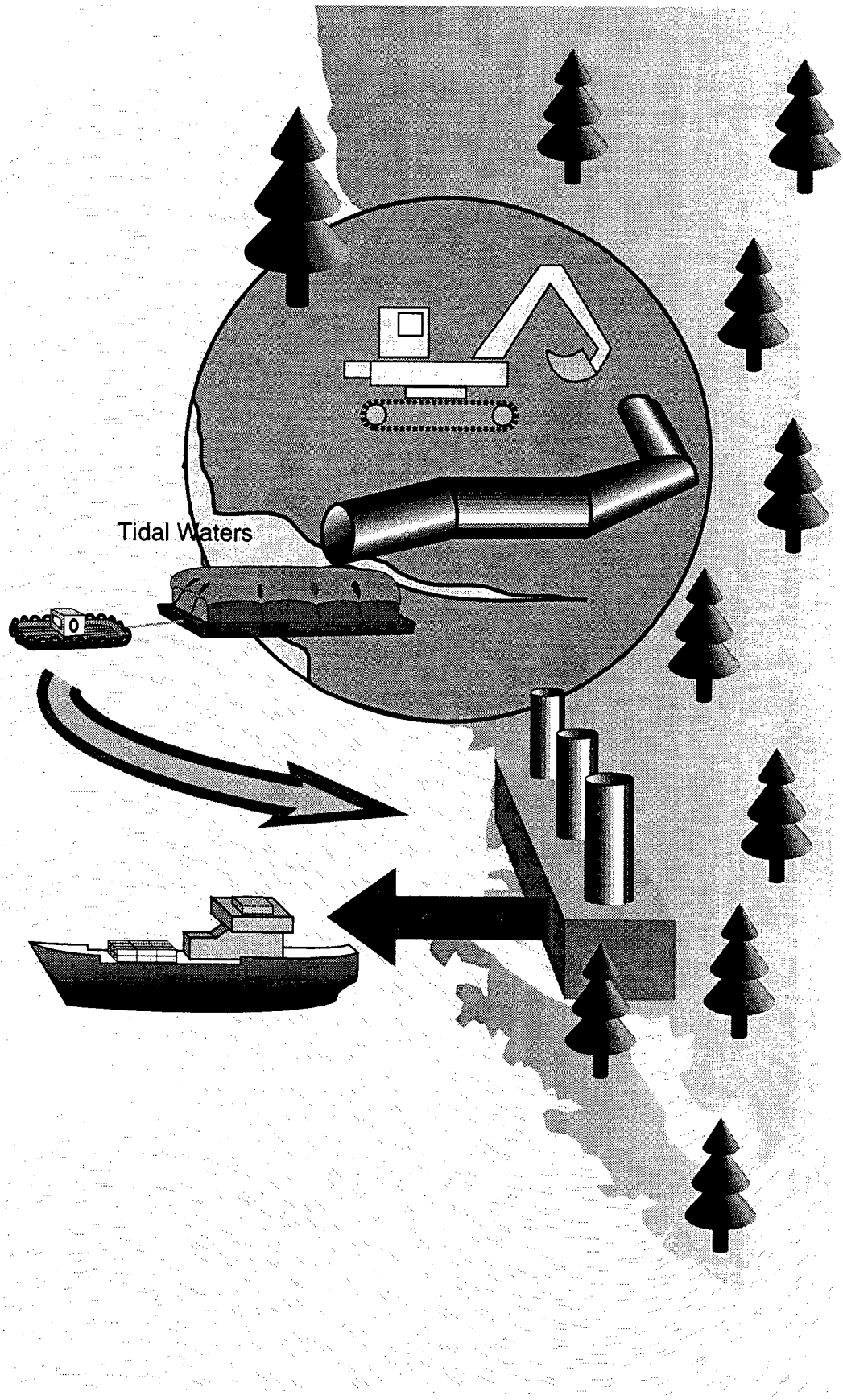


Figure 5-1 Production Concept

similar unit would transfer the material to a minesite crushing plant to produce a suitably sized aggregate for transporting by pipeline as a water slurry.

The occurrence of various dykes and pods will require a selective mining approach to minimise dilution.

Two material dumps are contemplated: the top soil/root zone material stored as part of the reclamation programme and a dump for dyke and other selectively rejected material as shown in the Cliff face in Plate 3-2.

.2 Shipping

Transport of the raw wollastonite from the claims is envisaged by a small (12 to 20 mm) diameter pipeline to a riverside landing and then by barge for transfer to a beneficiation plant at a suitable port. The pipeline would be installed on the surface and held down by suitable rock bolt type anchors.

