MORRO DO OURO SITE ARD MANAGEMENT PROGRAM

2018 ICARD – PRETORIA - SOUTH AFRICA

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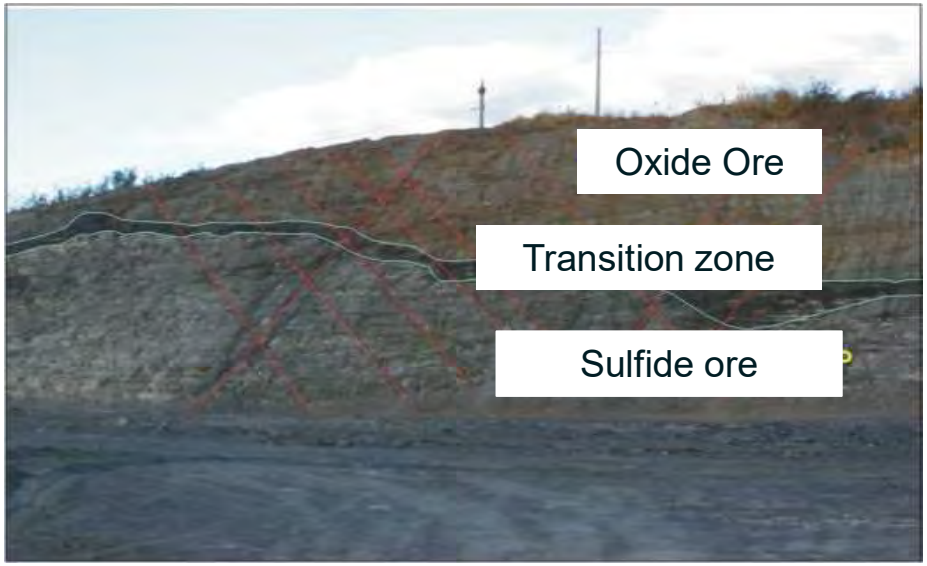
Morro do Ouro Site Location

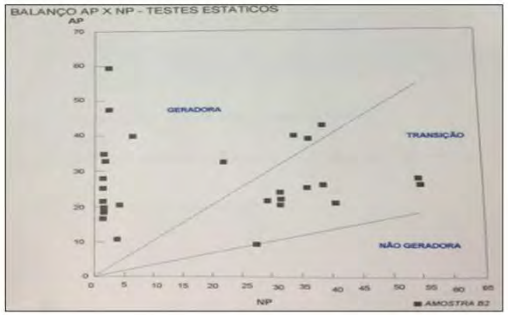
Geology



ARD Research Program

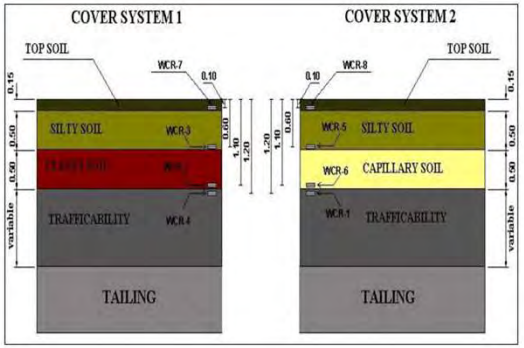
Testing Timeline

1991-1993

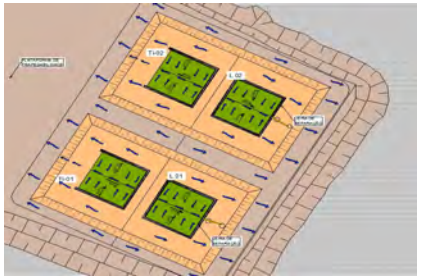


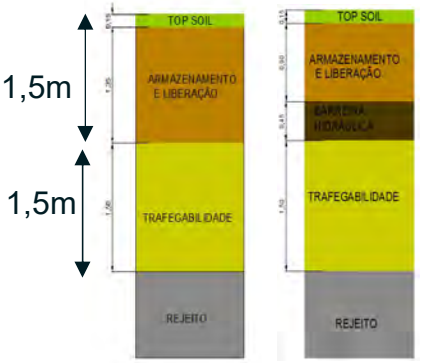
1994 - 1997

2010 - 2018



Field test installed at Santo Antonio dam facility to investigate potential covers:



