



Association of mine managers of Zimbabwe

November 2023

Presenter W. Nemasasi



“emerging world trends that will impact on the decision process of the future mine manager”

*nuGen™ Zero Emissions Haulage Solution (ZEHS) truck launch - Mogalakwena Mine, RSA on Friday 6 May 2023*



# Look back to 2018!

So now, let us imagine we are 5 years in the future. 2028



*August 2018  
The second  
Republic in  
Zimbabwe  
assumes  
power*



*Covid wasn't even a thing yet in  
2018*



*12 boys and their coach were trapped in a cave  
complex in Thailand recued after more than 2 weeks*



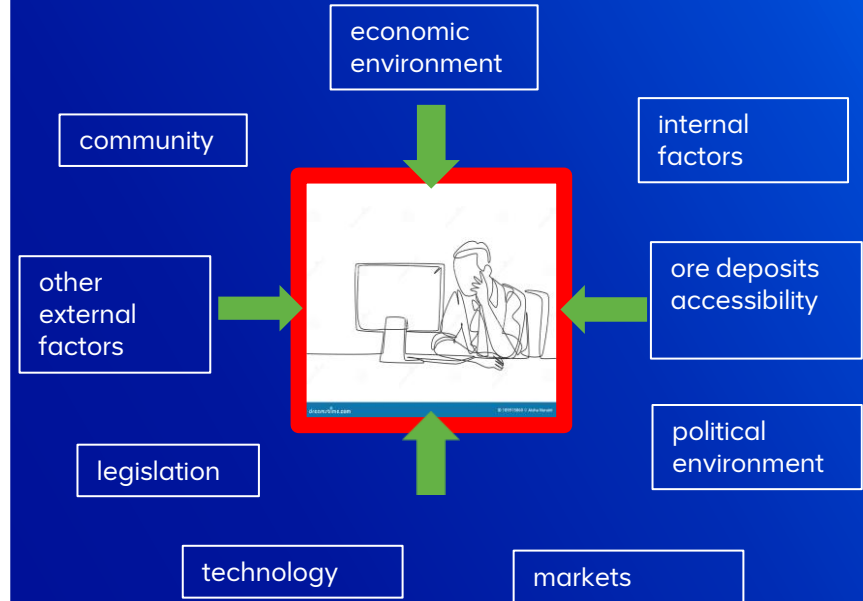
*Saudia Arabia started issuing  
driving licenses to women in 2*

# introduction

## changing world

- rapid technological advancement
- volatile economic environments
- politically unstable periods
- rising influence of civic organizations & NGOs
- call for responsible mining (IRMA)
- license to operate
- zero tolerance to environmental damage & zero injury to people
- fluctuating global metal prices
- episodes of high inflation

mine managers must carefully navigate the business internal and external context and adopt agile strategies to ensure mine viability



# mining technology

- **drilling**

jack hammer → muti-boom drill rigs autonomous rigs → tbms

- **machines**

maned → remote controlled → autonomous machines

- **access and equipment**

manual → wheelbarrow → winches → locos → trackless/conveyors → autonomous machines → robots

- **energy use and optimization**

coal → diesel → electricity → clean source of power → conservation of power (solar, ventilation on demand)

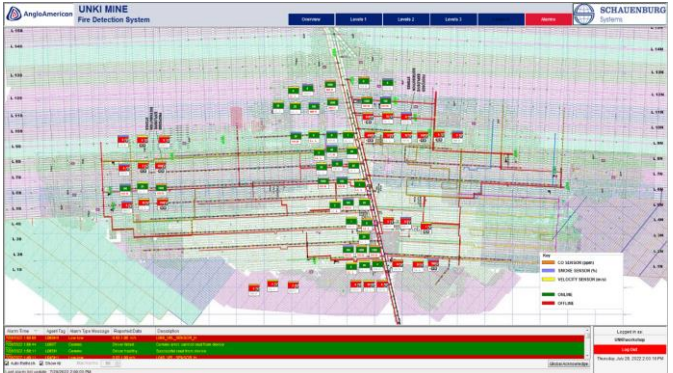
- **ore accounting and survey**

tape & ties → ranging rods and staff → theodolite & weightometres → gps → laser scanners.

