WASTE ROCK MANAGEMENT AT SANGATTA COAL MINE –

A CULTURAL CHANGE

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WASTE ROCK MANAGEMENT
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ACKNOWLEDGEMENTS
Deddi Handiko
Matthew Orr
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"ACID DRAINAGE IS THE MOST SIGNIFICANT ENVIRONMENTAL MANAGEMENT ISSUE FOR THE MINING INDUSTRY"
IT IS AVOIDABLE
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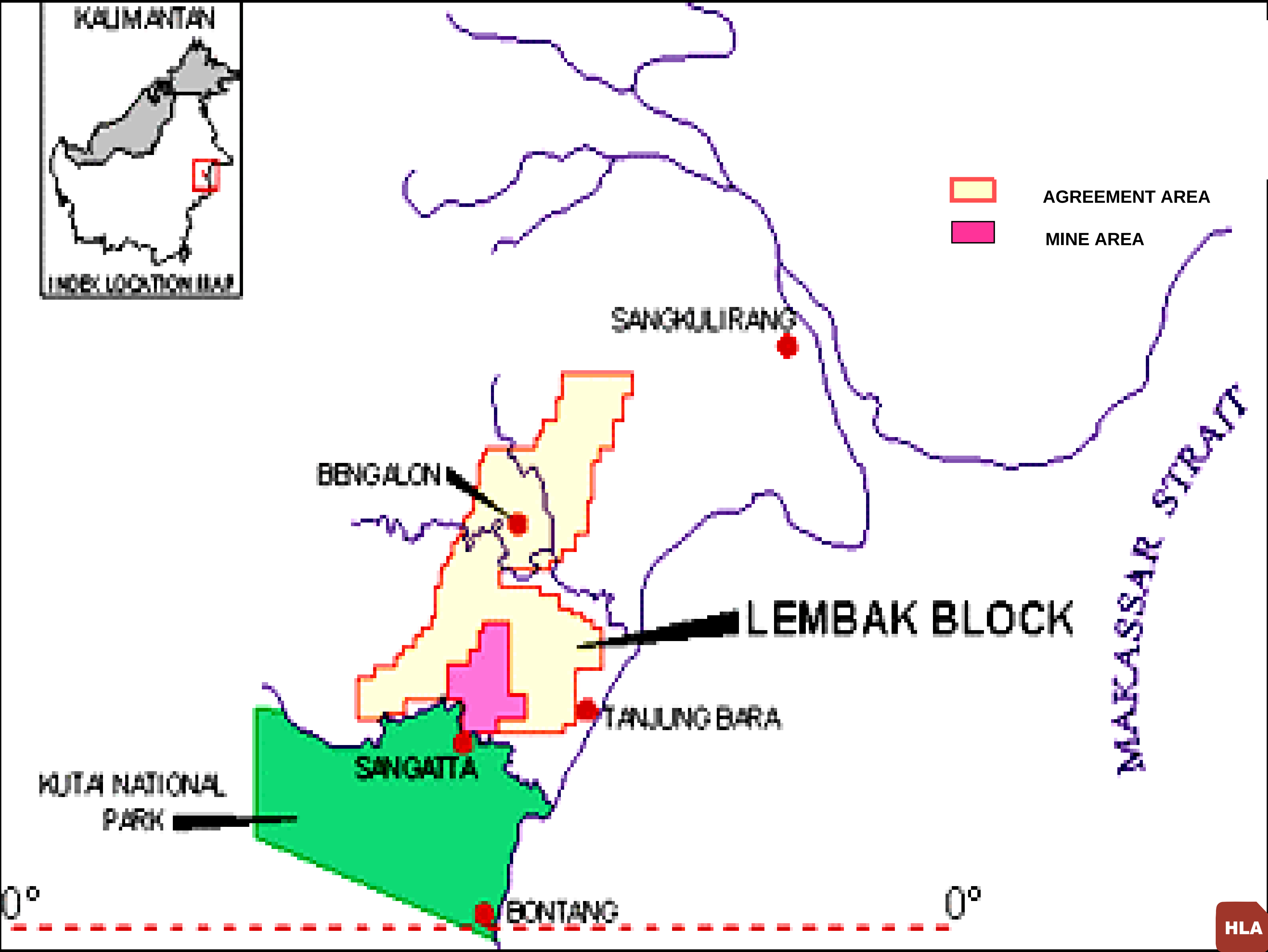
INDONESIA

THAILAND
CAMBODIA
SOUTH CHINA SEA
PACIFIC OCEAN
PHILIPPINES
BRUNEI
SINGAPORE
KALIMANTAN
SUMATERA
SULAWESI
JAVA SEA
JAVA
BALI
TIMOR
INDIAN OCEAN
AUSTRALIA



KALIMANTAN
INDEX LOCATION MAP
AGREEMENT AREA
MINE AREA
SANGKULIRANG
BENGALON
LEMBAK BLOCK
TANJUNG BARA
SANGATTA
KUTAI NATIONAL PARK
MAKASSAR STRAIT
0°
0°
BONTANG

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CULTURAL CHALLENGE

- Changing the way a mine traditionally operates to solve a very serious environmental and potentially high cost problem
- Changing the culture of Mine management at one the Worlds largest coal mines
- Used science to cross cultural boundaries
- Good news story

SETTING

- Sangatta Coal mine formerly owned and operated by PT Kaltim Prima Coal is located in undulating coastal uplands of East Kalimantan 1 degree north of the equator
- The site has an equatorial climate with a high annual rainfall of 2500mm
- The mine is one of the Worlds largest truck and shovel operations with large volumes of overburden mined annually with a high stripping ratio
- Pyrite is the principal sulfide in the waste rock

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SETTING

- Potentially acid forming waste rock (PAF) containing pyrite represents 20% of the overburden that will be mined to extract the coal resource.
- The way the mine PAF waste was being mixed with non-acid forming waste (NAF) which meant that most of the dumps could potentially generate acid drainage
- This had to be changed to control acid drainage

PRODUCTION

148 Bcms moved to produce 18 Mtonnes of coal

Waste rock is removed and placed in waste rock dumps to provide 290 Hectares for rehabilitation