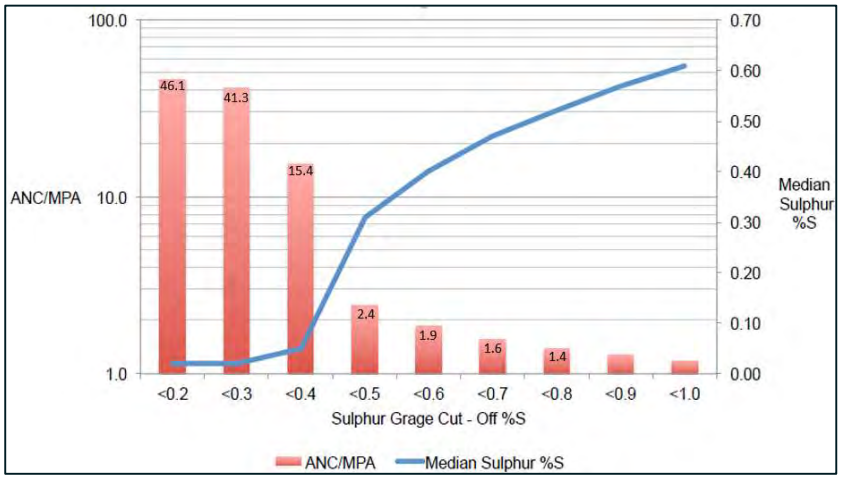


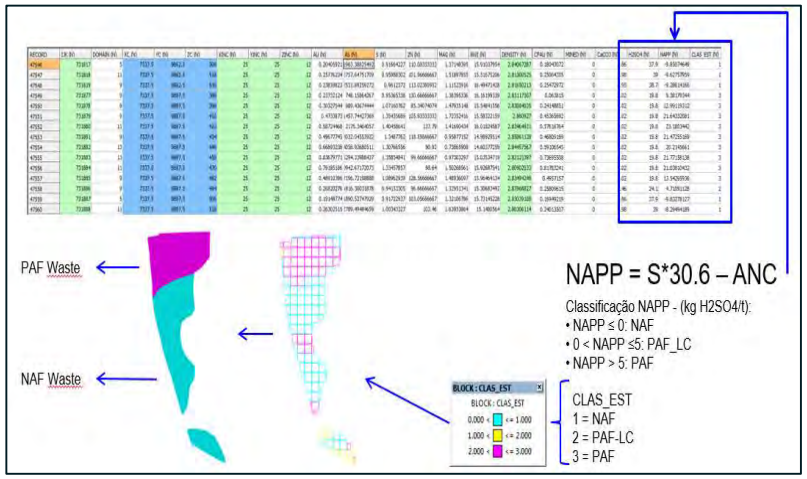
Integration of the Research Program Results in the Mine Processing Design