- **proximity Detection system (Safety)**



# evolution of gas testing and monitoring systems



Unki upgraded its RRMS to provide front line defense against fire/gassing in 2023. System has fixed smoke and gas sensors in the main and section intakes, strike conveyor head and tail (covering the section served by the belt and is connected to the Scada system.



real time remote monitoring (RRMS)



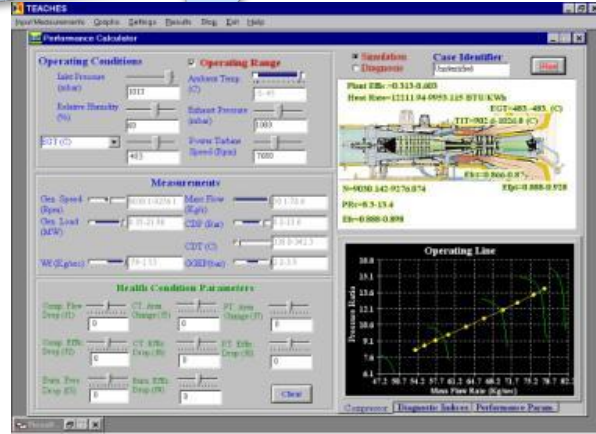
use of canary birds



use of Dave safety lamp

Auer II manual pump and chemical detector tubes

electronic multi-gas detector



# digital mining an opportunity to transform current mining methods

## opportunity

Mining's digital potential lies in leveraging a unique combination of digital and physical assets

## approach

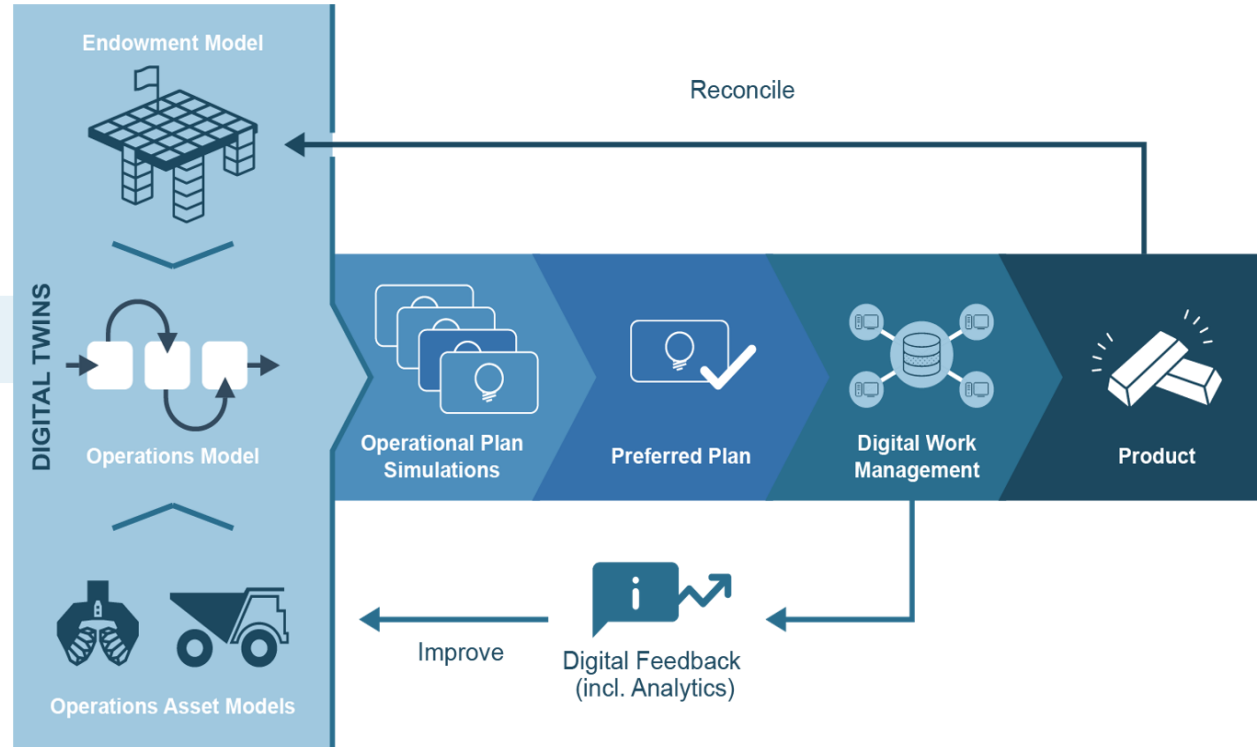
- The use of modelling & simulation ("digital twins")
- Improving the current business model (assets, processes and people)
- Standard use of machine learning