By using water – as a neutral carrier – and a suitable crush for the wollastonite a gravity feed to the riverside should be possible – with suitable energy dissipation breaks. Water storage will be needed at both pipeline head and tail. At the riverside suitable raw feed drainage and storage will be needed as well as a landing for barge tie up and loading.

Water supply alternatives are the snow melt run-off at minesite or water take from either the Iskut or Stikine rivers. The pipeline water requirements offer the alternatives of:

- single use and discharge at the barge landing point
- closed-circuit recycling of the carrier water – with make up – after draining from the wollastonite at the landing.

Use of a high density polyethylene pipe (HDPE) for the slurry line could mean a separate water line as HDPE may not suitable for the hydraulic heads involved in supplying water to the minesite.[26]

.3 Beneficiation

Beneficiation will be at a port equiped for receiving raw material by barge and exporting product by sea and will not take place at the mine site. Use a site already approved for industrial activity is contemplated.

The process is seen as a magnetic separation and flotation to concentrate the wollastonite. Product preparation will be by grinding and sizing to the market specifications. The principle of this approach has been demonstrated from the trials carried out on samples – § 333 – and encompass standard elements of technology.

---

[26] while HDPE has been in use for at least thirty years and is considered standard in mining operations. it is not designed for the high static head needed in the ISK application.

.4 Mine Access

No road access is planned or contemplated for the mine site. Equipment, only partially assembled if necessary, would be moved in by helicopter. Crew could live in a small camp on site. No road will be needed for the pipeline as helicopter support would be adequate for transporting bundles of the light weight (10 kg/m) HDPE pipe.

5.4 CLOSURE AND RECLAMATION

The ideal situation is for a "walk away" situation following restoration to an internal environmental capability at least equal to the status before the operation.

For the minesite this would require removal of equipment, contouring of mine reject dumps if and where necessary and final spreading of the top soils. For the shipping area the pipeline and rockbolts are easy to remove as will be the river landing and the equipment and fill-in of any excavation should be routine.

5.5 REJECT MANAGEMENT

Section 5.3 has set a general concept for the operation. Until the actual process is chosen and described it is premature to address the reject control in detail. The following notes are included, however, to provide an indication of controls.

At the minesite the dyke and other rejected minerals will be assigned to a suitably placed dump so as not to dilute the raw wollastonite or impede natural drainage.

The only possible reject from the pipeline operation could be fine particulate wollastonite in the water. After recovery from the water these fines this would be shipped out with the wollastonite. The recovery technology to handle this is considered routine ranging from settling ponds to mechanical settling or even filters. Water volumes would be small, possibly in the order of 1 000 m^3/d

5.6 PROPOSED DEVELOPMENT PROGRAMME

The section has presented a broad production concept for a commercial operation to mine, ship and beneficiate the raw wollastonite. To achieve this concept, however, there is clearly a need for further investigations of the deposits, site hydrology, pipeline route and riverside site as well as environmental and ecological description of the internal environment. With this information a design can then be completed with due regard to ecological sensitivity.

The next stage of the investigations are proposed in § 8 - Development Proposal which incorporates the findings of § 6 – Ecological Issues and § 7 - Economics.

6 ECOLOGY

6 ECOLOGY

6.1 PREAMBLE

Section 6 – Ecological analyses the presently described internal environment – § 4 – in combination with the proposed concepts – § 5 – to examine the sensitivity to ecological balance and thus provide direction for design.

Here we use the term ecological in the meaning –

'...pertaining to the branch of biology that deals with organisms' relations to one another and to the physical environment in which they live'.[27]

Given that satisfactory balances and mitigation can be foreseen then an examination of the project economics – § 7 – is justified.

6.2 ECOLOGICAL FOCUS

As a guide to the development of the project we believe the essentials are to:

avoid

- discharge of any injurious materials
- upsetting the balance of the present environment
- a development and operation if it does not require the minimum of closure and reclamation

and

- at least meet the applicable regulations

6.3 ISSUES

631 PREAMBLE

Any activity must balance the wollastonite extraction and shipping against any ecological concerns and at least meet the guidelines of § 6.2.

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[27] Shorter Oxford Dictionary

632 MINING

The mining concept presented in § 532.1 proposes to emulate the natural weathering of the deposit which has taken place on the Cliff deposit and deposited mineral as scree at the base. The mining will, however, be in a controlled manner with the removal of broken material as opposed to the steady accumulation now occurring naturally.

