Tom Schroeter Oct. 28/86

Premier
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A PROSPECTUS

TO THE B.C. MINE DEVELOPMENT STEERING COMMITTEE

FOR

SILBAK PREMIER AND BIG MISSOURI PROPERTIES,

STEWART, B.C.

SUBMITTED BY

WESTMIN RESOURCES LIMITED

OCTOBER 1986

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EXECUTIVE SUMMARY

Westmin is a diversified natural resources exploration and development company with interests in oil, natural gas, base metals, precious metals, coal and industrial minerals in Canada and the United States. Before 1981 the company was Western Mines Limited and had been engaged in mineral exploration since 1951 and had operated gold-silver-copper-lead-zinc mines at Myra Falls on Vancouver Island since 1967. Buttle Lake

In early 1981, Westmin Resources Limited, identified additional reserves at their Myra Falls operations, the H-W Mine, and this was the basis for a three-fold expansion of the original production rate. At that time Westmin entered the Mine Guidelines Review Process and undertook the preparation of a Stage I and Stage II Environmental Impact Assessments for the B.C. Mine Development Steering Committee. Approval-in-Principle was received and in September 1985 Westmin commissioned a new 2,700 tonne/d mine and milling complex. Westmin staff have, as a consequence, become familiar with the requirements of the MDSC and the approach necessary to developing an environmentally sound operation. *

Westmin Resources Limited is presently conducting detailed exploration and pre-feasibility work on the Silbak Premier and Big Missouri properties, both former gold and silver operations are approximately 15 km north of Stewart, B.C. The exploration program which began in 1979 consists of diamond drilling, trenching, panel and chip sampling of former underground workings and geophysical and geochemical surveys. Preliminary geological ore reserves established to December 1985 have been estimated at 8,844,755 tonnes grading 2.29 g/tonne gold and 67.87 g/tonne silver at an overall waste to ore ratio of 3.7 to 1. Additional work carried out in 1986 indicates an expansion of these preliminary reserves. Both properties - see breakdown

A conceptual mine development plan involving the simultaneous development of both properties has been formulated. Mining will initially be by open pit methods with mining of the Big Missouri deposits on a 6 month per year basis to supplement year round mining at Silbak Premier. The mill will be located at the Silbak Premier site and employ conventional flotation followed by leaching of a bulk concentrate to recover gold and silver. However, further metallurgical testing is required to evaluate alternative processes and to provide firm design criteria. Several alternative proposals for tailings disposal and hydroelectric power generation are also under investigation. A preliminary economic evaluation indicates that a combined open pit operation on the basis of a 1,814 tonnes/d concentrator, would be viable under economic conditions prevailing in the second half of 1986.

Could be as high as 2700 T/d

Development of new mining operations in the Stewart area will be extremely beneficial in terms of economic stimulus to the entire community. Since 1979, the community of Stewart has already benefited from the exploration program in that local services and people have been utilized wherever possible in the exploration program. Direct employment during operations is expected to create in excess of 120 full time positions and would add more than $5.5 million per annum in salaries alone to the local economy. Spin-offs and indirect benefits to the community and the local tax base have not been estimated, but will represent a significant infusion to the community base.

We see the primary environmental concerns as being protection of water quality and the protection of downstream fisheries resources. To this end Westmin will undertake the development of a comprehensive Waste Management and Water Management Plan. These will be reinforced by incorporating provisions for environmental monitoring and spill contingencies into the overall development concept.

1.0 INTRODUCTION

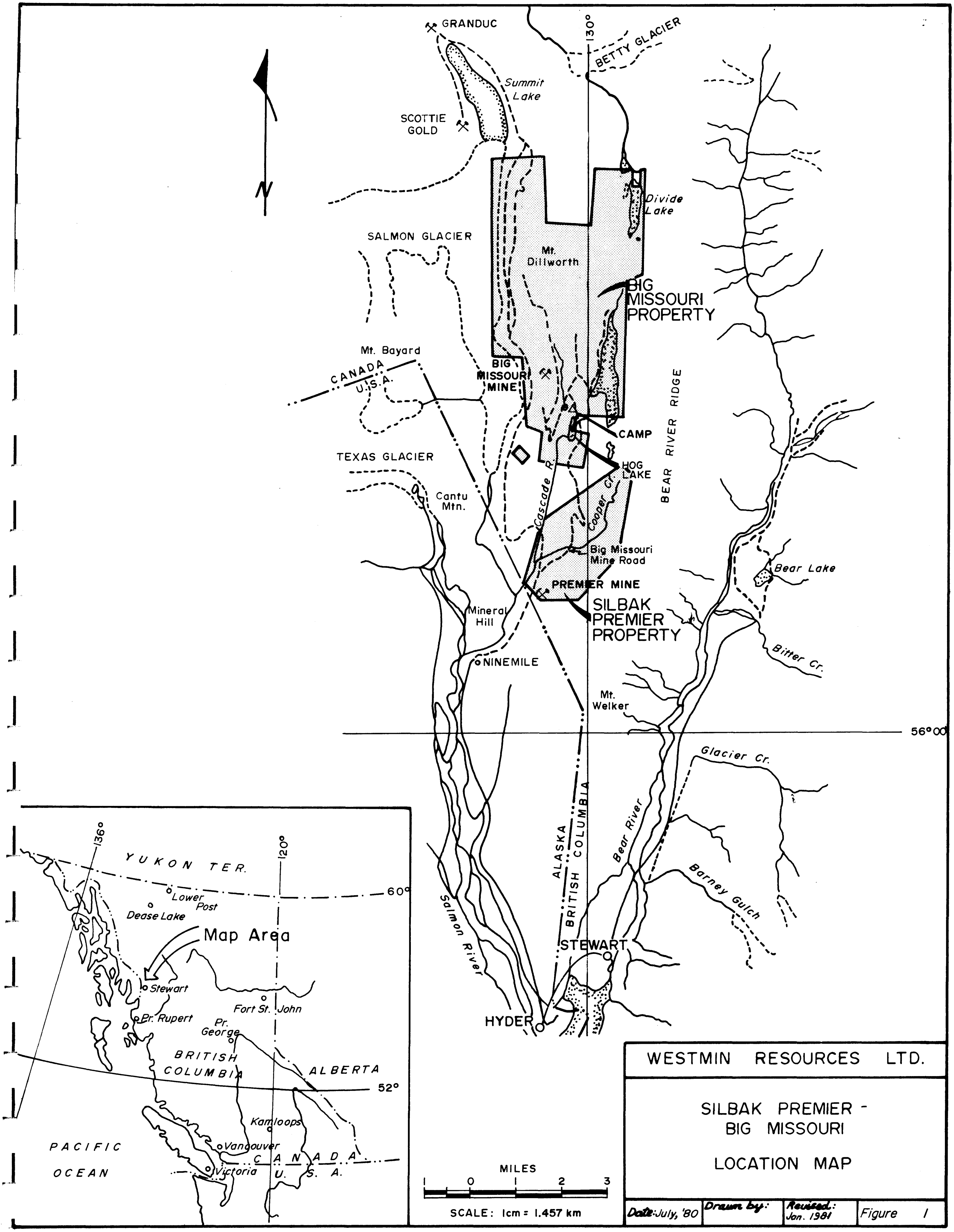
Westmin Resources Limited is presently conducting exploration work on two gold-silver properties north of Stewart, British Columbia (Figure 1):

(a) The Silbak Premier Property - located 15 km from Stewart consists of 1,820 ha and is held under terms of a joint venture agreement with British Silbak Premier Mines Limited.