## challenge

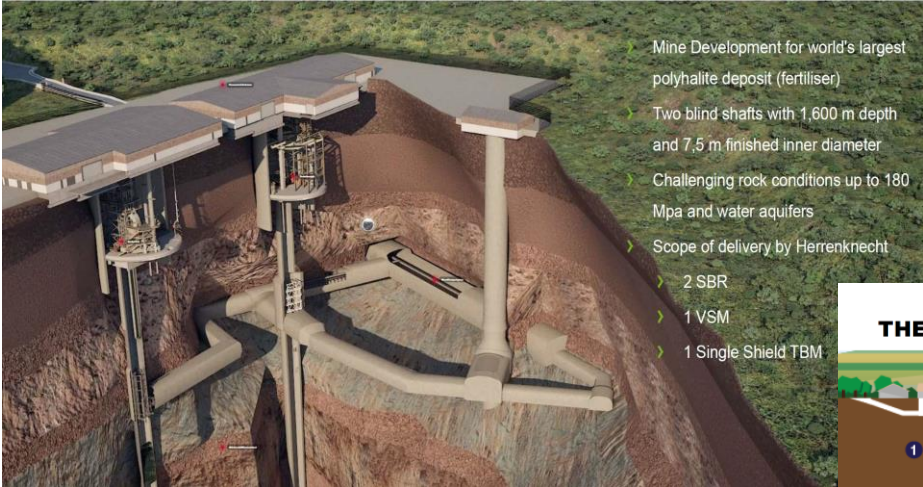
Predict and shape operational outcomes

## approach

- Digital planning & work management
- Predictive condition-based monitoring and maintenance
- Advanced process control
- Automation



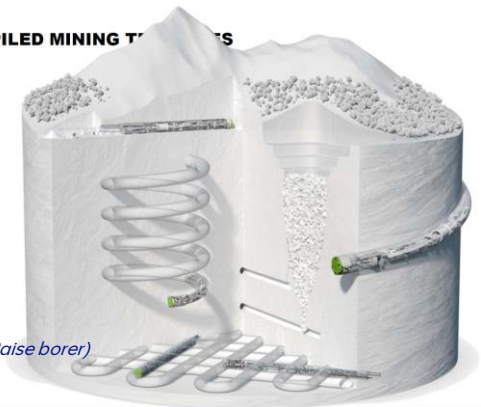
# tbms in mine development



## HERRENKNECHT COMPILED MINING TECHNOLOGIES

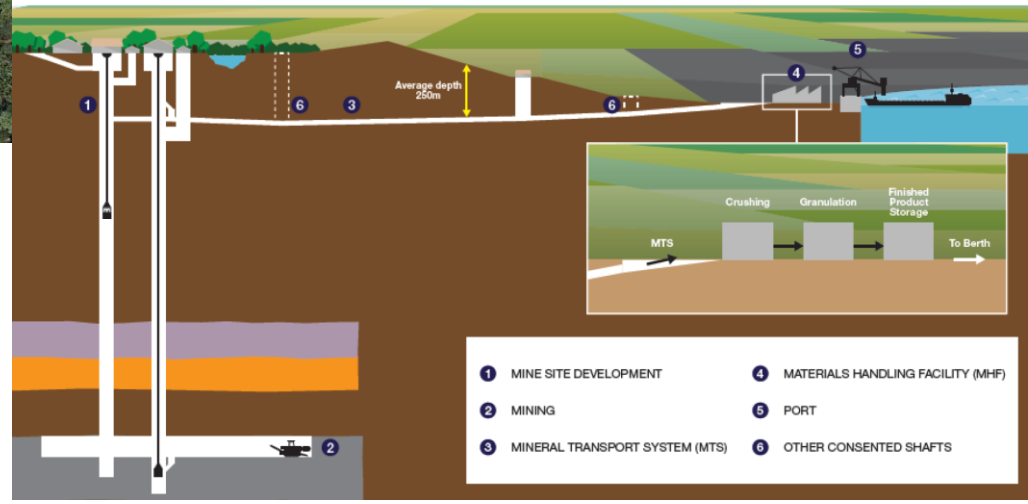
Overview

- Standard TBM
- Helix/ Ramp TBM
- Decline TBM
- Horizontal infrastructure TBM



- SBR: Shaft Boring Roadheader
- VSM: Vertical Shaft Boring Machine (Raise borer)
- TMB: Tunnel Boring Machine

