Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	Rosebud Mine - Black Model Checks
AUTHOR	D. E. Cameron; C. Muerhoff; R. Clayton
DATE OF DOC(S)	1997
MULTI_DIST Y / N? Additional Dist_Nos:	N? (circled)
QUAD_NAME	Sulphur 7.5'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Hecla Mining Co.; Rosebud Mining Co., South Zone, North Zone; East Zone
COMMODITY If not obvious	gold
NOTES	correspondence; resources; assay handwritten notes 11 p

Keep docs at about 250 pages if no oversized maps attached
(for every 1 oversized page (>11x17) with text reduce
the amount of pages by ~25)

SS:	DD	3/20/08
	Initials	Date
DB:		
	Initials	Date
SCANNED:		
	Initials	Date

Revised: 1/22/08

6000592
4010

60000592

facsimile
T R A N S M I T T A L

to: C. Muerhoff

fax #:

re: Rosebud Resource Checks

date: February 6, 1997

pages: 12, including this cover sheet.

Charlie--

This fax is to confirm the steps we discussed yesterday to check the resource model:
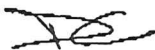
> 1) Check for unbiasedness by running a nearest-neighbor comparison using the same anisotropy as the kriged model. Tag the block with the domain label of the nearest(capped) composite, not the domain label determined by the envelopes. Compare the tons and grade of each domain by both models, and the overall tons and grade by each model.

> 2) Run the kriged model without any capping, but all other parameters the same.

Large differences in either test are not expected, but if they occur, then we will have to decide what is to be done.

As to reserve classification, I suggested reviewing the assumptions about the continuity of high-grade mineralization against the assignment of these grades to a tabular domain. If the tabular model is reasonable, then do we still feet the 40-foot and 75-foot search restriction for the highest-grade material are the best estimate, or should all material in these envelopes be estimated? If a question remains, then you could try the cross-validation technique of removing data so as to achieve a wider spacing than the restrictive search radius, or greater than 40 feet. Then, if the model is rerun without these data, and the result is not much different, the search radius can be extended.

Please advise me of progress by February 17, 1997. I would like to report that week whether we feel the 1997 model is conservative, why, by how much and/or for what reasons, and whether anything else is required. I'll check my answering machine daily should you wish to contact me prior to that.

From the desk of...

Donald E. Cameron
Chief Geologist — Operations
Hecla Mining Company
6500 Mineral Drive
Coeur d'Alene, ID 83814

208-769-0412
Fax 208-769-4122

THE ROSEBUD MINING COMPANY, LLC.
HECLA MINING COMPANY - MANAGER OF MINING

February 19, 1997

Memorandum to: Don Cameron

From: Charlie Muerhoff

RE: Progress Report: Rosebud Resource Validation

Two alternate resource calculations have been completed for the Rosebud Deposit resource: a kriged model using uncut outlier drill composites, and a nearest neighbor estimate. All results and comparisons reported herein are at a 0.14 Au oz/t cut-off grade.

- A kriged model was run without capping the high-grade composites which were cut for calculating the reported 1997 Measured and Indicated Resource. All other estimation parameters, including gold domain boundaries, remained the same as used in the current model.

  The uncapped version resulted in an overall increase in gold grade of 3% (0.014 Au oz/t) and an increase in contained gold ounces of 3% (13,617 AuOz) as compared to the reported resource. Gold ounces increased by 9,154 in the South zone and by 4,463 in the East zone. There was no change in the North zone since no drill composites were capped. The Measured and Indicated *equivalent* resource with uncapped drill composites is 984,446 tons at a grade of 0.510 Au oz/t, for 502,182 contained gold ounces.

- A nearest neighbor estimate was also completed for all three zones. This estimate was performed using the same drill composites, and their corresponding gold domain codes, as were used for estimating the current model. Domain codes were attached to the drill composites so that the results of the nearest neighbor estimate could be compared to the kriged estimate on a domain-by-domain basis. Gold domain boundaries were not used, except for the extreme outside boundary, which generally represents 0.01 Au oz/t.

