1.0 INTRODUCTION

Geostat Services (GS) was commissioned by Harmony Gold Operations Ltd (Harmony) to undertake a geostatistical resource estimate of the Princess Louise deposit in December 2002 - January 2003. This deposit comprises part of the Burnside Project area, located approximately 180km south of Darwin in the Northern Territory, Australia. The aim of this work was to provide a geostatistical gold resource of the Princess Louise orebody, using the latest available drilling assays and the greater understanding of the deposit geology.

2.0 DATA

A total of 159 exploration drillholes were used for the resource estimate, representing 6,147.3m. Validation of the drillhole database was not performed, as this was considered to be completed by Harmony prior to receiving the data. Drillhole data spacing is variable, with an average spacing of 10m along-strike and 8m across-strike. Larger drillhole spacings along-strike up to 60m are located on the margins of the deposit, with across-strike spacings up to 25m. All holes defining the Princess Louise resource are oriented grid east, with holes dipping at an average of -60°.

A topography surface constructed from drillhole collars, and two surfaces representing the base of weathering, and top of fresh material were supplied by Harmony. Densities applied were 2.4 t/m^3 from the topography surface to the base of weathering, then 2.5 t/m^3 to the transitional zone between the base of weathering and top of fresh material, and 2.6 t/m^3 to blocks within fresh material below this transitional zone.

3.0 WIREFRAMING

Three grade envelopes were delineated for the Princess Louise deposit by Harmony, corresponding to an approximate 0.7g/t Au cutoff. The main lode (PL001) comprises a steeply dipping, continuous zone of mineralisation with an average downhole thickness of 3.5m. The second lode, PL002 has a similar geometry to that of PL001, with most of the 4m thick lode located in the northern half of the deposit. PL003 comprises a series of small, thin discontinuous solids based on singular sections only and lacking in strike continuity, averaging 3.6m in total downhole thickness. Sectional interpretations were made using vertical east-west sections, linked to form solids and validated by Harmony.

4.0 STATISTICS

4.1 Descriptive Statistics – Exploration and Grade Control Data

Sample intervals within the exploration database were examined to determine the dominant sample length. Nearly all sample intervals were 1m in length, and compositing was performed on the dataset to 1m to ensure all composites within solids were of equal length. Statistics were run within the exploration drillhole database for all constrained composite data by lode, and are presented in Table 4.1, for both cut and uncut data. No other mineralisation indicators were used, as data was extracted from within wireframes.

Parameter	PL001		PL002		PL003	
	Cut (10g/t)	Uncut	Cut (10g/t)	Uncut	Cut (10g/t)	Uncut
No composites	269	269	244	244	88	88
Minimum	0.05	0.05	0.05	0.05	0.03	0.03
Maximum	10	28.2	10	38.7	10	17.5
Mean	2.23	2.47	2.39	2.73	2.15	2.24
Median	1.29	1.29	1.49	1.49	1.44	1.44
Standard deviation	2.56	3.53	2.56	4.14	2.16	2.58
Variance	6.55	12.44	6.55	17.17	4.67	6.66
Coefficient Variation	1.15	1.43	1.07	1.52	1.00	1.15

Table 4.1 Exploration composite statistics within solids (g/t Au)

The coefficient of variation (CV) describes the variability of data relative to the raw average grade, and in general, values above 1.0 will indicate that problems may be caused by extreme values. CV values also provide an indication of the need for top-cutting prior to interpolation. However, the coefficient of variation assumes an underlying normal distribution, thus its application is limited. All lodes at Princess Louise show high coefficient of variation values within the uncut dataset, indicating that extreme values are likely to be problematic during interpolation of gold grades.

Exploration composites for all lodes suggest a lognormal distribution, as shown by statistical plots in Figures 4.1 to 4.3. Mixed mineralisation populations are evident for all lodes, with multiple peaks present on the lognormal histograms. A prominent inflexion is present on the lognormal probability plots at around 10-12g/t Au, which indicates the presence of a separate small high-grade population distinct from the mainstream population.

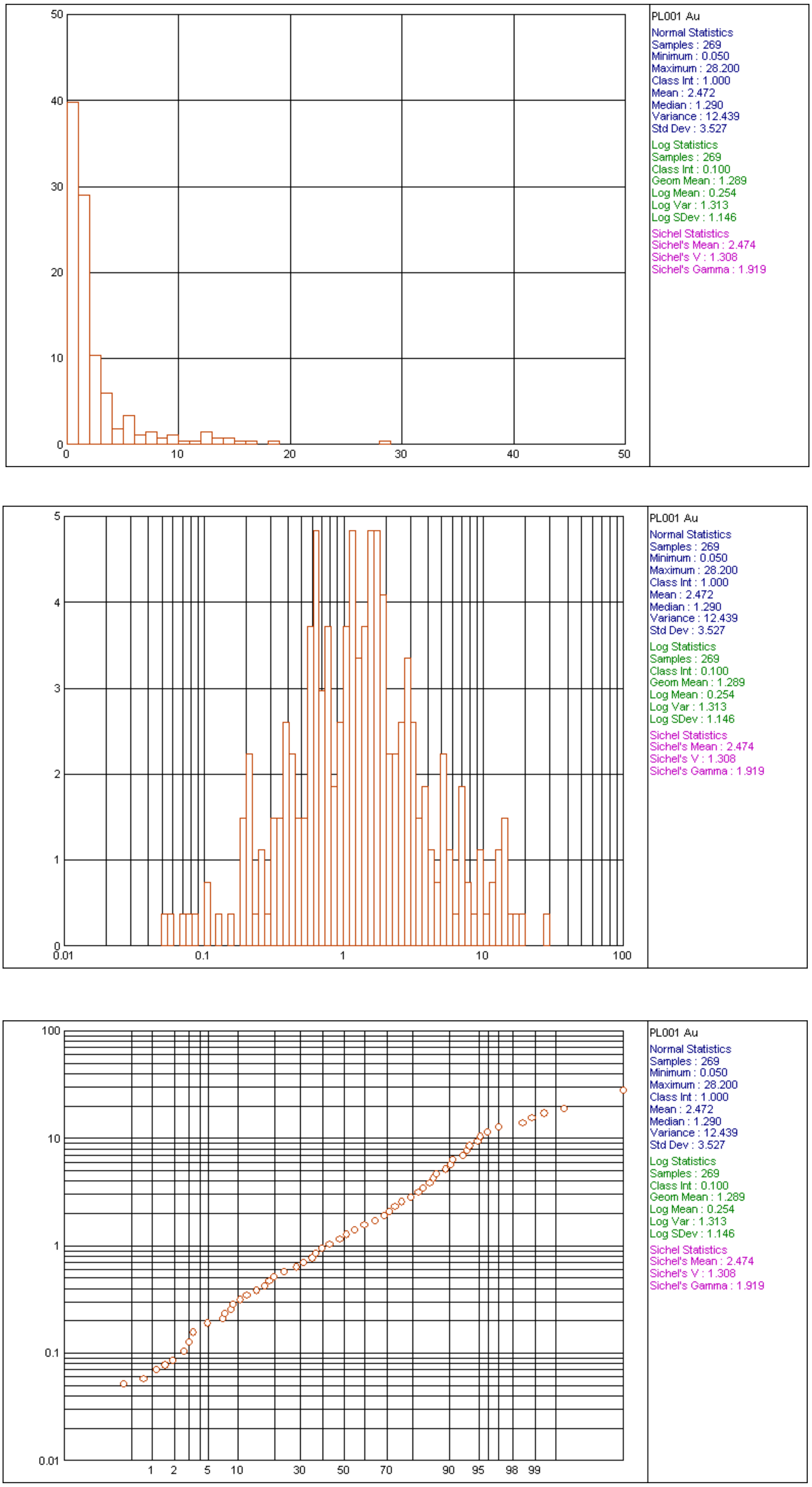
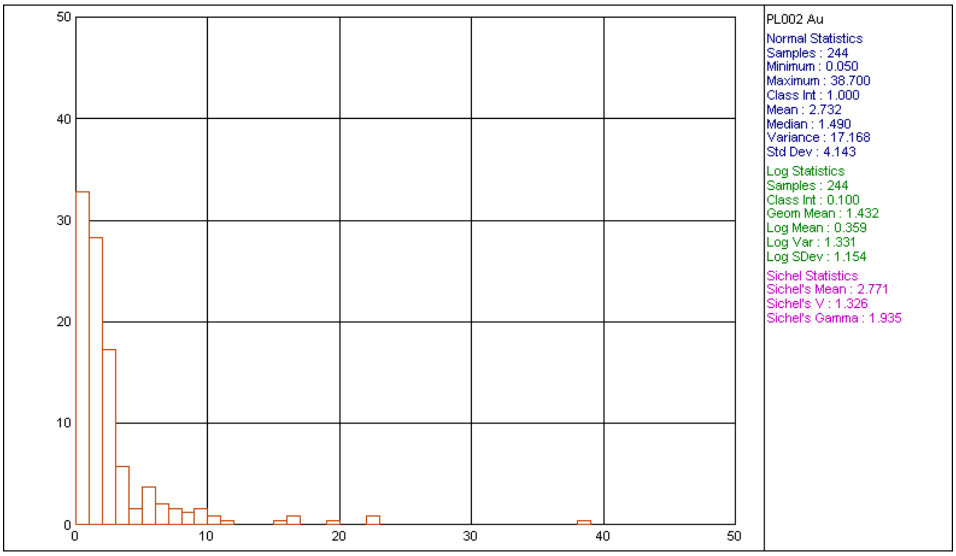
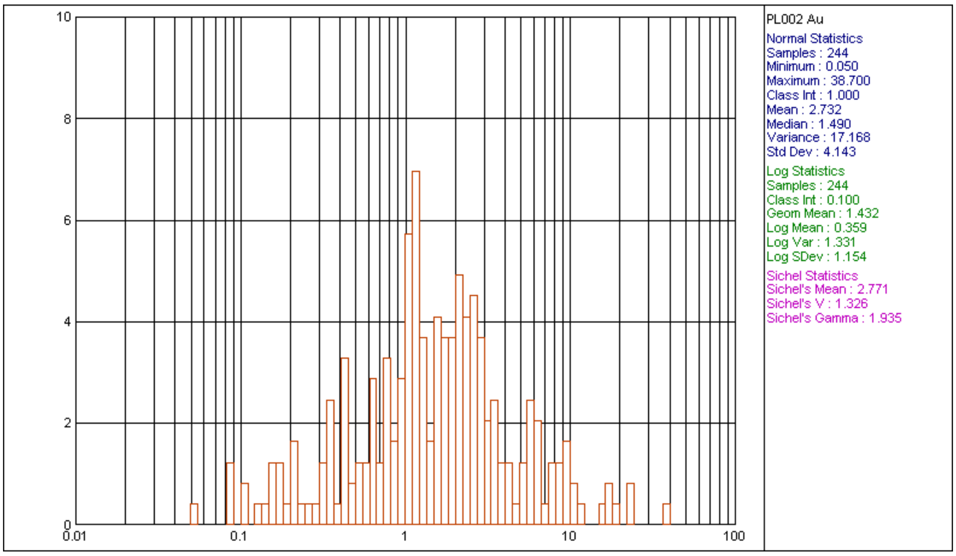


