HUNTER VALLEY
OPERATIONS

HVO WEST PIT
WS 117 DUMP FAILURE

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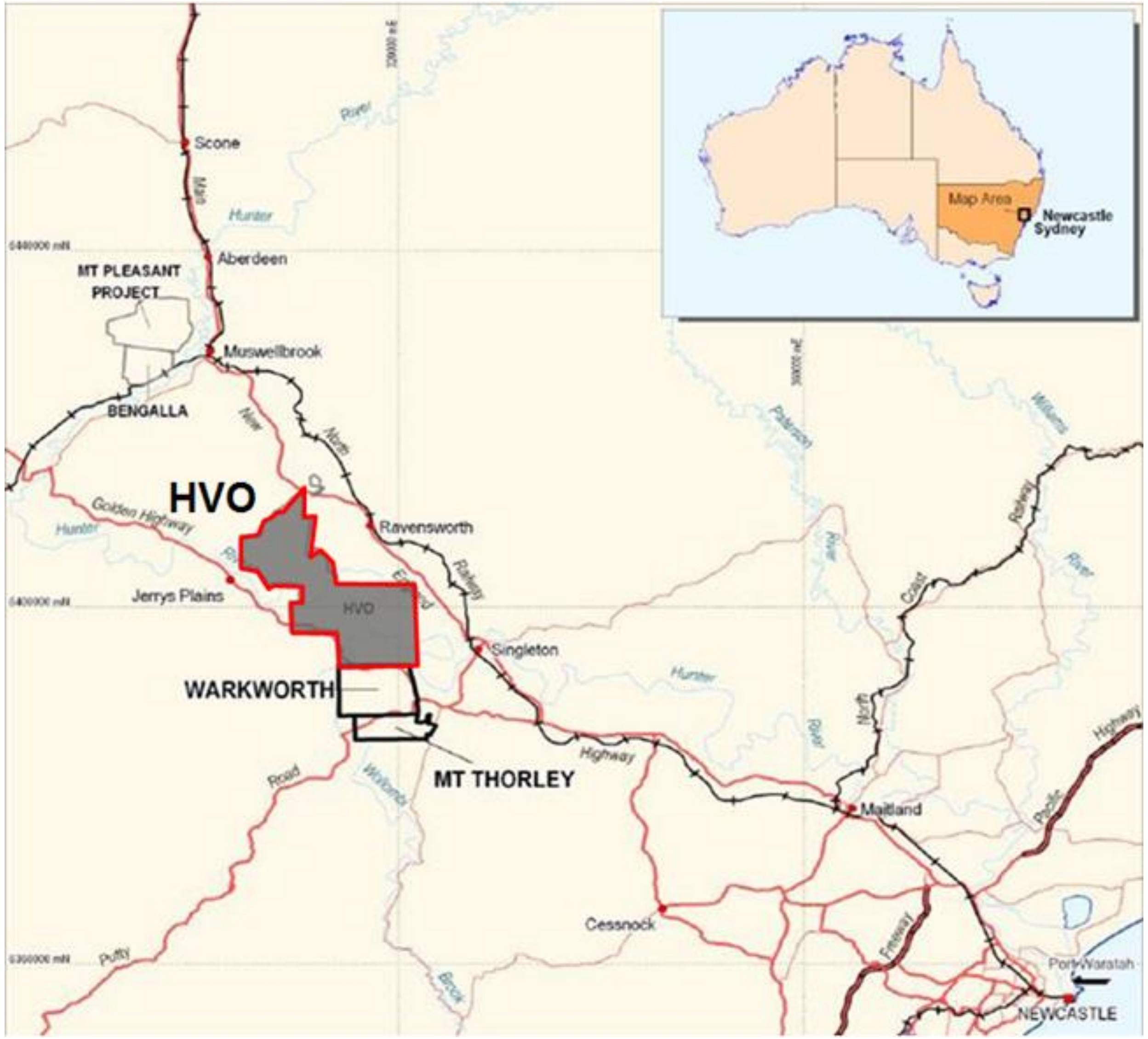
OC COAL MEM FORUM 15 MARCH 2023

Location


Scone
Aberdeen
MT PLEASANT
PROJECT
Muswellbrook
BENGALLA
HVO
Ravensworth
Jerrys Plains
Singleton
WARKWORTH
MT THORLEY
Maitland
Cessnock
NEWCASTLE
Port Waratah
Golden Highway
Map Area
Newcastle
Sydney

