

# OCEANA GOLD (NEW ZEALAND) LIMITED

## GLOBE PROGRESS GOLD PROJECT

### PROCESS DESIGN CRITERIA

REV	DATE	DESCRIPTION OF REVISION	PREPARED	APPROVED	CLIENT
0	17.11.2006	Approved for Construction	AM <i>AM</i>	WJ <i>WJ</i>	

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## PROCESS DESIGN CRITERIA

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## 1. INTRODUCTION

This document is a control document defining the scope of the process plant design and documenting data provided by the client or agreed between GRD Minproc and the client.

The design criteria form the basis for the design of the processing facilities and required site services. Together with the process flow diagrams, these data allow for the definition of the mass balance and the design and specification of equipment. In addition, they allow for the development of schedules for operating requirements such as power, water and reagents. Any recovery or similar data presented herein are used for the purpose of this process design only and are not statement of predicted plant performance.

The design criteria are based on data from many documents and all data are referenced to the source. It is of particular importance to note areas in which assumptions have been made and which require verification.

### References

- 1 Client advice
- 2 Correspondence from Oceana Gold (NZ) Limited (OGL)
- 3 Testwork
- 4 Agreement between OGL and GRD Minproc Limited (GRD Minproc)
- 5 GRD Minproc recommendation
- 6 Calculated data
- 7 Assumption
- 8 Vendor data
- 9 Globe-Progress Project DFS, January 1995
- 10 Kingett-Mitchell and Associates report (Ref. 100760)
- 11 1995 metallurgical testwork
- 12 Dave Peterson and Associates
- 13 Project 50530 documentation
- 14 Study 50847 documentation
- 15 Grinding Circuit Update report, March 2006

In addition to referencing the source of data, each data version is described by a letter of the alphabet or a number and corresponds to the document revision.

	Units	Value	Ref	Rev
<b>2. SITE DATA</b>				
<b>General</b>				
Location		Reefton, South Island, New Zealand	1	A
Site elevation	m	540	2	B
<b>Seismic Conditions</b>				
Seismic activity		High	1	A
Code		NZS 1170.5:2004	2	B
Site subsoil category		Class B, (Clause 3.1.3.3)	2	B
Hazard factor		Z=0.37 (Clause 3/1/4)	2	B
<b>Rainfall</b>				
Mean per annum	mm	2 340	2	A
Minimum monthly average	mm	75	2	A
Maximum monthly average	mm	417	2	A
<b>Snow Conditions</b>				
Snowfall	days/a	10-15	2	A
Design code		AS/NZS 1170.3:2003	2	B
Region		N2, Figure 2.2	2	B
<b>Wind Conditions</b>				
Dust conditions		Low	2	A
Wind direction		North-east to South-west	2	A
Wind speed	m/s	1.4 (NIWA 1993)	2	A
<b>3. ORE CHARACTERISTICS</b>				
Head grade				
- Gold	g/t	2.56	2	B
- Sulphur	%	1.35	2	B
- Arsenic	%	0.86	3	A
- Antimony	%	0.28	3	A
Ore types and quantities				
- Pug Breccia	% w/w	11	1	A
- Quartz	% w/w	11.5	1	A
- Other	% w/w	5.5	6	A
- Host Breccia (greywacke)	% w/w	72	1	A

	Units	Value	Ref	Rev
Specific gravity				
- Ore		2.62	1	A
- Flotation tails		2.62	1	A
- Concentrate		3.4	3	A
Ore moisture	% w/w	6	1	A
Unconfined compressive strength				
- Range	MPa	40 to 162	11	A
- Design	MPa	160	11	A
Impact crushing work index				
- Range	kWh/t	2 to 31	3	A
- Design	kWh/t	10	3	B
Autogenous work index	kWh/t	17.0	11	A
Bond rod mill work index	kWh/t	14.1	3	A
Bond ball mill work index	kWh/t	16.2	3	A
Bond abrasion index		0.17	3	A
Angle from horizontal				
- Repose	degrees	37	11	A
- Drawdown	degrees	65	11	A
- Surcharge	degrees	20	11	A