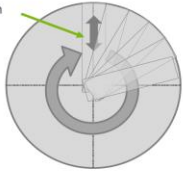
## THE WOODSMITH MINE PROJECT



### SHAFT BORING ROADHEADER - SBR

Excavation and Mining Cycle

Starting position of mining cycle



- Steps of Mining Cycle:
  - Cut trench in 120° clock
  - Move boom to center position
  - Slew a few degrees clockwise
  - Cut next trench
  - Repeat until in 120° clock position
  - Extension of the boom
  - Re-start of the cutting cycle
  - When 1m of the bench is cut, the SBR will be lowered 1m and the Mining Cycle starts again...





## robotics

devices powered by artificial intelligence

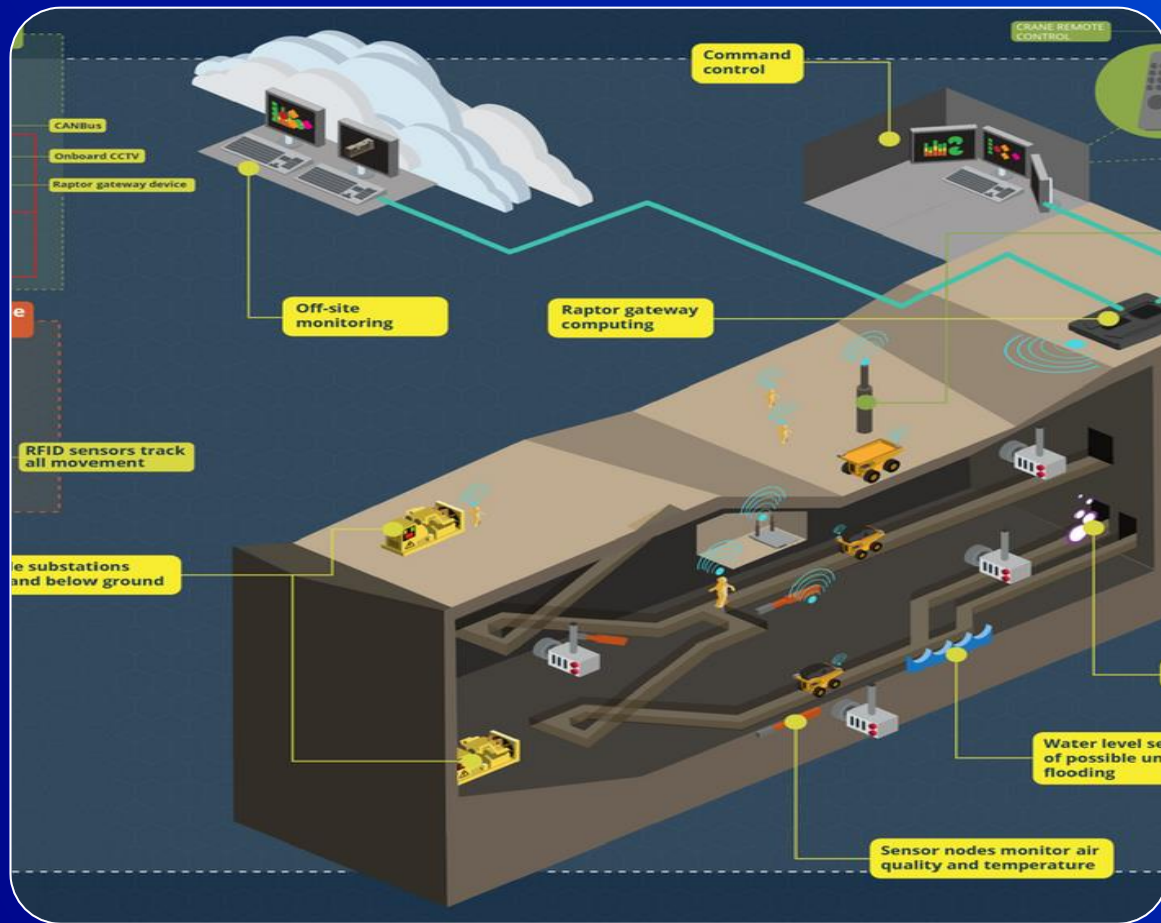
- drilling, blasting loading
- conveyance, bolting and sampling etc.