HVO Site Overview

- Hunter Valley Operations (HVO) is a large-scale open cut operation that produces some of the highest quality thermal and semi-soft metallurgical coal in the world.
- HVO is an integrated operation – Howick, Hunter Valley and Lemington Mines
- HVO Joint Venture is jointly owned by Yancoal 51% and Glencore 49% from 4 May 2018
- Glencore is providing systems and operational support services to HV Operations Pty Ltd
- Total waste material movement of ~ 85.3 MBCM (2022)
- Saleable coal: ~10.2 Mt product (2022)
- Supported by existing infrastructure including rail and port

Incident Description

Date & Time of Incident:	9th December at 12:55 AM
Location:	West Pit WS 117 Dump
Incident Summary:	Dump Failure during Tipping Operations
Persons Involved:	Truck Operator - 3 months experience in truck Dozer operator during incident (experienced in small dozers, D11T 3 months)

Description

- At approximately 10:30am on 8th December the dozer operator on WS 117 Dump identified cracking at the tip head.
- The dump was closed, and the truck fleet relocated.
- After Inspection by the OCE, the direction was to cut down the dump and re-establish the tip head with suitable material under an Orange TARP (double windrows and 5 metre offset).
- Upon completion of rectification works, the OCE inspected the WS 117 Dump and reopened the dump under a Yellow TARP (monitor windrows / conditions).
- The WS 117 Dump activities executed during the shift were recorded in the OCE Shift Report and communicated to the Night Shift Supervisors, the WS 117 dump operator and to the entire Mining Team at Night Shift HCOM.

Incident Description

Continued

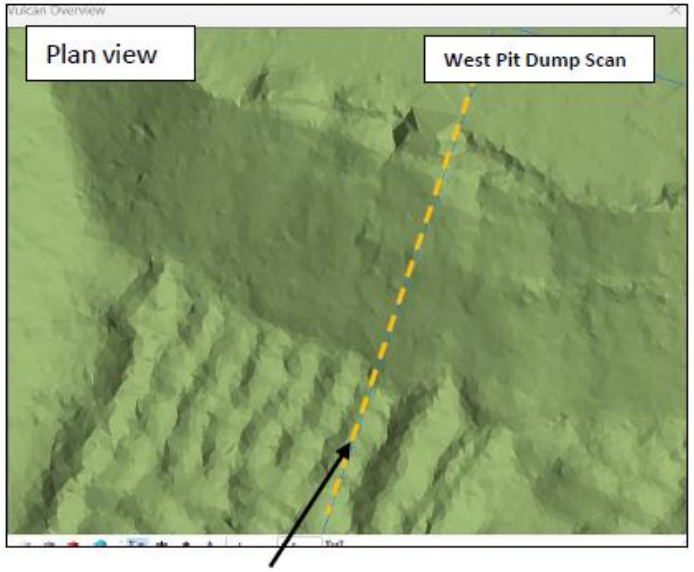
- Just before 1:00am Truck 422, a Komatsu 830E, entered the WS 117 dump and proceeded to the tip head to tip off.
- While tipping off the load, the rear wheels of the truck have sunk when the truck body was half raised.
- The operator of T481 contacted the operator of T422 to inform him “the tip face had failed”.
- The operator of T422 exited the cab and climbed down the emergency ladder the with assistance of the operator of T481.
- **Emergency response was activated, incident scene secured and required notifications undertaken.**
- **Incident investigation initiated:**

Incident Description

Continued

- Resource Regulator attended site next morning to inspect the incident scene and gather relevant information.
- After the scene was cleared a risk assessment was undertaken for recovery of the truck inclusive of other operational and functional testing before being returned to the fleet.
- HCOM developed to communicate Incident details across site and group.
- WS 117 area secured to preserve scene to facilitate investigation.
- **Following the incident, The site Geotechnical Engineer and DAS Mining's Geotechnical Engineer were engaged to conduct a review of the WS117 Dump including material characterization to assist with the investigation .**

HVO Dump Scan



Section line taken for analysis

221209_WS117_Dump.00t dump scan was provided for accurate analysis of the area.

Angle of repose changes indicated the base of the failure and the limit of the movement.