#### 4. CONCENTRATE CHARACTERISTICS

Gold content	g/t	31.7	6	B
Sulphide content	% w/w	17.1	6	B
Arsenic content	% w/w	10.9	6	B
Iron content	% w/w	17.7	6	B
Antimony content	% w/w	3.5	6	B
Pyrite content	% w/w	20.6	6	B
Arsenopyrite content	% w/w	23.7	6	B
Stibnite content	% w/w	4.9	6	B
Specific gravity		3.4	3	A

	Units	Value	Ref	Rev
<b>5. RAW WATER ANALYSIS</b>				
Specific gravity	g/cm <sup>3</sup>	1.0	1	A
Total dissolved solids	mg/L	42	9	A
Calcium	mg/L	3	9	A
Magnesium	mg/L	1	9	A
Sodium	mg/L	2	9	A
Chloride	mg/L	3	9	A
Iron	mg/L	<0.05	9	A
Manganese	mg/L	<0.01	9	A
Cadmium	mg/L	<0.03	9	A
Nitrate	mg/L	<1	9	A
Phosphate	mg/L	<1	9	A
Sulphate	mg/L	3	9	A
Cyanide	mg/L	<0.01	9	A
<b>6. PLANT OPERATING SUMMARY</b>				
Design life of mine	years	10	1	A
<b>Plant Schedule</b>				
Ore treatment rate	t/a	1 000 000	6	A
Ore sources		Globe Progress	2	B
		General Gordon	2	B
		Souvenir	2	B
		Empress	2	B
Design throughput	t/h	120	1	B
Days per week	days	7	4	A
Hours per day	h	24	4	A
Operating hours per annum	h	8 322	6	A
Availability	%	95	4	A
<b>Ore Treatment Method</b>				
Crushing		Single stage jaw crusher	5	A
		direct to SAG mill		
Milling		Single stage low aspect SAG mill	5	A
Flotation		Flash flotation / scavenger flotation /	5	A
		cleaner flotation		
Concentrate processing		Transport to Macraes	5	A
Oxidation		Macraes POX circuit	5	A
Leach		Macraes CIL	5	A
Elution		Macraes AARL circuit	5	A

	Units	Value	Ref	Rev
<b>Concentrate Schedule</b>				
Concentrate mass	t/a	73 421	6	B
Concentrate mass pull	% w/w	7.34	6	B
Days per week	days	7	5	A
Operating hours per day	h	24	5	A
Design availability	%	95	5	A
Hours per annum	h	8 322	6	A
<b>Recovery</b>				
Flotation recovery	% Au	91.0	3	B
	% S	93.0	3	B
Concentrate CIL recovery	% Au	97.0	3	A
Overall recovery	% Au	88.3	6	B
<b>Production</b>				
Gold production	oz/a	72 651	6	B
Sulfur production	t/a	12 555	6	B

## 7. CRUSHING PLANT

Plant feed		Front end loader	5	A
Run of Mine (ROM) size				
- Maximum	mm	650	4	A
- P <sub>80</sub>	mm	500	4	A
Feed rate	t/h	120	5	B
ROM bin capacity	t	60	5	A
Grizzly spacing	mm	650	5	A
Primary crusher				
- Type		Single toggle jaw	5	A
- Size	inches	48 x 36	8	B
Crushed product size	P <sub>80</sub> mm	100	5	A