## remote operating and monitoring platforms

- improved safety
- stable operations
- variability
- preventive to predictive maintenance

## benefits

- costs & productivity
- Safety
- quick decision & stock management



## internet of things

convergence of wireless technologies and mining offer new ways of maintaining mine safety and productivity.

- micro-electromechanical systems
- Internet, for transform

## Remote operation

- removes operator from potentially hazardous work areas.

## automation

- self operating with personnel off site

# mobile miner

Every miners dream!



"One machine, in one heading, operated by only one person **continuously** excavating rock, easy to transport on conveyor or even in a pipe."

Compared to drill and blast:

- Reduced preparation costs
- No tied up capital in open drifts (excl. machine)
- Very low ventilation costs
- Reduction in rock support cost
- No environment impact due to gases, vibrations, sounds or other emissions
- Mine development lead times lowered by up to 45%
- Small step to full automation compared to D&B



### *MN330 Rock Cutter Project*

*A mechanized cutting machine designed to operate in low stoping widths (+/- 1.5 m) and steep dipping angles =<30°. In 2018 – 2019 a study in conjunction with Sandvik was done to develop the MN330 Rock Cutter, and a suitable mine design that can accommodate all the equipment. The equipment is undergoing trials at Borwa Shaft Mototolo Mine ( Anglo American Platinum, RSA)*

*Great Dyke Roadheader Project ( 1990 -1994) Mutorashanga, Zimbabwe  
A joint venture :Ministry of Mines, Union Carbide and Zimbabwe Alloys embarked on a Roadheader ET1 10 plus Joy 14CM5 continuous miner on narrow chrome seams . Attempts used coal-based technologies equipment experienced too many breakdowns*

# Mining and processing activities with minimum footprint disturbances

Pyhasalmi Mine (Finland)  
Zinc -Copper deposit



# Mining and processing activities with minimum footprint disturbances

LaRonde Mine (Quebec, Canada)  
Gold Deposit



# processing technology



## 1 Safer

- **Processing without Harm**
- Removing people from harm through automation and robotics



## 2 Cleaner

- **Reimagining the processing value chain** to support the Living Mine and Circular Economy
- Developing **self-sustaining plants**
- Evaluating our role as a **secondary producer**



## 3 Smarter

- Integrating **augmented people and plant**
- Adopting **precision processing** to maximise separation and recovery efficiency
- Designing **modular flexible plants** that are responsive to changes in input and output parameters

**We empower the communities where we operate**

Leaving thriving sustainable communities after we leave



# Processing without Harm: 2030 Breakthrough Vision



## 1 FutureSmart Processing – Safer



## online analyzers

- plant feed particle size distribution (PSD) (Lynx cameras) optimizing to improve plant throughputs through better PSD consistency.
  - Significant plant throughput increases can be realized.
  - Some Anglo operations are using these.
- online analyser (OA) for flotation, smelting and refining facilities gives real-time plants performance resulting in improved plant control, better efficiencies through real time interventions
  - conventional laboratory methods have high TATs of around 24hours.
  - applications in base metals prevalent