  As compared to the current kriged model, the nearest neighbor estimate contains 70,146 more tons at a grade of 0.140 Au oz/t (9,854 AuOz) in the South zone, 23,170 more tons at a grade of 0.591 Au oz/t (13,699 AuOz) in the North zone, and 41,572 more tons at a grade of 0.857 Au oz/t (35,625 AuOz) in the East zone. For the entire deposit, the nearest neighbor estimate includes 134,888 more tons than the kriged model, at a grade of 0.439 Au oz/t, for additional contained gold ounces of 59,178.

  I have not yet had a chance to review the South zone nearest neighbor results on an individual domain basis, but I believe the increase in tonnage at the marginal grade (0.140 Au oz/t) can be attributed to domains 31 through 35. These domains represent the lower-most stratabound ore horizon on the hanging wall of the South Ridge Fault and have the least amount of drill data as compared to the rest of the South Zone. There are several very high-grade composites (up to 6.0 Au oz/t), in very close proximity to each other, which are surrounded vertically by lower grades. I believe the domain boundary applied to this high-grade zone was more liberal than the nearest neighbor routine; the high-grade tons were replace by tons which were estimated using the 'closer' lower grade composites.

At the other end of the spectrum, the East zone nearest neighbor estimate contains additional tonnages at a very high grade (0.857 Au oz/t). Again, I haven't had a chance to review this on a domain-by-domain basis or on section.

Right now, my gut feeling is that the nearest neighbor estimate is not indicating that overall we are being overly conservative with the kriged model (i.e., the reported Measured and Indicated Resource). There are probably local exceptions to that. I believe the differences between the kriged model and the nearest neighbor estimate can be more attributed to the disregard of domain boundaries (which in turn implies the disregard of geology). However, I am trying to keep an open mind and hopefully we will be able to come to a more substantiated conclusion once all the data has been reviewed.

Tables comparing the uncut composites versus cut composites kriged models and the kriged model versus the nearest neighbor estimate (all broken down by zone) are attached.

c: R. Clayton

Rosebud Resource
Kriged Model: Uncut Composites vs. Cut Composites
(0.14 Au oz/t cut-off)

Zone	Kriged Model w\Cut Composites (M & I Resource)			Kriged Model w\Uncut Composites			Difference (Uncut-Cut)			Percent Difference (1-Uncut/Cut)		
	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)*	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces
South	555,917	0.564	313,537	555,917	0.581	322,691	0	0.017	9,154	0%	3%	3%
North	135,845	0.405	55,057	135,845	0.405	55,057	0	0.000	0	0%	0%	0%
East	292,684	0.410	119,971	292,684	0.425	124,434	0	0.015	4,463	0%	4%	4%
Total	984,446	0.496	488,565	984,446	0.510	502,182	0	0.014	13,617	0%	3%	3%

*Uncut Au Grade - Cut Au Grade

Rosebud Resource
Measured & Indicated Kriged Resource vs. Nearest Neighbor Estimate
(0.14 Au oz/t cut-off)

Zone	Kriged Model (M & I Resource)			Nearest Neighbor Estimate			Difference (Nearest Neighbor-Kriged))			Percent Difference (1-Nearest Neighbor/Kriged)		
	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)**	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces
South	555,917	0.564	313,537	626,063	0.517	323,391	70,146	0.140	9,854	11%	-9%	3%
North	135,845	0.405	55,057	159,015	0.432	68,756	23,170	0.591	13,699	15%	6%	20%
East	292,684	0.410	119,971	334,256	0.465	155,596	41,572	0.857	35,625	12%	12%	23%
Total	984,446	0.496	488,565	1,119,334	0.489	547,743	134,888	0.439	59,178	12%	-1%	11%

**Difference Au Ounces / Difference Tonnage

Hecla
MINING COMPANY

February 28, 1997

MEMORANDUM TO: C. Muerhoff

FROM: D. Cameron

SUBJECT: Rosebud Reserve Checks

I agree with most of the conclusions in your communications of February 19 and February 28, and suggest that you address the resource classification issue mentioned in my fax dated February 6. Nevertheless, I hope you can clarify a couple of things for me.