	Units	Value	Ref	Rev
<b>8. MILLING CIRCUIT</b>				
<b>Milling Parameters</b>				
Feed rate	t/h	120	5	B
Feed size	F <sub>80</sub> mm	100	5	A
Circuit product size	P <sub>80</sub> μm	110	15	B
Design crushing work index	kWh/t	10	3	B
Design Bond rod mill work index	kWh/t	14.1	3	A
Design Bond ball mill work index	kWh/t	16.2	3	A
SAG mill inefficiency factor		1.35	15	B
Circulating load	%	400	5	A
<b>Sag Mill</b>				
Type		Morgardshammar	8	C
Mill shell length flange to flange	m	6.8	8	B
Mill shell length (EGL)	m	6.2	8	B
Mill diameter (ISL)	m	5.04	8	B
Calculated pinion power	kW	2 145	6	B
Mill motor power	kW	3 650	8	A
Mill critical speed	% critical	77	15	B
Sag mill charge				
- Design ball charge	% v/v	20	15	B
- Maximum ball charge	% v/v	25	5	A
- Maximum total charge	% v/v	31	5	C
Ball size	mm	100	5	C
Liner type		Composite / rubber	8	C
Discharge type		Vertical grate	8	A
Liner thickness				
- shell plates	mm	80	8	C
- lifter bars	mm	200	8	C
Mill discharge density	% w/w	72	5	A
<b>Mill Trommel</b>				
Size	mm	1410 (dia) x 3460	8	A
Aperture	mm	14	8	A
Wire diameter	mm	5	8	A
Flow through trommel	m <sup>3</sup> /h	451	6	B
Gross area available	m <sup>2</sup>	11.9	6	B
Existing trommel flux	m/h	70	6	B

	Units	Value	Ref	Rev
<b>Mill Discharge Hopper</b>				
Residence time	sec	60	5	B
Hopper live volume	m <sup>3</sup>	10	6	B
<b>Classification</b>				
Circulating load	%	400	5	A
Classifying device		Cyclones	5	A
Type		250CVX10	8	A
Diameter of cyclones	mm	250	8	A
Number of cyclones				
- duty		9	8	B
- standby		2	8	B
Feed density	% w/w	61.5	6	B
Overflow density	% w/w	35	5	A
Underflow density	% w/w	75	8	A
Cyclone cutsize P <sub>80</sub>	µm	110	15	B
Operating pressure	kPa	105	8	B

## 9. FLOTATION

### Flash Flotation

Cell type		SK500	4	A
Cell size	m <sup>3</sup>	23	4	A
Number of Cells		1	4	A
Split of cyclone U/F to unit cell	%	80	5	B
Average flowrate	m <sup>3</sup> /h	465	6	B
Feed density	%solids (w/w)	55	5	A
Air addition	Nm <sup>3</sup> /min/cell	2.2 at 53 kPa	8	B
Air hold up	%	5	8	B
Residence time	mins	3.4	6	B

### Flash Flotation Cleaner

Cell type		OK6.5TC	4	A
Cell size	m <sup>3</sup>	6.5	4	A
Number of Cells		1	4	A
Average flowrate	m <sup>3</sup> /h	31.3	6	B
Feed density	%solids (w/w)	12.3	5	A
Air addition	Nm <sup>3</sup> /min/cell	3.8 at 25 kPa	8	B
Air hold up	%	10	8	B

	Units	Value	Ref	Rev
Residence time	mins	12.1	6	B
<b>Scavenger Flotation</b>				
Cell type		OK100TC	4	A
Cell size	m <sup>3</sup>	100	4	A
Number of Cells		4	4	A
Average flowrate	m <sup>3</sup> /h	272.6	6	B
Feed density	%solids (w/w)	30	5	A
Air addition	Nm <sup>3</sup> /min/cell	20.5 at 44 kPa	8	B
Air hold up	%	10	8	B
Residence time	mins	85.5	6	B
<b>Cleaner Flotation</b>				
Cell type		OK16	4	A
Cell size	m <sup>3</sup>	16	4	A
Number of Cells		3	4	A
Average flowrate	m <sup>3</sup> /h	131.2	6	B
Feed density	%solids (w/w)	13	5	A
Air addition	Nm <sup>3</sup> /min/cell	9.4 at 24 kPa	8	B
Air hold up	%	10	8	B
Residence time	mins	19.5	6	B
<b>Cleaner Scavenger Flotation</b>				
Cell type		OK16	4	A
Cell size	m <sup>3</sup>	16	4	A
Number of Cells		3	4	A
Average flowrate	m <sup>3</sup> /h	87.3	6	B
Feed density	%solids (w/w)	13	5	A
Air addition	Nm <sup>3</sup> /min/cell	9.4 at 24 kPa	8	B
Air hold up	%	10	8	B
Residence time	mins	29.2	6	B
<b>Recleaner Flotation</b>				
Cell type		OK8	4	A
Cell size	m <sup>3</sup>	8	4	A
Number of Cells		3	4	A
Average flowrate	m <sup>3</sup> /h	33.7	6	B
Feed density	%solids (w/w)	12.5	5	A
Air addition	Nm <sup>3</sup> /min/cell	5.4 at 20 kPa	8	B
Air hold up	%	10	8	B
Residence time	mins	41.2	6	B