(b) The Big Missouri Property - located 25 km north of Stewart comprises a total of 3,440 ha and is held under terms of an option agreement with Tournigan Mining Explorations Ltd.

Based on the results of exploration work which began in 1979, sufficient combined reserves of both properties have been delineated to warrant the commencement of a feasibility study leading to a possible production decision in 1987.

This "Prospectus" summarizes preliminary information on geology and mineralization, a conceptual development plan, existing environmental information, and proposed scope of work for development of a Stage I Socio-Economic and Environmental Impact Assessment. On the basis of this information, Westmin Resources Limited is seeking a designation of a "small" development under the Guidelines Review Process. To ensure that the proposed work will fulfill the Stage I requirements we propose a follow-up meeting in early December with members of the Steering Committee Review Panel.



WESTMIN RESOURCES LTD.

SILBAK PREMIER - BIG MISSOURI

LOCATION MAP

Date: July, '80	Drawn by:	Revised: Jan. 1981	Figure 1

2.0 SILBAK PREMIER AMD BIG MISSOURI MINES

2.1 Location & Land Tenure

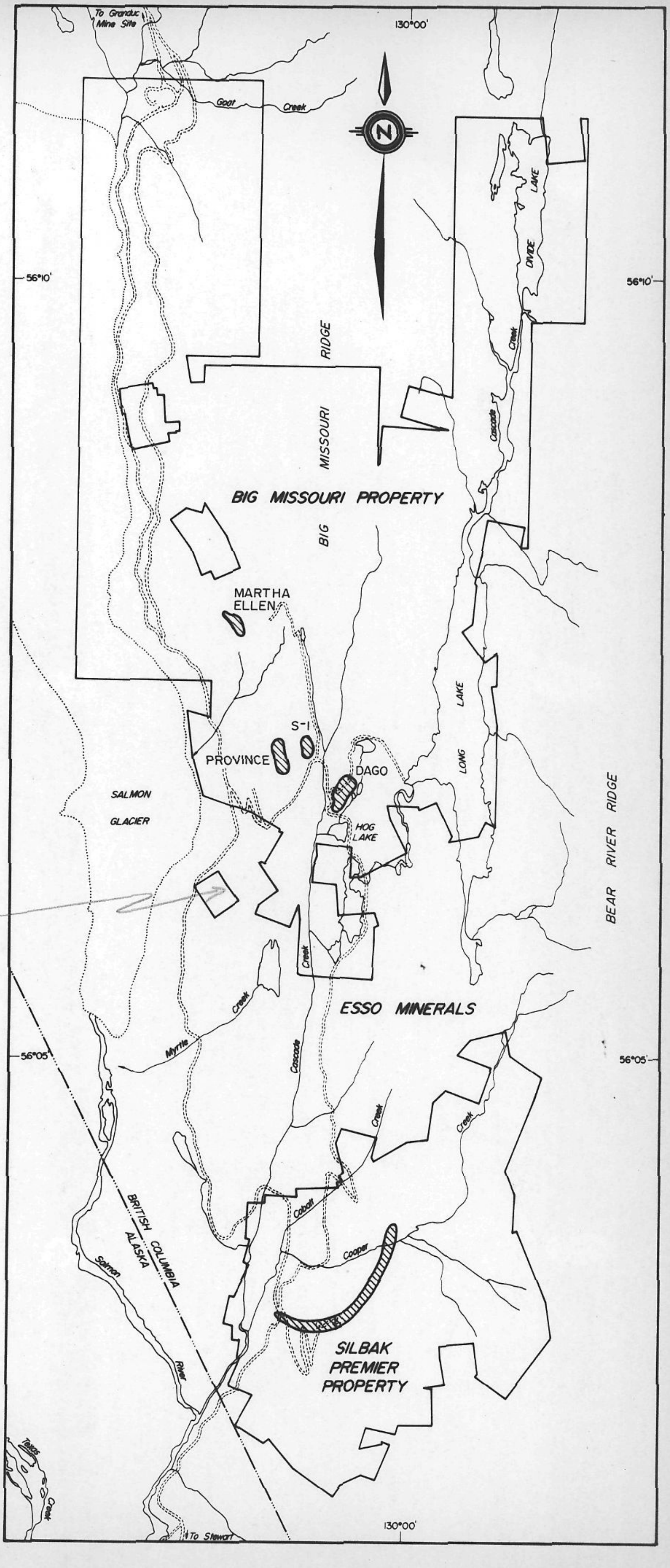
The Silbak Premier property comprises 87 Crown-granted mineral claims, 1 reverted Crown-granted mineral claim and 5 units of located mineral claims, 15 km from Stewart and adjacent to the Alaskan border (Figure 2). The Silbak Premier workings are on the east side of the Cascade Creek/Salmon River valley. The top of the mineralized area is located in a gently sloping area at 600-650 m on an otherwise steep hillside. The present camp is at 200 m elevation.

The Big Missouri property consisting of 23 Crown-granted, 68 reverted Crown-granted and 90 units of modified grid claims (approximately 3,440 ha) (total 181 units) is located 25 km north of Stewart, B.C. and 6 km north of the Silbak Premier property. Road access is from Stewart through Hyder, Alaska. The Granduc Road flanks the west side of the Big Missouri property. A four-wheel-drive road leaves the Granduc Road at the Silbak Premier property and continues 8 km to Hog Lake and the main camp at Big Missouri. Numerous drill roads provide access to the remainder of the property (Figure 2).

Slopes on the Big Missouri property are generally moderate with abundant rocky terrain. Vegetation is sub-alpine with tree-line at 1,100 m. The main camp and main level in the previous Big Missouri mine are at a 900 m elevation. Most of the exploration areas are between 900 and 1,100 m elevations on the Big Missouri Ridge.

The Stewart area, being near the coast, receives abundant precipitation with an average annual precipitation of 220 cm at Silbak Premier including an average snowfall of 11 m. Precipitation and particularly snowfall will be considerably greater at Big Missouri. The main Big Missouri camp area at a 900 m elevation is generally free of snow in early July continuing into mid-to-late October or slightly later.

Tenajon
-Silver Butte
deposit
('ore')



LOCATION MAP

1280 640 0 1280 2560 3840 metres

Figure 2

2.2 History of Site

2.2.1 Silbak Premier

Premier Gold Mines Limited was reputed to be the largest dividend paying precious metals mine in the western hemisphere between 1922 and 1936. Although primarily a gold-silver mine, it has produced significant zinc, lead and copper. Total production from 1918 to 1968 was 4,283,229 tonnes containing 56,443,749 g of gold and 1,180,779,603 g of silver. The history of mine development relates to the acquisition of adjacent lands and discovery of new ore zones.

The Premier orebody was discovered in 1916 to become Premier Gold Mines Limited. The adjoining properties of B.C. Silver and Sebakwe Mines were not amalgamated until 1936 to form British Silbak Premier Mines Limited. The Premier zone was the main source of ore until the discovery of the more base metal-rich Northern Light orebody in 1940.

Production peaked in 1937 at 499 tonnes/d and declined until 1953 when the mine was closed due to low metal prices and depletion of ore reserves. Most of the ore in the latter years was from the Northern Light zone.