First, was the un-capping done only on the flyers, or is it inclusive of those samples that were capped if they exceeded their domain grade range?

Second, is there any reason to assume that the discrepancies between the nearest-neighbor estimate in the North are for different reasons than those in the East zone? I agree that the spatial factors might be causing the differences in tons and grade in both zones. Alternatively, the differences might be telling us that the geologic model is less robust, more interpretive, and more biased?

The other half of this exercise pertains to reserve classification. Given your confidence in the South zone and the nearest-neighbor confirmation, are search radii appropriate within the domains? Why should there be any inferred blocks within grade domains containing data that are all, or nearly all above cutoff? Is that intuitive? Are there any statistical criteria used to assign search distances within the higher grade domains? We discussed cross-validation as a technique to check the assumptions. Let me know how you plan to address resource classification, as I think that this part of the resource estimate is also very important.

On another issue, Ann will be sending Kurt another paper I acquired from MRDI on qa/qc. I haven't heard from Kurt yet, and urge you to have him get in touch soon. It takes a couple of months to get a program in place.

c: G. Johnson

① no grades were left capped.

② Yes, there are reasons for discrepancies between the north & east zones — read the report! And, yes. The geologic model for the north & east is less robust, it is more interpretive, & it is biased — the resource model is biased to the geology — not all biases are bad! hence the increase in Inferred material

③ talk to S.R. about search radii.

THE ROSEBUD MINING COMPANY, LLC.
HECLA MINING COMPANY - MANAGER OF MINING

February 28, 1997

Memorandum to:	Don Cameron
	Ron Clayton
From:	Charlie Muerhoff *Charlie*
RE:	Rosebud Resource Validation
	Kriged Model vs. Nearest Neighbor Estimate

Introduction

A nearest neighbor estimate has been completed for the Rosebud South, North, and East zones as a check of the measured and indicated kriged domain model which was used to calculate the 1997 resource for the Rosebud Deposit. The nearest neighbor estimate was performed using the same drill composites, and their corresponding gold domain codes, as were used for estimating the kriged model. Domain codes were attached to the drill composites so that the results of the nearest neighbor estimate could be compared to the kriged estimate on a domain-by-domain basis. Gold domain boundaries were not used, except for the extreme outside boundary, which generally represents 0.01 Au oz/t. It was necessary to use this boundary so that grades were not unreasonably projected beyond *defined* (not interpreted) geologic contacts (i.e., South Ridge Fault, Bud/LBT contact, etc.).

As previously reported, the nearest neighbor estimate contains 134,888 more tons (+14%) and 59,178 more gold ounces (+12%) than the kriged model (at a 0.14 Au oz/t cut-off), but at a lower average grade of 0.489 Au oz/t as compared to an average grade of 0.496 Au oz/t for the kriged model (-1%).

Comparisons of the kriged model vs. the nearest neighbor estimate were done on a zone-by-zone basis and on a domain-by-domain basis. In addition to tabulating and comparing the data from each method, the resultant block models (plan and section) were reviewed relative to each other and relative to the geologic model.

South Zone (0.14 Au oz/t cut-off)

As compared to the South zone kriged model, the nearest neighbor estimate contains 70,146 additional tons at a gold grade of 0.140 oz/t (9,854 AuOz). This represents a 13% increase in tonnage, a 3% increase in gold ounces, and an 8% decrease in gold grade relative to the South zone kriged model.

The nearest neighbor estimate for the South zone is dominated by an increase in lower grade material (nearly 150,000 tons at 0.147 Au oz/t), which is only partly offset by a slight increase in very high-grade (4.5 oz/t +) tons. There is a consistent loss of material in the 0.25 to 1.00 Au oz/t range as compared to the kriged model. Review of plans and sections show the nearest neighbor model contains significant 'smearing' of low grades into higher grade regions defined in the kriged model; most notably, domain 12 grades extending into domain 13 areas, and domain 22 grades extending into domains 23 and 24 areas. Also, a significant portion of the nearest neighbor low-

grade material occurs within inferred areas of higher-grade material of the kriged model. This is a function of not using the domain boundaries in the nearest neighbor model.