	Units	Value	Ref	Rev
<b>10. CONCENTRATE DEWATERING</b>				
Method		Thickening / filtration	5	A
Design treatment rate	t/h	8.8	4	B
<b>Concentrate Trash Screen</b>				
Screen type		Vibrating deck	5	A
Deck inclination	degrees	5	8	C
Screen dimensions	m	1.2 (w) x 2.4 (l)	8	A
Screen aperture	µm	800	8	B
Screen deck material		Polyurethane	5	B
Screen spray water	m <sup>3</sup> /h	5	8	B
<b>Thickener</b>				
Type		High rate	5	A
Solids settling rate	t/m <sup>2</sup> /h	0.25	3	A
Underflow density	% solids	65	3	A
Thickener diameter - selected	m	8.0	5	B
<b>Filter Feed Tank</b>				
Residence time	h	8	5	A
Tank live volume	m <sup>3</sup>	59	6	B
<b>Filter</b>				
Type		Ceramec® CC-30	5	A
Design availability	%	90	5	B
Design rate (instantaneous)	t/h	9.8	6	B
Feed density	% solids	65	5	A
Filtration rate	kg/m <sup>2</sup> /h	700	3	A
Cake moisture content	% w/w	8.5	3	A
<b>11. WATER TREATMENT PLANT</b>				
Design flowrate				
- average	m <sup>3</sup> /d	4476	6	B
- design (90 <sup>th</sup> percentile)	m <sup>3</sup> /d	7276	2	A
	m <sup>3</sup> /h	303	2	A
Feed composition				
- Arsenic	g/m <sup>3</sup>	2.83	3	A

	Units	Value	Ref	Rev
- Antimony	g/m <sup>3</sup>	3.69	3	A
- Zinc	g/m <sup>3</sup>	1.18	3	A
- Nickel	g/m <sup>3</sup>	0.02	3	A
- Copper	g/m <sup>3</sup>	0.02	3	A
- Total suspended solids	g/m <sup>3</sup>	100	3	A
Ferric molar ratio addition	Fe:As	10	3	A
	Fe:Sb	10	3	A
	Fe:Zn	10	3	A
	Fe:Ni	10	3	A
	Fe:Cu	10	3	A
<b>Oxidation Tank</b>				
Residence time	hours	0.5	3	A
Tank live volume	m <sup>3</sup>	155	6	A
Airflow rate	Nm <sup>3</sup> /h	10.3	6	B
<b>Precipitation Tank</b>				
Residence time	hours	0.5	3	A
Tank live volume	m <sup>3</sup>	155	6	B
Airflow rate	Nm <sup>3</sup> /h	10.3	6	B
<b>Clarifier</b>				
Type		High rate	12	B
Design feed flowrate	m <sup>3</sup> /h	303	4	A
Design rise rate	m/h	1.05	12	A
New feed solids	g/m <sup>3</sup>	270	6	A
Underflow density	% solids	0.5	12	A
Clarifier diameter - selected	m	20	12	A
<b>Discharge Lagoon</b>				
Feed flowrate				
- average	m <sup>3</sup> /h	168	6	B
- 90 <sup>th</sup> percentile flow	m <sup>3</sup> /h	303	2	A
Residence time				
- average	hours	41.7	6	C
- peak	hours	23.1	6	C
Live volume	m <sup>3</sup>	7000	2	C