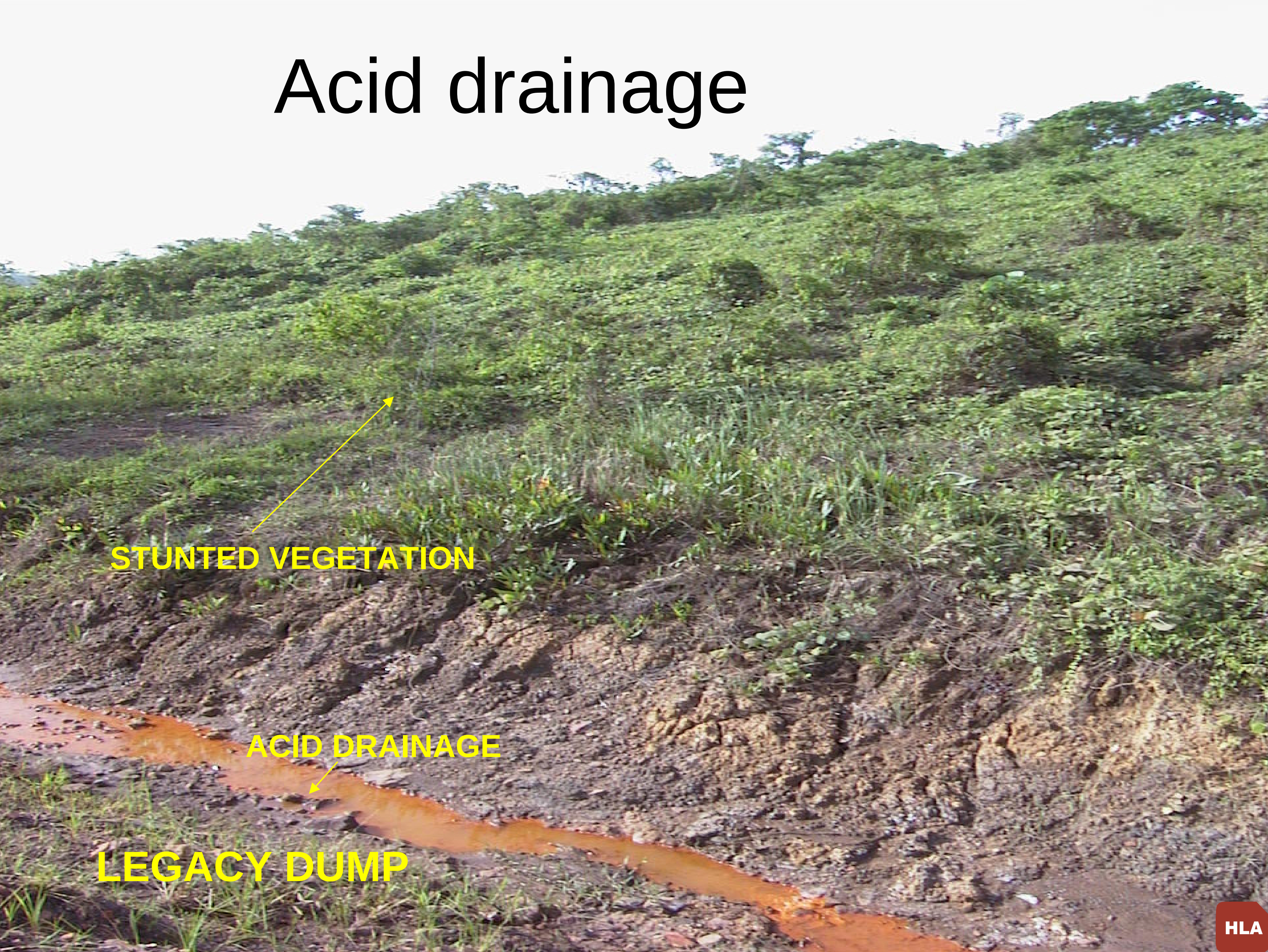
3 main pits are currently operating

400,000 bcm waste rock are moved daily to four dump areas

HISTORY

- Acid Drainage was not considered an issue for the overburden when mining commenced in the early 1990s
- Sulfides and AD potential had been recognised within the coal washings
- The first pit had produced low AD generation
- The next pit started to generate AD in 1994 from waste dumps (legacy dumps)
- Detailed testing of overburden was undertaken to determine AD potential after mine start-up
- Retro-engineering to cap and cover acid generating legacy dumps

Acid drainage




Acid drainage generated from
exposure of seam roof and floor
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CULTURAL CHALLENGE

- AD was extensive with most of the dumps generating acid and AD diverted to large holding ponds for treatment
- Needed to reduce to a manageable state the acid drainage within the site, reduce the cost of reprocessing waste dumps and eliminate legacy dumps
- Needed to change the way the mine operated with respect to its waste handling
- In effect we had to create a cultural change in the thinking of the mine management
- Assisted by a smart young geologist Deddi Handiko and supported by the General Manager of Health Safety and Environment Matthew Orr