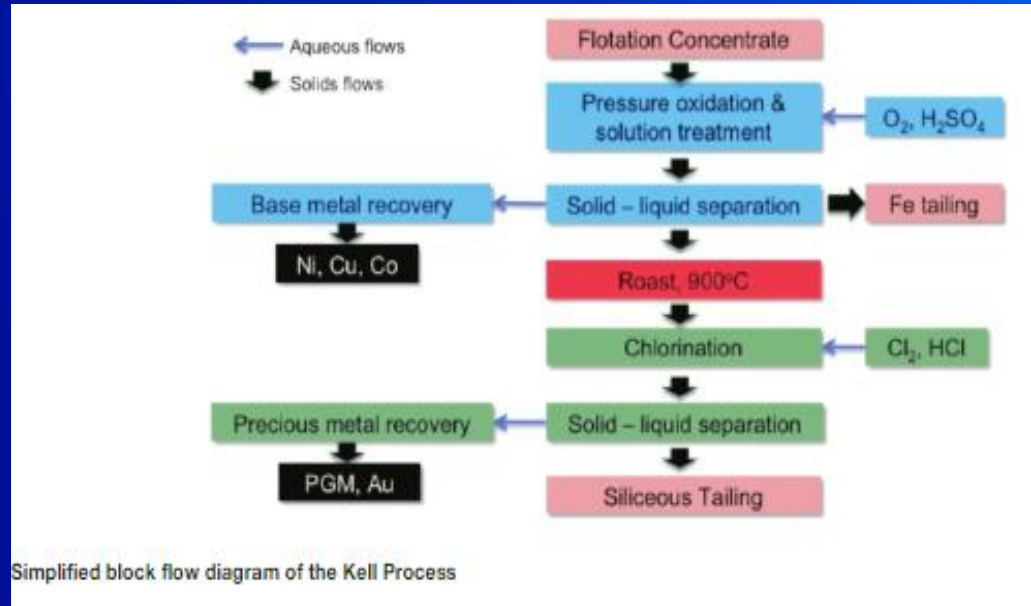


## Kell hydrometallurgical process

- direct extraction of platinum group metals extraction and base metals from flotation concentrates

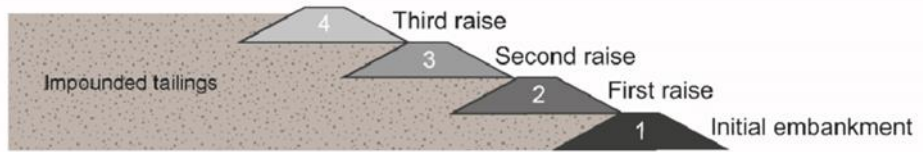
- Total energy consumption—50% reduction.
- Electrical energy consumption—84% reduction.
- Energy consumption costs—76% reduction.
- CO<sub>2</sub> emissions—70% reduction.
- Installed power requirement—92% reduction

(K Liddell, T Newton, M Adams & B Muller, 2010)

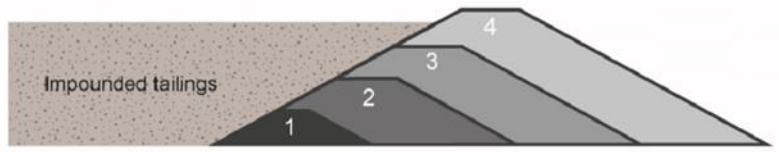




# tailings storage facilities (TSFs)



Upstream construction method



Downstream construction method



Centreline construction method

Upstream ( outlawed) Centre line (yes) Downstream (maybe too costly)