Figure 4.1 Normal and log histograms, and lognormal probability plots – PL001 Lode





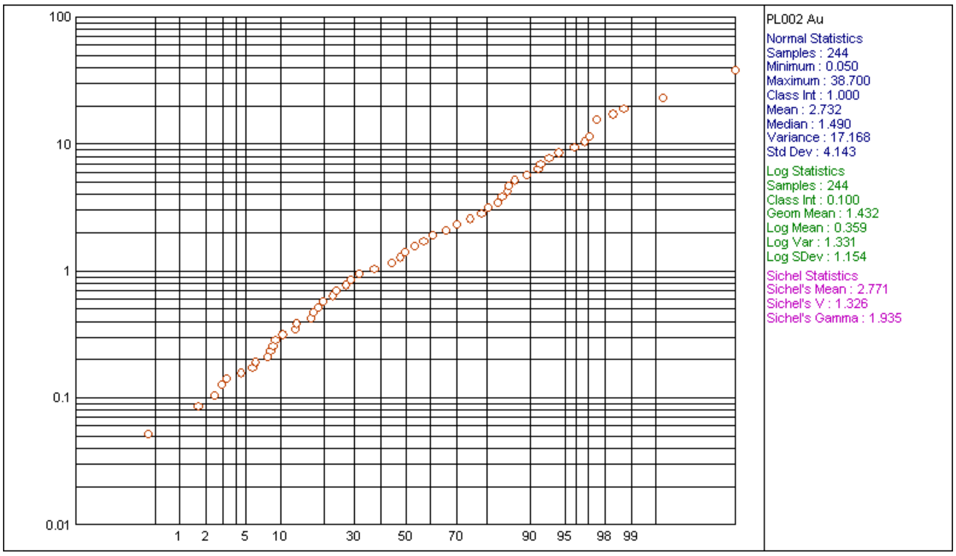
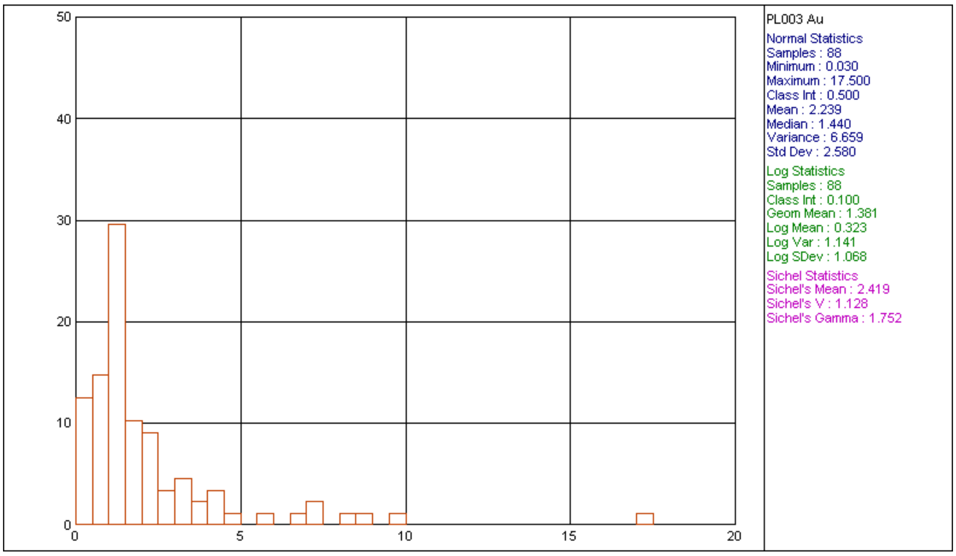
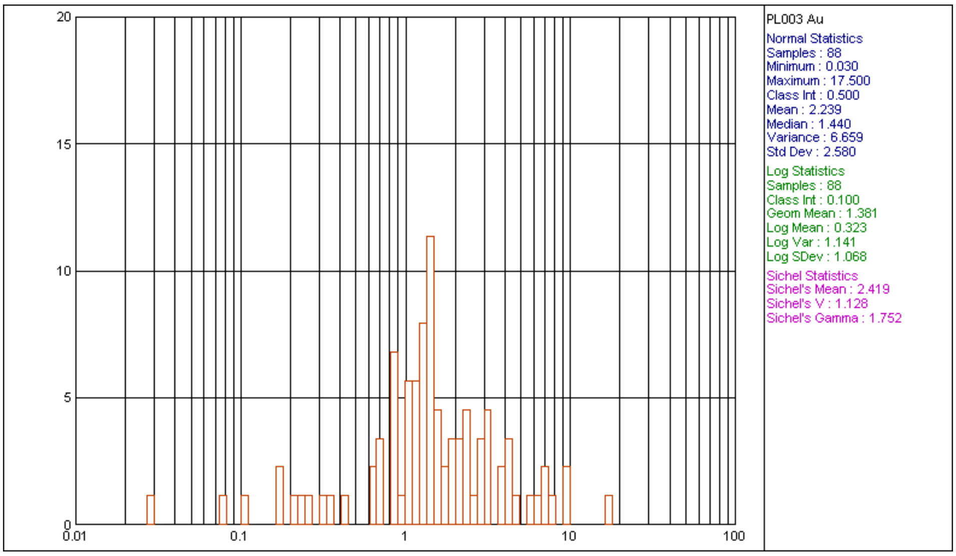


