



MANUFACTURED AND INTELLECTUAL CAPITAL

RELEVANT MATERIAL ISSUES

- Managing production and performance to ensure the successful execution of our business strategy

RELEVANT IDENTIFIED RISKS

- Optimising the responsible usage of our productive natural resources (managing the complexity and availability of Merensky Reef)
- Not meeting production targets
- Single stream process concentrator and smelter
- Safety and health

Our manufactured capital inputs include the specialised plant, machinery, equipment and infrastructure necessary for us to conduct our business.

Operating our mines requires a range of particular skills and technologies, and this intellectual capital input is only made possible by the skills and competencies inherent in our human capital. (See Human capital on page 44 for details of how we develop our employees.) Both our manufactured and intellectual capital inputs have as a focus the drive to make mining safer and to improve efficiencies.

Drilling technology at work at Zondereinde ►



MANUFACTURED AND INTELLECTUAL CAPITAL

THE OPERATING ENVIRONMENT

	Depressed metal prices persist		Labour relations climate remains volatile and uncertain		Regulatory uncertainty
	Community unrest		Currency and interest rate fluctuations		

BUSINESS UNITS

At Northam we consider our operations, their infrastructure and associated activities to be the major components of the group's manufactured capital stock. Core activities are conducted at the following long-life, low cost business units:

- The established, mature, deep-level, long-life Zondereinde mine
- The processing and smelting facilities at the Zondereinde mine
- The shallower, long-life, modern and mechanised Booyssendal North mine

The group's projects are essentially brownfield developments at the Booyssendal North mine, along with the establishment of the Booyssendal South mine. These are the most mature of the projects under development.

2016 KEY FEATURES OF OPERATIONS

	Consistent safety performance at Zondereinde, achieving five million fatality free shifts		Sustained excellent safety performance at Booyssendal		Group unit cash costs reduced by more than 1%
	Progressing the ore mix rebalance at Zondereinde to UG2 60%; Merensky 40%		Zondereinde deepening project on track		Installation of underground refrigeration plant on 13 level completed
	Bulk sample, trial mining and feasibility study for the Merensky expansion at Booyssendal complete, adding 25 000oz/annum		Another 30 000oz from UG2 expansion at Booyssendal North		Growth plans to take production profile to 800 000oz by 2022

GENERAL COMMENT AND KEY FEATURES

Group operations continued to perform steadily, illustrating the success of our strategy grounded on sound operating performances and on containing the costs of producing each PGM ounce, while also working through what has now been a sustained metal price trough. Both operations posted solid operating profits for the year.

The contribution of the Booyssendal North UG2 mine came in at steady-state levels of 160 000oz, pushing the group's annual output to 440 000oz. This creditable performance underscores the significance of a stable working environment, with minimal extraneous disruptions, which was certainly the case in the first half of the financial year at Zondereinde, where management signed a three-year wage deal in July 2015.

A sustained emphasis on safety has yielded good results. Both management and employees deserve to be commended for the sound achievements at both operations.

Community protests in the Booyssendal area earlier in the financial year inevitably impacted operations, making it difficult for employees to get to work. Later in the year the murder of a Zondereinde employee in the town of Northam, followed by the death of a second employee, sparked high levels of tension at the operation. The loss of production was contained to eight days, and with the cooperation of law enforcement authorities, and interventions from the minister of Mineral Resources, operations resumed safely again on 14 June. A total of 8 000oz was lost owing to the interruptions. (Please see page 54 for more detail in the *Human capital* section on the management of this incident.)

MANUFACTURED AND INTELLECTUAL CAPITAL CONTINUED

ZONDEREINDE MINE

– mature, reliable, long-life operation

Resource	Reserve	Tonnes milled	Production
84.1Moz	11.7Moz	2 020 425t	8 796 kg (282 765oz)
Capex	Operating cost		
R554.1 million	R3 464.4 million		

MINING ACTIVITIES AND PRODUCTION

Zondereinde's sound operational performance in the year was matched by the achievement of five million fatality free shifts for the first time. This is a commendable performance at a deep level mine such as Zondereinde. Unfortunately the injury frequency rates regressed despite continuous campaigns focused on reducing the number and severity of injuries. Operational management remains resolved to minimise the number of injuries sustained by employees while on duty. The LTIR was 1.92 (FY2015: 1.31) and the RIIR was 1.11 (FY2015: 0.94).

