COMPUTER MODEL -V- BLASTED.

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Noted Aug 25/89
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CURRAGH RESOURCES INC.

INTER-OFFICE MEMORANDUM

TO: Kurt Forgaard
Bill Weymark
Marv Pelley

FROM: Gregg Jilson
Vice-President, Exploration
Whitehorse Office

RE: Investigations carried out at Faro with regards to shortfalls of grade ore tonnage and grade

DATE: 1989 08 24

INTRODUCTION

Mine planning information has been examined to investigate the persistant shortfall of high grade ore tonnage and grade. This investigation focused on a comparison of ore blocked out in the pit by blastholes compared to that predicted by computer models.

A number of questions were addressed including:

1) Does MAXIPLAN misrepresent PCMINE data?

2) Does the F8805 PCMINE model accurately represent the ore deposit grades?

3) Does any difference between design and dig limits account for tonnage variances.

Items not investigated were issues of stockpile quantities and millfeed. The question here was simply limited to how does ore of each grade class as blocked out in the pit, compare to ore expected to be blocked out in the pit.

CONCLUSIONS

1) The F8805 model is a reasonably accurate representation of the ore body at a 5% Pb + Zn cutoff grade. In BZ phase on 3410 to 3310 bench 1.73 million tonnes averaging 7.3% Pb + Zn was predicted, 1.63 million tonnes averaging 7.5 % Pb + Zn was actually blocked out by blastholes.

2) The blasthole grade distribution and the model grade distribution are very different. The blastholes peak in the 5-6% Pb + Zn class while the model peaks in the 8-9% Pb + Zn class. This

results in the poor model performance at a 7% Pb + Zn cutoff.

3) The grade distribution problem results in fewer tonnes of high grade ore being realized than predicted but substantially more medium grade. Both the high grade and medium grade categories as blocked out by blastholes are higher grade than indicated by the model.

4) The grade distribution problem is thought to be due to the layering thickness in the ore body being close to the bench (?) height. This results in high grade ore being combined with lower grade to produce a larger medium grade class when blocked out by 20' long blasthole samples. As the cutoff grade decreases ore layers become thicker, easier to sample, and more reliably predicted.

5) The 3410 bench showed major (200,000 tonnes) high grade ore losses due to a large sulphide waste lens that was not drilled in exploratory holes. The presence of this lens caused large amounts of high grade to be downgraded to medium grade by blastholes. This lens also affected the 3390 bench. As an illustration of the grade distribution phenomenon, on this bench the +5% material actually shows <u>more</u> tonnage than predicated at a <u>higher</u> average grade than predicted. At a 7% cutoff the predicted versus realized tonnage and grade is very different. (See figure 1)

6) The 3390 bench was also particularly bad in comparison to the mineplan because approximately 50,000 tonnes of high grade was lost due to variance in design versus actual limits (temporary wall); an addition 80,000 tonnes of high grade was downgraded to medium grade by blastholes.

7) Hand calculations of July, August, and September 1989 reserves were carried out as a check on the model tonnage and grade. The comparison was good. (See table I)

8) Checks between reserves calculated for the same portion of a bench form PCMINE and MAXIPLAN using the F8805 model as the database in both cases showed good correlation well within reasonable limits of rounding and error.

9) Accurate use of MAXIPLAN becomes particularly difficult near the current mining surface where good fit with topography is needed and previously mined then backfilled areas must be taken into account. One area of JB phase mining contributed extra non-existant reserves in an area of backfilling.

10) The cause of the grade distribution difference is not currently certain, but it is thought to be due to very restrictive rock type matching during interpolation which enhances grade distinction between ore types. A looser rock matching is being tried as a remedy. The Vangorda and Grum block models use a loose matching scheme rather than the highly restrictive one used

for the F8805 model. Composite type (geological unit versus bench composites) may also be a significant factor.

11) The global reserve estimate for all Curragh deposits is unaffected by these considerations since a low cut off grade is used for such estimates. Mine plans employing a 5% Pb+Zn cutoff should not be affected, but plans that use a high cutoff and stockpile medium and low grade may be affected depending on the model.

12) The original 1989 budget used preliminary model files which had higher grades than the final model files used for the April 1989 plan.

13) Comparing actual blocked out quantities to the original 1989 budget is complicated by the fact that large quantities of ore were left in the temporary SW wall of the BZ phase. The difference here is larger than that between the April 1989 plan and the actual dig limits.