Figure 4.2 Normal and log histograms, and lognormal probability plots – PL002 Lode





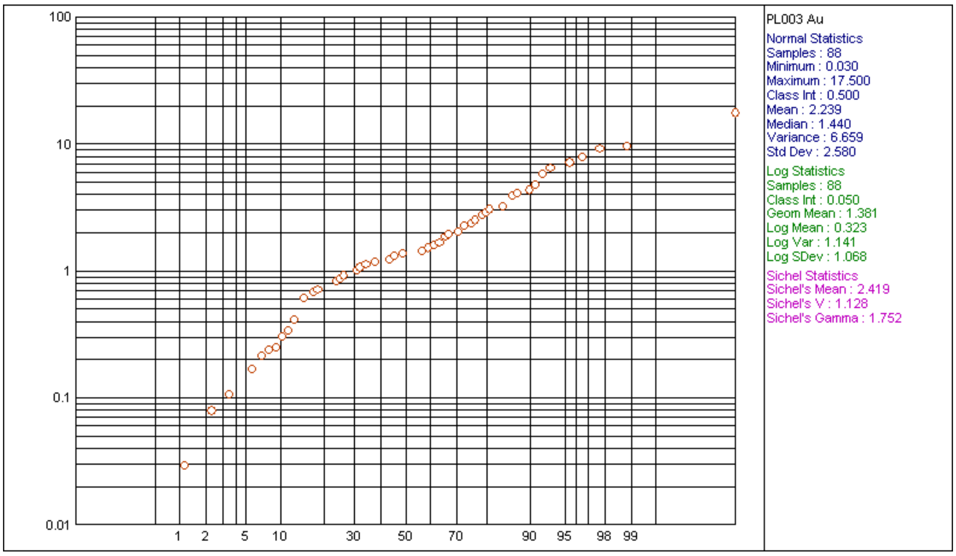


Figure 4.3 Normal and log histograms, and lognormal probability plots – PL003 Lode

4.2 Top-cutting of exploration composite data

Composite data within the exploration database was assessed for the need of a top-cut to be applied to data prior to grade estimation. The determination of a high-grade cut is made on the basis of probability plots, with the general criteria for the top-cuts being a marked change, a kink, or pronounced disintegration at the higher end of the probability distribution.

Since Au composites exhibit several high-grade extreme values, with the mean grade low relative to the spread of data, and are characterised by very high coefficients of variation, top-cutting of Au data is necessary to reduce the impact of extreme values on estimation of Au grades. It is recommended that a top-cut of 10g/t Au is used for all lodes at Princess Louise. This top cut value coincides with the inflexion present on the probability plots in Figures 4.1 to 4.3, and also represents the start of the curve disintegration at the higher end of the probability distribution. A top-cut of 10g/t Au lowers the CV for all lodes close to 1.0, thus providing a more representative dataset for accurate interpolation of grades.

5.0 VARIOGRAPHY

Variography analysis using traditional variograms was performed on composite data for the resource model. Exploration composites within all lodes were combined together in order to provide sufficient data for reliable variography analysis. Fan interpretation of variograms in the horizontal plane show a 010° strike, with across-strike plane interpretations showing a dip of -60° towards 270°.

Variograms with two spherical structures were modelled, with results in Table 5.1. The quality of variograms was poor, particularly for the down-dip and downhole directions, due to the low data levels, thin lode nature and lack of data continuity. Lode solids are relatively uninformed at depth, with most composite data located in the first 20m below the surface, thus contributing to the lack of spatial continuity down-dip. The narrow lode width of the Princess Louise lodes have also resulted in poor downhole variography, with a flat linear structure close to the sill and the lack of a definitive nugget effect.

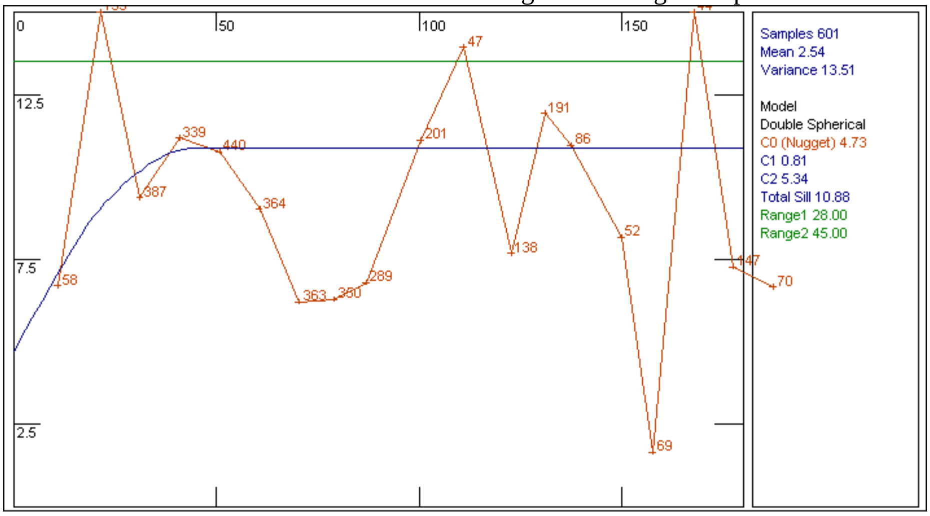
Lode	Nugget Effect	Sill 1	Range 1*	Sill 2	Range 2*
PL001, 002, 003	0.39	0.29	28 x 3 x 2.5	0.32	45 x 20 x 5

*Note: Ranges are expressed in metres as strike x down-dip x downhole

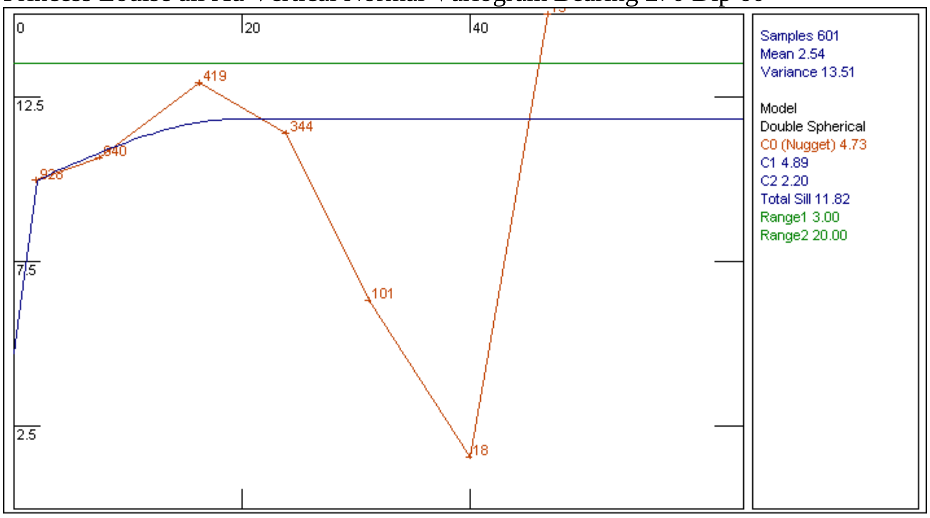
Table 5.1 Model variogram parameters for Princess Louise deposit

Maximum continuity ranges indicate that grade continuity along strike (45m) is more than twice that in the down-dip direction (20m). More drillhole data is needed to increase confidence in the variograms obtained, particularly infill drilling in the down-dip and across-lode directions. Variogram model plots are included as Figure 5.1.

