ACID MINE DRAINAGE

CRISIS? OR PART OF AN EVEN BIGGER ISSUE?

presented by

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what is ACID MINE DRAINAGE?

Acidic Water reacts with Dolomite

Ca^{++} & Mg^{++} + H_2SO_4 ⟶ $CaSO_4$ & $MgSO_4$ & Heavy metals

$2FeS_{2(s)} + 7O_{2(g)} + 2H_2O_{(l)} = 2Fe^{2+}_{(aq)} + 4SO_4^{2-}_{(aq)} + 4H^+_{(aq)}$

Oxidation of Iron Sulphides

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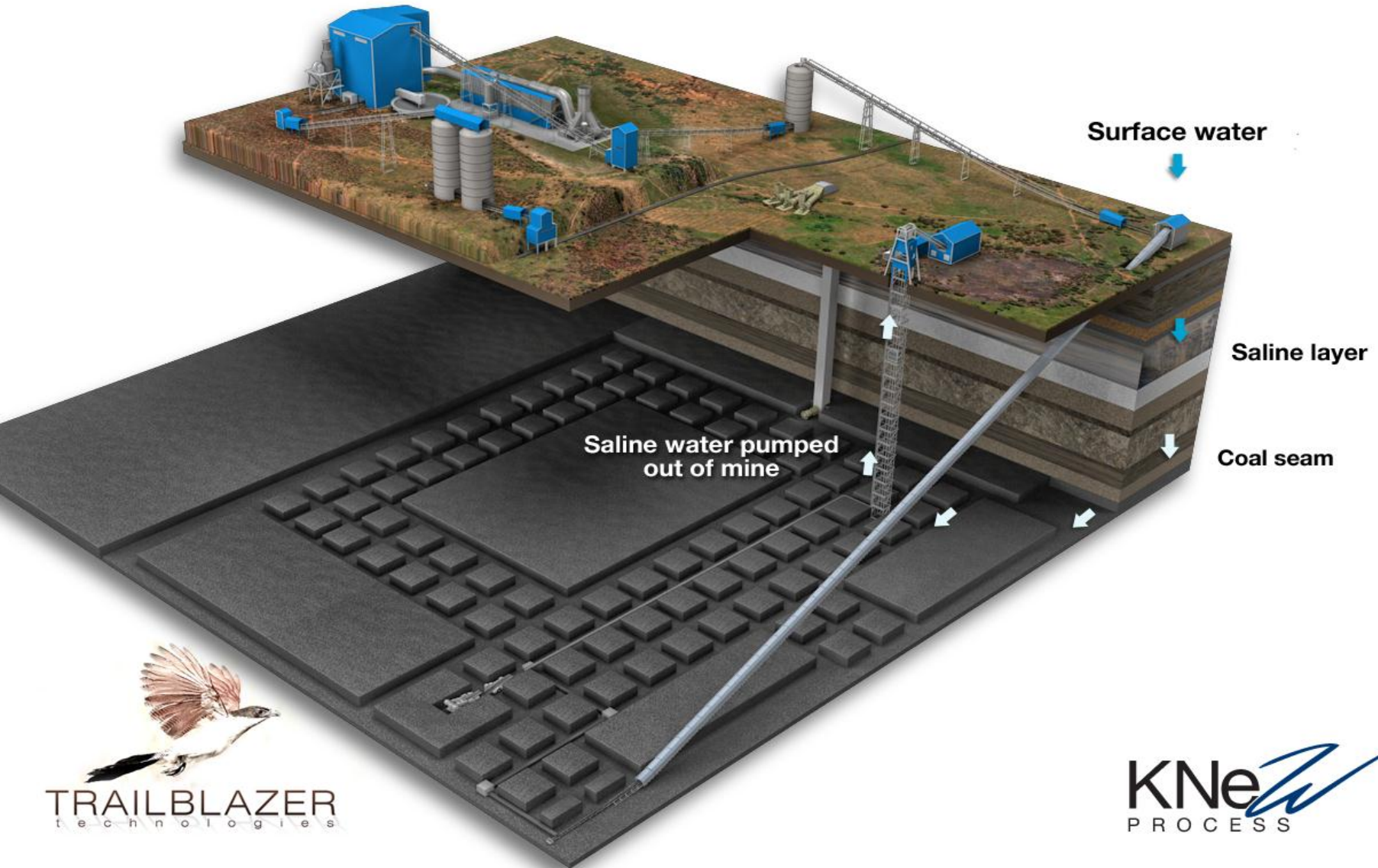
SALINE ~~ACID~~ MINE DRAINAGE?