Exploration in 1955 in the Northern Light zone below 6 Level identified 60,769 tonnes grading 2.40 g/tonne gold, 67.89 g/tonne silver, 4.3% Pb and 6.4% Zn but efforts to re-open the mine ended when the mill was destroyed by fire in 1956.

Mining rights above 2 Level were leased for one year in 1959. The leasee discovered bonanza grade ore in the Glory Hole, a collapse feature that formed about 1941 in the near surface part of the Premier zone. A 68 tonnes/d cyanide mill was constructed at 6 Level in 1964 to treat the newly found ore and with the intention of producing from the Northern Light zone. The latter did not materialize but the leasee's discovery led to production of 26,000 tonnes at 39.43 g/tonne gold and 833.14 g/tonne silver.

Little work was carried out between 1965 and 1979 at which time a program of surface and underground exploration was begun under new ownership. This work led to an option agreement between British Silbak Premier Mines Limited and Westmin Resources Limited in March 1983.

2.2.2 Big Missouri

The Big Missouri property was first examined in 1904 and exploration work between 1904 and 1926 revealed the presence of silicified zones containing scattered values of gold and silver. In 1927 an agreement was signed between the owners, Big Missouri Mining Company and Consolidated Mining and Smelting Co. Ltd. (Cominco) to undertake development of the property under a subsidiary company Buena Vista Mining Co.

In 1930 a 91 tonnes/d pilot mill was erected and processed 683 tonnes producing 25.2 tonnes of concentrate averaging 8.57 g/tonne gold. The pilot mill operated until September 1931 and processed a total of 23,218 tonnes but because of poor values and lack of funds, work on the property ceased.

Exploration work was re-initiated in 1933 and continued through to 1937 at which time a decision was made to install a 454 tonne/d underground mill below the 2,300 Level, and construct a hydroelectric development on Long Lake. The mill and stope developments were complete in 1938 and operations continued at approximately 680 tonnes/d until 1942. Total production was 688,645 tonnes grading 2.71 g/tonne gold.

Tournigan Mining Explorations Ltd. later acquired the property and amalgamated various claims into the existing property. Westmin Resources Limited and Tournigan Mining Explorations Ltd. completed an option agreement in late 1978 and Westmin has continued exploration and development of ore reserves.

3.0 GEOLOGY AND MINERALIZATION

3.1 Geological Setting

The property is within the Intermontane Tectonic Belt near the east margin of the Coast Crystalline Belt. The Silbak Premier and Big Missouri deposits are contained within rocks of the early to mid-Jurassic Hazelton Group. The Hazelton Group is a widespread calc-alkaline marine and non-marine volcanic suite with lithologic variety consistent with an island arc origin. Texas Creek granodiorite and related porphyritic rocks intrude the base of the Hazelton Group.

Regional geologic mapping shows Hazelton Group strata strike north and generally dip steeply. In the vicinity of the Silbak Premier mine workings and on the Big Missouri property the strata dip gently to moderately westward.

To East? OA
To West? HM

3.2 Mineralization

3.2.1 Silbak Premier

Two types of mineralization have been recognized at Silbak Premier. The principal type, accounting for more than 3,600,000 tonnes of past production, is related to emplacement of a moderate to steeply dipping subvolcanic porphyritic dacite-Premier porphyry, within host andesite of the Hazelton Group. Premier porphyry is both conformable and discordant with host andesite stratigraphy. Previously mined high grade gold-silver-zinc-lead sulphide zones are up to 5 m wide, and are contained within a lower grade zone up to 60 m wide, the latter having gradational boundaries.

The second style of mineralization at Silbak Premier occurs entirely within andesite as stratigraphically controlled zones with sharp boundaries to wallrock alteration. This type is represented by the Northern Light zone which produced about 450,000 tonnes of zinc-lead-copper-gold-silver ore between 4 and 6 Levels in the later years of the mine's life. It was actively being developed and mined below 6 Level when production was curtailed in 1953.

Exploration since 1983 has focused on the bulk tonnage potential of the Premier porphyry-related zone in the Glory Hole area and upper levels of the former mine. Mining from 1918 to 1933 was largely in this area and produced approximately 2,086,000 tonnes grading 19.20 g/tonne gold and 476.57 g/tonne silver from the mining of narrow structures. Most of the exploration from 1983 through 1986 was within a 600 m length of the bulk tonnage zone. It is open to the north and south as well as to depth. Mineralization occurs as a 30 to 60 m wide zone of stockwork quartz-veined porphyry and adjacent brecciated and irregularly veined andesite. Pyrite, lesser sphalerite and galena with minor but very important argentite, ruby silver, native silver and electrum are the economic minerals.

3.2.2 Big Missouri

More than 16 zones of surface mineralization occur within three regionally extensive stratigraphic horizons within andesitic volcanic rocks of the Hazelton Group. The zones are generally lens-shaped and range from 100 to 700 m in strike length.

The mineralized lenses consist of an altered footwall quartz stringered andesite, one or more 1 to 3 m thick bands of cherty tuff (a siliceous exhalative rock), and an altered hanging wall quartz-stringered andesite. Appreciable gold and silver values are associated with finely disseminated or semi-massive lenses of pyrite, sphalerite, galena and chalcopyrite within the cherty tuff. Thin quartz stringers containing disseminated pyrite, sphalerite and galena are found in the immediate footwall and hanging wall andesite.

One or more lenses of mineralization up to 5 to 8 metres thick make up the various zones occurring within the three mineralized horizons. Reserves are distributed as follows: Dago occurs in the lower horizon; S-1 and Martha-Ellen occur in the middle horizon; and Province occurs in the upper mineralized horizon.

3.3 Preliminary Geological Ore Reserves

3.3.1 Silbak Premier

Drilling in the previously stoped Glory Hole area has defined near-surface geological reserves on the Premier zone as shown below, based on open pit mining with an aggregate waste to ore ratio of approximately 5.5 to 1. Numerous other mineralized zones offer potential for additional reserves, such as underground extension of the Premier and Northern Light zones, and on 6 Level.

Table 1. Silbak Premier Preliminary Geological Ore Reserves (as of December, 1985)

Deposit	Tonnes	g/tonne	
		Gold	Silver
Premier Zone			
Probable	2,420,450	2.16	96.00
Possible	3,355,605	1.97	79.24
	5,776,055	2.06	86.40
Other			
Probable	319,300	4.18	36.69

Additional drilling during 1986 has focused largely on upgrading the confidence level of the above reserves. Preliminary results of the 1986 program suggest a signficant improvement in grade and quantity.

Figures for Dec. 15th meeting?!

3.3.2 Big Missouri

Drilling activity to date has established geological reserves on the property.

Table 2. Big Missouri Preliminary Geological Ore Reserves (as of December, 1985)

Deposit	Tonnes	g/tonne Gold	Silver
Dago			
Probable	671,300	2.54	42.17
Possible	29,900		
* S-1			
Probable	181,400	2.95	10.28
Possible	176,000		
Province			
Probable	308,400	2.22	12.00
Possible	90,700		
Martha Ellen			
Probable	804,700	2.67	38.74
Possible	487,000		
Sub Total			
Probable	1,965,800	2.57	32.57
Possible	783,600	(same as probable)	
TOTAL	2,749,400	2.57	32.57

Additional work was undertaken in 1986 to further delineate the reserves in the four known mineralized zones and to test other mineralized zones on the property. The results of this work indicate an expansion of reserves. What?!