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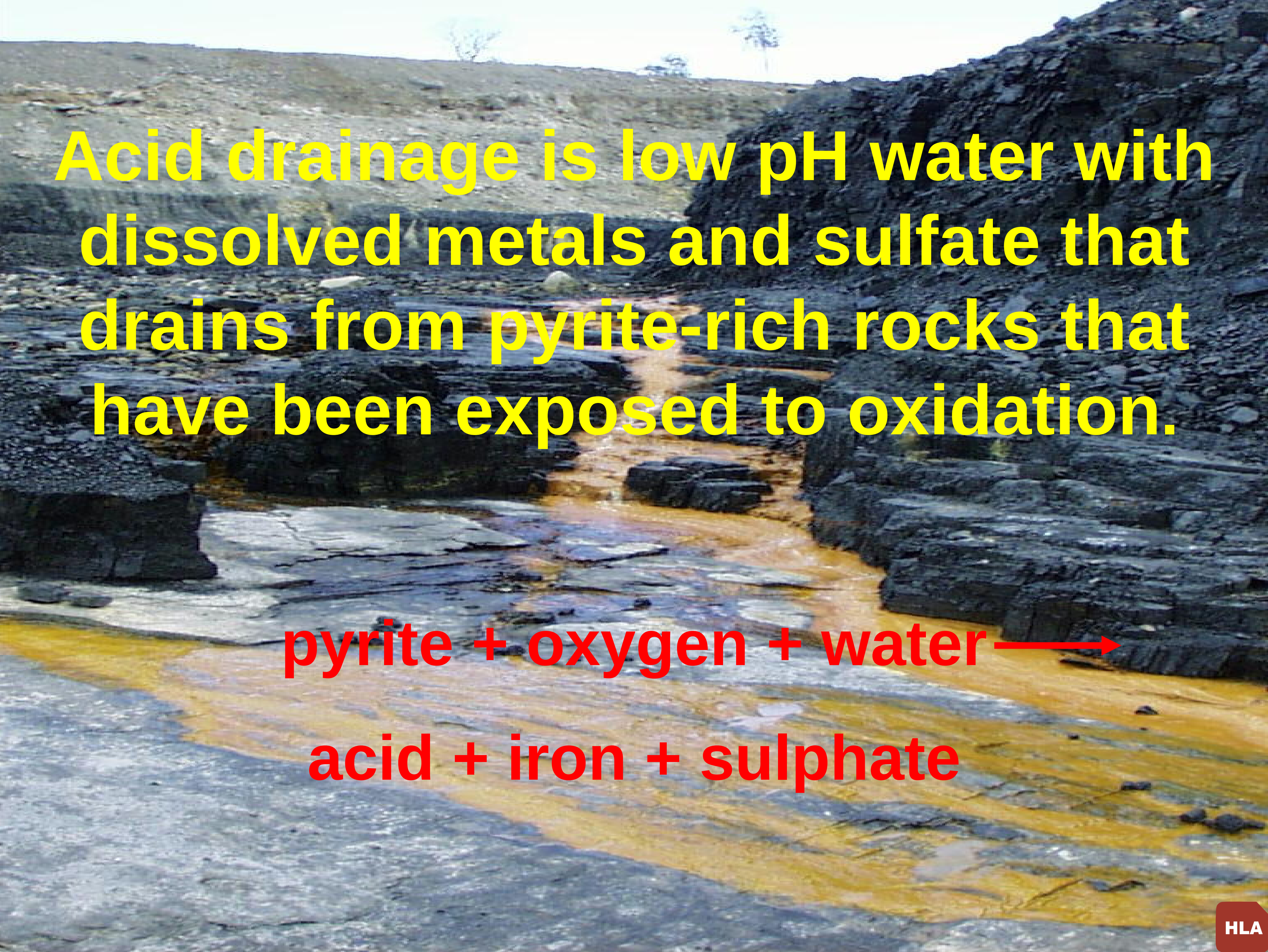
Acid drainage is low pH water with dissolved metals and sulfate that drains from pyrite-rich rocks that have been exposed to oxidation.
pyrite + oxygen + water ⟶
acid + iron + sulphate
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HISTORY

- Waste classification complex 7 waste classes based on NAG pH
- Broad drill hole spacing used to define waste distribution - grid spacing 500-1000m
- Blast hole sampling used to define handling of waste
- Limited onsite lab capacity for testing blast holes samples for AD
- Short and long term planning of waste was interpreted manually to calculate the quantity of potentially acid forming overburden
- Acid drainage was common within the mine area and waste dumps
- No discharge to the environment had occurred
- Controlling acid drainage appeared impossible

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CURRENT

- Waste classification simplified
- Detailed sampling for Waste definition in proposed pit areas drilling grid 100m spacing
- Computer modelling of Waste used to define *in situ* waste rock distribution
- Waste sampled from blast holes to validate waste model in pit only
- Lab capacity increased to 400 samples per day processed and QA check by two offsite labs
- Waste model merged with resource model and waste schedule for ROM generated for selective mining and placement of NAF and PAF waste
- Mining Department were encouraged to take responsibility for AD management

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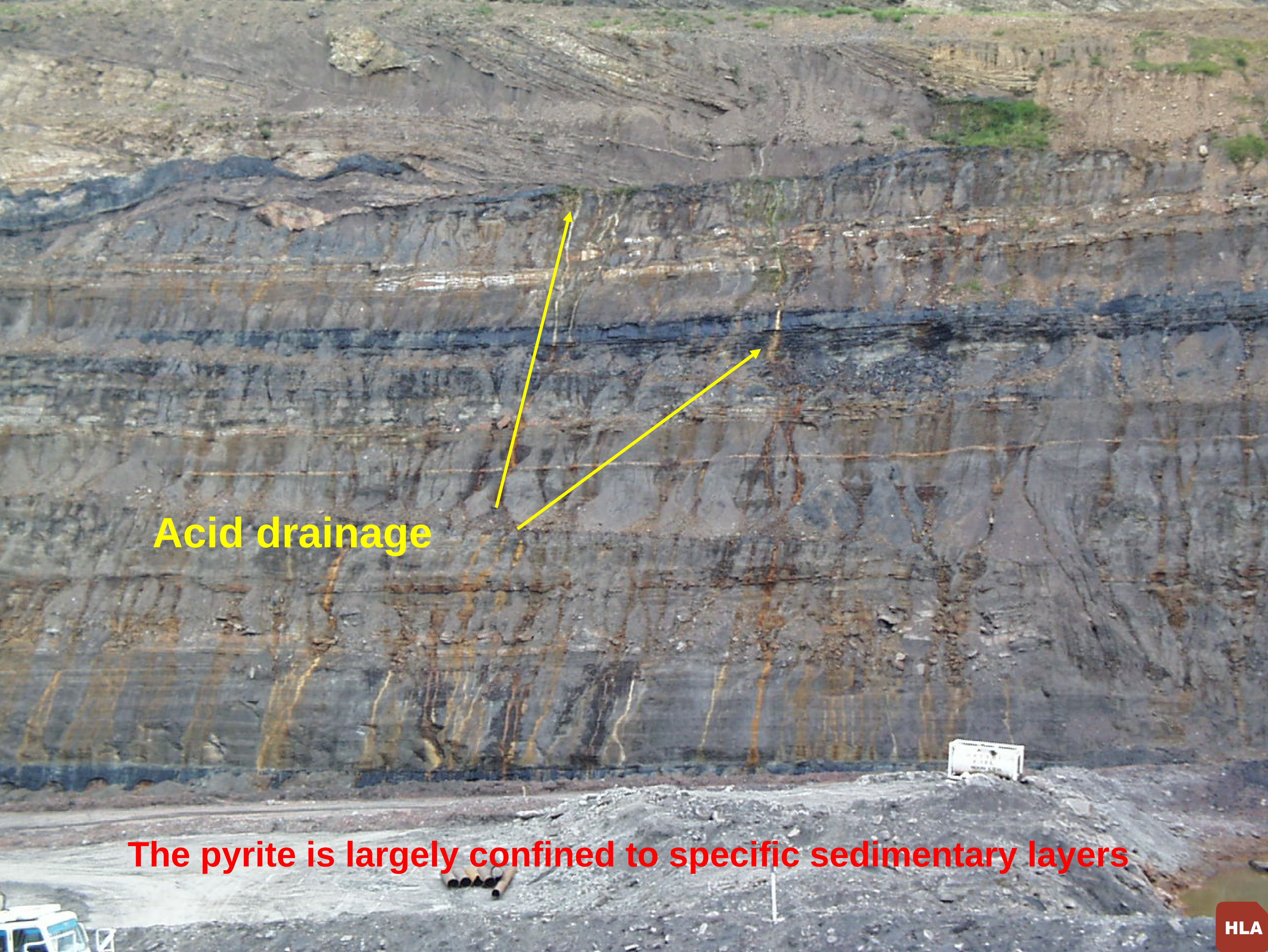
Acid drainage
The pyrite is largely confined to specific sedimentary layers
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MANAGING WASTE