633 PIPELINE

.1 Route

The pipeline concept as described in § 532.2, in being a surface installation held down by occasional rock bolts, avoids the need for trenching and, by using a small diameter HDPE pipe, can be snaked to a degree around trees and over obstructions. Both points minimise environmental disturbance. Shut down by removal of the installation would be straightforward and not an issue. Occasional trestles may be necessary to cross over ephemeral creeks.

Preliminary examination of the proposed route does not appear to show evidence of mass movements or slides and thus the route should be satisfactory from that aspect – Plate 5-1.

.2 Operation

.21 Water Take

Taking water, for neutral carrier use, from the Iskut and discharging to the Stikine is merely a diversion since the Iskut flows into the Stikine. Similarly taking water from and then returning it to the Stikine is also a temporary diversion. The volumes should not be an issue relative to the flow of the rivers. The alternative of intercepting an ephemeral mountain run-off and using this in the slurry line does not affect the issue of the discharge since this would be a temporary diversion of an ephemeral tributary of the Iskut. However, it is expected that the snow-melt flows would not be sufficient to meet the pipeline needs which could be in the order of 1 000 m^3/d.

The take point is important from an economic viewpoint. In the case of water discharge a direct line from a point on the Iskut due north of the claims could provide water feed and this water discharged at the barge loading facility. For recycling a take point could be either at the Iskut or Stikine. Prudent examination and design could eliminate a site specific sensitivity associated, for example, with the braiding.

The erection and use of water tanks at the minesite and loading dock should not, with prudent engineering and construction, be an issue either.

.22 Water Quality

By recycling the neutral carrier water the issue of whether anything is added to the water which could be injurious either as suspended solids or dissolved does not arise except at final shut down – see also § 4.7 Geochemistry and §'s 641, 642 & 643 for the significance.

634 BARGING

The Stikine, which is wide and fast flowing, is carrying extremely high levels of particulate matter – fed in part from the Iskut – and no clear water surface layer has been observed.

Barging, providing the movements are coincidental with peak tides on the Stikine and the towing speeds are kept to a prudent level, should not be a problem.

Overlying the barging itself is the right of use of the Stikine as governed by international agreement. The terms of the 1825 agreement between Britain and Russia, which drew the boundary between the Crown Lands (Canada) and the Russian possession (Alaska), should not be forgotten. In the 1867 purchase agreement between the United States and Russia, all the 1825 agreements were to be honoured. Article VI of the 1825 agreement states, in part:

> "...shall forever enjoy the right of navigating freely and without hindrance whatever, all the rivers and streams which in their course to the Pacific Ocean may cross the line of demarcation upon the line of coast ..."

This agreement provides the base for the Snip operations for water borne transport.

635 BENEFICIATION

All beneficiation will be at a port and in a facility presumed to be already approved for industrial use. The operation in being one of crushing, grinding, magnetic separation and flotation are standard type activities common to mineral dressing facilities. With standard operating practices implemented there should be no issues arising from the facility.

6.4 ENVIRONMENTAL INDICATIONS

641 ACID GENERATION POTENTIAL

In § 4 we presented the results of the acid based accounting tests carried out on six samples of raw wollastonite and dyke rocks from both the Cliff and Glacier deposits. The consistently high level of net neutralisation potential demonstrate there is no acid generation potential.

642 WOLLASTONITE SOLUBILITY

Solubility of wollastonite and associated minerals is important for the following three situations:

- liability in the raw state either from the outcrop or from rock piles arising from a mining operation
- dissolution in the pipeline transport
- dissolution in storage or barge transport

The SWEP testing showed no evidence of solubility sensitivity.

643 PARTICULATE MATTER

Particulate control of the carrier water from the pipeline would be routine with application of standard engineering practice. Water volumes will be low and, if needed, a treatment facility would be small – §'s 532.2 and 5.5. Recovered particulate matter will be added to the shipments of wollastonite.