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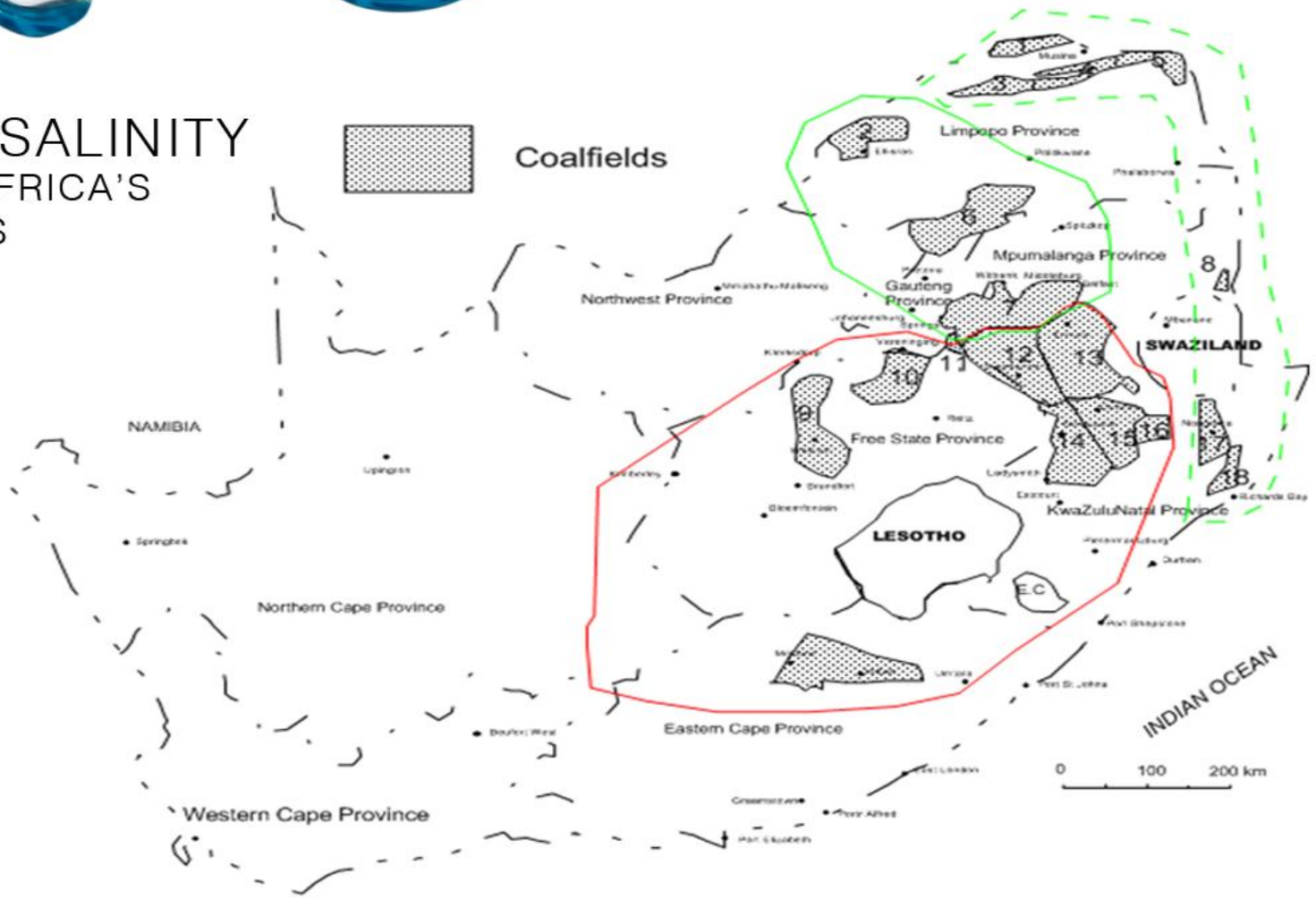
MAP OF SALINITY
IN SOUTH AFRICA'S COALFIELDS



1. Tuli; 2. Ellisras, 3. Mopane, 4. Tshipise, 5. Pafuri, 6. Springbok Flats,
7. Witbank, 8. Kangwane, 9. Free State, 10 Vereeniging-Sasoblburg
11. South Rand, 12. Highveld, 13. Ermelo (Formally Eastern Transvaal)
14. Klip River, 15. Utrecht, 16. Vryheid, 17. Nongoma, 18 Somkele, 19 Molteno-Indwe

Source: Professor B. Zhao

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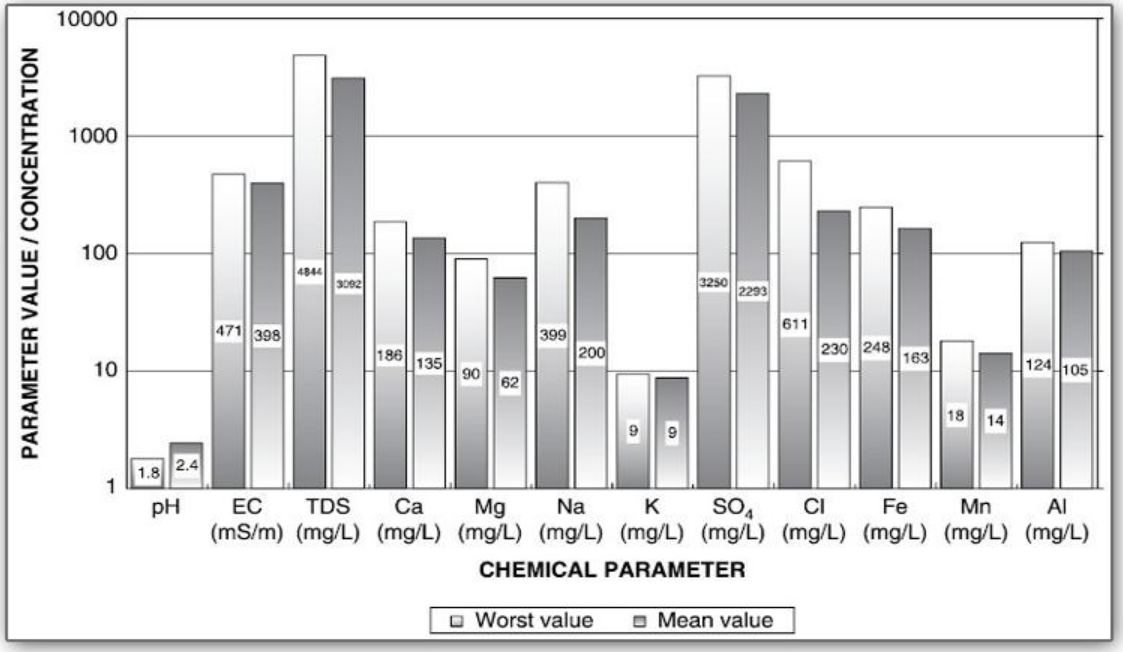
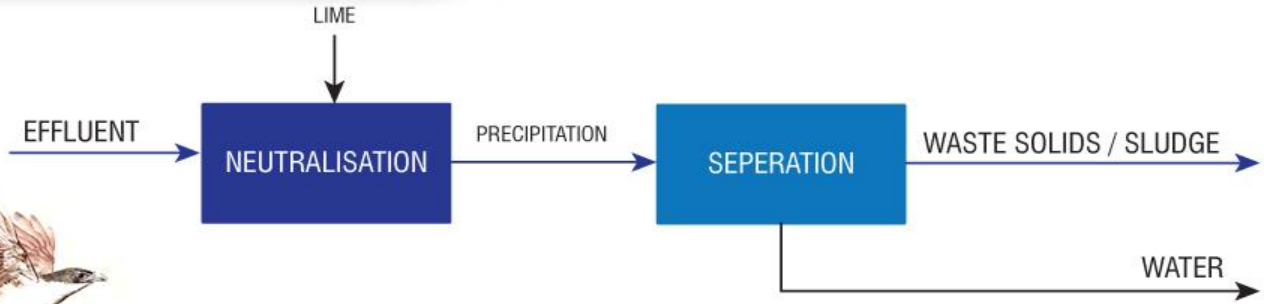
Available Solutions