Princess Louise all Au Horizontal Normal Variogram Bearing 10 Dip 0



Princess Louise all Au Vertical Normal Variogram Bearing 270 Dip 60



Princess Louise all Au Downhole Normal Variogram Downhole

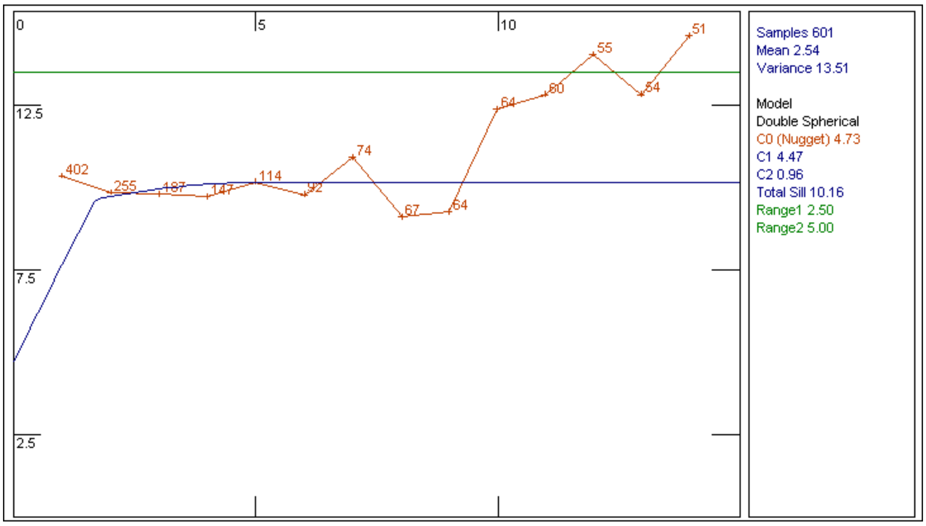


Figure 5.1 Variogram models for all lodes – Princess Louise deposit

6.0 BLOCK MODELLING AND GRADE INTERPOLATION

6.1 Block sizes and modelling parameters

Block size dimensions were considered for the Princess Louise deposit, taking into account drilling density and distribution of assay data within wireframes. A block size of 5m x 2m x 2.5m (along-strike x across-strike x RL) is recommended as being the optimum overall block size for all lodes, given the average drill spacing of 10m x 8m.

Block model origin and extents are defined below in Table 6.1.

Model Limits	Extent of Model	No of Blocks	Block Size
6860-7080N	220m	44	5m
9660-9780E	120m	60	2m
1152.5-1032.5mRL	120m	48	2.5m

Table 6.1 Princess Louise Resource Model Extents

A standard block model method was used, which considers a whole block to be ore if a minimum of 50% of the block is interpreted as ore. The solid wireframes were used to constrain the blocks available for grade interpolation. Wireframe volumes were compared to block model volumes to validate the standard block model methodology, with results in Table 6.2. The PL003 lode reports a lower filling of the wireframe by the rock model, which is attributed to its awkward geometry and discontinuous nature along strike. The difference between the two volumes is within adequate margins for JORC classification of the resource model.

Lode	Wireframe Volume	No of Model Blocks	Model Volume	% difference
PL001	26,984	1,105	27,625	2.4%
PL002	29,199	1,191	29,775	2.0%
PL003	11,158	427	10,675	-4.3%
TOTAL	**67,341**	**2,723**	**68,075**	**-1.1%**

Table 6.2 Validation of block model volumes against wireframe volumes

Ordinary kriging, using parameters derived from the traditional variograms was chosen to interpolate grades into blocks for all lodes. The skewed nature of the data distribution makes this technique ideal, whereas other techniques such as inverse distance interpolation assume a normal distribution, which can lead to errors if the data is not cut appropriately. Inverse distance techniques also do not utilise the information obtained from the variogram in interpolation of blocks, and thus the spatial correlation between composites is not taken into account.

Inverse distance interpolation using a power weighting of 2 was also used to interpolate grades into blocks as a validation of the kriged model, and for comparison of final model grades. An octant search was utilised for inverse distance interpolation, with a maximum of three composites per octant. All other inverse distance model parameters are identical to those used for ordinary kriging.

Each lode was treated as a separate hard boundary, restricting the Au grade interpolation to drillhole data located within each solid. A minimum of 2 composites and a maximum of 20 composites were used to interpolate each block grade for all lodes, apart from PL001, which utilised a maximum of 25 composites to interpolate block grades. A discretisation array of 5 (north) by 2 (east) by 2 (RL) was used to refine the kriging weights for each model block.

A search ellipse was used to select the composites to estimate a particular block. Generally, this is less than or equal to the maximum range parameters for the three principal directions modelled in the variography. Search ellipses for PL001 and PL002 lodes are identical to variography maximum ranges, with PL003 slightly expanded to account for its unique geometry and lode nature. Table 6.3 lists the search ellipses employed for each lode.

Orientation	PL001	PL002	PL003
Along-strike search ellipse	45m	45m	50m
Down-dip search ellipse	20m	20m	35m
Across-lode search ellipse	5m	5m	5m

Table 6.3 Search ellipses for interpolation of Au grades – Princess Louise deposit

The search ellipse orientations are usually based on strike and dip directions determined from fan contours and variograms during variography analysis of the dataset. However, since the variography is based on combined lode datasets, set directional increments and low data levels, with the resulting interpretations not always reflecting local variations in geometry, some fine-tuning of the search ellipse orientations is often required to best fit the actual geometry of the individual lodes. The lodes were subdivided into three interpolation domains by northing to reflect the changing geometry of the lodes with respect to strike and dip. Table 6.4 below lists the strike and dip orientations employed for each lode and interpolation domain.

Domain	PL001		PL002		PL003	
	Strike	Dip	Strike	Dip	Strike	Dip
6870N - 6950N	010	-75/280	010	-75/280	000	-70/270
6950N - 6980N	015	-65/285	010	-75/280	000	-70/270
6980N - 7080N	025	-50/295	030	-65/300	000	-70/270

Table 6.4 Strike and dip orientations for all lodes – Princess Louise deposit

For the PL001 lode, a rotation in strike is evident from 010° to 025° with increasing northing, coinciding with a shallowing in dip from -75° to -50°. A similar scenario is present for the PL002 lode, with the lode strike orientation rotating from 010° to 030°, and a steep dip of -75° moderating to -65°

towards the north. The PL003 lode has a consistent strike and dip throughout the deposit, although this is partly a function of its discontinuous nature and patchy distribution.

A high-grade search ellipse was also used for the PL001 lode, for the domain represented by 6950N to 6980N to control smearing of high grades into adjacent areas. The cut-off grade for application of this high-grade search ellipse was established at 4 g/t Au, with ellipse dimensions of 25m x 15m x 4m (N x E x RL).

A total of 7 blocks were left unfilled after interpolation of grades, and were filled manually using model grades from adjacent blocks.

6.2 Block model validation

The Princess Louise block model was validated by several methods, including visual validations on-screen, global statistical comparisons of input and block grades, and local grade/depth and grade/northing relationships. The model was validated visually by viewing vertical sections and plans of the block model, with spatial comparison of kriged block grades against input composite grades to ensure grade trends were represented correctly.

Input average composite grades were also statistically compared with mean block grades by lode, with results tabulated in Table 6.5 below. Ordinary kriging interpolation clearly gives a closer reconciliation with sample input grades for the PL001 and PL002 lodes. For the PL003 lode, inverse distance interpolation gives a closer global mean grade to the average composite grade compared with that for the ordinary kriged model. This is a function of the small, discontinuous nature of the lode, and low data levels on singular sections, where inverse distance interpolation extrapolates higher composite grades as opposed to the smoothing effect of ordinary kriging, giving lower grades.