6.5 SENSITIVITY OF COMMERCIAL DEVELOPMENT

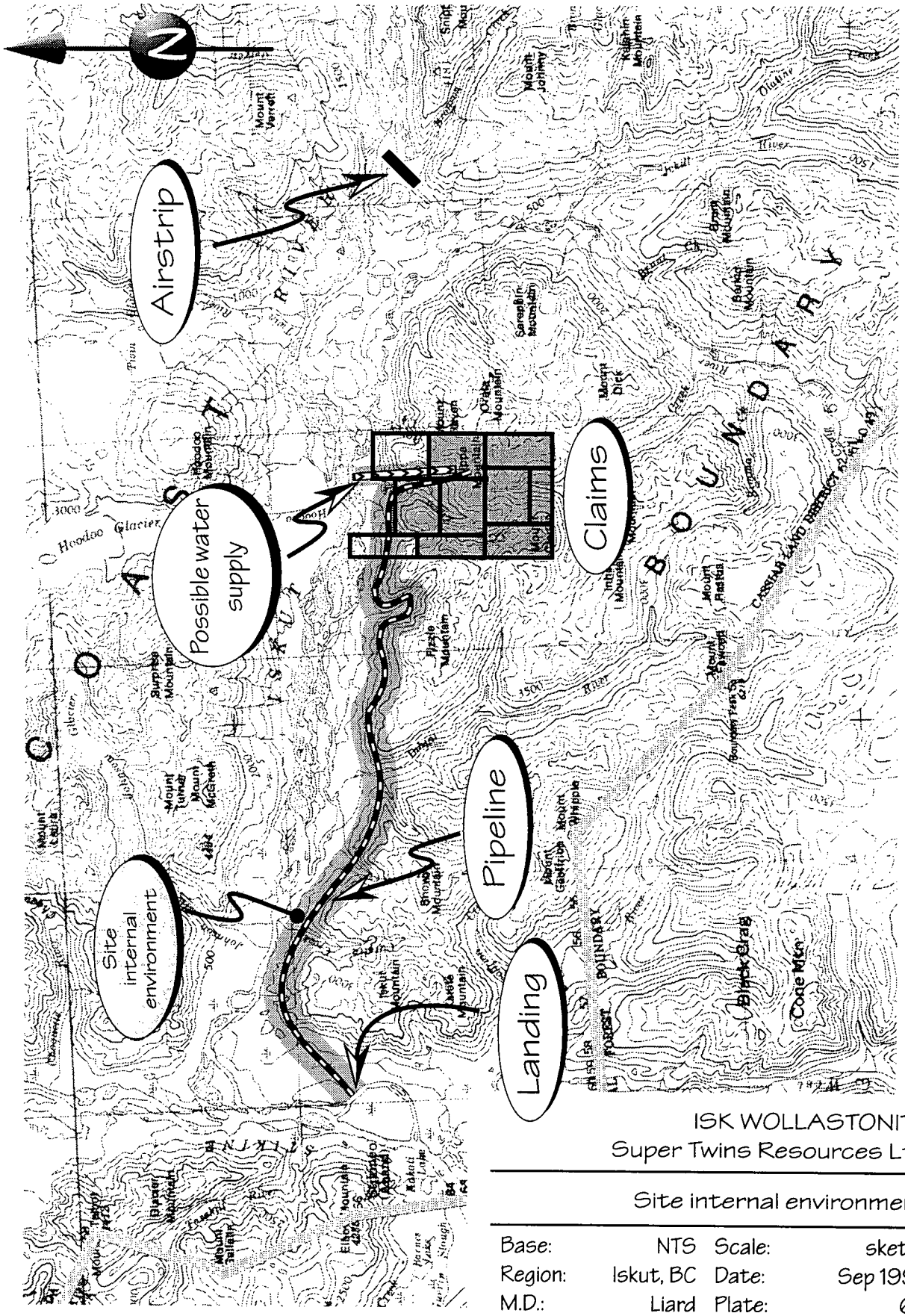
Standard tests for acid drainage potential and rock solubility show no threats. No chemicals or processing plants are planned for the minesite or landing and the water for the pipeline will be a neutral carrier. The mine operation is one of slicing a segment off a hill-side and no open-pit is contemplated. A small diameter – 12 to 20 mm – surface installed pipeline will reduce physical disturbance to a minimum. A reclamation plan can thus allow for a "walk away" closure.

Such an operation, for mining and shipping of raw rock, against a background of a remote location bereft of human habitation and the simple short season surface mining and pipeline transport of crushed raw rock for onward shipping by barge to a suitable port does not appear to pose any specific ecological sensitivity to the region.

Standard engineering practice can then be presumed to allow for a satisfactory design and implementation and operation and thus an examination of the economics is justified – § 7.

6.6 ENVIRONMENTAL BOUNDARY

At this stage we believe the preliminary boundary for the internal environment can be drawn as in Plate 6-1 which traces the conceptual pipeline route and covers seven of the claims.