STEP 1 - Neutralisation





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Putting AMD in PERSPECTIVE

RAND WATER BOARD
4100 ML/day

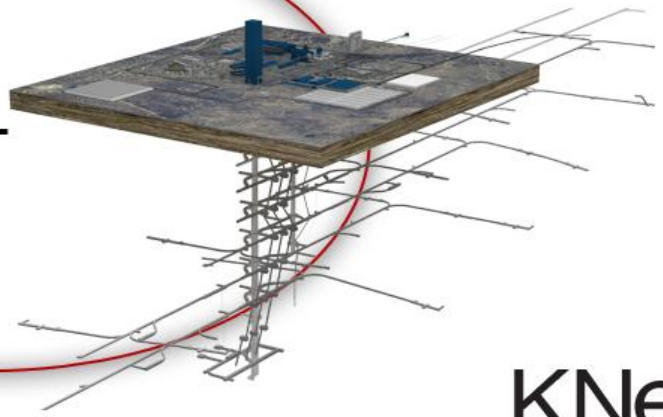
8.5%

350 ML/day

SALINE MINE RUNOFF

+

ACID MINE DRAINAGE



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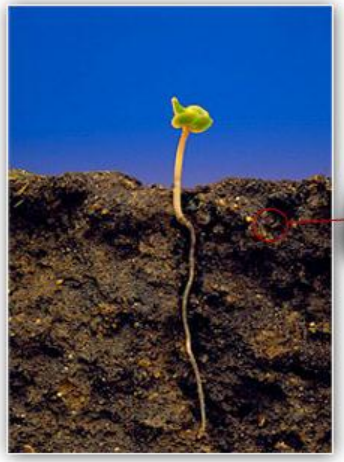
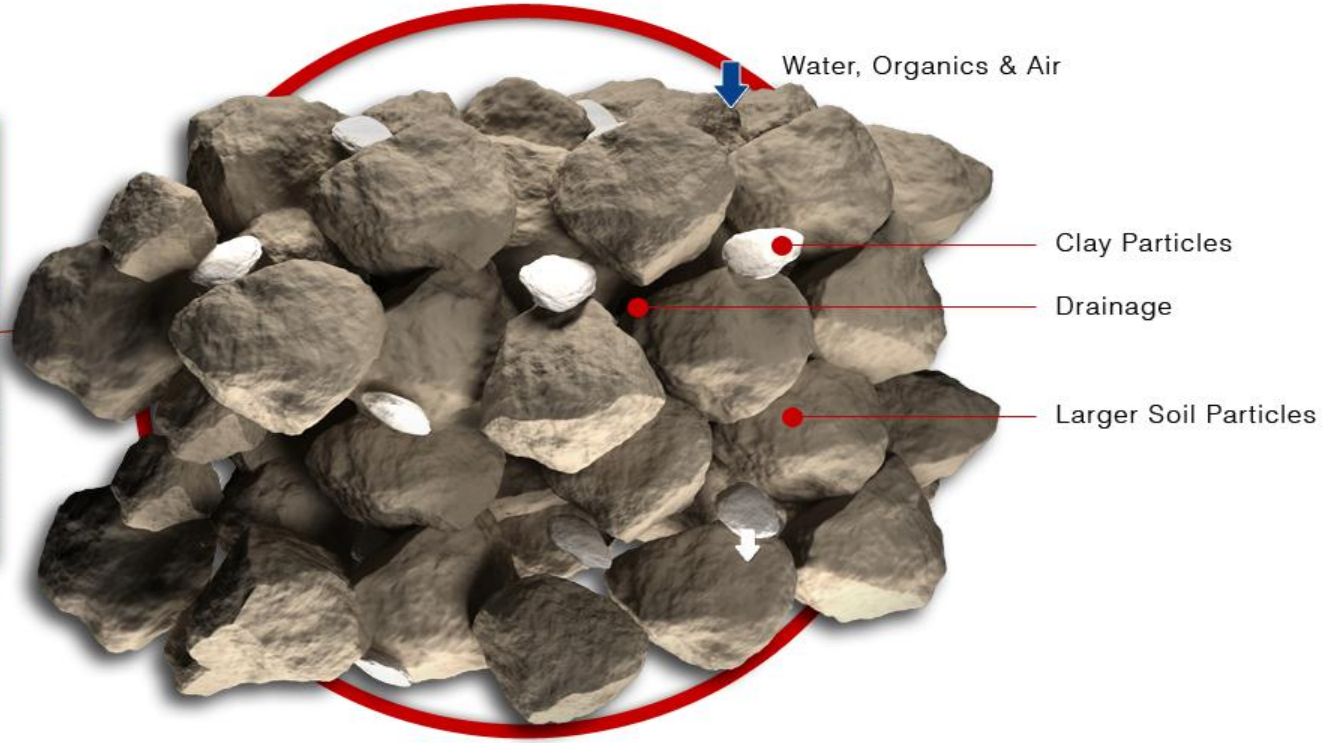
POTABLE WATER or AGRICULTURAL WATER?