Lode	Number of Composites	Number of Blocks	Method	Block mean grade	Composite mean grade	% difference
PL001	269	1105	OK	2.141	2.226	-3.8%
			ID	2.123	2.226	-4.6%
PL002	244	1191	OK	2.406	2.388	0.8%
			ID	2.436	2.388	2.0%
PL003	88	427	OK	2.077	2.153	-3.5%
			ID	2.126	2.153	-1.3%

Table 6.5 Statistical validation of Au interpolated grades – Princess Louise deposit

Figures 6.1 to 6.3 illustrate the grade/depth relationship averaged within 5m RL increments for both input data and model grade data, together with the number of composites for all lodes within the Princess Louise deposit. Figures 6.4 to 6.6 illustrate the grade/northing relationship averaged within

10m northing increments for input composite data and 5m northing increments for model grade data, together with the number of composites for the PL001, PL002 and PL003 lodes respectively.

A smoothing of grades for the PL001 lode with respect to depth is present, with model grades averaging out the high variability of sample input grades (Figure 6.1). The slight underestimation of composite grades by the block model from 1120mRL to 1110mRL is coincident with very low numbers of composites over this interval, and a large variability in the few composite grades present, including one high grade cut to 10g/t Au. Below 1105mRL, very few composites are present, thus comparisons of model grades with input composite grades should take this into consideration and be treated with caution. Comparison of model grades with composite grades with respect to northing reveals a very close reconciliation, with model grades reproducing the fluctuations in composite grades (Figure 6.4). The closer global comparison of ordinary kriging mean block grades with the average composite grade than that of inverse distance interpolated grades for PL001 (Table 6.4) is reinforced in the grade/northing relationship plot, with the ordinary kriged model trend following that of the composite grades more closely on a bench by bench basis than the trend given by inverse distance interpolated grades.

The grade/depth relationship for PL002 shows a very similar trend to that for PL001, with model grades showing a slight smoothing of composite grades (Figure 6.2). The southern solid of PL002 (6920N to 6950N) is represented by very few numbers of composites, thus making reproduction of composite grade trends very difficult by the resource model, as evident in the grade/northing relationship plot (Figure 6.5). North of 6970N, PL002 is represented by a very close reproduction of composite grades by block grades, with the only deviation occurring from 7040N to 7060N. This deviation is a function of two separate solids over this interval, one with a single section comprising high-grade composites, and the other solid comprising low-grade composites over regular sections within this area. The high-grade composites, with no adjacent sectional composites to control interpolation of grades, have caused smearing of high block grades into adjacent areas and thus elevated average block model grades through this area.

The PL003 lode shows a reasonable reconciliation of model grades with composite grades with respect to depth (Figure 6.3), with the only deviation occurring around 1130mRL. Only two composites occur at this depth, thus providing insufficient data for reliable comparison of block grades with composite grades. The grade/northing relationship plot reveals a close reconciliation of model grades with composite grades, with local composite grade fluctuations reproduced by those of the resource model (Figure 6.6). The single solid to the south (6920N) is based on a singular sectional drill intercept, with a limited number of model blocks within this solid, thus the average model grade is biased by the few interpolated model grades present.

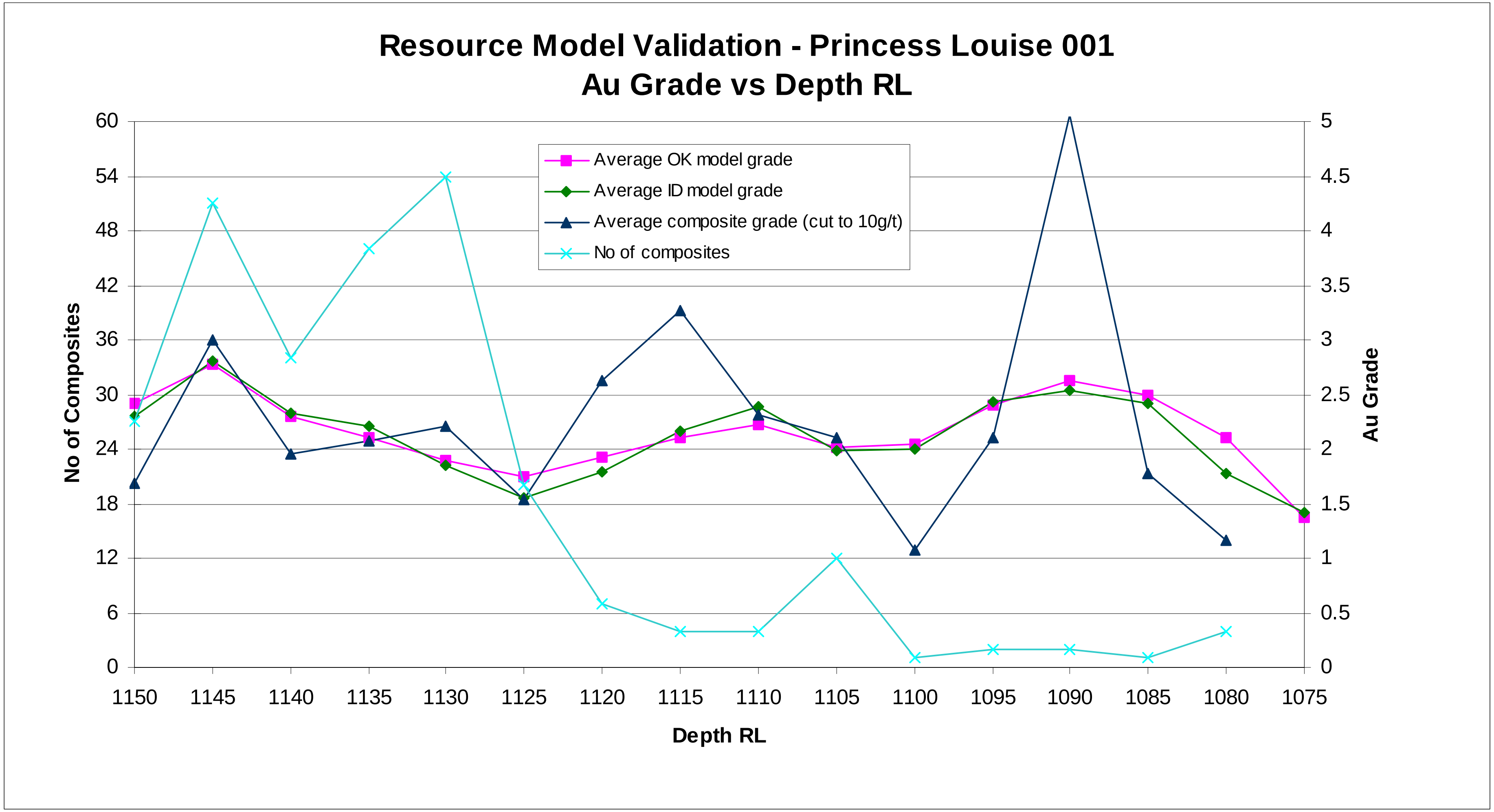


Figure 6.1 Au Grade vs Depth validation plot – PL001 lode, Princess Louise deposit