ISK WOLLASTONITE
Super Twins Resources Ltd

Site internal environment

Base:	NTS	Scale:	sketch
Region:	Iskut, BC	Date:	Sep 1995
M.D.:	Liard	Plate:	6-1

7 PROJECT ECONOMICS

7 PROJECT ECONOMICS

7.1 PREAMBLE

§ 7 – Project Economics examines the profit potential given the preliminary sequential findings of resource potential, beneficiation amenability, market characteristics and no negative ecological impacts as described in the previous sections. The section starts with a review of risks of the present levels of information and from this a discount rate is set for valuation. From a preliminary scenario cost are estimated and a value derived.

At this stage costs should be viewed as preliminary and conservative and reflect judgement based on the presumptions and descriptions contained in this report rather than the results of detailed design. Further investigations will be necessary before a production decision can be made.

7.2 RISKS

721 PREAMBLE

Use of the term risk in this study covers the degree of knowledge. Clearly as more work and investigations are carried out, the technical risks are reduced until the point is reached that production decision can be taken. Timing of that point has to be expedient between the need for greater knowledge and the costs of the greater knowledge – the marginal cost of acquisition of the extra knowledge must be less than the marginal reduction of risk.

Project economics focuses on an examination for profit when in commercial production. While there are many techniques for estimation of profit the preferred are those which ignore revenue inflation, recognise the concepts of discounting and reflect cost estimates based on sound judgement (reflecting considered examination) and application of a realistic discount rate. Such a suitable approach is the use of the net present value – NPV.

A project to have commercial merit must have an NPV greater than zero. The NPV hinges on the choice of the appropriate discount rate based on the risks of the project at the time of the valuation.

The following discussions are presented as a preliminary review.

722 MARKET DEMAND

That the present world supply of wollastonite products is about 350 000 t/a is not an indication of low demand but rather of restricted supply in limited geographical areas.

Market growth reflects the typical caution of potential users who will only agree to switching from present minerals to wollastonite when they are assured of a guaranteed supply of tonnage at a consistent quality. This usually means new deposits being brought on stream rather than increasing production at existing sites which may, because of geographical siting or geological limitations, be limited.

Marketing is needed to identify potential buyers. This needs integrating with the characterisation work on Isk wollastonite to identify market type products.

723 COMPETITIVE FORCES

Most of the *barriers to entry* are not considered applicable for the Isk project given the quality and tonnage potential as well as the location virtually on tide water.

It is believed that the market opportunities hinge around *substitution of other industry products* which means the Isk wollastonite competing on its own characterisation merits. The factors of *seller power* lie with management direction; *buyer leverage power* can be minimised by virtue of the substitution factors.

724 TECHNICAL

.1 Mining

Production of raw wollastonite by the simple blasting of benches with a degree of selection to avoid dykes and other diluting material can be considered routine and need not be considered risky in this context. Designing for a summer season – about three months – production should be no problem. Should the season prove shorter the daily production rate can be increased.

.2 Reserves

At this stage it is early to consider the precise tonnage, yield, grade and market areas but from our judgement based on investigations to-date we conclude the resource potential is vast and in the millions of tonnes. Given that a production volume of say 50 000 t/a is small relative to the potential 2M t of the Cliff deposit alone illustrate that the resource size is not a potential problem in the sense of covering the capital investment risk. However, more knowledge of the continuity and distribution of grades and deposit geometry are needed for planning and design – § 8.2.

.3 Shipping

The installation and operation of a pipeline using water as a neutral carrier is considered standard engineering. A small diameter proven HDPE line, simplicity of surface installation and ease of

reclamation all combine to discount risk at this stage. Barging is a standard activity and use on the Stikine River is guaranteed under international agreement. Pipeline route and landing site information is needed – § 8.2..

.4 Beneficiation

The preliminary testing shows that the raw wollastonite has low calcite and magnetic cleaning can remove the typical garnets and other magnetic minerals present. Flotation offers additional cleaning to allow for concentrating the wollastonite. Combined with selective mining to control dilution the production of an acceptable concentrate is foreseen. Further testing is essential for flow sheet development

.5 Market Preparation

Wollastonite markets are segmented by chemical purity and physical attributes of particle size distribution and aspect ratios. Other needs are for brightness and other select attributes which would be specific to contract description.

Good chemical purity has been demonstrated from the sampling to-date and brightness measurements have shown a satisfactory high value. Grinding trials have shown that good acicular material with excellent aspect ratios can be achieved in commercial particle size ranges.