Another observation in comparing the two models: the nearest neighbor model consistently projected grades vertically (up and down) from drill holes angled from underground, rather than projecting them up-dip or down-dip along stratigraphy. This is especially noticeable in the higher grades. Again, this is clearly a function of disregarding the geologic controls and domain boundaries when estimating with the nearest neighbor method.

North Zone (0.14 Au oz/t cut-off)

In the North zone, the nearest neighbor estimate contains an additional 23,170 tons (+17%) grading 0.591 Au oz/t for an additional 13,699 contained gold ounces (+25%) as compared to the kriged model. The average grade of the nearest neighbor model (0.432 Au oz/t) is 7% higher than the average grade of the kriged model (0.405 Au oz/t).

While nearly 50% of the tonnage increase is attributable to additional lower grade material (average 0.159 Au oz/t), the most significant difference is due to the addition of 9,390 tons grading 0.994 Au oz/t (9,330 AuOz) in domain 52 in the nearest neighbor model. While the increase tonnage in this grade range is not very significant (8%), there is a substantial increase in grade (22%) and contained gold ounces (32%). While it is clear from reviewing the sections and plans that the nearest neighbor model is ignoring the geologic and mineralogic boundaries, I am uncertain as to why the grade of this domain is so much higher in the nearest neighbor model than in the kriged model when the difference in tonnage is so low. This could be a function of the number of composites (15) allowed to estimate a block in the kriged model, as compared to the more 'localized' assigning of grades in the nearest neighbor model.

East Zone (0.14 Au oz/t cut-off)

The East zone nearest neighbor estimate contains an additional 41,572 tons (+14%) grading 0.857 Au oz/t, for an additional 35,625 gold ounces (+30%), as compared to the kriged model. The average grade of the nearest neighbor model (0.465 Au oz/t) is 14% higher than the average grade of the kriged model (0.410 Au oz/t).

In the East zone, the increase in nearest neighbor tonnages occur in the lower grade domain 62 (0.050 - 0.349 Au oz/t) and in the higher grade domain 64 (1.00 Au oz/t +), but all domains have an increase in contained gold ounces. This increase in tonnage is dominated by significantly more tons within domain 62.

The average grade of the nearest neighbor model is increased mainly due to domain 63 (0.35 - 1.00 Au oz/t), where there is a decrease of 17% in tonnage, but an increase of 11% in ounces, which results in an increase in grade of 34%. The reason for this appears to be the same as cited for the North zone, where the lower grades contained in domain 63 had much less influence in the nearest neighbor model than they had in the kriged model.

Conclusions

On a global basis, it appears the nearest neighbor estimate shows good correlation to the kriged model when comparing tonnages and ounces. However, there is a relatively poor correlation between the two models when comparing the spatial occurrences of differing grades of mineralization. This is due to the disregard of geologic and mineralogic (i.e., domain) boundaries by the nearest neighbor routine.

As for an indicator of whether or not the kriged model is conservative, I do not believe the nearest neighbor model shows that to be the case for the South and North zones, but it may point to possible upside potential within the measured and indicated portion of the East zone.

For the South and North zones kriged model, given the number of composites allowed to influence the grade of a block (15), there has undoubtedly been some smoothing of localized high grades internal to domain boundaries, but the nearest neighbor model clearly projected grades into areas not substantiated by the interpreted geologic controls (which appear to be holding up as shown by the current limited development into South zone ore). Given that the geologic controls for both of these zones are similar, I find it curious that the zone for which we have considerably more data (South) did not have an overall increase in higher grade tons in the nearest neighbor model.