4.0 CONCEPTUAL DEVELOPMENT PLAN

The following conceptual mine, milling and waste disposal plans are preliminary in nature and are presented primarily for initial review by the Mine Development Steering Committee. These plans will be modified during the engineering and design phase as a result of expected changes in ore reserve estimates.

4.1 Conceptual Mine Plan

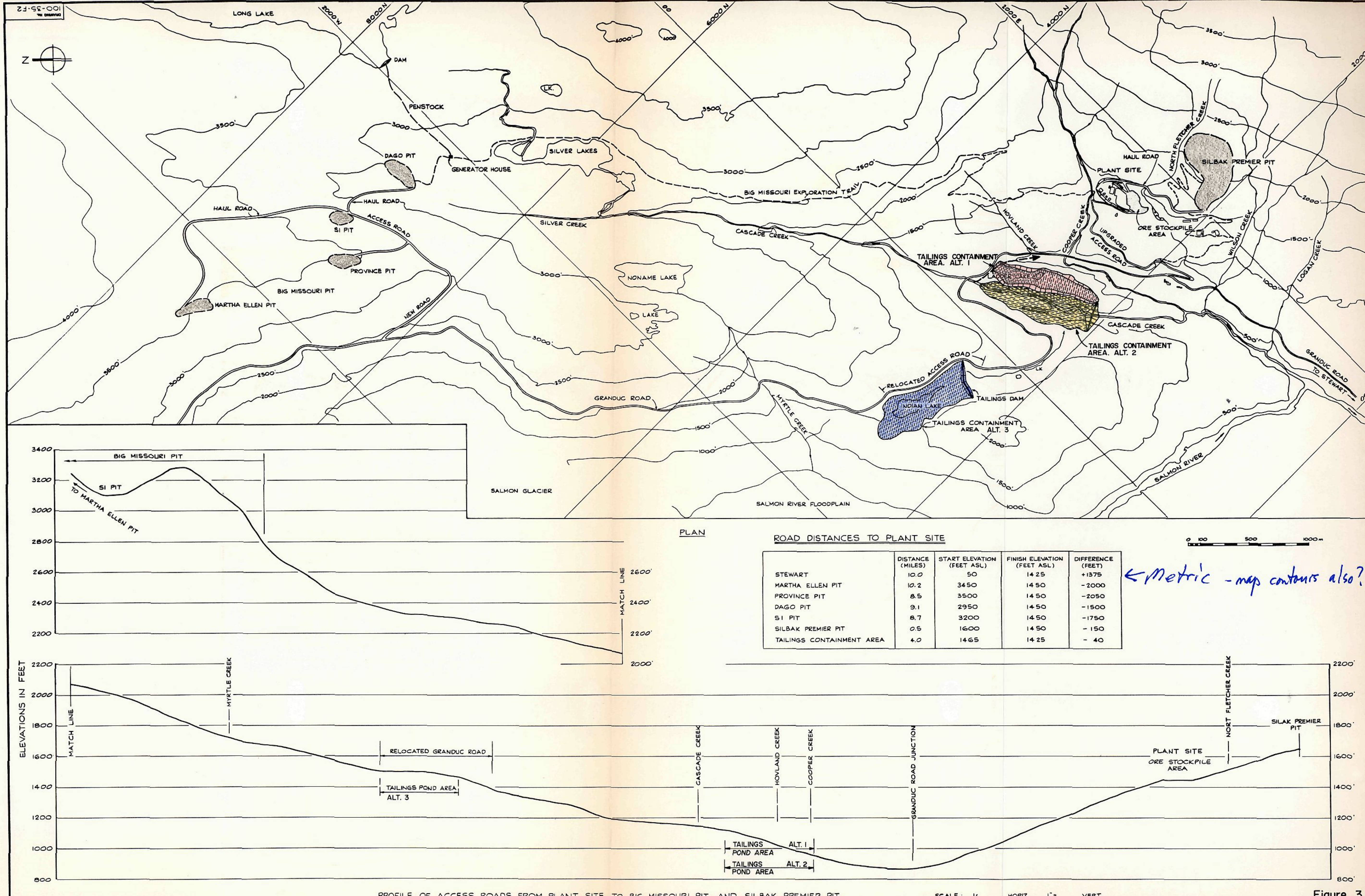
Mining will be conducted by conventional open pit methods at both the Silbak Premier and Big Missouri properties and will provide a combined production of 662,110 tonnes of mill feed per year. A generalized plan of pit locations is provided in Figure 3. The average daily production rate will be 1,814 tonnes of ore on a 365 day per year basis.

Increase to 2700 T/d?

Mining will be by standard truck and shovel/loader operation. During the first four years of operation approximately 50% of the mill feed will originate from summer operations at Big Missouri with ore stockpiled at the plant site to supplement year round production from the Silbak Premier pit.

The Silbak Premier open pit will be located in the "Glory Hole" area. Initially two first stage pits will be excavated. The larger of the two pits will strike approximately north-south and will be 325 m long by 220 m wide. The smaller pit (240 m x 100 m) will be located near the south end of the larger and strike approximately east-west.

Ramps will be required for the initial pits but as mining progresses these ramps will be absorbed into a single larger pit and horizontal access will be available at the downslope end of the pit. The average stripping ratio for mining at both properties will be 3.7 waste to 1 ore with all overburden treated as mine waste. A standard bench height of 5 m will be used with a resultant overall pit wall slope of 50°.



ROAD DISTANCES TO PLANT SITE

	DISTANCE (MILES)	START ELEVATION (FEET ASL)	FINISH ELEVATION (FEET ASL)	DIFFERENCE (FEET)
STEWART	10.0	50	1425	+1375
MARTHA ELLEN PIT	10.2	3450	1450	-2000
PROVINCE PIT	8.5	3500	1450	-2050
DAGO PIT	9.1	2950	1450	-1500
SI PIT	8.7	3200	1450	-1750
SILBAK PREMIER PIT	0.5	1600	1450	-150
TAILINGS CONTAINMENT AREA	4.0	1465	1425	-40

← Metric - map contours also?

Figure 3

SECTION: CIVIL LAYOUT	CLIENT: WESTMIN RESOURCES LIMITED	TITLE	B.O.M. No.
SCALE: 1:10000 / DATE		BIG MISSOURI & SILBAK PREMIER	PROJECT No. 7816 / DIVISION No. 15
DESIGNED BY: ARW JAN 86	LOCATION. STEWART, B.C.	OVERALL SITE PLAN AND ROAD PROFILE	DRAWING NUMBER
DRAWN BY. PL JAN 84	KILBORN		100-35-F2
CHECKED BY:			REV. A
APPROVED BY: JAN 84			

A ISSUED FOR PREFEASIBILITY JAN 84 DK

No. DESCRIPTION REVISIONS

DWG. NO. REFERENCE DRAWINGS

Any acid generation? (downslope)

Waste rock will be placed adjacent to the pits. Water from the Silbak Premier pit will be pumped to the process water storage tank and water from the Big Missouri pits will be diverted to a small tank for dust control purposes.

4.2 Conceptual Milling Plan

For reasons of efficiency and economy the proposed mill will be located at the Silbak Premier property, as shown in Figure 4. Good!