Development of S and ANC Database for Mining Plan

1. Sulfur and acid neutralizing capacity (ANC) were conducted using the geological samples

2. In the absence of ANC data, a risk-based approach to define a workable and realistic S grade cut-off for NAF and PAF



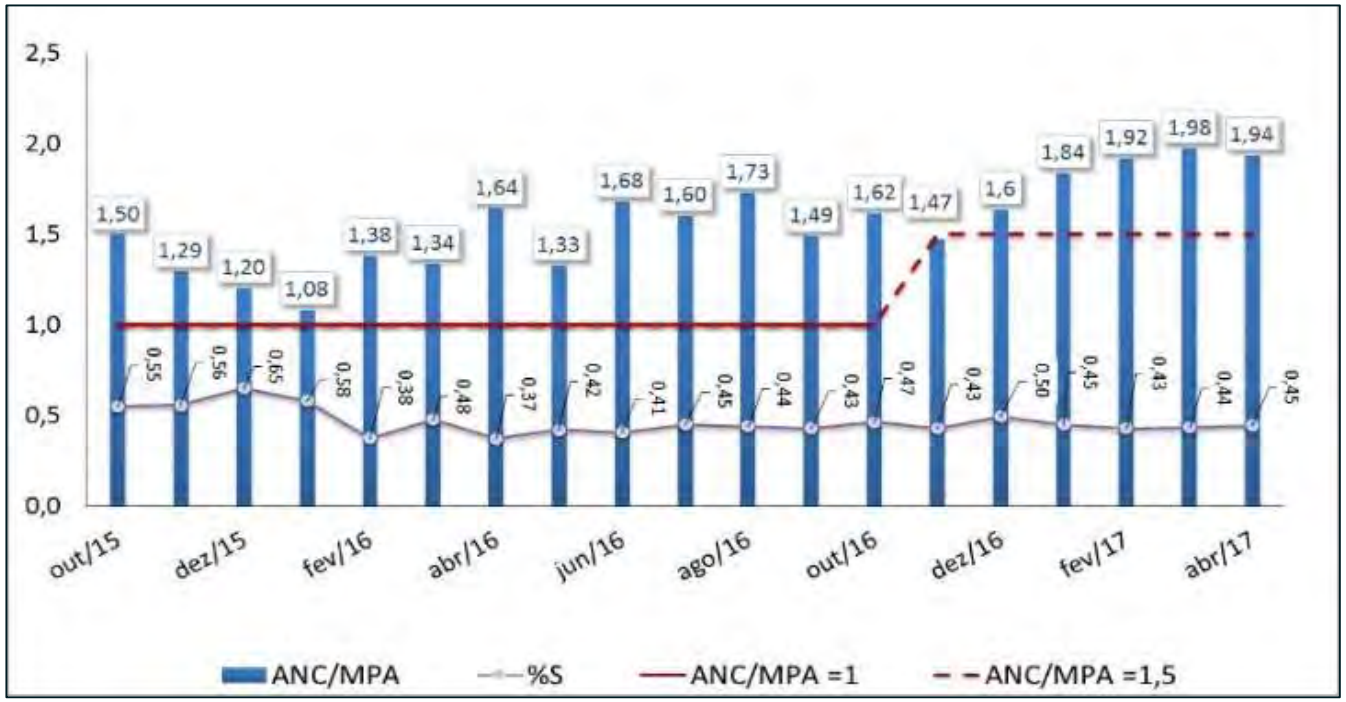


Segregation of Sulfides

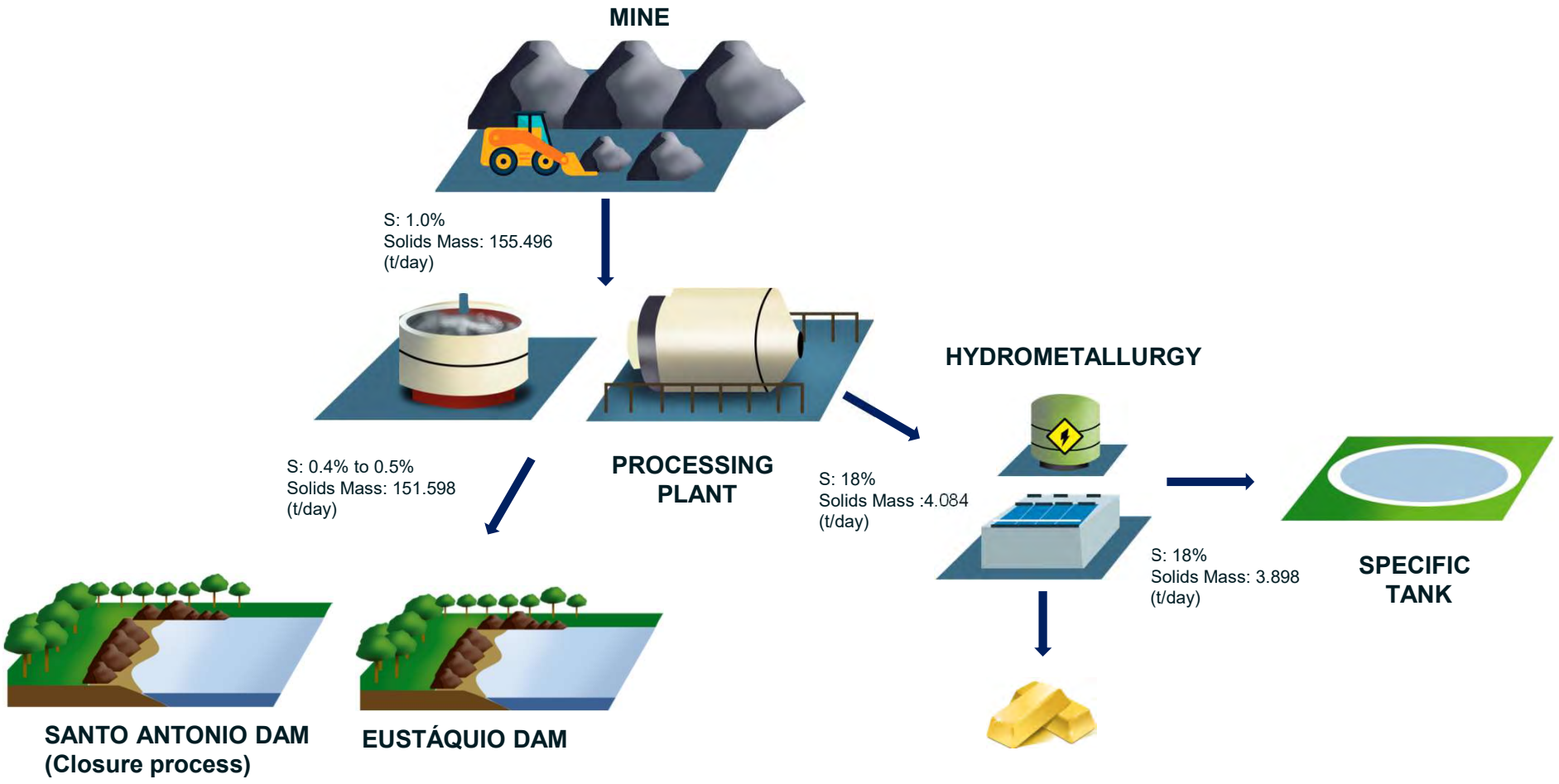
CIL tailings rich sulfide (18% S) are disposed in double sealed sumps (or specific tanks) excavated in bedrock and double lined with a local red clay and HDPE liner.