14) Blasthole calculations that use an average density of 3 tonnes/cubic yard. (SG-4.0) may be underestimating tonnes of high grade ore blocked out as all data indicate that high grade ores are heavier than low grade ores. At an average for all material over 4% Pb + Zn, 3.0 tn/bcy is an excellent average. For high grade ore 3.1 tn/bcy more likely but for low grade 2.9 may be better.

RECOMMENDATIONS

1) Caution should be exercised with predictions of high grade ore greatly in excess of medium grade ore if predicted by the F8805 model.

2) The model should be recalculated with a number of different interpolation algorithms and compared to blastholes. These should include less restrictive geological matching, bench composites and extreme value clipping.

3) The practice of adjustment for dilution and mining loss should be changed to better reflect pit operations, especially with regard to high grade ore where a large mining loss to the medium grade category is more realistic than a 10% dilution by ore grade and 5% mining loss.

4) Use of average density of 3 tonnes per cubic yard should be scrutinized as it applies to high grade and low grade ore when calculating blasthole quantities. A new database is already available to make density specific for each rock type.

TABLE I

CURRAGH RESOURCES INC. - FARO MINE 07-Aug-89

COMPARISON OF MAXIPLAN AND PCMINE CALCULATION OF JULY 1 TO SEPT 30 1989 MINING RESERVES

FOR COMPARISON
IN JULY 1989

ALL BUT BLASTHOLES DILUTED BY 10% AT ZERO GRADE WITH 95% MINING RECOVERY

		TONNES	LEAD	ZINC	Pb METAL	Zn METAL	TOTAL METAL
	5% TO 7%	8,888	1.74	3.66	155	325	480
	PLUS 7%	163,967	3.43	5.74	5,624	9,412	15,036
MAXIPLAN	PLUS 5%	172,855	3.34	5.63	5,779	9,737	15,516
PCMINE	PLUS 5%	178,229	3.20	5.40	5,709	9,623	15,332
HAND CALC OF HI GRADE		180,917	2.44	5.27	4,414	9,534	13,949
BLASTHOLES		178,616	3.77	5.66	6,734	10,110	16,843

FOR COMPARISON
IN AUGUST 1989

		TONNES	LEAD	ZINC	Pb METAL	Zn METAL	TOTAL METAL
	5% TO 7%	5,503	1.87	3.68	103	203	305
	PLUS 7%	360,150	3.84	5.75	13,830	20,709	34,538
MAXIPLAN	PLUS 5%	365,653	3.81	5.72	13,933	20,911	34,844
PCMINE	PLUS 5%	361,514	3.84	5.74	13,874	20,739	34,613
HAND CALC OF HI GRADE		336,736	3.77	6.06	12,695	20,406	33,101