Underground mining activities at Zondereinde remained focused on balancing the depletion of the remaining resources at the mine by changing the split of the Merensky and UG2 ore ratio to 40:60. This more realistic ratio reflects the abundance of conformable, planar UG2 reef at the Zondereinde operation, and the complex geological difficulties associated with the Merensky reef – which severely impacts mining flexibility on this reef.

Whilst the UG2 reef has a lower head grade than the Merensky reef, the higher density of the orebody and better mining productivity renders the profitability of mining this reef on a par with that of Merensky. The transition has proceeded well with the major benefit being an extension to Zondereinde's LoM to more than 20 years. This life of mine estimate includes resources to 18 level some 2 400 metres below surface the lowest practicable mining level at Zondereinde.

On both orebodies, the ore reserve position remains satisfactory, with availability of 20 and 24 months for the Merensky and UG2 orebodies respectively. The development programme has maintained this position for some time now.

The deepening project at Zondereinde is focused on opening up mineable Merensky reserves to make up for the constraints posed by mining conditions, notably the loss of Merensky resources on the east of the mine some years ago. Mining infrastructure is being extended down to 18 level. Development work to establish the conveyor decline leg between 16 and 17 levels is in progress, and due for completion by the end of calendar year 2017. Lateral development on 16 level is advancing well and includes the breakaway of two crosscuts to reef as well as a connection to the material decline. Blasting of the material decline between 14 level and 16 level has been completed and equipping has started.

The contribution of the normal Merensky reef at the lower levels of the mine now represents 35% of the total Merensky ore mined.

The growth in metal concentrate purchases reflects the volume build-up at Booysendal.

Zondereinde's capex programme continued without any significant interruptions. Capital investment reached R554.1 million in the year under review, notably on the new furnace construction, the deepening project down to 18 level and other necessary sustaining capital expenditure.

Zondereinde – sustaining capital investment



New 20MW furnace
R291.6million



18 level deepening project
R132.7million



Other sustaining capex
R129.8million

Capital investment in 2017 is likely to increase to an estimated R682.7 million, fairly distributed between expansionary and sustaining capex, with expansionary capex relating almost entirely to the new furnace.

The group-wide cost containment exercise demonstrated some notable successes. At Zondereinde this resulted in unit cash costs, in terms of equivalent refined metal, declining by 1% to R374 846/kg.

METALS PROCESSING AND SMELTING ACTIVITIES

The smelter at Zondereinde has for years treated Zondereinde's output, and spare capacity has been used to toll-treat third party concentrate. Now, with growing output anticipated from the Booyssendal complex, a new furnace is being built in order to accommodate the anticipated higher volumes. The design of the new furnace allows it to run as a pure UG2 furnace, or as a conventional Merensky/UG2 furnace – thereby providing the flexibility to accommodate the growth in UG2 mining. See page 31 in the *Financial capital* section for more information on the strategic partnership and funding for the new furnace.



The Zondereinde smelter

MANUFACTURED AND INTELLECTUAL CAPITAL CONTINUED

BOOYSENDAL NORTH UG2 MINE

– shallow, mechanised, long-life

Resource	Reserve	Tonnes milled	Production
6.02Moz	4.00Moz	2 072 958t	4 865 kg (156 410oz)
Total capex	Operating cost		
R459.3 million	R1 541.0 million		

The Booyseendal North mine also put in an impressive performance for the year, reaching the steady state production run-rate at the end of the first half of the financial year.

Booyseendal's exemplary safety record continues – illustrating the differentiating properties of this relatively shallow orebody and the mine's mechanised workings. In September 2015, Booyseendal achieved two million fatality free shifts. The injury frequency rates also improved year on year, with an LTIIR of 0.44 (FY2015: 0.54) and an RIIR of 0.32 (FY2015: 0.41).

Capital investment continued apace at Booyseendal, amounting to R616.4 million. Given the platform that the Booyseendal North mine creates for brownfields expansion and to optimise operations on the vast Booyseendal orebody, the bulk of this investment covers expansionary capital costs, and includes R55.2 million on the resource base at Everest, the existing UG2 mine and deepening project, employee accommodation and the feasibility study for the growth into Booyseendal South.