Conversely, the interpreted geologic controls for East zone mineralization are much less defined than those for the South and North. Controls used to model grades in the east zone were the attitude of the South Ridge Fault and the mass of silicification and silica-replacement which occurs on the fault's footwall. Gold domains in the East zone were contoured within these observed controls, as such, the locations of boundaries were often based on grade changes (as seen in drilling), rather than on geologic contacts. While I do not believe we can automatically (or justifiably) say the East zone has been underestimated by 41,000 tons and 35,000 ounces, I think the conclusion that can be drawn from the nearest neighbor exercise is that there is the potential for the East zone to contain more tonnage at a higher average grade than indicated by the kriged model. As development proceeds into the East zone, we will have the opportunity to better understand the controls on, and distribution of, mineralization.

1997 Rosebud Resource Validation
Kriged Model vs. Nearest Neighbor Estimate
Summary by Zone

27-Feb-97

Zone	1997 Kriged Model (0.14 Au oz/t cut-off)			Nearest Neighbor Estimate (0.14 Au oz/t cut-off)			Nearest Neighbor-Kriged			(Nearest Neigbor/Kriged)-1		
	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade	Au Ounces
South	555,917	0.564	313,537	626,063	0.517	323,391	70,146	0.140	9,854	13%	-8%	3%
North	135,845	0.405	55,057	159,015	0.432	68,756	23,170	0.591	13,699	17%	7%	25%
East	292,684	0.410	119,971	334,256	0.465	155,596	41,572	0.857	35,625	14%	13%	30%
Total	984,446	0.496	488,565	1,119,334	0.489	547,743	134,888	0.439	59,178	14%	-1%	12%

1997 South Zone Resource Validation
Kriged Model vs. Nearest Neighbor Estimate
Summary by Gold Domain

Au Domain	Au Grade Range (oz/t)	1997 South Zone Kriged Model (0.14 Au oz/t cut-off)			1997 South Zone Nearest Neighbor (0.14 Au oz/t cut-off)			Nearest Neighbor-Kriged			(Nearest Neigbor/Kriged)-1		
		Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade	Au Ounces
11	0.010 - 0.049	0		0	6,859	0.166	1,139	6,859	0.166	1,139			
12	0.050 - 0.249	21,724	0.157	3,416	97,669	0.146	14,213	75,945	0.142	10,797	350%	-7%	316%
13	0.250 - 0.999	251,591	0.319	80,367	194,346	0.366	71,207	-57,245	0.160	-9,160	-23%	15%	-11%
14	1.000 - 4.499	74,227	1.244	92,334	73,502	1.210	88,942	-725	4.679	-3,392	-1%	-3%	-4%
15	4.500 +	5,495	6.293	34,580	5,794	6.428	37,242	299	8.912	2,662	5%	2%	8%
21	0.010 - 0.049	0		0	1,491	0.138	206	1,491	0.138	206			
22	0.050 - 0.249	3,282	0.147	482	49,996	0.151	7,525	46,714	0.151	7,043	1423%	2%	1461%
23	0.250 - 0.999	114,213	0.323	36,870	86,617	0.333	28,853	-27,597	0.291	-8,017	-24%	3%	-22%
24	1.000 - 4.499	31,357	1.215	38,086	21,332	1.243	26,511	-10,025	1.155	-11,575	-32%	2%	-30%
25	4.500 +	523	7.933	4,151	1,370	7.461	10,222	847	7.170	6,071	162%	-6%	146%
31	0.010 - 0.049	0		0	0		0	0		0			
32	0.050 - 0.249	5,660	0.160	907	22,920	0.156	3,577	17,260	0.155	2,670	305%	-3%	294%
33	0.250 - 0.999	19,450	0.288	5,606	16,829	0.452	7,610	-2,621	-0.765	2,005	-13%	57%	36%
34	1.000 - 4.499	9,901	0.986	9,767	13,656	1.289	17,606	3,755	2.088	7,839	38%	31%	80%
35	4.500 +	398	5.902	2,349	0		0	-398	5.902	-2,349	-100%	-100%	-100%
41	0.010 - 0.049	0		0	0		0	0		0			
42	0.050 - 0.249	6,394	0.168	1,072	15,689	0.156	2,443	9,295	0.148	1,371	145%	-7%	128%
43	0.250 - 0.999	11,702	0.303	3,550	17,993	0.339	6,096	6,290	0.405	2,545	54%	12%	72%
Total	>= 0.140	555,917	0.564	313,537	626,063	0.517	323,391	70,146	0.140	9,854	13%	-8%	3%