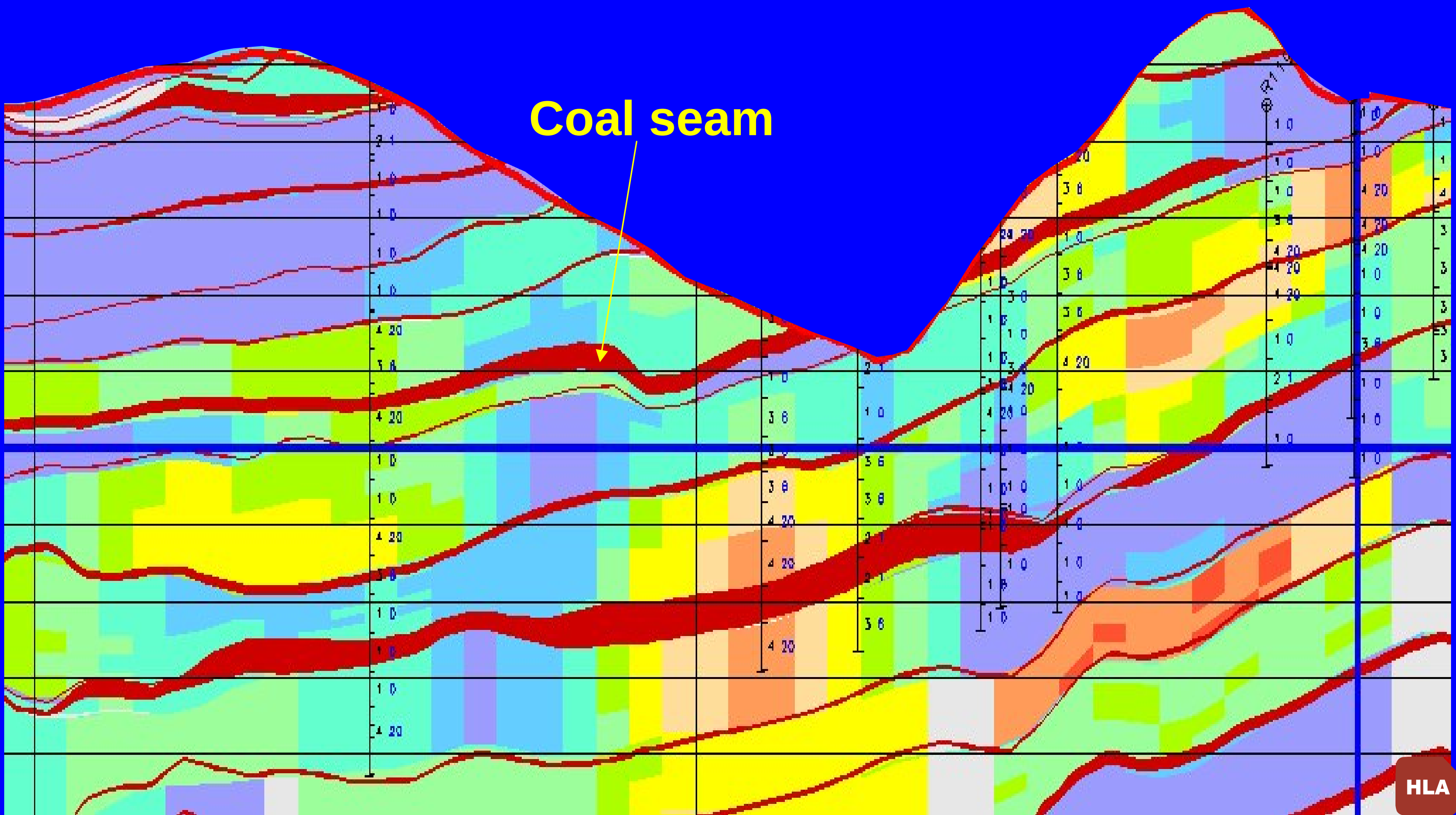
- Management of acid drainage needs knowledge of the distribution of pyrite within the mine sequence that will be mined as waste rock
- Management of acid drainage is facilitated through Waste Modelling, Planning and Selective Waste Handling