Booyseendal – expansionary capital investment



Resource base
at Everest

R55.2million



UG2 phase 1 mine
and deepening project

R178.0million



Employee
accommodation

R14.3million



Booyseendal South
feasibility study

R63.5million

Having reached steady state at the North UG2 mine, and the increase in metals in concentrate produced, operating costs rose in line, with total operating costs at Booyseendal pegged at R1 541.0 million, 29.3% higher year on year. At a unit cash cost level, this increase translates to a 1.4% reduction at R298 500/kg or R9 284/oz.

Management estimates that expansionary and sustaining capital expenditure will be R527.0 million and R86.9 million respectively in FY2017.

BOOYSENDAL EXPANSION PROJECTS – MODULAR, FLEXIBLE, SCALEABLE AND ADDING OPTIONALITY

Booyseendal North UG2 deepening project

The Booyseendal North UG2 deepening project involves the addition of two levels to the existing mine. This first expansion runs parallel with the establishment of the Merensky North mine, and will add some 30 000oz to the UG2 mine's existing production profile, at a capital cost of R270 million over three years.

Booyseendal North Merensky mine

Resource	Reserve	Tonnes milled
1.76Moz	1.36Moz	92 645t
Production of metals in concentrate	Capex	
152 kg (4 890oz)	R157.1 million	

The orebody at Booyseendal is massive at 105.2Moz and is mostly well explored and known. The Booyseendal North UG2 mine is likely to exploit a total of 7.78Moz or 7.4% of the orebody, and management is constantly focused on being able to turn to account ounces which are relatively shallow, easily accessible, and with mechanisable potential. Essentially, the Merensky North mine provides optional, modular production growth, as a swing producer with low fixed working costs.

With this in mind, the Merensky North mine, the first of the brownfields expansion projects, was started in 2015, with a boxcut being established for access, and a bulk sample taken for trial mining and metallurgical testwork. The group invested capex of R82.5 million to establish a box cut in 2015 and to conduct trial mining and bulk sampling.

The testwork concluded that the narrower Merensky reef could also be subject to mechanised extraction and would also yield an acceptable run of mine ore grade.

In the short term, limited concentrator capacity will contain this to being a small mine, producing 25 000oz initially. With sufficient concentrator capacity in future, this output could be expanded to 75 000oz, should market conditions be favourable. The Merensky ore is currently being co-processed in the UG2 concentrator at Booyseendal. An advantage of the project is the high base-metal content of the Merensky ore, a definite sweetener in that it enhances PGMs recovery in the metallurgical processes. Furthermore, since the mining method, skills and equipment required are the same as those used at the Booyseendal North UG2 mine, the staff can be transferred from the one mine to the other, thereby taking advantage of efficiencies and synergies, and leveraging off the existing capital footprint.

A key component of this extension is the construction of a 5 000 tonne surge capacity underground silo that will connect the deeper, new section to the existing mine. However, the silo will also decouple these two parts to ensure continuous mining during unexpected stoppages. Construction of the silo started in May 2016 and is due for completion in July 2017.

Capital expenditure of R300.0 million over two years was approved for the construction of a small mine, producing 25 000oz. The project involves the development and equipping of the primary decline cluster and the establishment of mining sections.

Given that most of the project development is on reef, some revenue will be generated during the development phase. The project is due to be completed in June 2018.

BOOYSENDAL SOUTH

The third phase of the expansion at Booyseendal envisages the exploitation of the Booyseendal South orebody by developing a new portal system near the centre of the greater Booyseendal property. The Booyseendal South mine incorporates the infrastructure and workings of the contiguous Everest mine, which was purchased in June 2015, with the mining right being transferred in November 2015. This acquisition of Everest, for R450.0 million, included a 250 000 tonne per month concentrator plant, an integrated chrome extraction plant, power and water supply, tailings facilities, workshops and other infrastructure.

Given the complex topography in the region, Northam intends using, for the first time in South Africa, a rope conveyor system to transport the mined ore to the Everest processing site. This custom-built conveyor system will be commissioned during the 2019 financial year, with the start-up of the concentrator at Booyseendal South. At steady-state levels, the Booyseendal South expansion will add some 240 000oz annually, with capex estimated at R4.2 billion in real terms over six years.

For further detail on production statistics for Zondereinde and Booyseendal see the five-year operating review on page 11.