2019 Brumadinho dam disaster (Brazil) triggered changes in tails facilities management ( GISTM)

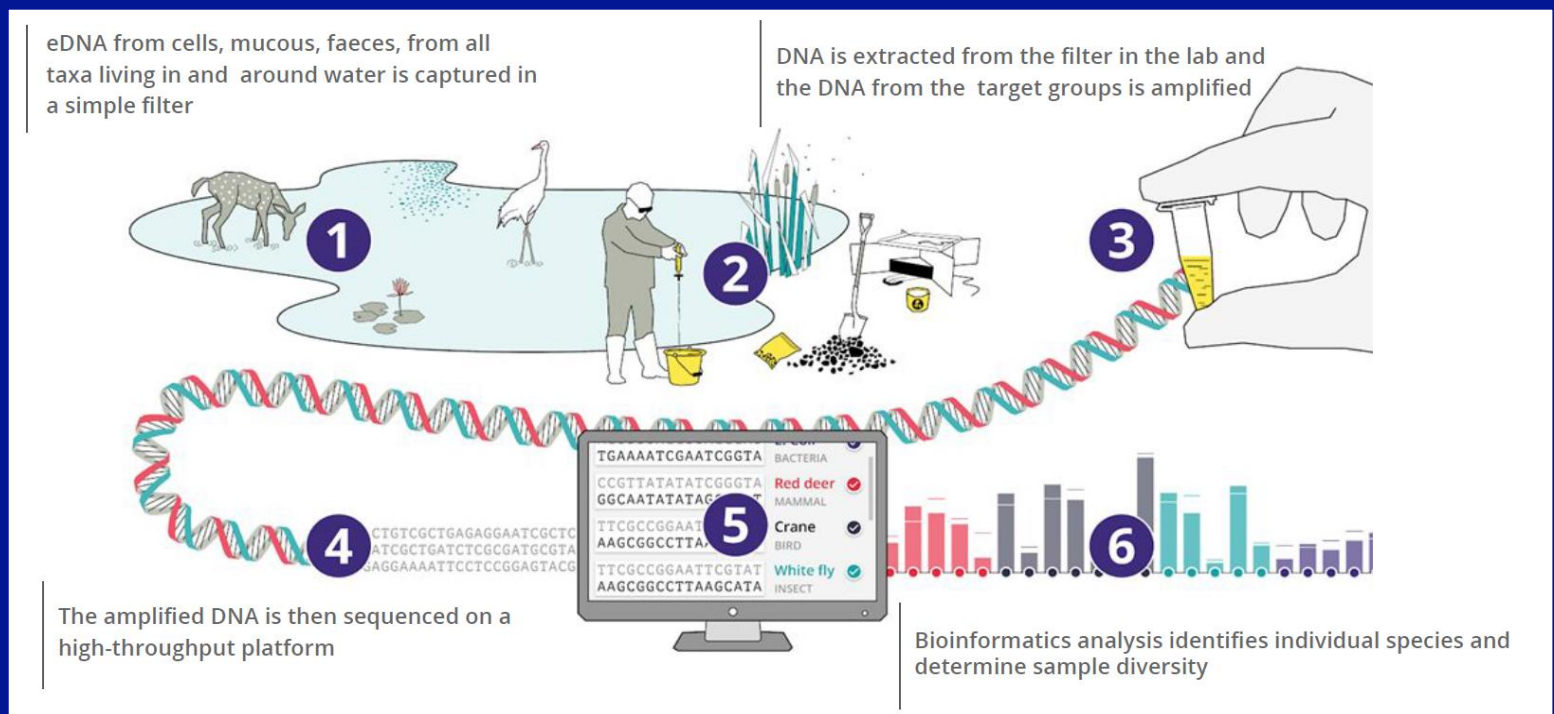


*Church of England Pension Board, together with Council of Ethics of the Swedish Nation Pension Funds lead a collaboration of investors with over usd\$20 trillion in assets under their management to press for further investigations 2 years after the disaster - resulting in the creation of independent global monitoring group on TSFs*

# biodiversity monitoring using eDNA

why eDNA biomonitoring technique ?

all living organisms leave traces of their DNA in the environment. eDNA techniques identifies individual species DNA from small samples of soil, sediment, water and air. eDNA analyze both existing and historical species in an environment.



# inclusion and diversity

- eradication of gender-based violence in the workplace
- equal employment opportunities for all irrespective of gender
- gender balance at all levels of the organisation
- gender sensitive policies and facilities



## environment

## social

## governance

## advancing to a greener world

- **reduction of CO2 emissions**  
*hydrogen-powered vehicles e.g. nuGen truck.*
- **maintaining a healthy environment**  
*Improving air quality e.g. capturing SO2 from smelting plants.*
- **protecting bio-diversity**  
*Protecting threatened species and essential ecological processes e.g. eDNA sampling.*
- **renewable energy**  
converting electricity power to renewable energy e.g. solar.
- **reducing water use and waste**  
*recycling and reuse*



## collaboration with communities and countries for a better future

- **being ethical and accountable**  
*ethical mining, responsible sourcing and Listening to our host communities.*
- **building thriving communities**  
*supporting job creation in communities, Investing in education, health, water, sanitation and livelihoods*



## good corporate governance

- **risk management**
- **compliance to standards**
- **ethical and transparent business practices**
- **avoiding conflict of interest**

# Initiative for responsible mining assurance (IRMA)

IRMA standard defines responsible mining through over 400 requirements, across four principles.



## 1 Business integrity

- Legal compliance
- Stakeholder engagement
- Human rights due diligence
- Revenue transparency / Anti-corruption

## 2 Planning for positive legacies

- Environmental and social impact assessment and management
- Resettlement
- Emergency preparedness and response
- Planning and financing reclamation and closure

## 3 Social responsibility

- Labour rights
- Worker health and safety
- Community health and safety, security

## 4 Environmental responsibility

- Water management
- Waste (tailings) management
- Air quality
- Biodiversity, ecosystem services, protected areas



“How do we make more of what’s in and on the earth, to make the most of life on it?”

*(Charles Eames)*



Thank you