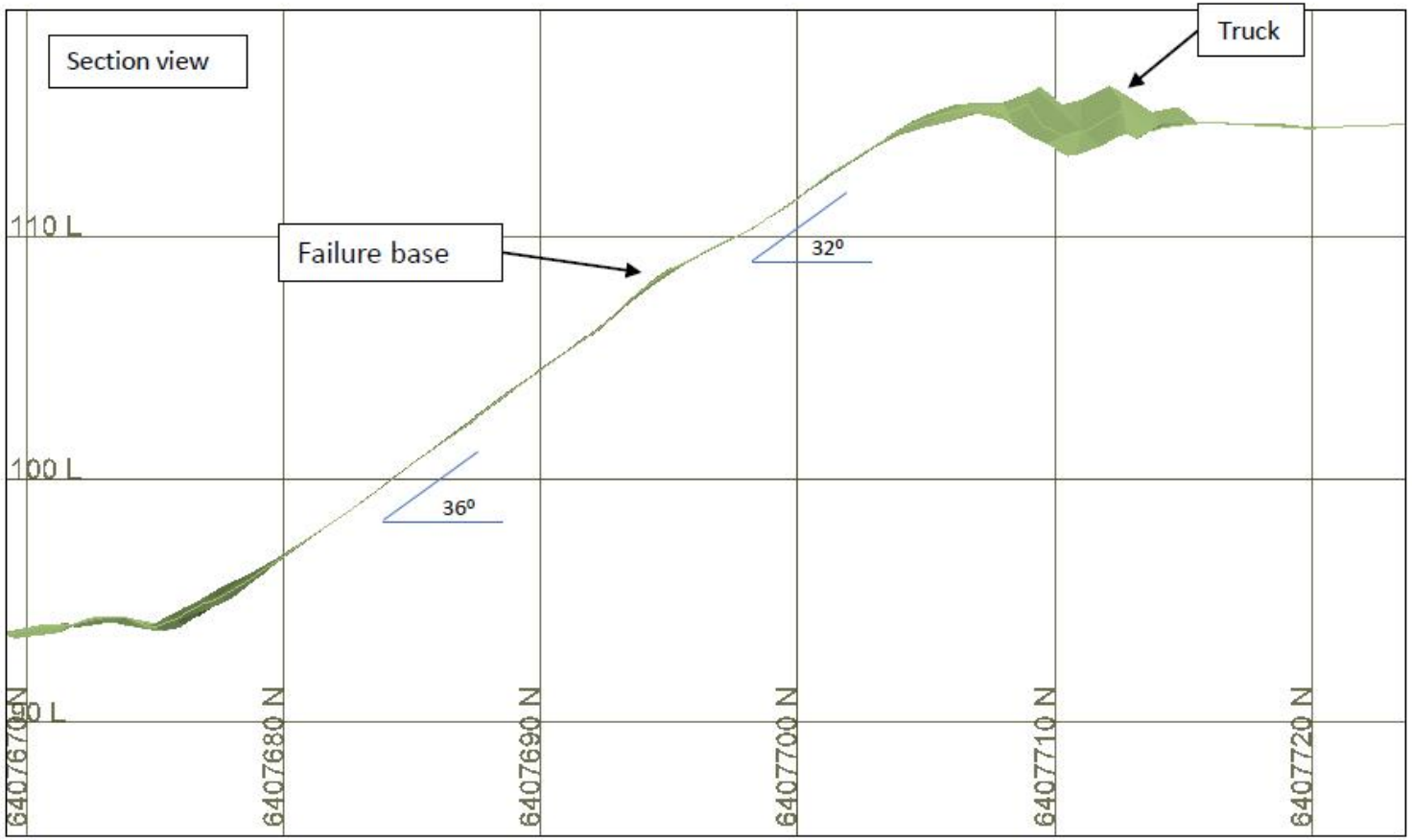


Image 09/12/2022

Comments

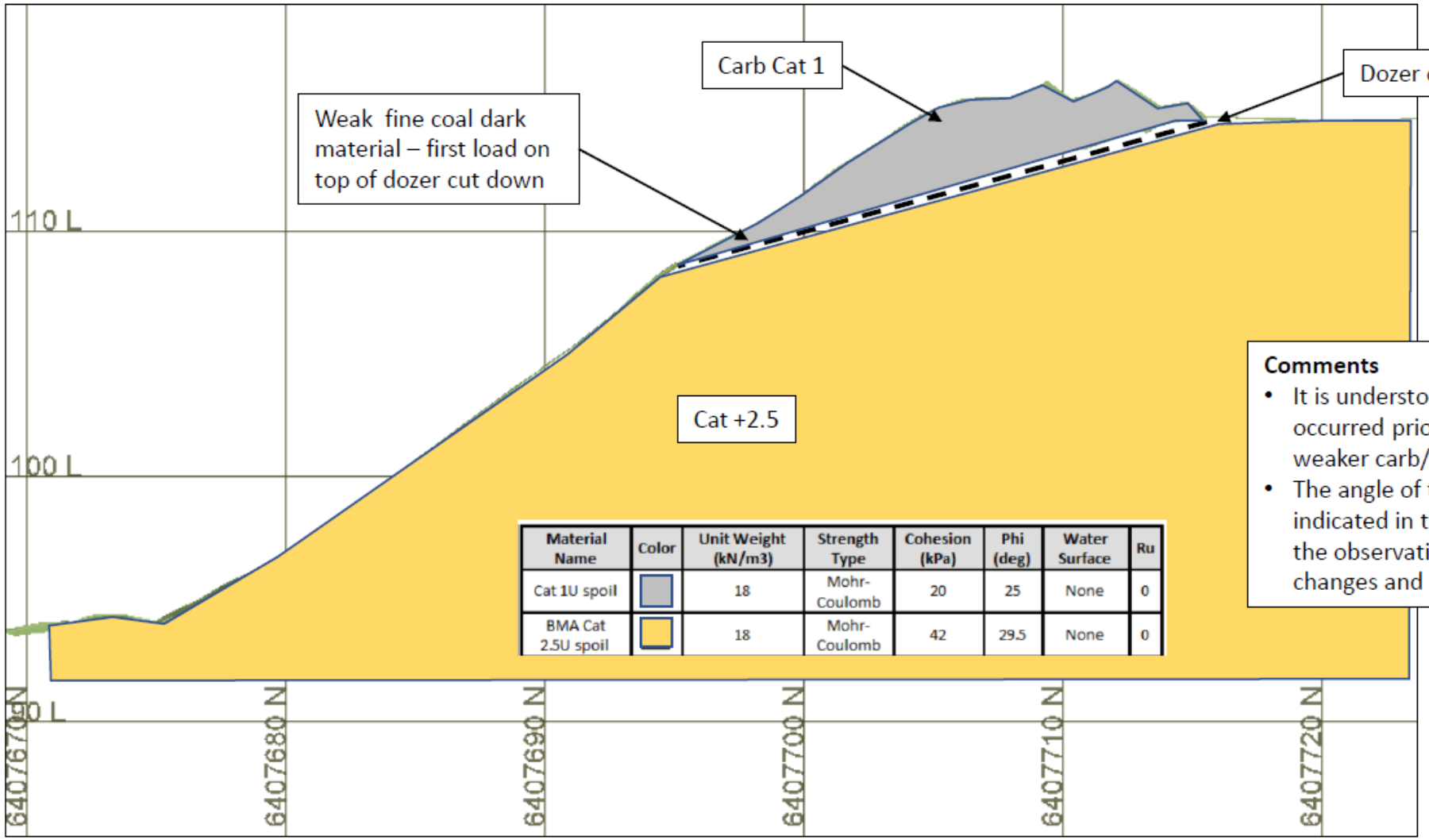
- There has been a dozer push down of the crest prior to filling with car/coal material
- The toe of the slope has not failed, the failure is at the interface of the carb Cat1 / Cat 2.5 material.
- Weaker (coal fines or similar) has been placed on the dozer cut down. This is the base of the failure.
- The lateral limits of the failure is limited to the location of the weak material and the truck point loading

Image 12/12/2022

Comments

- Dump toe is competent rock spoil, no foundation issue at base of current slope.
- Future dump foundation will contain coarse reject.
- No cracking at the dump surface indicating the backscarp location was very specific and limited by the dozer cut down.

Schematic of Geometry and Material Placement



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Cat 1U spoil		18	Mohr-Coulomb	20	25	None	0
BMA Cat 2.5U spoil		18	Mohr-Coulomb	42	29.5	None	0

Comments

- It is understood that a dozer cut down occurred prior to filling with the weaker carb/coal material.
- The angle of the dozer cut down is indicated in this section located by the observations of the material changes and back scarp location.

Static / Dynamic Loading

Due to the shallow material interface of the weak (Cat 1) material the point loading from the truck wheels has more significance for the initiation of this failure.