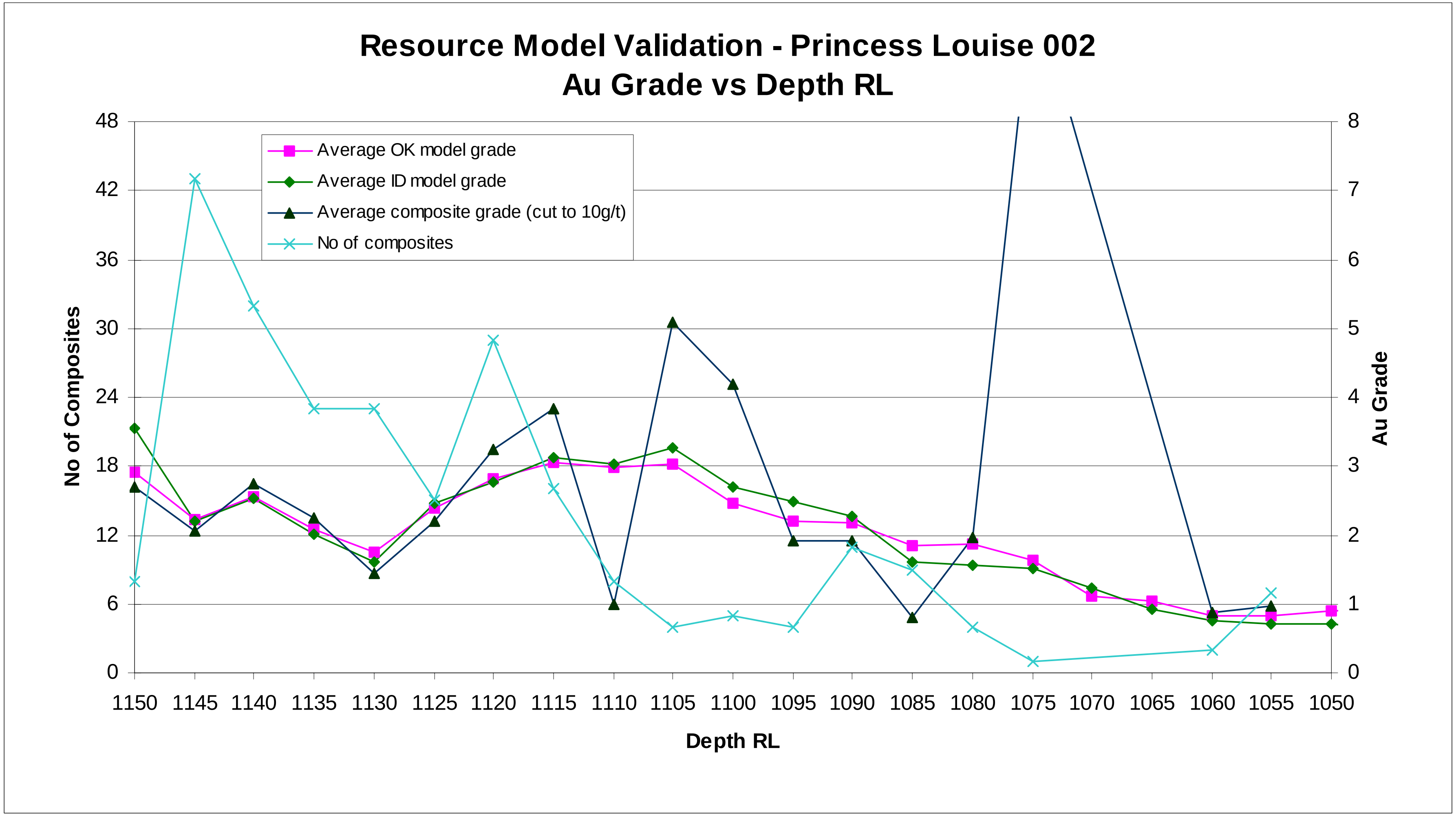


Figure 6.2 Au Grade vs Depth validation plot – PL002 lode, Princess Louise deposit

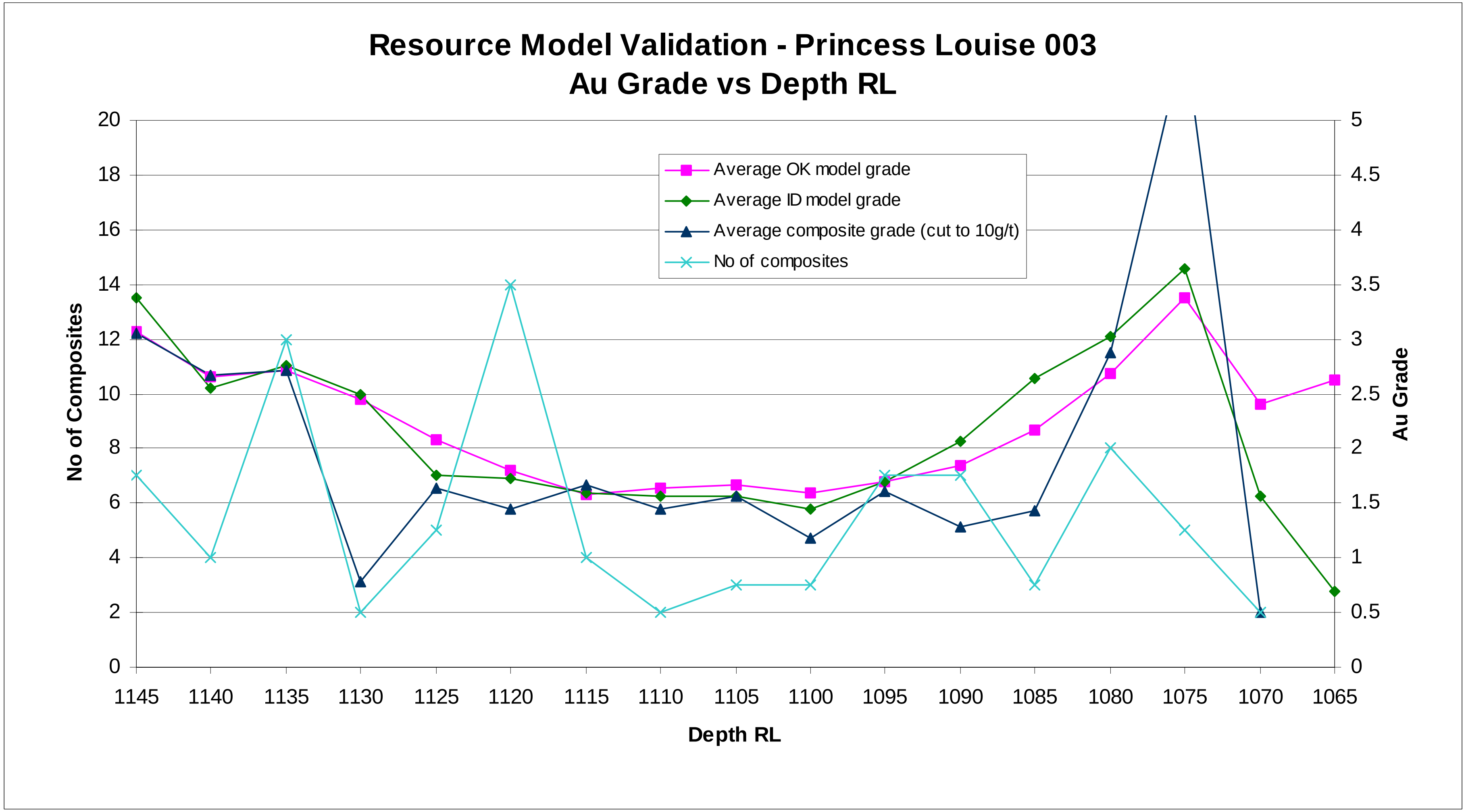


Figure 6.3 Au Grade vs Depth validation plot – PL003 lode, Princess Louise deposit