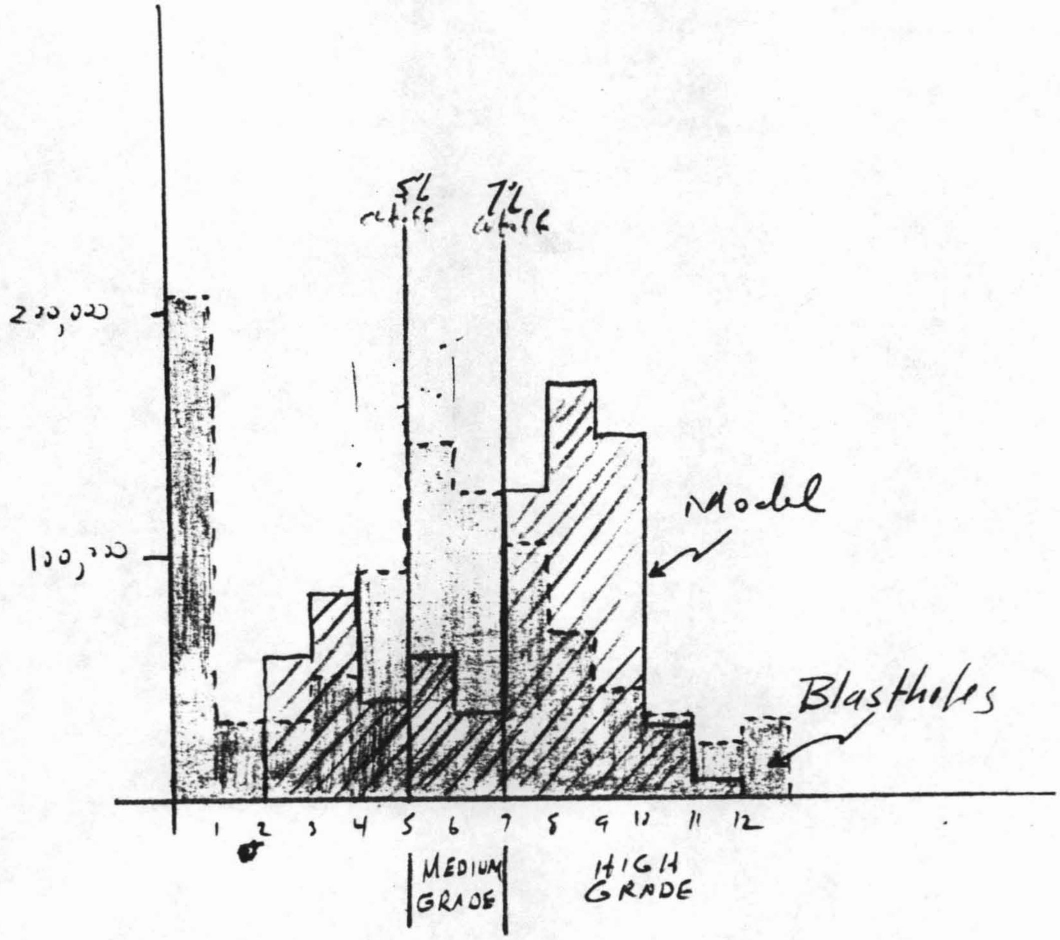
FOR COMPARISON
IN SEPTEMBER 1989

		TONNES	LEAD	ZINC	Pb METAL	Zn METAL	TOTAL METAL
	5% TO 7%	42,558	2.10	3.74	894	1,592	2,485
	PLUS 7%	332,951	4.78	6.23	15,915	20,743	36,658
MAXIPLAN	PLUS 5%	375,509	4.48	5.95	16,809	22,335	39,143
PCMINE	PLUS 5%	NA	NA	NA	NA	NA	NA
HAND CALC OF HI GRADE		360,981	4.33	6.13	15,622	22,145	37,767