While these values and measurements are excellent they are preliminary in that they apply to general but limited sampling and have not been carried out for optimised concentrates or grinding trials. Flowsheets have not yet been developed. For the descriptions to be applied to a total deposits the results of the detailed 1996 field programme are needed – see § 8.2.

.6 Ecological

Testing has demonstrated that the wollastonite and associated minerals do not pose a threat from acid generation and solubility. No minesite chemicals or processing are contemplated. Particulate control can be handled by routine engineering design. As such the minerals and operations do not present a chemical threat to the environment.

.7 Reclamation

Concepts and environment information to-date suggest that the withdrawal of equipment will allow for a "walk-away" reclamation plan.

725 COUNTY RISK

While British Columbia presents the image of being unfriendly to the mining industry – by virtue of the "green lobby" – this must be placed in the perspective of the metal mines which, because of the potential sulphides, can require extensive engineering control and mitigation. Unfortunately this has been exploited

by those self-interest groups who without any technical or engineering rationale make a living out of opposing any development.

The need for barges to at least pass through the Alaskan portion of the Stikine poses an additional country dimension. Given the international treaty on travel this is not considered a risk.

That the Isk Wollastonite project does not appear to present sensitivities either in the minerals or land disturbance of the area which is not included in the park reserves leads us to conclude that both the regional and mineral risk is low. However, this will not stop various groups from agitating; this will require a well planned and executed information programme.

726 WOLLASTONITE PRICES

With a small world production there are no standard prices for the various products. It is fair to presume that with the ongoing evolution and need for improved materials and composites that the increasing demand arising from increasing supply for wollastonite, because of its engineering attributes, will sustain a satisfactory price levels.

Increasing supply will not necessarily lead to reduced prices but rather substitution of other minerals presently in use according to the grades and products made available. A supply imbalance is not expected as prudent management will not bring new production on stream without prior sales contracts.

727 COSTS

Cost estimates at this stage can be considered reasonable based on general experience, judgement and discussions with equipment suppliers.

7.3 DISCOUNT RATE

In adopting the net present value approach to valuation the key is setting the discount rate to be used. The ultimate choice of the rate must reflect the risks of the project with the rate higher at the pre-engineering stage than the same project after detailed design.

Overall the information and data to-date cover a lot of the fundamental points and, based on the above analysis, we do not believe the project has an overall high risk at this stage. Taking as the traditional definition of risk free as the basket of rates with treasury bills and prime we believe that an inflation-free, constant-dollar discount rate of about 20%, to be reasonable to examine the profit potential at this stage.

As additional information is gathered this rate can be decreased in line with the greater level of knowledge and hence reduced risk with a nominal prime plus four percent at the production decision stage.

7.4 INITIAL MODELLING

741 PREAMBLE

For this stage of development we are examining the economic indications for profit potential as indicated by a positive NPV.

As such we are adopting the technical concepts presented in § 5.

742 CRITERIA

For this initial modelling we have focused only on the Cliff deposit and adopted the criteria as in Table 7-1. We have allowed for first year production at 12 000 t of raw material, then the second year at 36 000 t with an annual 10% growth thereafter. These figures have no significance apart from this current analysis.

Table 7-1 Production Criteria for evaluation

Component	value
raw wollastonite production	36 000 t/a
first year factor	12 000 t
growth from year 3	10% annually
mine recovery	90%
beneficiation recovery	85%
Cliff resource potential	2 Mt
gross saleable tonnes	1.53 Mt

743 COSTS

.1 Capital

Capital costs cover the development, pipelines and barge facilities, beneficiation plant and administration for both investigations, engineering design and implementation. At this stage we are allowing $C 9 million for start up and a further $C 3 million after eight years for improvements. This presumes that the mine operation is handled by contract.

Pipeline throughput can be increased by extended hours of operation per day and increased slurry densities.

.2 Operating

Operating costs include the mine contract and we allow an overall $C 55/raw tonne mined. This is believed to be a conservative approach as it is applied to the total tonnes mined of which an estimated 90% is shipped via the pipeline and 10% sent to the reject dump.

744 WOLLASTONITE REVENUE

Prices of wollastonite tend to be set by contract as it is not an internationally traded commodity. As a preliminary we are presuming an overall gross revenue of $US 225/t product sold and paid ex beneficiation and *free alongside*.[28] This revenue figure is considered a weighted mean for a product mix of tonnages of various product grades.

745 TAXATION

Taxation is allowed for in the model for both Canada and British Columbia. and is applied consistent with the various tax acts through pools. Accelerated depreciation is handled, initially for CEE then CDE and then CCA to defer tax payments and increase the cash flows in the earlier years of operation.