WASTE MODELLING

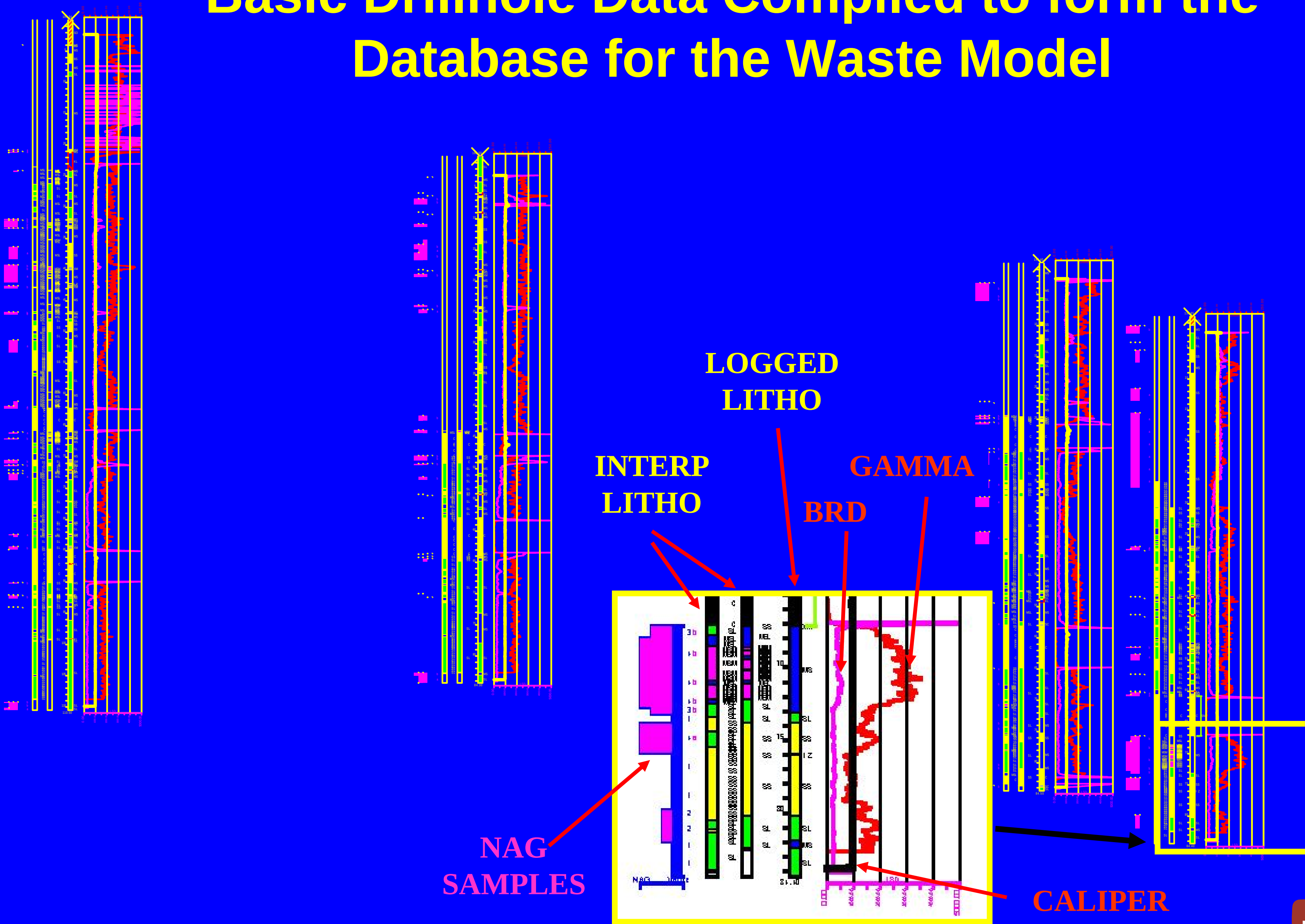
- Combines geological knowledge of the pit with waste geochemistry and defines the Spatial distribution of non acid forming waste (NAF) and potentially acid forming waste (PAF)
- The waste model is like the coal resource model it defines the distribution and volume of waste rock types that will be mined
- Changed from block modelling to layer modelling using geology and geochemistry

Example of Previous Waste Grade Modelling

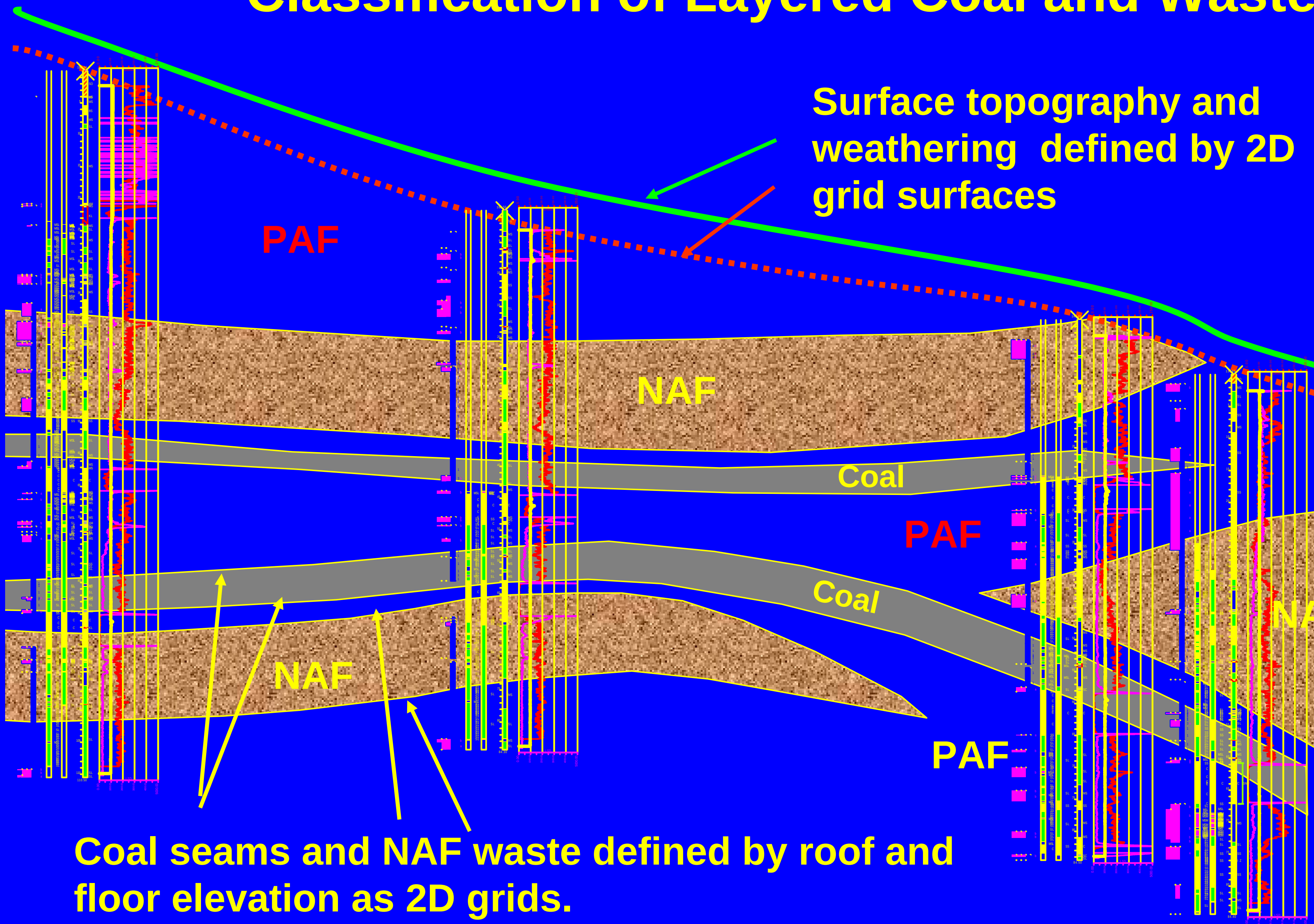
Brown = High PAF Values grading to Blue = NAF Values