The dynamic loading is a phenomenon whereby the deceleration of the truck transfers additional force to the tip crest as opposed to the static weight scenario. However, for the purpose of this review it appears the truck had stopped and was in the process of tipping when the failure occurred.

The calculation of the appropriate loading has been done using the static weight distribution as this is deemed more appropriate for this situation. The truck is estimated to be in the class of a Cat 793. (Komatsu 830E)

	Empty (kg)	Payload (kg)	Loaded (kg)	Loaded (t)	Front dist (t) - 33%	Rear dist (t) - 67%
CAT 793F	159662	224087	383749	384	126.64	257.11

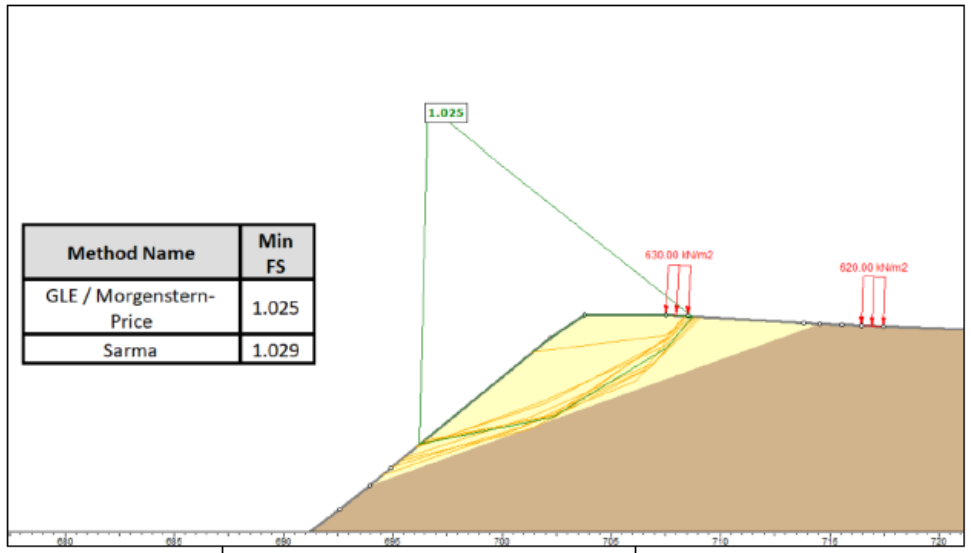
	Empty (kg)	Payload (kg)	Loaded (kg)	Front dist (t) - 33%	Rear dist (t) - 67%
				kN/m	kN/m
CAT 793F	Static (0km/h)			620.94	630.35
CAT 793F	Dynamic (10km/h)			452.68	798.61

Truck in process of tipping it load during failure

Point load v Distributed Load

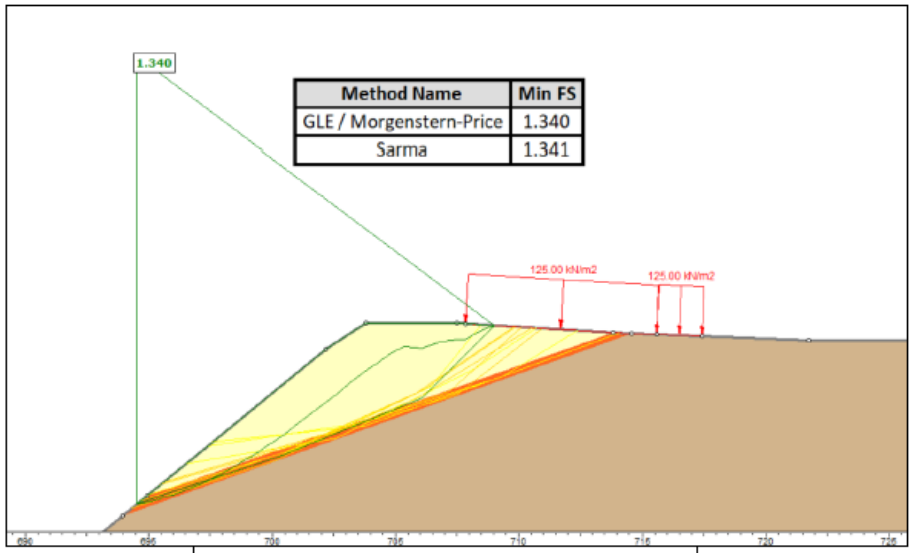
As discussed the shallow placement of the weak (Cat 1) material and the dozer push down interface just below the surface of the truck has influenced the stress impact generated by the truck. Normally for a dump of this height it is appropriate to use a distributed load for the truck as the force will be distributed progressively as it extends to the base of the dump. However, the shallow nature of this event and the near surface proximity of the weaker material suggests that the point loading method is more appropriate and more likely to represent the actual event.