	Units	Value	Ref	Rev
<b>12. REAGENTS</b>				
<b>Collector</b>				
Type		SIBX	5	A
Transport form		Solid	5	A
Transport packaging		1 t bulka bags	5	A
Mix strength	% w/w	20	5	A
Addition points			5	A
- Mill feed / unit cell feed	g/t	150	5	A
- Cyclone overflow	g/t	100	5	A
- Cleaner circuit	g/t	50	5	A
Total addition rate	g/t	300	3/5	A
Consumption	kg/d	864	6	B
	L/d	4536	6	B
Mix / storage tank capacity	m <sup>3</sup>	10	5	A
	hours	53	6	B
<b>Activator</b>				
Type		Copper Sulphate	5	B
Transport form		Solid	5	A
Transport packaging		1 t bulka bags	5	A
Mix strength	% w/w	15	5	C
Addition points			5	A
- Mill feed	g/t	200	3/5	A
- Cyclone overflow	g/t	100	3/5	B
Total addition rate	g/t	300	3	A
Consumption	kg/d	864	6	B
	L/d	5272	6	C
Mix / storage tank capacity	m <sup>3</sup>	10	5	A
	hours	46	6	C
<b>Frother</b>				
Type		MIBC	5	B
Transport form		Liquid	5	A
Transport packaging		200 L drums	5	A
Solution strength	% w/w	100	5	A
Addition points			5	A
- Unit cell feed	g/t	25	5	A
- Scavenger feed box	g/t	25	5	A
Total addition rate	g/t	50	3	A
Consumption	kg/d	144	6	B
	L/d	180	6	B

	Units	Value	Ref	Rev
Storage tank capacity	m <sup>3</sup>	1	5	A
	hours	133	6	B
<b>Promotor</b>				
Type		AP238	5	B
Transport form		Liquid	5	A
Transport packaging		200 L drums	5	A
Solution strength	% w/w	100	5	A
Addition points			5	A
- Unit cell feed	g/t	15	5	A
- Cyclone overflow	g/t	10	5	A
Total addition rate	g/t	25	3	A
Consumption	kg/d	72	6	A
	L/d	64	6	A
Storage tank capacity	m <sup>3</sup>	1	5	A
	hours	375	6	A
<b>Flocculant</b>				
Type		Magnafloc 24	5	A
Transport form		Solid	5	A
Transport packaging		25 kg bags	5	A
Mix strength	% w/w	0.25	5	A
Secondary dilution	% w/w	0.025	5	A
Addition points				
- Concentrate thickener	g/t of conc	10	3	A
- Clarifier	g/m <sup>3</sup> clarifier feed	2	3	A
Total Consumption	kg/d	16.7	6	A
(Based on Clarifier max rate of 303 m <sup>3</sup> /h)	L/d	6669	6	A
Mix system		Jet wet	5	A
Storage tank capacity	m <sup>3</sup>	10	5	A
	hours	36	6	A
<b>Ferric Chloride</b>				
Transport form		Liquid	5	B
Transport packaging		Delivery from Isotainer	8	B
Solution strength	% w/w	42	8	B
Addition points				
- oxidation tank	g/m <sup>3</sup> clarifier feed	141	3	A
Total Consumption	kg/d	1025	6	B
(Based on Clarifier max rate of 303 m <sup>3</sup> /h)	L/d	1708	6	B

	Units	Value	Ref	Rev
Storage tank capacity	m <sup>3</sup>	30	5	B
	hours	421	6	B
<b>Hydrated Lime</b>				
Transport form		Solid	5	A
Transport packaging		1 bulka bags	5	A
Mix strength	% w/w	20	5	A
Addition points				
- Precipitation tank	g/m <sup>3</sup>	40	3	A
Total Consumption	kg/d	291	6	B
(Based on Clarifier max rate of 303 m <sup>3</sup> /h)				
	L/d	1290	6	B
Mix / storage tank capacity	m <sup>3</sup>	10	5	A
	hours	186	6	B

### 13. AIR SERVICES

#### Flotation Blower

- number of duty		2	5	B
- number of standby		0	5	A
- Blower 1 pressure	kPa	25 to 53	8	B
- Blower 1 total air flowrate (max)	Nm <sup>3</sup> /min	101.1	8	B
- Blower 2 pressure	kPa	20 - 24	8	B
- Blower 2 total air flowrate (max)	Nm <sup>3</sup> /min	83.5	8	B

#### Plant Air Compressor

- number of duty		1	5	A
- number of standby		1	5	C
- pressure	kPa	700	5	A
- total air flowrate	Nm <sup>3</sup> /min	5.25	6	C