Organics, Clay Particles and Minerals move through the Soil to feed & Maintain the Roots



The Physical Structure of Soil

As long as good drainage occurs, the plants are able to handle most water issues

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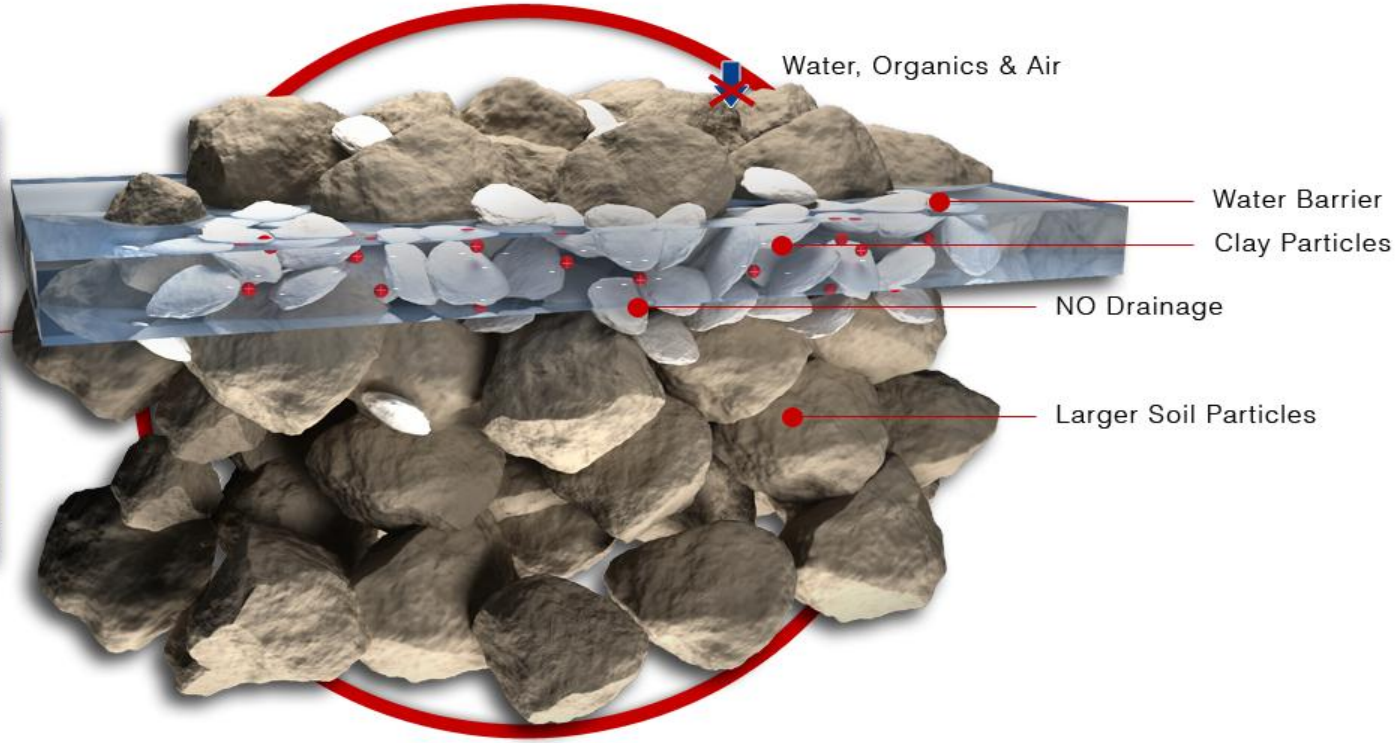
POTABLE WATER or AGRICULTURAL WATER?

Organics, Clay Particles and Minerals cannot penetrate the Soil.



The Physical Structure of Soil

Sodium modifies the Soil structure by acting as a flocculant for Clay Particles which becomes an **impermeable layer** stopping water, air and nutrient flow to the root zone

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CASE STUDY

AGRICULTURAL LOSS THROUGH SODIUM

ADDO

Sundays River

Sundays River Sodium Levels are not caused by AMD

1. 17000 ha of citrus **exporting R1 billion/year**
2. Irrigation averages 100ML/day
3. Sodium levels of **Sundays River average 140ppm**
4. Sodium levels of **soil have risen to over 2000ppm** in many areas due to irrigation with 140ppm Na water for 30 years
5. Recognised loss of yield at least 15% = **R150million /year** and will get bigger with time if not treated now
6. Average Na Level of most AMD is about 1000ppm = 350 t/day of Na, most of which will end up on our top soils and destroy about 70ha/day of good arable land

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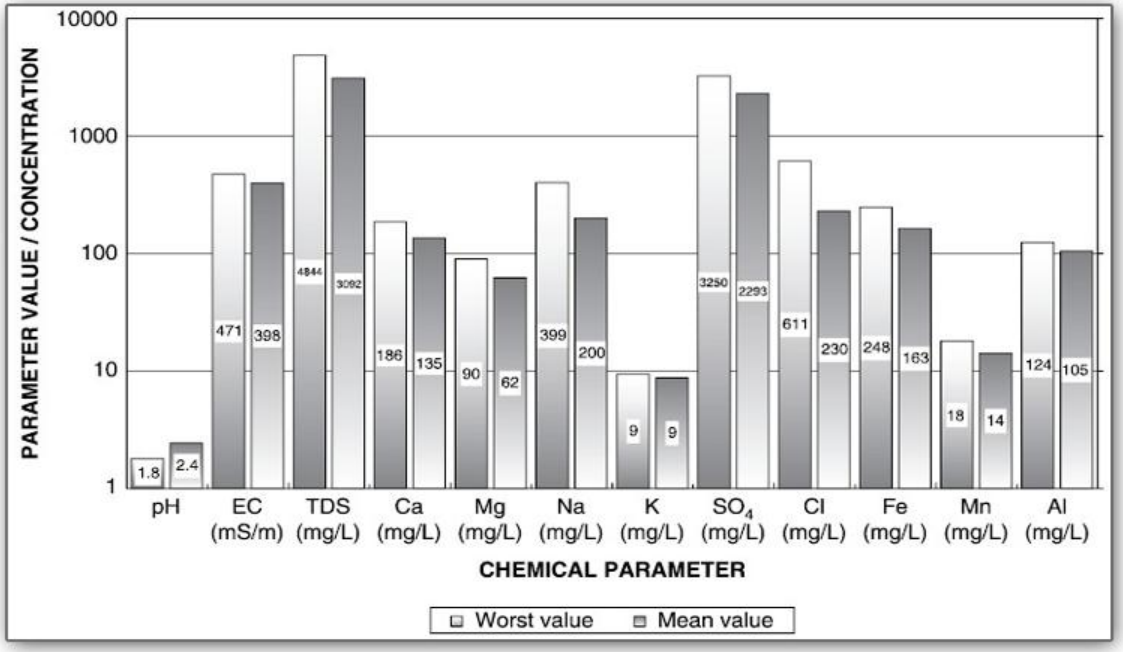
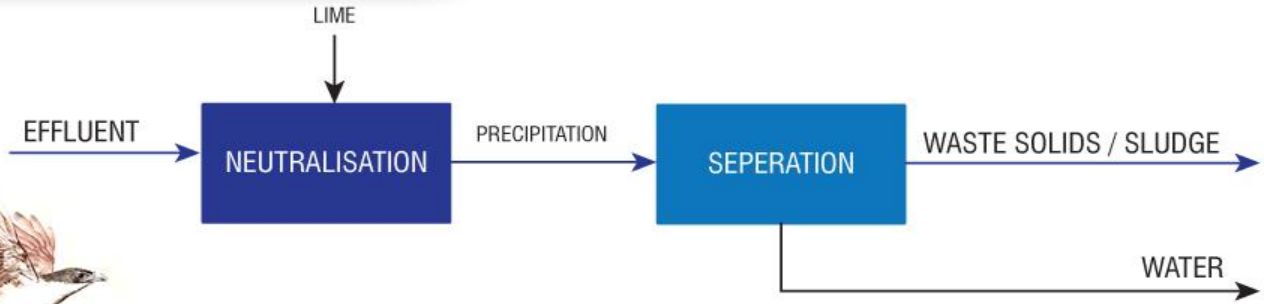
Available Solutions