TABLE : 2 Comparison of Predicted to Actual Ore and Waste Quantities

		FIV JULY DESIGN LIMITS GEOL COMP,STRICT MATCH CALCULATED BY PCMINE DILUTED 10%,95% RECVY ******F8805 MODEL******			FIV JULY DESIGN LIMITS GEOL COMP,STRICT MATCH CALCULATED BY MAXIPLAN DILUTED 10%,95% RECVY ******F8805 MODEL******			ACTUAL DIG LIMITS GEOL COMP,STRICT MATCH CALCULATED BY PCMINE DILUTED 10%,95% RECVY ******F8805 MODEL******			BLASTHOLES ACTUAL DIG LIMITS NO DILUTION		
		Tonnes	Pb+Zn (%)	Metal (tonnes)	Tonnes	Pb+Zn (%)	Metal (tonnes)	Tonnes	Pb+Zn (%)	Metal (tonnes)	Tonnes	Pb+Zn (%)	Metal (tonnes)
3410	Waste	14,990			(1,689)			67,692			NA		
	Sulphides	156,956			173,725			170,527			NA		
	4-5%	38,336	4.14	1,587	41,124	4.15	1,707	39,773	4.16	1,655	74,276	4.56	3,387
	5-7%	98,779	5.35	5,285	97,913	5.34	5,229	99,024	5.37	5,318	308,952	6.08	18,784
	+7%	499,620	7.89	39,420	492,657	7.89	38,871	507,985	7.9	40,131	303,569	9.04	27,443
	+5%	598,399	7.47	44,705	590,570	7.47	44,099	607,009	7.49	45,448	612,521	7.55	46,227
	+4%	636,735	7.27	46,292	631,694	7.25	45,806	646,782	7.28	47,103	686,797	7.22	49,614
	all ore+waste	808,681			803,730			885,001			NA		
3390	Waste	42,389			29,042			42,952			NA		
	Sulphides	111,990			123,505			96,014			NA		
	4-5%	49,805	4.23	2,107	49,428	4.25	2,101	42,605	4.26	1,815	77,223	4.99	3,853
	5-7%	238,511	5.48	13,070	237,140	5.48	12,995	198,278	5.44	10,786	200,245	6.21	12,435
	+7%	333,251	7.77	25,894	326,867	7.77	25,398	278,566	7.77	21,645	202,520	8.54	17,295
	+5%	571,762	6.81	38,964	564,007	6.81	38,393	476,844	6.80	32,431	402,765	7.38	29,730
	+4%	621,567	6.61	41,071	613,435	6.60	40,494	519,449	6.59	34,246	479,988	7.00	33,584
	all ore+waste	775,946			765,982			658,415			NA		
3370	Waste	44,782			29,546			82,466			NA		
	Sulphides	29,366			43,538			32,938			NA		
	4-5%	50,442	4.42	2,230	51,975	4.42	2,297	53,619	4.42	2,370	42,875	4.74	2,032
	5-7%	70,788	4.94	3,497	68,685	4.96	3,407	72,324	4.92	3,558	143,172	6.13	8,776
	+7%	326,563	8.45	27,595	323,041	8.43	27,232	305,798	8.22	25,137	256,953	8.36	21,481
	+5%	397,351	7.82	31,092	391,726	7.82	30,639	378,122	7.59	28,695	400,125	7.56	30,258
	+4%	447,793	7.44	33,321	443,701	7.42	32,936	431,741	7.20	31,065	443,000	7.29	32,290
	all ore+waste	521,941			516,785			547,145			NA		
3350	Waste	11,050			12,516			11,773			NA		
	Sulphides	30,092			30,413			30,654			NA		
	4-5%	50,557	4.1	2,073	49,490	4.08	2,019	44,888	4.13	1,854	64,167	4.53	2,907
	5-7%	33,889	5.41	1,833	34,581	5.41	1,871	35,593	5.42	1,929	71,083	6.56	4,663
	+7%	177,681	7.61	13,522	179,215	7.63	13,674	181,062	7.67	13,887	102,333	8.09	8,279
	+5%	211,570	7.26	15,355	213,796	7.27	15,545	216,655	7.30	15,817	173,416	7.46	12,942
	+4%	262,127	6.65	17,428	263,286	6.67	17,564	261,543	6.76	17,670	237,583	6.67	15,849
	all ore+waste	303,269			306,215			303,970			NA		
3330 and 3410	Waste	20,078			14,335			10,865			NA		
	Sulphides	63,638			63,602			48,285			NA		
	4-5%	41,450	4.10	1,698	42,321	4.09	1,729	29,192	4.04	1,179	36,000	4.87	1,753
	5-7%	98,136	5.44	5,343	98,018	5.44	5,331	15,090	4.67	705	10,967	5.75	631
	+7%	45,949	7.53	3,461	46,966	7.56	3,550	36,178	7.68	2,778	28,606	8.56	2,449
	+5%	144,085	6.11	8,804	144,984	6.13	8,882	51,268	6.79	3,483	39,573	7.78	3,079
	+4%	185,535	5.66	10,502	187,305	5.67	10,611	80,460	5.79	4,663	75,573	6.39	4,832
	all ore+waste	269,251			265,242			139,610			NA		
Total 3410 to 3310	Waste	133,289			83,750			215,748			NA		
	Sulphides	392,042			434,783			378,418			NA		
	4-5%	230,590	4.20	9,694	234,338	4.20	9,853	210,077	4.22	8,873	294,541	4.73	13,933
	5-7%	540,103	5.37	29,029	536,337	5.38	28,833	420,309	5.30	22,296	734,419	6.17	45,290
	+7%	1,383,064	7.95	109,890	1,368,746	7.94	108,725	1,309,589	7.91	103,578	893,981	8.61	76,947
	+5%	1,923,167	7.22	138,919	1,905,083	7.22	137,558	1,729,898	7.28	125,874	1,628,400	7.51	122,236
	+4%	2,153,757	6.90	148,613	2,139,421	6.89	147,411	1,939,975	6.95	134,747	1,922,941	7.08	136,169
	all ore+waste	2,679,088			2,657,954			2,534,141			NA		

FIGURE I



Comparison of Blasthole and Block Model grade distribution for 3410 Bench of BZ phase. This distribution is similiar to that for all other benches of the BZ phase. The area under the histogram, above a cutoff, is proportional to metal content. Thus, it is clear why above a low cutoff, the model prediction of tonnage and grade is valid but at a 7% cutoff there are major differences.