7.5 VALUATION

The cash flow run for the preliminary modelling of the Cliff deposit gives in summary

Table 7-2 Valuation

	Indices	Value
Project		
	net present value	$C 22 308 000
	internal rate of return	84.63 %

These figures are taken from Table 7-3 the cash flow run for the criteria and costs given above. Note the internal rate of return is a measure of the break even discount rate only (i.e. the discount rate at which the npv = 0). This is illustrated in Table 7-3 which shows an NPV of $C 22M for the discount rate set at 20%. As the project parameters are more accurately described, following additional investigations and the 1996 summer field programme, then the risk decreases allowing a lower discount rate to be used.

The magnitude and high internal rate of return adequately indicate the potential for commercial opportunity and justify a detailed investigation to describe conditions for planning and confirm the general conclusions of this study.

[28] seller arranges delivery to alongside name vessel. Buyer arranges for export/import, loading, freight and unloading

ISK Wollastonite

Super Twins Resources Ltd

Cashflow projections – preliminary $C 000's

Cliff Deposit – 36 000 t/a with 10% growth

– base case, all equity financings
– figures are Super Twins' 100% share

Cash Flow yr	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*Total*
Net Revenue	2 209	7 289	8 018	8 820	9 701	10 672	11 739	12 913	14 204	15 624	17 187	18 905	20 796	22 876	25 163	27 679	30 447	33 492	36 841	33 550	368 125
Interest Expense																					
Canada & BC Taxes			1 696	2 807	3 349	3 688	4 060	4 468	4 526	5 085	5 626	6 546	7 201	7 921	8 714	9 585	10 544	11 598	12 758	11 618	121 791
Fixed Assets Net	5 300								3 000												8 300
Development	3 500																				3 500
Property	500																				500
CCA balance																					
Salvage																				830	830
net cash yearly	(8 091)	7 289	6 322	6 013	6 352	6 983	7 679	8 445	6 678	10 540	11 561	12 359	13 595	14 954	16 449	18 094	19 904	21 894	24 083	22 761	233 864
net cash cumulative	(8 091)	(802)	5 519	11 532	17 884	24 868	32 546	40 991	47 669	58 208	69 769	82 128	95 723	110 678	127 127	145 221	165 125	187 019	211 102	233 864	

IRR (%)		=	84.63	Effective Tax rate %
			$C 000's	34.32
after-tax NPV @	10%	=	59 765	
(inflation free rate	15%	=	35 463	
– $1996)	20%	=	22 308	34.32

Notes

intent	– prepared to examine the financial opportunities of producing from the presently described Cliff Deposit for the following assumptions:
confirmation	– confirmation needed from detailed mine planning and current tax regulations
reserves	– preliminary resource estimate, for the Cliff deposit is 2 Mt at 90% mine recovery and 85% yield
production	– assumed base of 36 000 t/a wollastonite with 10% annual growth; start up at 33% in 1997
costs	– operating costs assumed at $C 55/t raw wollastonite, capital costs as per above run
revenue	– assumed $US 225/t wollastonite sold
exchange rate	– $C 1.00 = SUS 0.72

8 DEVELOPMENT PROPOSAL

8 DEVELOPMENT PROPOSAL

8.1 PREAMBLE

§ 8 – Development Proposal presents the needs for the next stage of development for ISK Wollastonite. In § 8.2 we discuss first the needs against the background of the findings and conclusions today and then, in § 8.3 provide an budget estimate.

8.2 PROGRAMME

Our risk analysis in § 7.2 has identified the need for field work to improve various descriptions of the resource and environment.

In the field the initial need is for diamond drilling to provide samples to investigate the distribution and continuity of the grades within the Cliff, BriL and BartNick and detailed mapping, trenching and sampling is needed across the Cliff, BriL and BartNick. The route for the pipeline and site for the landing on the Stikine need inspection and testing where necessary and similarly for the possible water take point on the Iskut and waterline route. A flora and fauna and a background hydrology baseline survey is needed to cover the internal environment. Hydrogeology should only be necessary for parts of the pipeline routes and landing area. A geotechnical evaluation is also important as is a slide assessment.

In anticipation of a lease application the mineral claims need a cadastral survey[29] and this can be an opportune time to tie in the deposits to the property location and also provide a more detailed topographic description. Aerial video taping of the internal environment with integration to a global positioning data is recommended not only for reference in planning but also for baseline pre-disturbance information and to support filing applications.