	Units	Value	Ref	Rev
<b>14. WATER</b>				
Process water tank capacity	m <sup>3</sup>	500	5	B
	hours	1.2	5	C
Raw water tank capacity - Total	m <sup>3</sup>	500	5	A
- Process allocation	m <sup>3</sup>	68	6	C
	hours	2.6	6	C
- Fire Water allocation	m <sup>3</sup>	432	5	C
Potable water tank capacity	m <sup>3</sup>	30	4	B
	hours	120	4	B
<b>15. TAILINGS</b>				
<b>Tailings Hopper</b>				
Residence time	sec	90	5	A
Hopper live volume	m <sup>3</sup>	8	6	B
Tailings flowrate	m <sup>3</sup> /h	319	6	B
Tailings slurry density	%solids (w/w)	28.7	6	B
Flushing water flowrate	m <sup>3</sup> /h	150	6	A
<b>16. CONCENTRATE TRANSPORT</b>				
<b>Transport Method</b>				
Container loading		Front End Loader	1	A
Plant site to Reefton		Road	1	A
Reefton to Palmerston		Rail	1	A
Palmerston to Macraes		Road	1	A
<b>Transport Requirements</b>				
Concentrate transported (wet)	t/a	80,224	6	B
Concentrate moisture	%	8.5	3	B
Transportation cycle	days / week	6	1	C
<b>Concentrate Characteristics</b>				
Transportable moisture limit (TML)	%	9.6	3	A
Angle of repose	degrees	42	3	A
Bulk density	t/m <sup>3</sup>	2.72	3	A
Stowage factor	m <sup>3</sup> /t	0.37	3	A
Relative ignition temperature	°C	>365	3	A

	Units	Value	Ref	Rev
<b>17. CONCENTRATE REPULPING (MACRAES)</b>				
<b>Concentrate Delivery</b>				
Delivery method	type	Truck with trailer	2	C
Truck capacity (concentrate)	wet t	12	2	C
Trailer capacity (concentrate)	wet t	16	2	C
Concentrate per delivery	wet t	28	2	C
Delivery frequency	hrs	2	2	C
Deliveries per day	No.	9 to 10	6	C
Delivery days per week	No.	6	2	C
<b>Concentrate Receival Bin</b>				
Bin size	t	56	4	C
Bin lining	type	12mm UHMWPE	8	C
Feeder system	type	Screw feeder	5	C
Screw type	type	Twin	8	C
Flight type	type	Variable pitch	8	C
Feeder rate (normal)	tph	12.8	5	C
Feeder rate (maximum)	tph	38.4	5	C
<b>Repulping Tank</b>				
Tank live volume	m <sup>3</sup>	10	4	C
Residence time	mins	48	6	C
Repulping slurry density	%solids (w/w)	60	5	C
Agitator type	type	Single impeller	8	C
Repulping power intensity	kW/m <sup>3</sup>	2	4	C
Agitator power	kW	30	6	C
<b>Regrind Surge</b>				
Trash screen type	type	Static	8	C
Screen aperture	mm	5	8	C
Tank live volume	m <sup>3</sup>	150	5	C
Tank surge capacity	hrs	13	6	C
Tank slurry density	%solids (w/w)	55	6	C
<b>Regrind Mill</b>				
Mill type	type	IsaMill M1000	8	C

	Units	Value	Ref	Rev
Mill power installed	kW	500	8	C
Power consumption	kWh/t	16	8	C
Media type	type	Sand	8	C
Media consumption	kg/h	30	8	C
<b>Operating time</b>				
- Days per week	days	6	2	C
- Hours per day	hrs	24	4	C
Mill feed rate	tph	10.3	6	C
Milling density	%solids (w/w)	50	8	C
Product size	P <sub>80</sub> μm	15 to 20	8	C
<b>Concentrate Storage</b>				
Trash screen type	type	Vibrating	5	C
Screen aperture	mm	0.8	5	C
Tank live volume	m <sup>3</sup>	1500	4	C
Tank slurry density	%solids (w/w)	42	4	C