Some preliminary metallurgical test work has been completed on both the Silbak Premier and Big Missouri ores and these have been compared with historical data for previous milling operations at both sites. A specific metallurgical process has not yet been determined, and further testing is in progress to evaluate several alternative separation processes and to provide firm design criteria. However, it is expected that operations will employ crushing, grinding and flotation to produce a bulk concentrate. A decision has not been made on the method of gold and silver recovery or on recovery of base metals. One of the most common processes being considered is the extraction of precious metals from the bulk concentrate by cyanidation. Tonnage, grade and gold/silver content would favour the use of the Merrill-Crowe process for precious metals recovery. This would necessitate additional effluent treatment, possibly employing chlorination or the Inco SO_2/Air process. good!

4.3 Ancillary Facilities

The proposed ancillary facilities will consist of an administration building, changehouses, mine equipment maintenance shop/warehouse complex, metallurgy/assay laboratory, water supply and distribution system.

Process water will be obtained from existing underground developments (primarily 4 and 6 Levels) and from open pit dewatering settling ponds. This water will be pumped to storage tanks at the mill

Figure 4

SECTION:	CIVIL
SCALE:	1:1000
DESIGNED BY: ARW	JAN. 86
DRAWN BY: PL	JAN. 86
CHECKED BY:	
APPROVED BY:	JAN. 86
CLIENT:	WESTMIN RESOURCES LIMITED
LOCATION:	STEWART, B.C.
TITLE	BIG MISSOURI & SILBAK PREMIER — PLANT SITE LAYOUT PLAN
PROJECT No.	7816
DIVISION No.	15
DRAWING NUMBER	100-35-F1
REV.	A

KILBORN

REVISIONS: A — ISSUED FOR PREFEASIBILITY — JAN. 86 — DK

DWG. NO. | REFERENCE DRAWINGS

site, at which point it will be used in the milling process. Domestic and fire water will be obtained from an adjacent creek; possibly Lesley Creek. Westmin currently maintains the original water licences on Cascade, Lesley and Cooper Creeks for domestic and industrial purposes.

4.4 Electric Power Alternatives

The proposed operations will require an estimated peak power demand of 4.6 MW and average demand of 4.0 MW. Three alternative sources are being considered and include diesel electric generators, connection to the B.C. Hydro grid and local hydroelectric development.

B.C. Hydro is presently evaluating the requirements of the Stewart area and potential supply routes. At the present time, Stewart's power supply is provided by diesel generator. If a new transmission line is brought into the area, Westmin would consider connecting to the system as part of its evaluation of alternatives.

Diesel electric generation of the necessary power supply involves both a large capital cost and operating costs. Standby capacity and a fuel supply system will be required. These combined disadvantages make diesel electric the least attractive alternative.

Consideration has been given to reinstating the existing Long Lake/Hog Lake generation plant and transmission of the power to the plant site. Preliminary investigations indicate that the previous system can be upgraded to 2.3 MW maximum generation capacity. However, there is some question as to the reliability of this power since it is reported that the previous operations at the Big Missouri mine were required to shut down periodically because of a shortage of water. In this alternative, supplementary power would be provided by two on-site diesel generators sized such that one generator would operate continuously with the other on standby.

Reconstruction of the Long Lake dam and relocation of the generating station at a lower elevation near the minesite is considered a viable second alternative. This would however, require a much longer penstock but would increase the amount of hydraulic head available and reduce the amount of water required for power production. Further investigations in this area have been initiated. Westmin is presently undertaking detailed hydrological investigations of the watershed to ensure sufficient information is available for preliminary engineering purposes. Water licence applications for storage, diversion and hydroelectric power generation for these alternatives have been filed and posted with the B.C. Water Management Branch and final approval of these is pending. Good ✓

4.5 Conceptual Tailings Disposal Plans

A number of alternative tailings disposal methods and possible sites have been evaluated to determine the most economical and environmentally acceptable system. Five alternative methods of confined tailings disposal were considered, of which a conventional impoundment was considered most appropriate. Of twelve potential disposal sites identified, initially from topographical maps, only three are considered viable alternatives on the basis of distance and elevation from the proposed mill site, suitability of configuration to provide sufficient storage volume, and isolated from potential adverse affects on adjacent drainage. The three alternative sites are shown in Figure 3.

Site 1, also known as the Ladder Lake site, encompasses an undulating low area between Lesley Creek and Cascade Creek that embodies a perched, marshy swamp and a small (0.3 ha) pond. To confine the required volume of tailings at this site would require berms for most of the perimeter. This site however, provides the advantage of being considerably lower than the proposed mill site and requires only 1000 m of tailings line.

Site 2 is located in a section of the existing Cascade Creek valley, better described as a canyon below the Granduc Road. Cascade Creek would be diverted into the Lesley Creek watershed at this point. A single earthfill dam would be constructed across the canyon to accommodate approximately 3,700,000 cubic metres of tailings. This site provides the advantage of being both significantly lower in elevation and being relatively close to the proposed mill site.

Site 3 contains a small lake (5.0 ha) also known as Indian Lake, bounded to the east by the Granduc Road and north and west by rising topography. Drainage from the lake is via a ravine in the southeast corner to Cascade Creek. This particular site offers the advantage of relatively small drainage area, sufficient capacity and potential for expansion, however, it has the disadvantages of being higher than and located some 2100 m from the proposed mill and will require relocating a section of the Granduc Road.

Further study and geotechnical investigations are required to determine which site is to be used.

4.6 Sewage Treatment and Disposal

It is proposed that all sewage be treated in a centralized Rotating Biological Contact Sewage Treatment Plant (RBC's). Appropriate grease traps would be included. RBC's are considered the most reliable technology for providing a consistent and acceptable effluent quality for discharge in small northern communities. However, it is further proposed that the sewage treatment plant effluent be pumped through a buried polyethylene forcemain to the tailings pipeline and subsequently to the tailings containment area.