1997 South Zone Resource Validation
Kriged Model vs. Nearest Neighbor Estimate
Summary by Gold Grade Range

Au Domain	Au Grade Range (oz/t)	1997 South Zone Kriged Model (0.14 Au oz/t cut-off)			1997 South Zone Nearest Neighbor (0.14 Au oz/t cut-off)			Nearest Neighbor-Kriged			(Nearest Neigbor/Kriged)-1		
		Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade	Au Ounces
11,21,31,41	0.010 - 0.049	0		0	8,350	0.161	1,345	8,350	0.161	1,345	-----	-----	-----
12,22,32,42	0.050 - 0.249	37,060	0.159	5,877	186,274	0.149	27,758	149,214	0.147	21,881	403%	-6%	372%
13,23,33,43	0.250 - 0.999	396,956	0.318	126,393	315,784	0.360	113,766	-81,172	0.156	-12,628	-20%	13%	-10%
14,24,34	1.000 - 4.499	115,485	1.214	140,187	108,490	1.226	133,059	-6,994	1.019	-7,128	-6%	1%	-5%
15,25,35	4.500 +	6,416	6.402	41,080	7,164	6.625	47,463	747	8.541	6,384	12%	3%	16%
Total	>= 0.140	555,917	0.564	313,537	626,063	0.517	323,391	70,146	0.140	9,854	13%	-8%	3%

1997 North Zone Resource Validation
Kriged Model vs. Nearest Neighbor Estimate
Summary by Gold Domain

Au Domain	Au Grade Range (oz/t)	1997 North Zone Kriged Model (0.14 Au oz/t cut-off)			1997 North Zone Nearest Neighbor (0.14 Au oz/t cut-off)			Nearest Neighbor-Kriged			(Nearest Neigbor/Kriged)-1		
		Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade	Au Ounces
51	0.010 - 0.139	0		0	11,560	0.159	1,843	11,560	0.159	1,843	-----	-----	-----
52	0.140 - 0.999	115,947	0.253	29,309	125,337	0.308	38,639	9,390	0.994	9,330	8%	22%	32%
53	1.000 +	19,897	1.294	25,748	22,118	1.278	28,274	2,221	1.137	2,526	11%	-1%	10%
Total	>= 0.140	135,845	0.405	55,057	159,015	0.432	68,756	23,170	0.591	13,699	17%	7%	25%

1997 East Zone Resource Validation
Kriged Model vs. Nearest Neighbor Estimate
Summary by Gold Domain

Au Domain	Au Grade Range (oz/t)	1997 East Zone Kriged Model (0.14 Au oz/t cut-off)			1997 East Zone Nearest Neighbor (0.14 Au oz/t cut-off)			Nearest Neighbor-Kriged			(Nearest Neigbor/Kriged)-1		
		Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade (oz/t)	Au Ounces	Tonnage	Au Grade	Au Ounces
61	0.010 - 0.049	0		0	660	0.149	98	660	0.148	98	-----	-----	-----
62	0.050 - 0.349	101,997	0.169	17,263	162,354	0.222	35,974	60,357	0.310	18,711	59%	31%	108%
63	0.350 - 0.999	158,942	0.368	58,532	131,961	0.494	65,159	-26,981	-0.246	6,627	-17%	34%	11%
64	1.000 +	31,745	1.392	44,176	39,281	1.384	54,365	7,536	1.352	10,189	24%	-1%	23%
Total	>= 0.140	292,684	0.410	119,971	334,256	0.465	155,596	41,572	0.857	35,625	14%	14%	30%