Prospecting for additional deposits should continue and separate investigations are needed for port and beneficiation facilities and further laboratory testing for flow-sheet development.

8.3 BUDGET ESTIMATE

The following budget should be considerd a preliminary allowance. A detailed timetable and estimate based on focused proposals from engineers and other disciplines will be necessary before implementation. Preliminary budgets have been requested from various companies and individuals.

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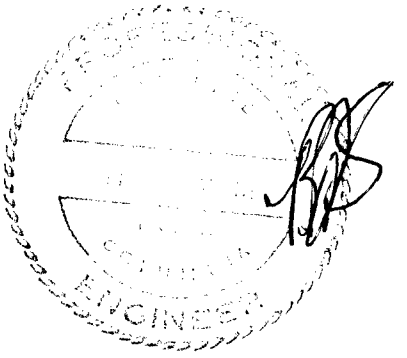
[29] a property survey carried out by a professional surveyor to establish the extent and measurements of the boundaries and to fix the location with regard to an established co-ordinate system

		$C
Resource	– d. drilling, core logging, trenching, sampling, mapping	350,000
Laboratories	– testing, mineralogy, flow sheet development	100,000
Environmental baseline	– flora and fauna, land hydrology, fisheries survey	50,000
Civils	– pipeline and support, landing & hydrogeology	125,000
Infrastructure baseline	– water takepoints, pipeline route and soils, video	30,000
Geochemicals	– soil & rock surveys & mapping and testing	25,000
Survey	– cadastral, deposit tie-ins	130,000
Ports	– investigations	25,000
Overheads	– camp, helicopter, travel	350,000
Management	– planning, monitoring, supervision, technical supplies communications, reports	100,000
	contingency	100,000
	preliminary total	1,385,000



APPENDICES

APPENDIX A

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Weather Records – Bob Quinn Lake, BC 1977-1992

Month	Temp – °C		Precipitation – mm			Snowfall – cm		
	av high	av low	mean	high	low	mean	high	low
Jan	-5	-11	52	26	8	36	83	4
Feb	-2	-10	37	73	2	25	6	2
Mar	5	-5	26	72	5	74	67	0.5
Apr	10	-2	26	49	2	7	34	tr
May	15	-1	28	57	12	0.6	5	0
Jun	19	5	32	78	3	-	-	-
Jul	20	8	55	101	15	-	-	-
Aug	20	7	51	88	14	-	-	-
Sep	14	4	90	200	43	-	-	0.5
Oct	7	0	98	214	51	8	24	0
Nov	-1	-7	63	121	15	29	77	4
Dec	-6	12	69	198	15	54	179	12
Overall			604	733	489	177	260	83

ENGINEER'S CERTIFICATE

ENGINEER'S CERTIFICATE

I, Bryan A. Slim, do hereby certify that:

1 I am a consulting mining engineer and a principal of MineStart Management Inc with a business address at 1763, Scott Road, North Vancouver, British Columbia, Canada, V7J 3J4. telephone: +1 604 986-7014, fax: +1 604 986-7017, email: minestart@mindlink.net

2 My qualifications and professional associations are:

- M.B.A. Simon Fraser University
- B.Sc. Mining Engineering, University of London.
- A.R.S.M. Associate of the Royal School of Mines
- Mine Managers Certificate of Competency, Republic of South Africa
- member of the Association of Professional Engineers and Geoscientists in the Province of British Columbia, Canada
- Chartered Engineer in England
- Member of the Institution of Mining and Metallurgy
- Member of the Canadian Institute of Mining and Metallurgy
- Member of the American Institute of Mining, Metallurgical and Petroleum Engineers.

3 I have been professionally active in my career in Canada, Africa, South America, Asia and U.S.A. since 1963.

4 This pre-feasibility study for Super Twins Resources Ltd Resources Ltd is based on site work from 14 July to 30 August, 1995, sampling as carried out under my direction, professional laboratory testing, examination of company files, discussions with company principals and other as noted, secondary data sources, experience and my professional engineering and marketing judgement.

5 As author of this report I consent to its exclusive use by Super Twins Resources Ltd Resources Ltd for their legitimate needs. Neither the report nor any information contained herein or otherwise supplied by MineStart™ in connection with the study shall be released by Super Twins Resources Ltd Resources Ltd or used by others in any connection without the express written consent of MineStart™ Management Inc and any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. MineStart™ accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Signed and sealed in North Vancouver, Canada, this 17 day of Apr 1996.

Bryan A. Slim, BSc, ARSM, MBA, MIMM, CEng, PEng.