Addition of Neutralizing Material to Ensure ANC/MPA > 1.0

Limestone is added in the processing plant to minimize the risk of acid generating in the dams. The acid base characteristics of tailings are routinely monitored.

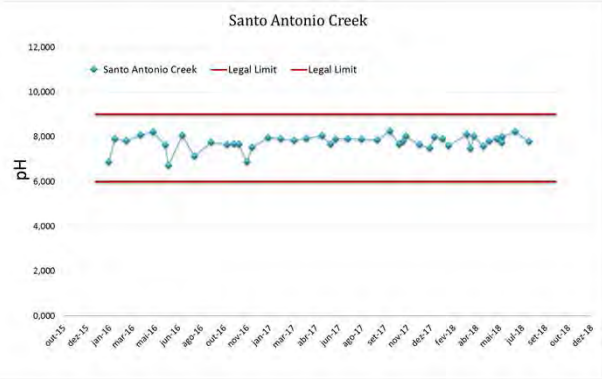


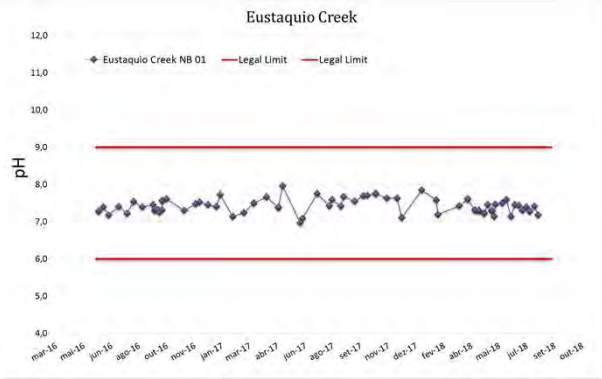
Processing Flowsheet

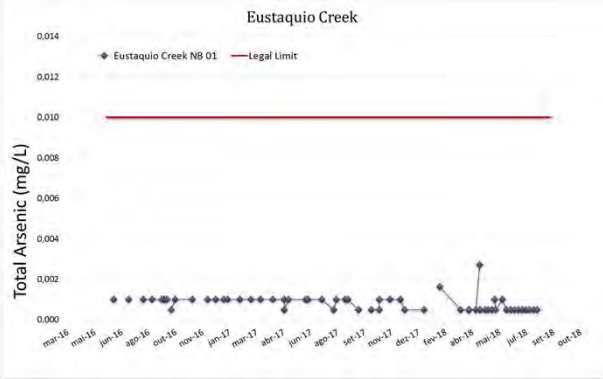


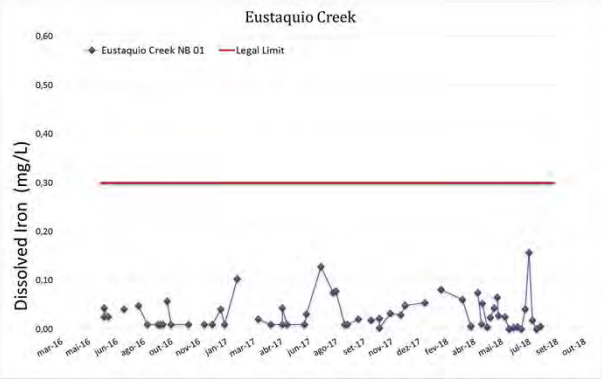
Benefits Arising from the ARD Control Program