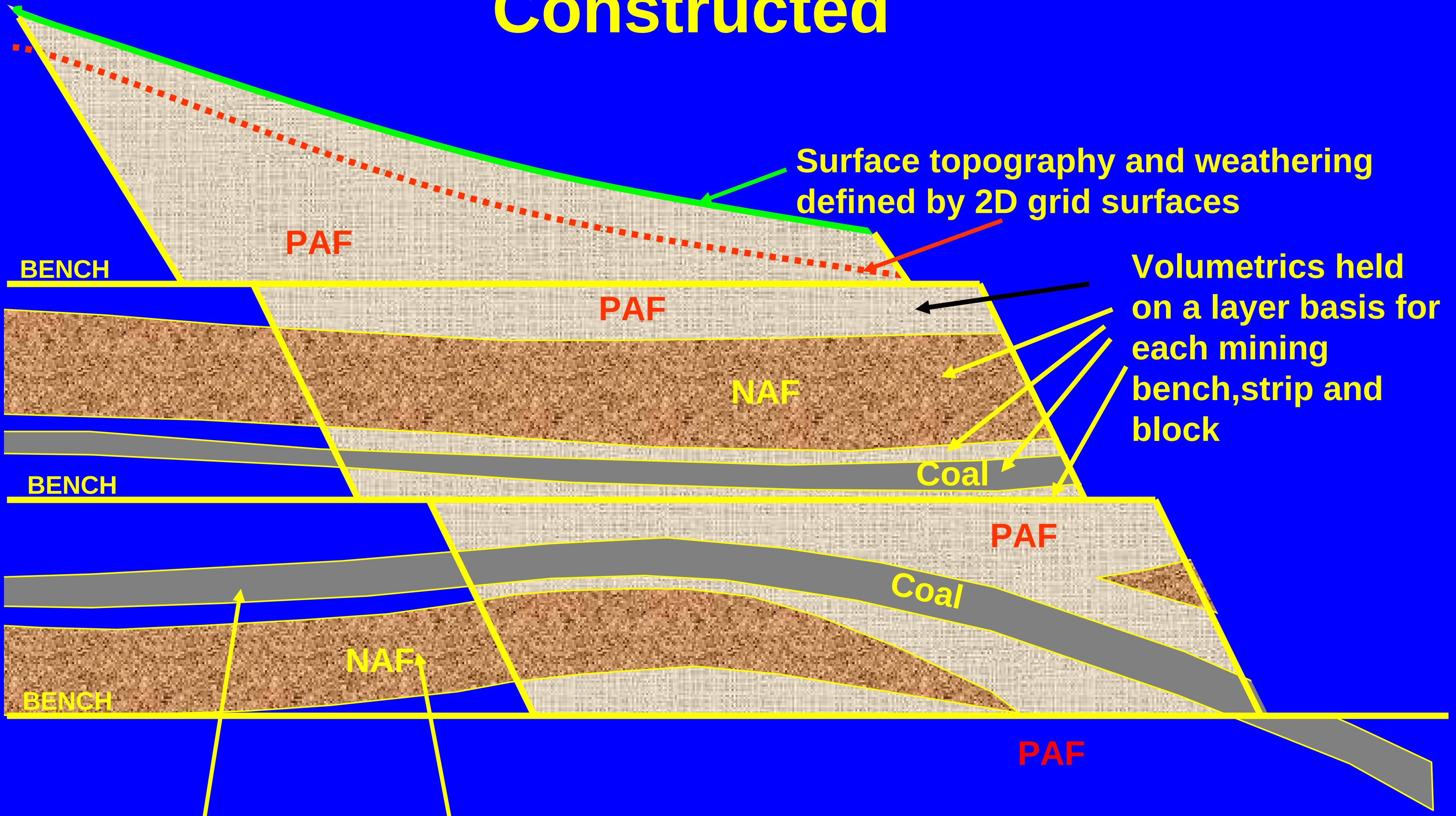
Basic Drillhole Data Compiled to form the Database for the Waste Model



Classification of Layered Coal and Waste



AD Layered Coal and Waste Model Constructed



Coal seams and NAF waste defined by roof and floor elevation as 2D grids. Other attributes such as thickness and interburden may be computed from these surfaces. The waste is constrained by the Seams

WASTE PLANNING

- The Mine planning process for acid drainage management involves waste dump design and scheduling overburden removal from pit for selective placement
- Sufficient NAF waste is scheduled for encapsulating PAF and placement of final cover for managing ingress of oxygen and water

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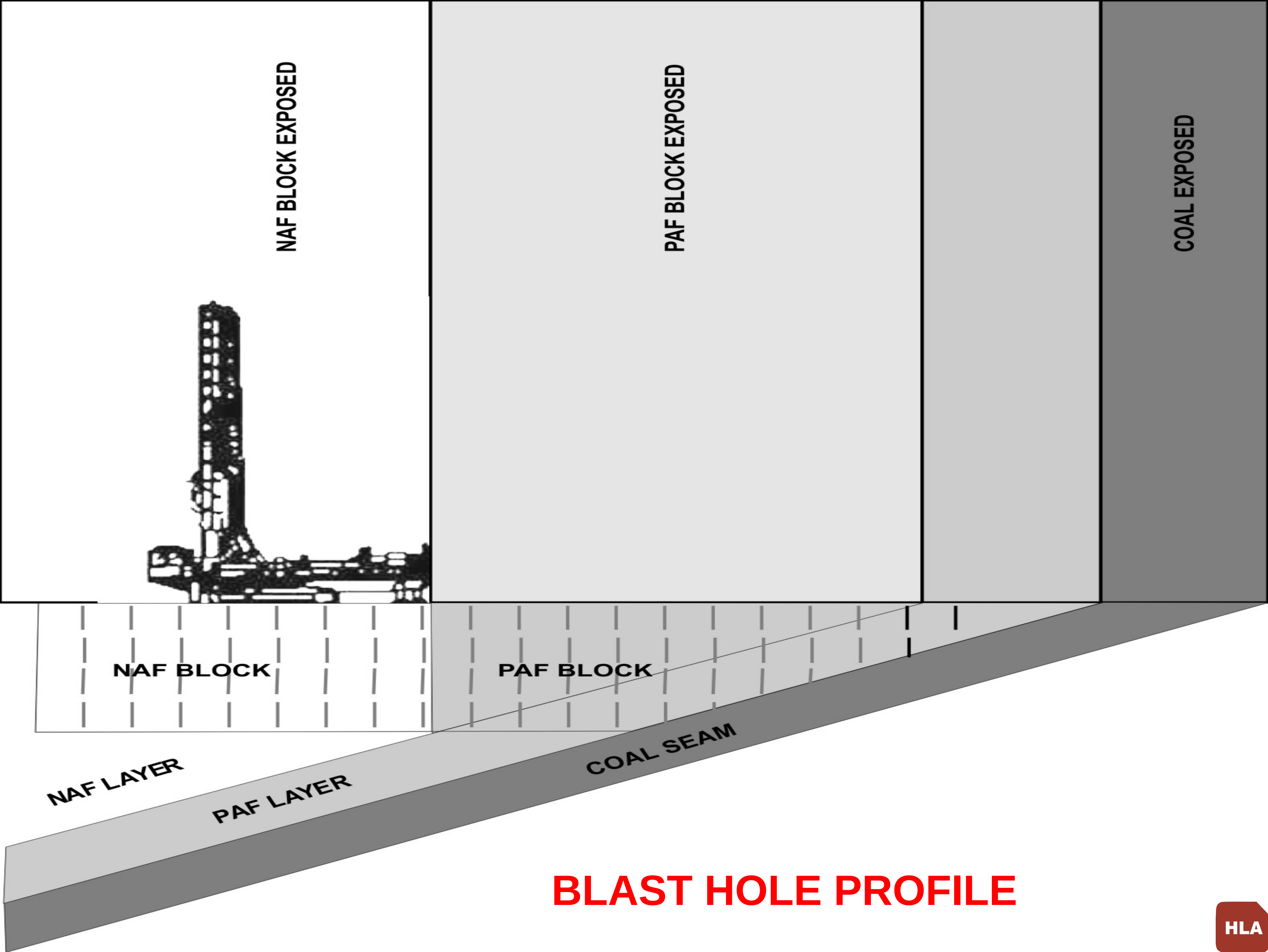
IN PIT VALIDATION