STEP 1 - Neutralisation





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Available Solutions

STEP 1 - Neutralisation

LIME	SODA ASH
Specifications	
Calcium Hydroxide	Sodium Carbonate
R1300 / Ton	R2700 / Ton
By Products	
Calcium Sulphate Dihydrate (Gypsum)	Sodium Sulfate
R55/Ton	R700 - R900 / Ton
Insoluble	Soluble - not recoverable
Issues	
High Solids to WASTE	High Cost
	Higher Sodium in product water
Economically Poor	Economically Poor

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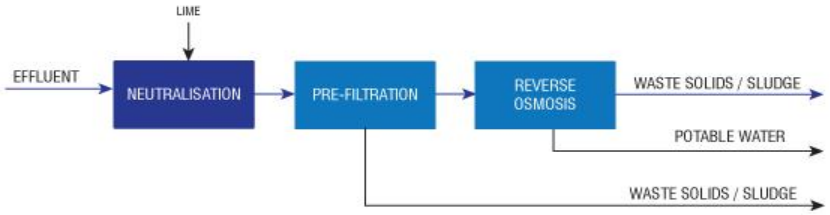
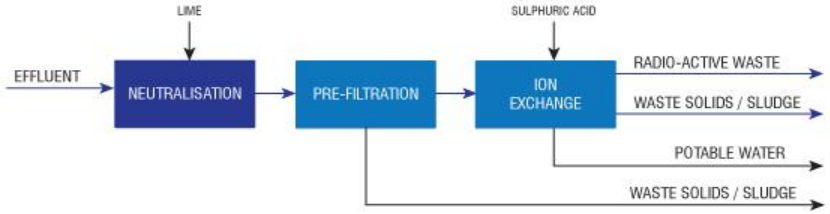
Available Solutions

STEP 2 - Cleanup Process

REVERSE OSMOSIS	CONVENTIONAL ION EXCHANGE
	
Specifications	
Can produce Potable Water	Can produce Potable Water
Overview	
Creates concentrated BRINE to dispose of	High WASTE for disposal
Cannot address SODIUM CHLORIDE issue	Can partially address SODIUM issue
Cannot separate RADIO-ACTIVITY usefully	Separates RADIO-ACTIVITY usefully
High COST to operate	Lower COST to operate
Energy Intensive	Lower Energy
$CaSO_4$ Scaling	Resins Foul with Gypsum

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Summary of treatments to date

All previous AMD treatments

- are expensive to operate
- require the product water to be sold as potable water to try to offset the cost of operation
- mostly require large expensive slimes dams in which to store the waste sludge.
- None of them address the “silent killer” – the sodium levels

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A Simple Solution

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Potasium Nitrate ex-Waste

International Patent (WO 2012-042483)

Solves SODIUM, SULPHATE & CHLORIDE issues
Removes RADIO-ACTIVITY usefully.
Low Energy Requirement
Low Heavy Metal / Waste Dumping

Produces Valuable & Commercially Pure Products
POTASSIUM NITRATE, AMMONIUM SULPHATE, DOLOMITE, SODIUM CHLORIDE.