Maintenance of Good Water Quality

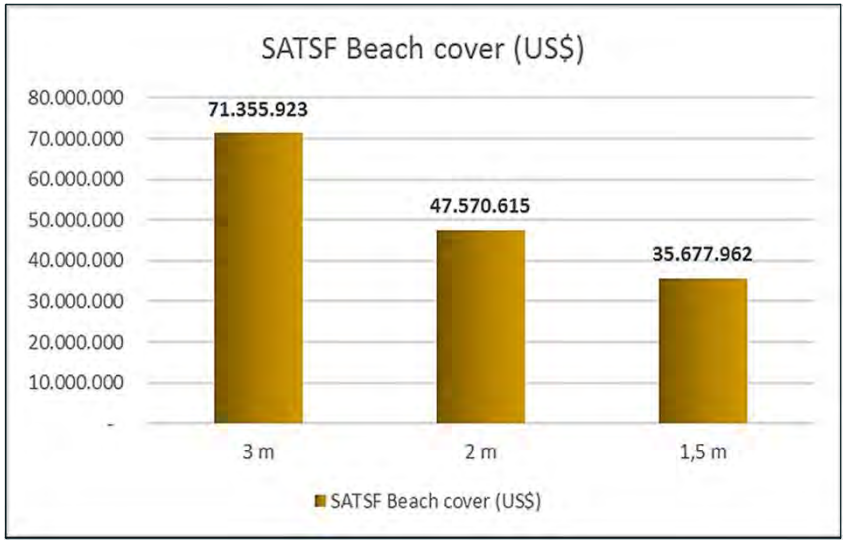


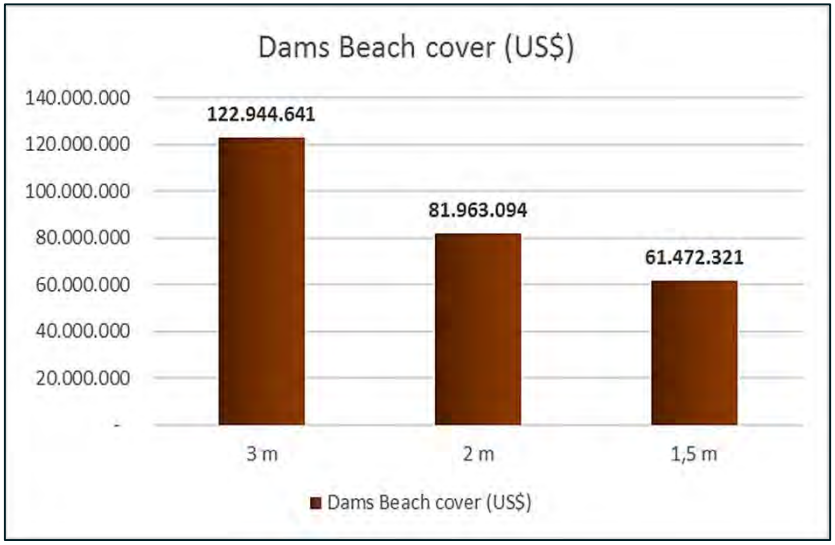






Reduced Closure Costs





Improved Perception Close to Environmental Regulators

- Issuing of environmental permits early than planned,
- Environmental agency recommending other mining sites to visit Morro do Ouro site to learn about ARD controls;
- Last year, the overall site (extended) permit was renewed for the next 10 years

Management Support

- ARD indicators like S and NAF/PAF ratios periodically monitored during production and mining department meetings;
- ARD control expenditures been integrated in the site business planning and into the decision making process.

Summary of Expenditures with ARD control by Morro do Ouro site (1,000,000 U$)

Item	2012	2013	2014	2015	2016	2017	2018	Total
Specific Tanks construction	3.59	11.99	5.83	10.4	6.36	6.78	7.10	**52.05**
Carbonate addition	4.45	1.88	2.73	1.26	0.00	0.00	0.77	**11.09**
Reagent addition	3.16	6.24	7.38	6.89	4.95	4.99	5.35	**38.96**
Geochemical assays	0.45	0.29	0.29	0.31	0.41	0.77	1.10	**3.62**
Consultancy support	0.11	0.16	0.10	0.17	0.4	0.62	0.26	**1.82**
Instrumented trial cover plot	0.00	0.00	0.00	0.16	0.04	2.67	0.11	**2.98**
Total	**11.76**	**20.56**	**16.33**	**19.19**	**12.16**	**15.83**	**14.68**	**110.51**

Final Remarks

- Taking account of ARD potential impacts in the early stages of mine planning has been key to properly define the best environmental and processing routes to mine a sulfide ore at Morro do Ouro site ;

- Support from management teams to incorporate ARD controls into their planning and budgets has been key for the success of the program;

- Benefits arising from a ARD Research program by far offset the investments made by the site, while maintaining its permit to operate and increasing its reputation close to the regulators

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