5.0 DEVELOPMENT SCHEDULE

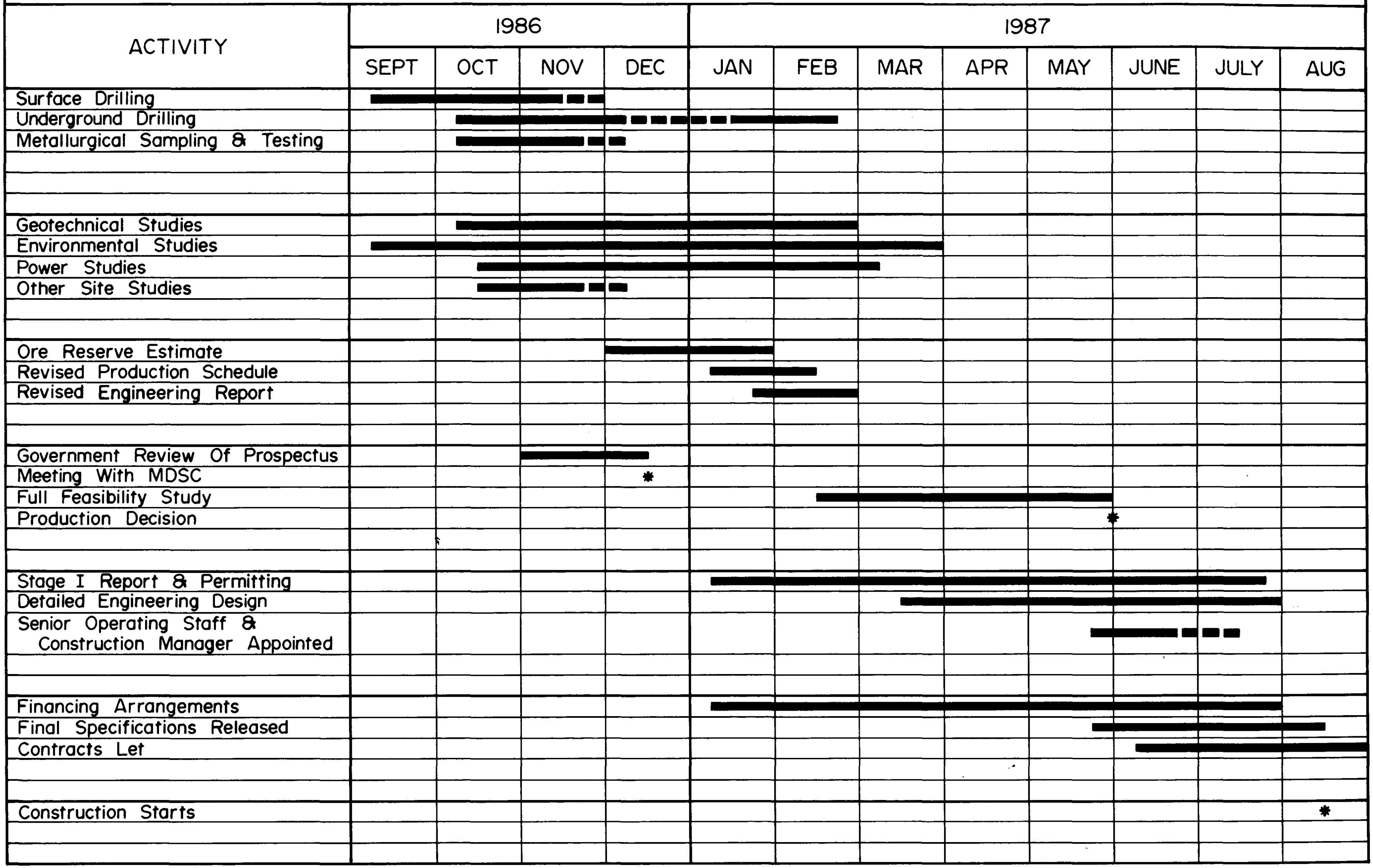
An overall development schedule is shown in Figure 5.

Westmin Resources Limited anticipates that sufficient reserves will be proven and engineering and design sufficiently advanced during the Stage I Studies for a production decision by the 2nd quarter of 1987. This will, however, be contingent upon the project receiving financial and government "Approval-in-Principle" by the end of May 1987.

To this end, Westmin Resources Limited, proposes to complete and submit a Stage I Socio-Economic and Environmental Impact Assessment to the B.C. Mine Development Steering Committee for review by early April, 1987. In order to accommodate this schedule we suggest a meeting be arranged for the week, December 15, 1986 to receive initial comment and feedback on this prospectus.

SILBAK PREMIER - BIG MISSOURI PROJECT
EVALUATION SCHEDULE

Figure 5



6.0 STAGE I SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Available Information

In order to identify data gaps and deficiencies in site-specific environmental data base all readily available information has been compiled. The following summary highlights some of that data base and forms the basis of the proposed environmental and socio-economic studies outlined in Section 6.3.

6.1.1 Fisheries Resources

Both the Silbak Premier and Big Missouri sites lie within the Long Lake/Cascade Creek and Lesley Creek watersheds, which are tributary to the Salmon River. All drainage is characterized by steep channels and high gradients, with cascading torrent flow which is entirely unsuitable for fish, their eggs, alevins and fry. The upstream migration of fish is blocked by a 20 m waterfall on Cascade Creek upstream of the Salmon River.

The Salmon River in Alaska, however, is utilized by four species of salmon; chum, pink, coho and sockeye as well as steelhead trout and Dolly Varden Char. Because of high glacial silt load and outbrust floods from Summit Lake, the Salmon River mainstem offers poor habitat for spawning and rearing. As a consequence the main fisheries habitat resource values are concentrated in small tributaries and side channels particularly Fish Creek near Hyder, Alaska (Helle and Swanson, 1974; Edgington and Larson, 1977; Alaska Dept. of Fish & Game, 1984, 1986; D.F.O., 1980). Enhancement projects using Fish Creek escapement are also being pursued by resource agencies in both Alaska and Canada to bolster Portland Canal runs (Hancock and Marshall, 1984; D.F.O., 1985, 1986; Williams, 1986).

at least 1 per yr.

6.1.2 Hydrology

There are five different Canadian gauging stations within 50 km of the minesite covering various elevations and drainage areas. These include Unuk River, American Creek, Bowser River, Bear River and Surprise Creek. All stations have similar mean annual runoff volumes on a unit area basis respective of the total drainage area involved, (ie: 2100 mm/km^2) and all stations exhibit similar annual hydrographs with the exception of Surprise Creek which peaks earlier than the others. Low flows generally occur in December through April, with peaks occurring in July and August as a result of snow melt (D.O.E., 1985). Considerable recent regional data is also available from B.C. Hydro as it relates to the Stikine-Iskut Development (B.C. Hydro, 1981, 1982, 1982b, 1983, 1984a, 1984b).

Daily discharge data from two stations in Alaska (Salmon River near Hyder and Fish Creek near Ketchikan have been obtained from the U.S. Geological Survey (1986). The records for Salmon River, however, are for the period 1964 to 1973 only at which time the station was lost as a result of an outburst flood event. The first such event occurred in December 1961, followed by second and third events in 1965 and 1967 causing significant downstream damage. The outburst floods of 1968 and 1970 caused much less damage as have annual events since 1970 (Mathews, 1965, 1970, 1973; Gilbert, 1969, 1971, 1972; Fisher, 1973; Clark, 1980; Ash, 1982).

Some historical site-specific hydrology data is also available for the period of Big Missouri operations as it related to Cominco's hydroelectric generating plant on Long Lake. These are partial records covering the years 1938 to 1940 and include lake elevation, power generated, equivalent acre-feet of storage, and water temperature.

6.1.3 Water Quality

A considerable amount of site-specific and related water quality information for the Cascade Creek-Lesley Creek-Salmon River watershed has been obtained from the following agencies:

Agency	(Ref)	Watershed	Period of Record
DOE, EPS	(1980)	Salmon River/Summit Lake	August 1980
DOE, EPS	(1981a)	Silbak Premier (tails)	June 1981
DOE, EPS	(1981b)	Salmon River/Cascade Cr. Lesley Creek	June 1981
DOE, EPS	(1983)	Salmon River/Cascade Cr. Lesley Creek	July 1983
DOE, IWD	(1986)	Salmon River	June 1981 - January 1985
B.C.MOE, WQB	(1986)	Salmon River	June 1981-November 1984
Alaska, DOEC	(1981a, (1981b)	Salmon River/ Cascade Creek/ Fish Creek	August 1980, January, 1981, June 1981
U.S.DOI, GS	(1986)	Salmon River	April 1967, October 1972

In addition to the foregoing there are detailed water quality data for Salmon River before and during the outburst floods of 1980 prior to Scottie Gold Mines Ltd. start-up (Ker, Priestman & Ass. Ltd., 1982; Scottie Gold Mines Ltd., 1980).