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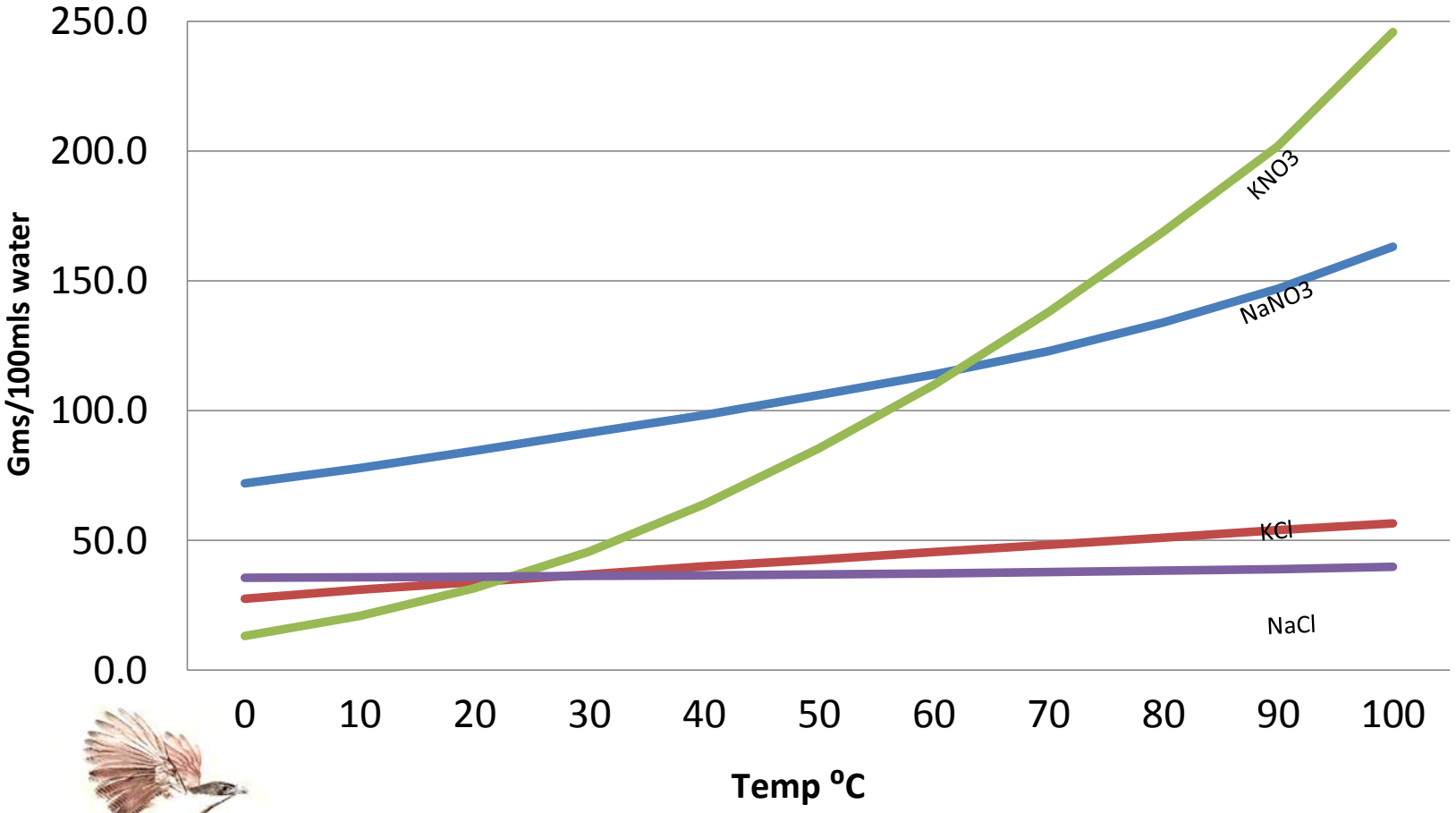
Solubilities



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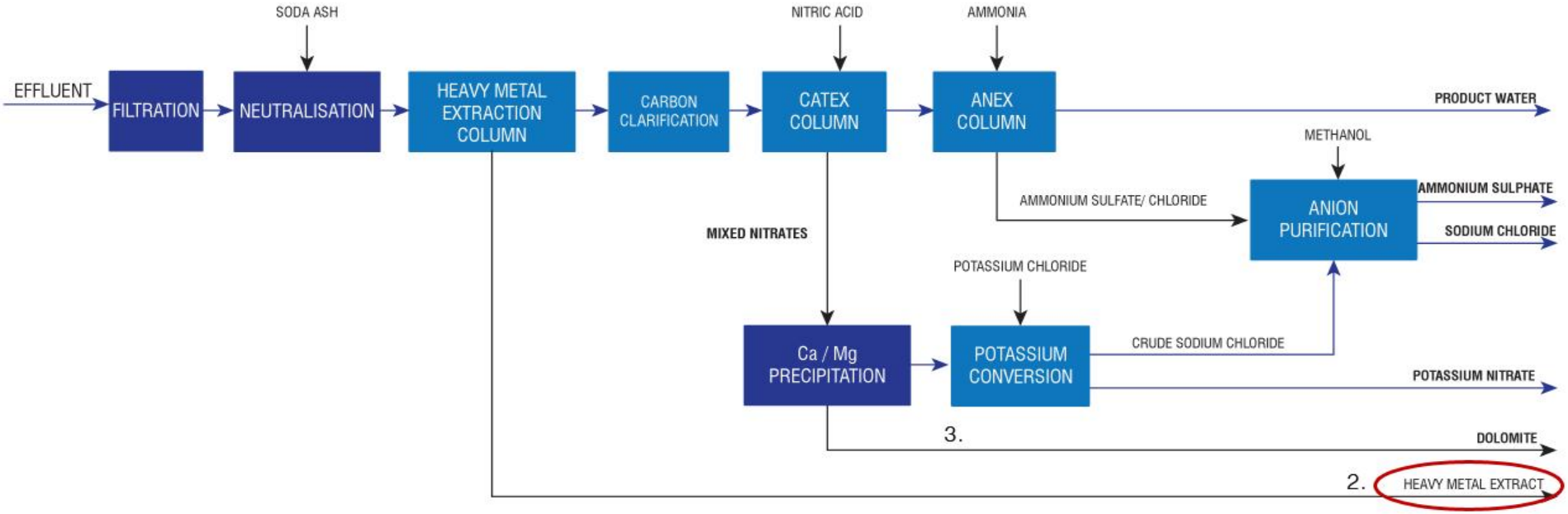

1. The KNEW process extracts all ions by ion exchange and converts the Na to useable pure Sodium Chloride
2. The KNEW process uses Soda Ash making the heavy metal content the only sludge for disposal and easy to safely delist
3. Calcium and Magnesium is converted to a pure Dolomite for soil amelioration
4. All acidity is converted to Sodium and extracted as Sodium Nitrate from the cation exchange process
5. The inherent Sodium Nitrate is converted to KNO_3 and salt by the addition of an equimolal amount of KCl
6. All anions are removed and present as Ammonium salts of Sulfate and Chloride which are separated in the Somet process to pure AS and salt