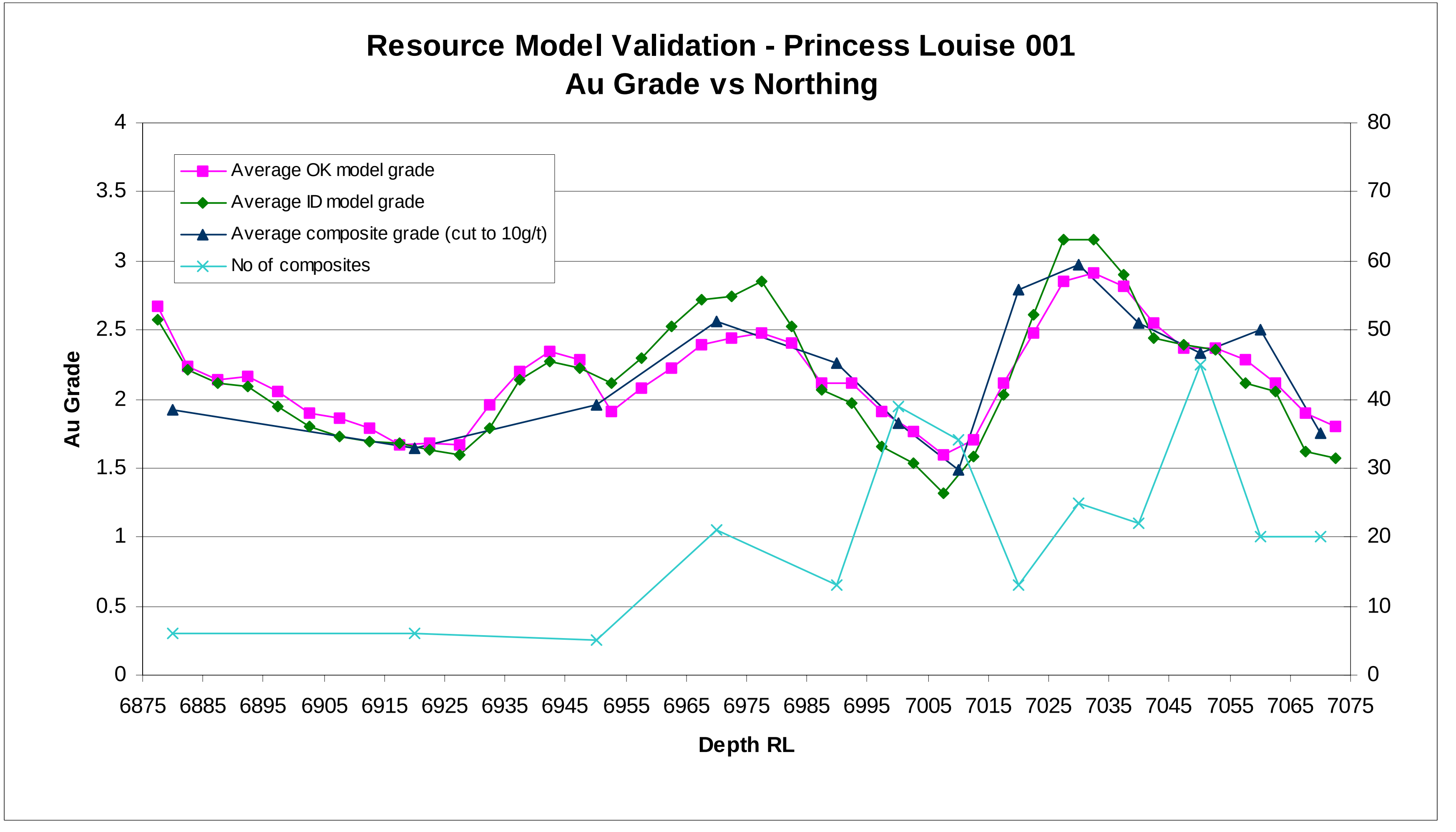


Figure 6.4 Au Grade vs Northing validation plot – PL001 lode, Princess Louise deposit

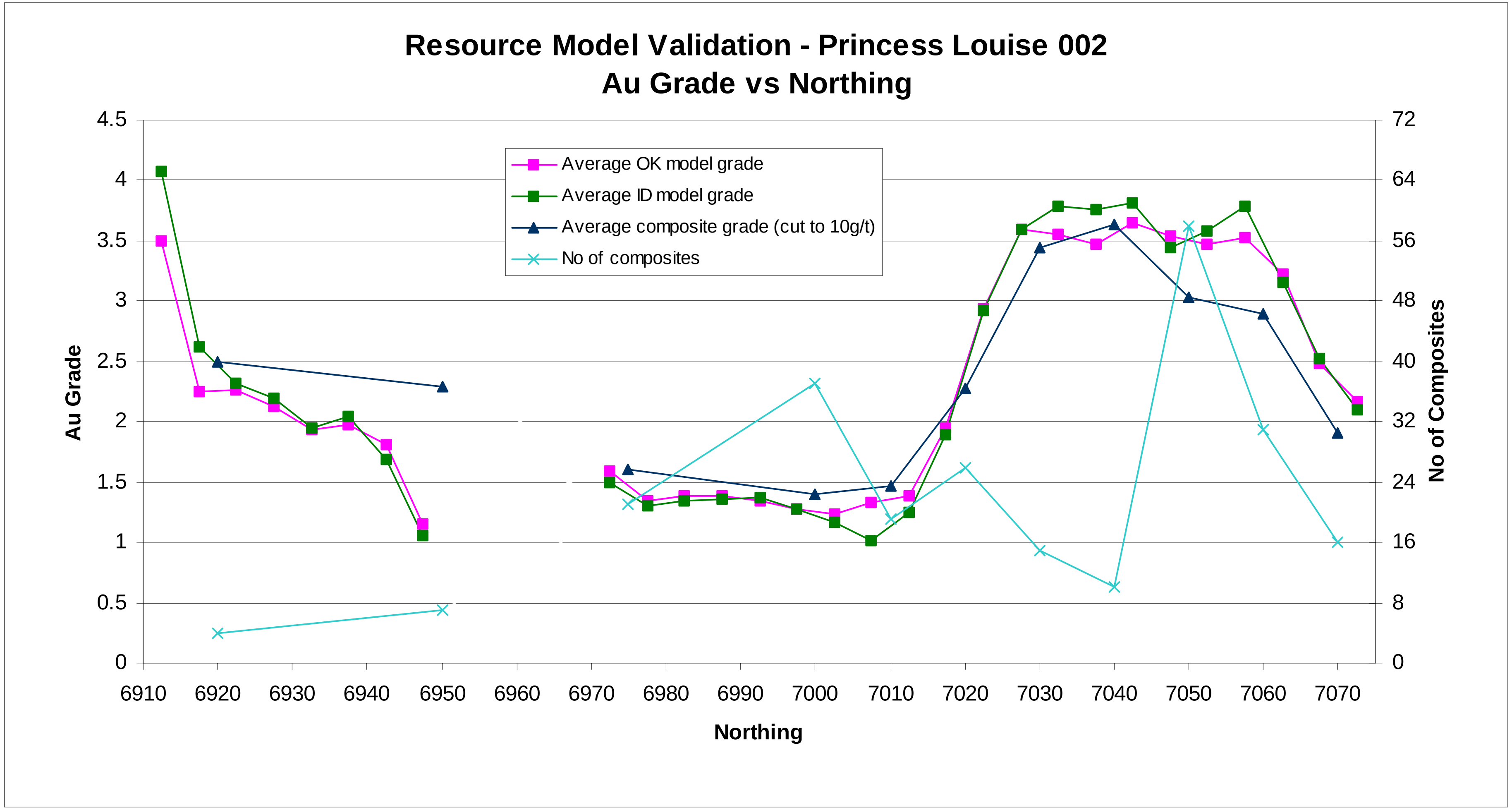


Figure 6.5 Au Grade vs Northing validation plot – PL002 lode, Princess Louise deposit