The most detailed and long term records are those of Inland Waters Directorate (DOE, 1986) for the Salmon River and indicate that seasonal variation in flow has a significant impact on Specific Conductivity, Turbidity, Hardness, Dissolved and Total Calcium, Magnesium, Sodium, Silica and Dissolved Sulphate.

Turbidity increases dramatically with the onset of high runoff periods and there is a corresponding decrease in Conductivity, Hardness (and related metals) and Sulphate content during these periods. Residues (Nonfilterable and Filterable) follow the same trend, as does Apparent Color. Metal levels including Cadmium, Copper, Lead, Mercury, Zinc are generally present in relatively low concentrations. Iron, however, increases significantly during freshet and may indicate that some natural leaching of iron-bearing deposits throughout the watershed are being flushed out. Anomalous peaks of Extractable and Total Copper were observed in both Inland Waters Directorate and Waste Management Branch data for mid 1982 and 1983.

E.P.S. (1981a) data indicate that the Cascade/Lesley Creek watersheds are generally of high quality. Waters are neutral in pH, soft, low in Alkalinity, Conductivity, and Sulphate content. Total Residues are slightly elevated as a result of glacial silts but both watersheds can be regarded as low in metal content. The exceptions to this are discharges from Silbak Premier 4 and 6 Levels which exhibit high Conductivity and Hardness, and elevated levels of Zinc.

6.1.4 Climate

Extensive climatic records exist for the Premier and Stewart areas. The Atmospheric Environmental Service (1980, 1986) has operated a station at the Premier site (Station No. 1066420) between the years 1926 and 1953 and at Stewart (Station No.'s 1067740 and 1067742) from 1910 to present. These data include, mean daily and extreme temperatures, daily and total annual and extremes in rain and snowfall. A brief summary is given below:

	Temperature (°C)			Precipitation (mm)			
Station	Mean	Max	Min	Rain	Snow	Total	Days
Stewart A	5.4	32.7	-23.4	1242	6686	1895	218
Stewart B	5.2	34.4	-30.0	1305	5560	1851	164
Premier	4.7	32.2	-30.0	1096	11030	2200	202

Excellent historical data!

B.C. snow course data summaries for Granduc Mine and Bear Pass are also available, albeit data for the Granduc Mine station is sporadic (MOE, 1985, 1986). A meteorological station was also operated briefly in the accumulation area of Salmon Glacier (el 1700 m) during the summer of 1957. Various data covering pressure, temperature, humidity, incoming radiation and wind velocity and direction were compiled (Adkins, 1958). A Climatological station was also operated at Hyder, Alaska for four years (1936-1939 inclusive) by NOAA (1986). These data include temperature and precipitation for the period of record.

6.2 Previous Environmental Studies

Two parallel socio-economic and environmental studies were commissioned by Westmin Resources Limited in 1980 concerning the potential re-opening of the Silbak Premier and Big Missouri Mines (Schultz International Ltd., 1983; Technology Resources Inc., 1984) At that time a conceptual mine plan had not been developed and an impact evaluation was not undertaken. These studies were conducted jointly and undertaken in sufficient detail to prepare a comprehensive biophysical description for a future Stage I Impact Assessment Report involving both properties. The information gathered in these studies will form the basis for the Stage I Report and include:

6.2.1 Meteorology - a compilation of all climatic data and the initiation of an air quality monitoring program.

6.2.2 Physiography - the mapping of bedrock, soils and surficial geology on a scale of 1:20,000.

6.2.3 Hydrology & Water Quality - a quarterly water quality and hydrology monitoring program between August 1980 to February 1982.

6.2.4 Vegetation & Forestry Resources - generalized mapping of vegetation and forestry on a scale of 1:20,000 covering alpine, subalpine, wetlands, and Coastal/Mountain Hemlock Zones.

6.2.5 Wildlife Resources - a documentation based on site observations, site investigations, published literature and personnel interviews with field biologists, foresters and conservation officers.

6.2.6 Fisheries & Aquatic Resources - site reconnaissance of habitat capability and documentation of downstream resource values.

6.2.7 Land Use & Capability - documentation of land tenure, historical land use and land use capability. Archeological and Heritage resources capability are addressed.

6.2.8 Socio-economic Environment - includes detailed description of demographics, employment, housing, and regional and local infrastructure. Social services such as police, fire protection and educational facilities are documented.

6.3 Stage I Report and Proposed Additional Studies

To complete a comprehensive data base for the Stage I Report, Westmin Resources Limited will be undertaking the following field studies, testing and investigations.

6.3.1 Physiography, Soils and Seismicity

A site survey will be undertaken by a team consisting of a surficial geologist and groundwater hydrologist to assess the stability of adjacent slopes, complete a detailed soils assessment, and to provide a seismic risk analysis for the two properties. The slope stability assessment will include mapping of rock screes, snow slide activity, slope scouring, colluvial material supplemented with stereoscopic examination and interpretation of aerial photographs.

Soils evaluation will include the collection and analyses of soil samples for:

- sand, silt and clay size fractions
- pH
- Total Nitrogen and Available Phosphorous
- Electrical conductivity
- Cation Exchange Capacity
- Exchangeable Cations Ca, Mg, Na and K
- Available Metals, Cu, Zn, Fe, Mn and Al
- Total Sulphur

and an interpretation of soil chemistry and fertilizer and lime requirements. This information will be incorporated into a conceptual reclamation plan.

Historical information on the seismicity for the minesite will be obtained from the Earth Physics Branch of the Pacific Geoscience Centre and estimates of experienced shock intensity, ground acceleration and Mercalli Intensity, will be presented together with predictions on expected events, duration intensity, and return frequencies.

6.3.2 Acid Generation Potential Tests

Representative samples from selected material representing waste rock, ore and potential tailings will be submitted to a competent laboratory for acid generation potential testing. These data will be used in the design and support of a tailings and waste rock disposal strategy and to assess potential for acid mine drainage. Stage 1?

6.3.3 Surface and Groundwater Quality

The baseline water quality monitoring program has been reinstated on a quarterly basis emcompassing a broader range of parameters for the purposes of keeping the data base current with present activities. A comprehensive list of analyses is provided in Table 3 and sample stations are shown in Figure 6.

6.3.4 Surface Water Hydrology

A more comprehensive hydrology program has also been initiated, and included the installation and calibration of discharge gauges of flows at 9 sites as shown in Figure 6. These data are being developed for purposes of engineering and design of site facilities and hydroelectric development. To date sufficient data for the network of gauging stations is adequate to provide a good description of the local, short-term hydrologic regime.

6.3.5 Socio-economic Studies

eg. Klappan coal 'interaction', etc., etc.

The existing socio-economic evaluation requires updating and a supplementary study will be commissioned to re-evaluate community populations, demographics, levels of employment, and housing availability. Interviews will be held with appropriate provincial, regional, and municipal agencies to document availability of community services such as schools, medical services, cultural and recreational programs, and police and fire protection. Information on community infrastructure, commercial and industrial sectors, communications and transportation will also be described. Interviews will be held with appropriate provincial and municipal authorities regarding municipal finances, including property base for municipal and educational taxes.