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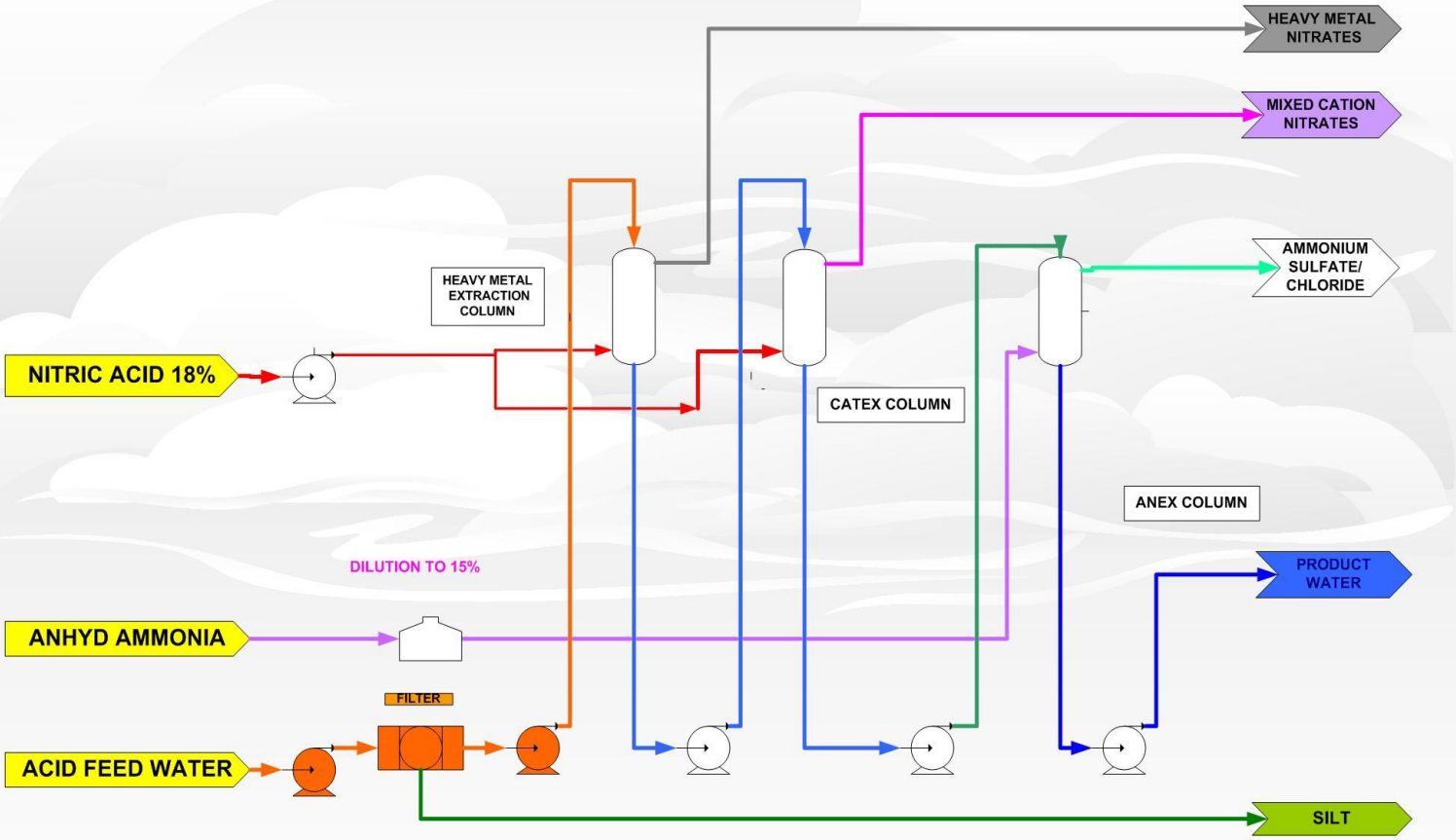
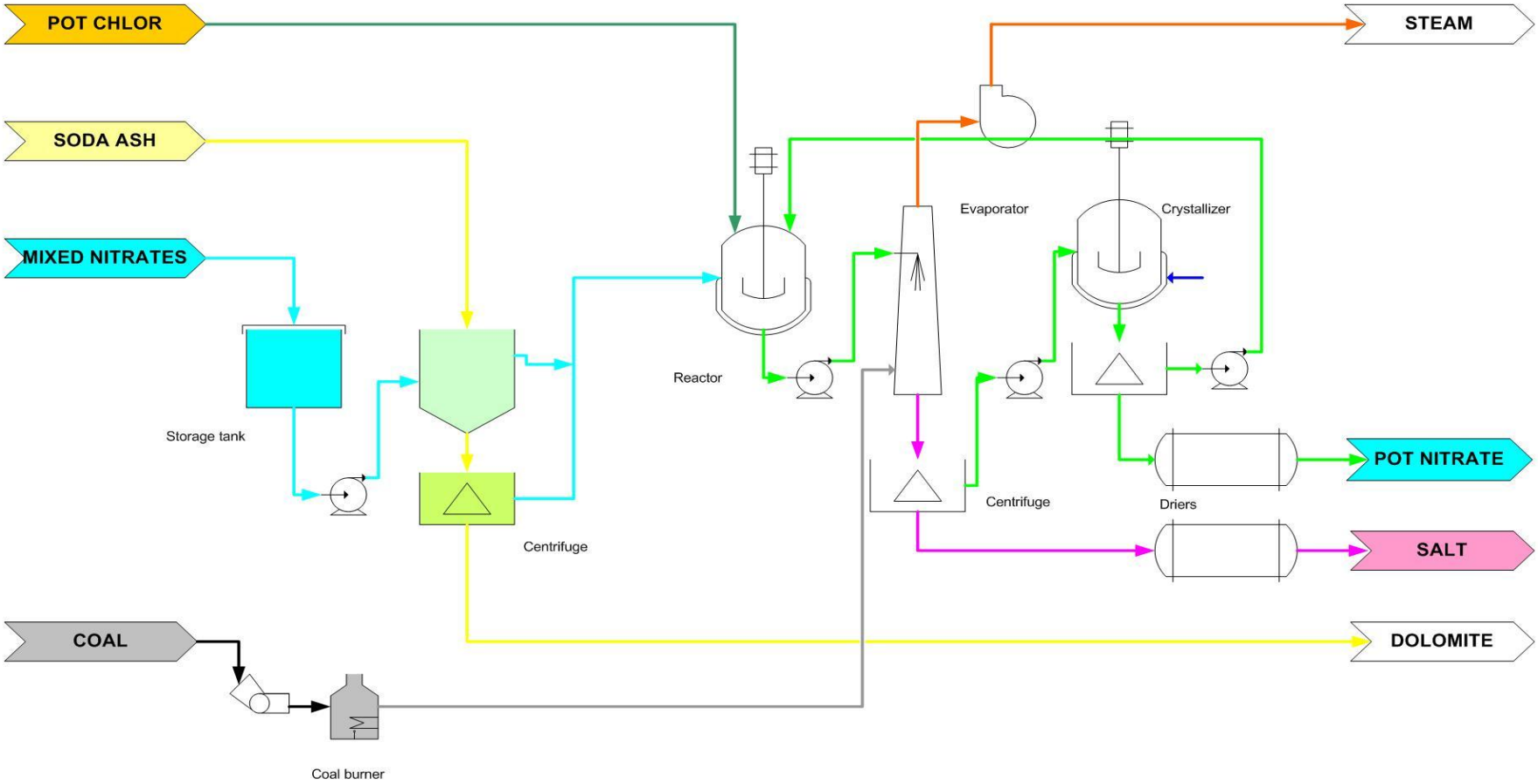
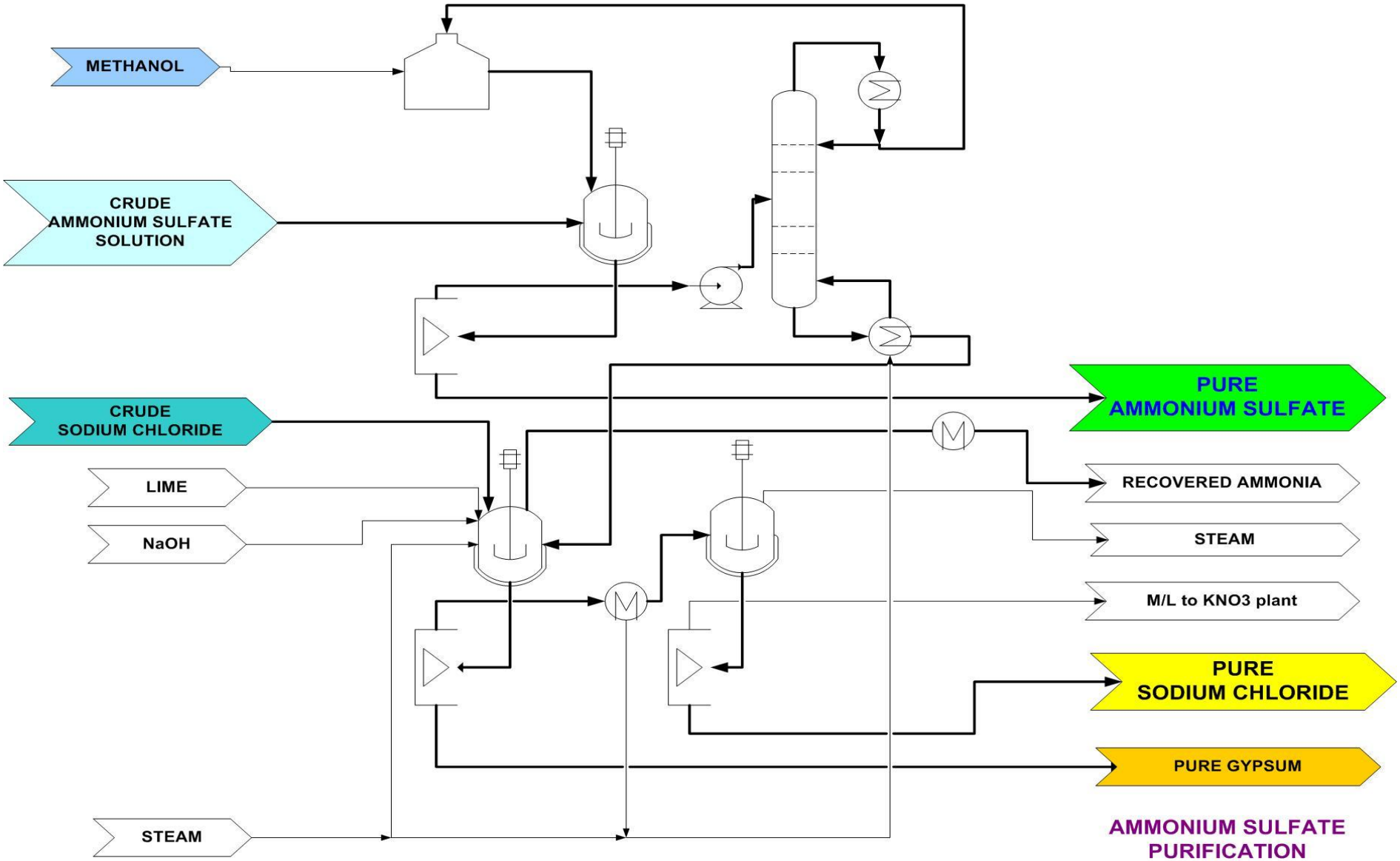


AMD IONEX FLOW DIAGRAM

05-11



POTASSIUM NITRATE PROCESS
Trailblazer Technologies (Pty) Ltd
03-10 JAB



AMMONIUM SULFATE PURIFICATION

JAB 01-11

POSITIVE ECONOMICS

The viability of the KNeW® PROCESS

The process converts **costly effluent into profitable end products**

Potassium Nitrate and **Ammonium Sulfate** are both
Highly valued Agricultural Chemicals

Greatly **reduced SLUDGE DUMPING**
(minimising the risk of a return cycle to water basins)

Ticks all the boxes in Enviromental Rehabilitation of Water

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