- **A set of bench plans for each Pit area is constructed showing NAF, PAF and coal**

- **The areas of NAF are marked out prior to blasting and checked following blasting to ensure no PAF is mixed with the NAF**



BLAST HOLE PROFILE

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COVER DESIGN FOR OUT OF PIT DUMPS

- The covers are designed to minimise oxygen entering the dump and thereby minimise oxidation of placed PAF waste rock
- The covers will only work if the correct material is used in their construction, this means that NAF must be carefully identified and selectively handled

COVER DESIGN

- **Following the placement of the PAF waste reducing the risk of AMD from the PAF waste is achieved by constructing a cover over the dump from non-acid forming waste rock with or without a compacted clay layer.**

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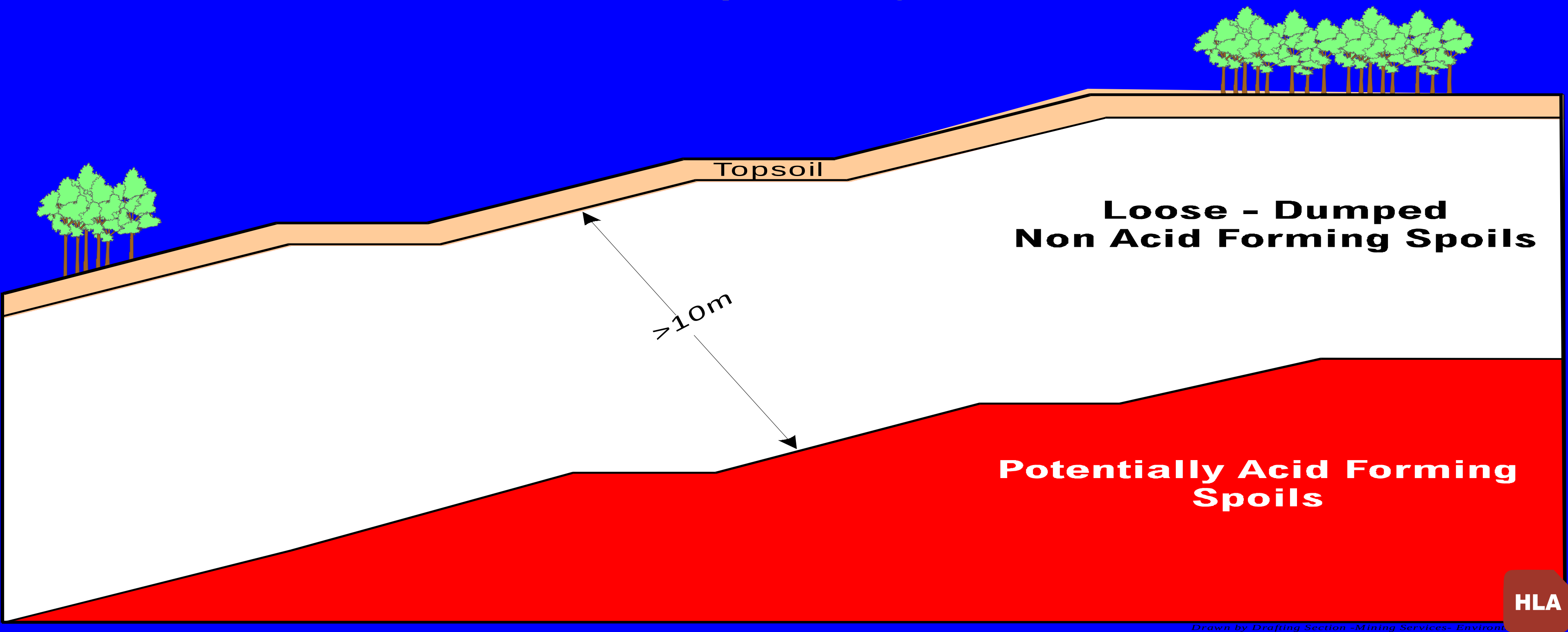
COVER DESIGN

- The current dumps that have a high degree of waste placement control utilise the TYPE 1 cover
- Legacy dumps have been covered using TYPE 2 covers