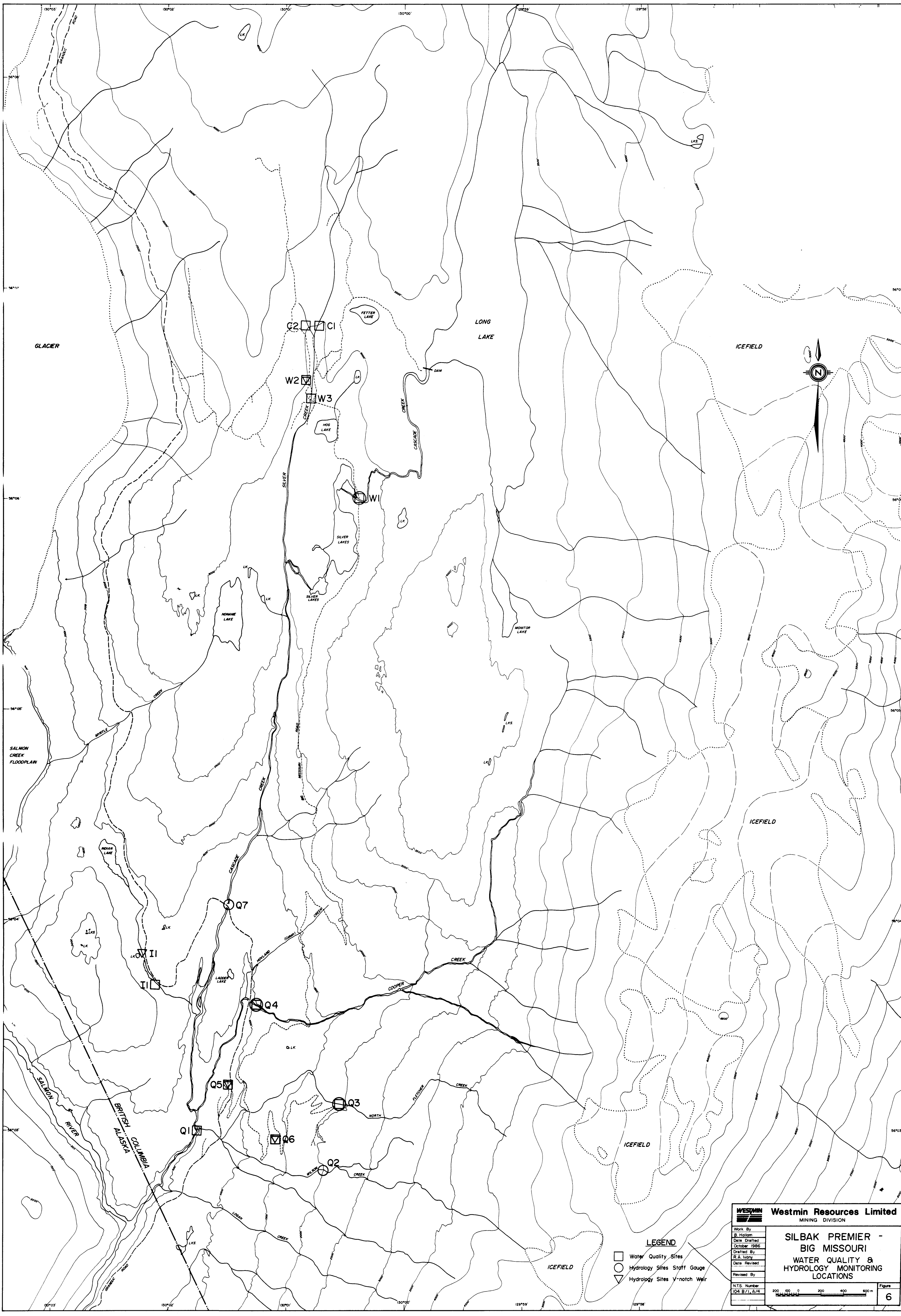

GLACIER
ICEFIELD
LONG LAKE
FETTER LAKE
HOG LAKE
SILVER LAKES
MONITOR LAKE
MOHAWK LAKE
INDIAN LAKE
LADDER LAKE
SALMON CREEK FLOODPLAIN
SALMON RIVER
BRITISH COLUMBIA
ALASKA
CASCADE CREEK
SILVER CREEK
COOPER CREEK
MYRTLE CREEK
NORTH FLETCHER CREEK
WILSON CREEK
LOGAN CREEK
DAM
C1
C2
W1
W2
W3
Q1
Q2
Q3
Q4
Q5
Q6
Q7
I1
LEGEND
Water Quality Sites
Hydrology Sites Staff Gauge
Hydrology Sites V-notch Weir
WESTMIN
Westmin Resources Limited
MINING DIVISION
Work By
B. Hallam
Date Drafted
October 1986
Drafted By
R.A. Ivany
Date Revised
Revised By
N.T.S. Number
104 B/1, A/4
SILBAK PREMIER - BIG MISSOURI
WATER QUALITY & HYDROLOGY MONITORING LOCATIONS
200 100 0 200 400 600 m
Figure
6

TABLE 3

PROPOSED STAGE I WATER QUALITY MONITORING PROGRAM

CHARACTERISTICS	DETECTION LIMITS
Temperature	Field
pH	Field
Dissolved Oxygen	Field
Suspended Solids	1 mg/L
Turbidity	0.1 NTU
Total Dissolved Solids	1 mg/L
Total Hardness	1 mg/L
Total Alkalinity	1 mg/L
Sulphate	1 mg/L
Nitrate	20 ug/L
Nitrite	5 ug/L
Ammonia	10 ug/L
Total Dissolved Phosphorous	3 ug/L
Total Cyanide	1 ug/L
Total Mercury	0.05 ug/L

TOTAL AND DISSOLVED METALS

CHARACTERISTICS	DETECTION LIMITS
Aluminum	10 ug/L
Arsenic	5 ug/L
Barium	100 ug/L
Cadmium	0.5 ug/L
Copper	1 ug/L
Iron	30 ug/L
Lead	1 ug/L
Molybdenum	1 ug/L
Nickel	10 ug/L
Selenium	1 ug/L
Silver	5 ug/L
Zinc	5 ug/L

ug/L - micrograms per litre

mg/L - milligrams per litre

6.3.6 Environmental Protection & Waste Management Plan

A report concerning environmental protection will be prepared in conjunction with Westmin's engineering staff during the development of the project plans, and included in the Stage I Report. This will include sections dealing specifically with:

(a) Waste Management Plans
(b) Water Management & Protection Plans
(c) Spill Contingencies Plans
(d) Environmental Monitoring Plans
(e) Conceptual Reclamation Plans

These components of the Stage I Report can not be finalized until potential design and resource conflicts are resolved in the phased environmental and preliminary engineering stage where negative impacts can be mitigated at an early stage of planning.

GLOSSARY

CONVERSION FACTORS AND UNIT ABBREVIATIONS

Metric	S1 Unit		Factor		Imperial
Tonne		x	1.1023	=	short tons
gram	g	x	0.03215	=	troy ounces
gram/tonne	g/tonne	x	0.02917	=	troy ounces/ton
hectare	ha	x	2.471	=	acres
kilometre	km	x	0.6214	=	miles
metre	m	x	3.281	=	feet
millimetre	mm	x	0.0394	=	inches

Imperial		Factor		Metric	S1 Unit
short ton	x	0.9072	=	tonnes	
troy ounce	x	31.1034	=	grams	g
troy ounce/ton	x	34.2857	=	grams/tonne	g/tonne
acre	x	0.4046	=	hectares	ha
mile	x	1.609	=	kilometres	km
feet	x	0.3048	=	metres	m
inch	x	25.4	=	millimetres	mm

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