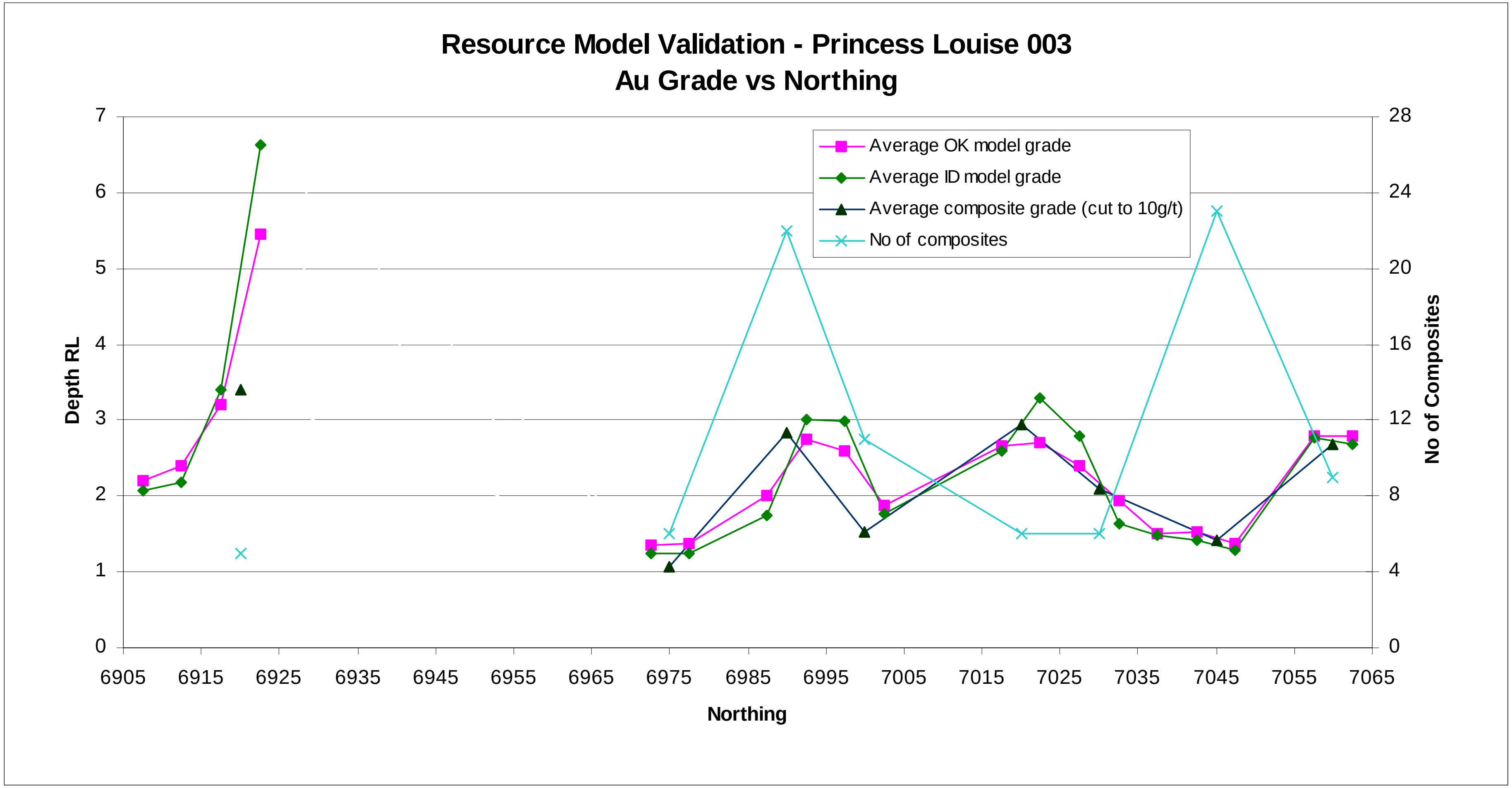


Figure 6.6 Au Grade vs Northing validation plot – PL003 lode, Princess Louise deposit

7 RESOURCE CLASSIFICATION AND REPORTING

The Princess Louise model resource has been classified into Indicated and Inferred categories according to the JORC code, using a combination of kriging variance, drilling density and confidence in grade continuity between drill sections. An Inferred category was applied to all blocks within the PL003 lode, as few drillhole intercepts are located within this lode, and there is uncertainty in lode continuity with poor definition by drilling. Blocks within these wireframes were interpolated by sparse drillhole data without supporting composite data along strike, and given the small, discontinuous nature of these lodes, an Inferred category was considered appropriate for these blocks. The PL001 and PL002 lodes were classified on the basis of kriging variance.

The kriging variance is used as an objective measure of the geostatistical confidence in a given block, and represents the value of the squared error between the actual grade and the estimated grade generated by the kriging process. It is dependent on a number of criteria, including block size, internal block discretisation, sample numbers and the variogram parameters but is independent of the actual grade. Thus, using the Princess Louise variography as a guide, blocks for the Princess Louise deposit were suitable to be classified as Indicated if they were spaced approximately within 12m along-strike from drillholes, and 5m down-dip between drillholes. An Inferred classification is appropriate for those blocks located more than 12m along-strike from drillholes, and greater than 5m down-dip between drillholes. The ranges above represent a guideline only for the classifications, and actual ranges used to determine the threshold between Indicated and Inferred blocks were applied to modified distances from those above, using the spatial distribution of composite data as an additional guideline.

The classified Mineral Resource is reported in Table 7.1 above a 0.7g/t Au cutoff as at 22nd January 2003. The topography and weathering surfaces were used to construct a density model, which was used in reporting of model tonnage and grades. Both ordinary kriged grades and inverse distance grades are reported for comparison.

Category	Volume	Tonnage	OK Au g/t	ID Au g/t
Indicated	42,700	105,220	2.30	2.28
Inferred	25,375	64,855	2.17	2.23
Total	**68,075**	**170,075**	**2.25**	**2.26**

Table 7.1 Princess Louise Classified Mineral Resource above 0.7 g/t Au – as at 22nd January 2003

A breakdown of this model resource by bench, and also by Au grade and classification category within each bench is included as Appendix 1.

Figure 7.1 illustrates the grade-tonnage relationship for all combined lodes for Princess Louise at a range of cut-off grades, to test the sensitivity of the model to the cut-off grade applied. Cutoff grades are bracketed next to points representing the tonnage and average grade applicable at these cut-off grades.

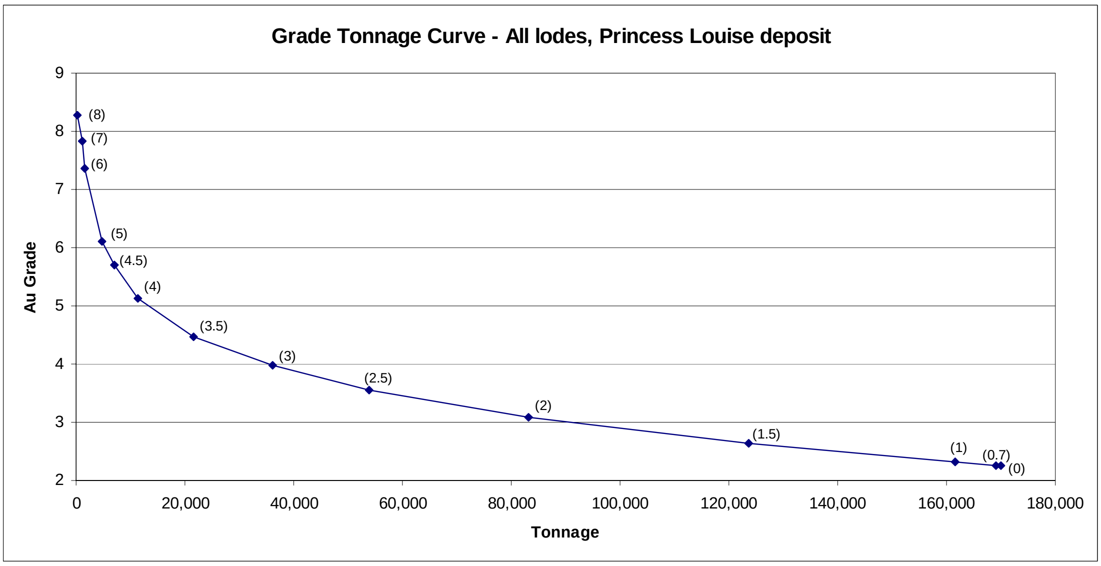


Figure 7.1 Grade Tonnage Curve for all lodes, Princess Louise deposit

Fleur Dyer

Consultant Resource Geologist

APPENDIX 1

PRINCESS LOUISE

RESOURCE MODEL DETAILED REPORTS