TYPE 1 COVER

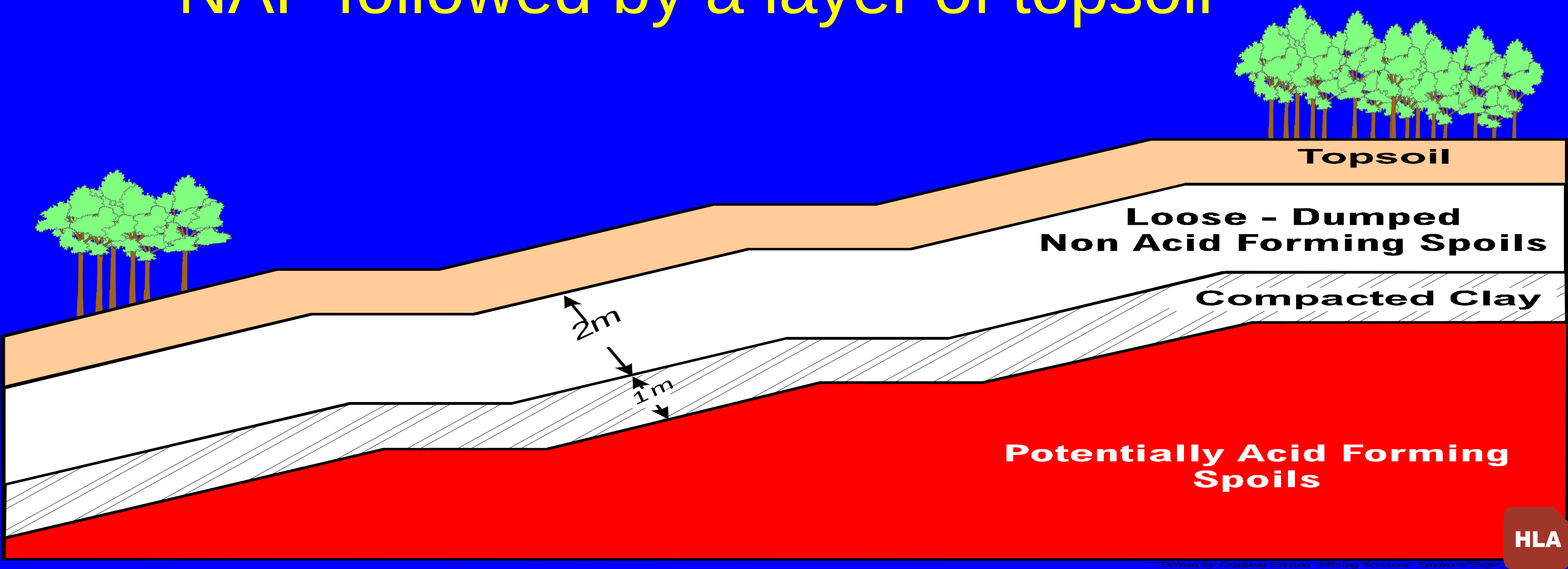
- Cover involves placement of a 10 metre un-compacted cover of NAF over PAF material with a topsoil growth medium



TYPE 1 COVER

TYPE 2 COVER

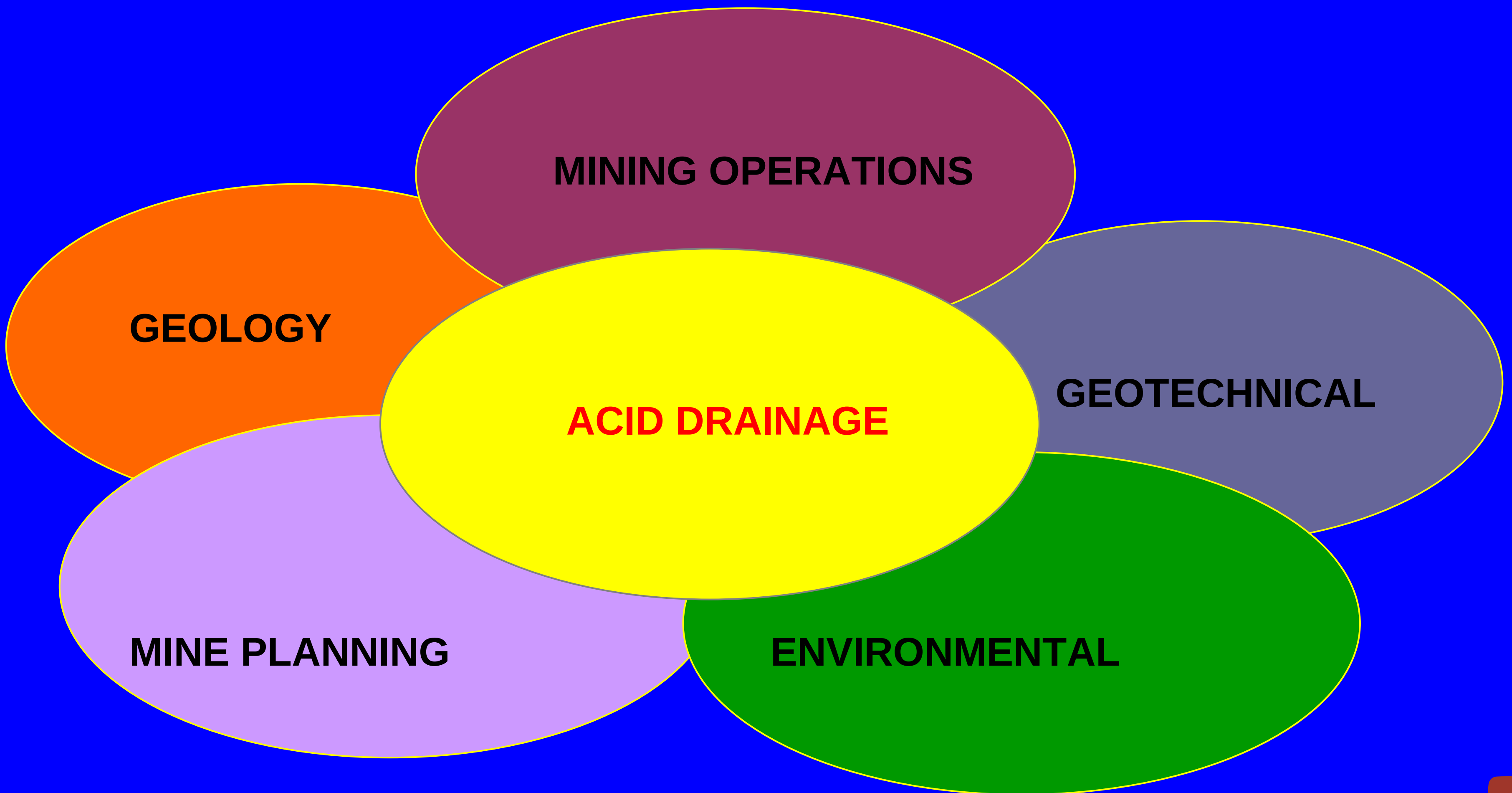
- This involves placement of a one metre compacted clay layer over the PAF followed by 2 metres of loose dumped NAF followed by a layer of topsoil



TYPE 2 COVER


2 METRES OF NAF MATERIAL
1 METRE LAYER OF COMPACTED CLAY
MURUNG DUMP

MANAGING ACID DRAINAGE WAS INTEGRATED INTO THE MINING PROCESS BY INVOLVING ALL DEPARTMENTS



The current management practices for acid drainage has ensured that no Type 2 cover has been required

Acid drainage management is now a integral component of the mine operation

Acid drainage has been greatly reduced and is now manageable


THANK YOU
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