Back analysis of the setting shows the point loading of the back wheels while using a static force is sufficient to destabilise the dump from a factor a safety calculation. FoS approaching 1 has been achieved in the model.



Method Name	Min FS
GLE / Morgenstern-Price	1.025
Sarma	1.029

Point loading of the rear axel



Method Name	Min FS
GLE / Morgenstern-Price	1.340
Sarma	1.341

Distributed loading of the total truck

Contributing Factors (External Report – DAS Mining)

Contributing Factors
1. The observation of dark fine coal at the toe of the dump failure indicates a weak material has been placed on the dozer cut floor which will have further contributed to the failure. 2. The dozer cut down has generated a slope angle for the carb (cat 1) material to be dumped on. This geometry promotes sliding on the material contact interface. 3. The dump was being serviced by two truck fleets at the time of the event. The speed at which material was being placed will have limited the compaction time and therefore strength of the spoil. 4. The trucks were dumping at the tip windrow, this places the load close to the edge and promotes the failure mechanism to develop.

Conclusion and Findings (External Report – DAS Mining)

Conclusion and Findings

An external report conducted by DAS Mining Solutions identified that no single factor resulted in the dump failure.
A combination of factors had contributed as per below;

1. The dozer cut down creating an angled sloping floor
2. The weak carb/coal material placement on the sloping dozer floor.
3. The truck dumping occurring at the tip head, generating maximum force within the weak (Cat 1) carb material.
4. The speed of the dump construction not allowing material to settle and generate its full strength potential.
5. The shallow nature of the weak carb (Cat 1) material and exposure to the wheel load of the truck.
6. The possibility of a very weak carb/coal material at the interface of the dozer push down and dump material contact.

Recommendations (External Report – DAS Mining)

Recommendations
1. When a dump crest is cut down the material placed over the top to re-establish the area should be dumped short and pushed (Orange TARP – Double Windrow / 5 m off-set) 2. Normal dumping processes should not recommence until the dump toe progresses past the toe of the dozer push down. 3. Placement of weak material within the dump system should be accurately controlled so stability is able to be controlled.

HVO - Investigation Findings

Root Cause/s
Failure to identify material characteristics resulted in early transition of TARP from Orange to yellow
Contributing Factors
1. Lack of supervisor training to identify characteristics of material and process 2. TARP detail lacks detail in some areas
Corrective Actions
1. Develop and implement a supervisor training package to improve knowledge and understanding of requirements to upgrade or downgrade and dump as per revised TARP, triggers and requirements 2. Review Dump TARP and clarify actions and requirements 3. Review planning process for management of low strength material types. Including ratio of material used in dump and rate of movement 4. Review with stakeholders the implementation of a TARP book or tool to make tracking and recording of dump TARP levels

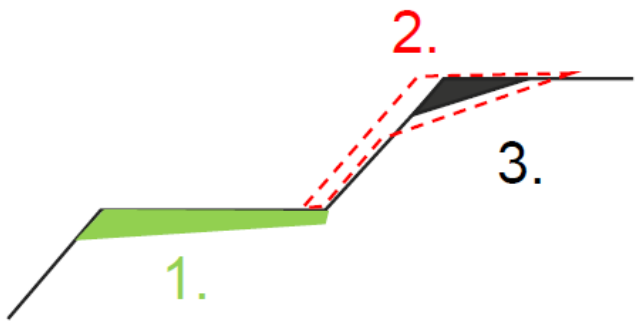
Truck Dump TARP Update

The investigation of the West Pit WS 117 Dump Failure on 9 December 2022 highlighted a number of issues and opportunities in the HVO Geotechnical Truck Dump TARP.

HVO undertook a benchmarking of the TARP documents of our sister mines on the East Coast Coal Operations resulting in:

1. Improved clarity and removal of ambiguity.
2. Clear TARP Communication requirements.
3. Requirement for the recording of TARP level conditions and changes in OCE Shift Report.

WS117 Recovery Plan

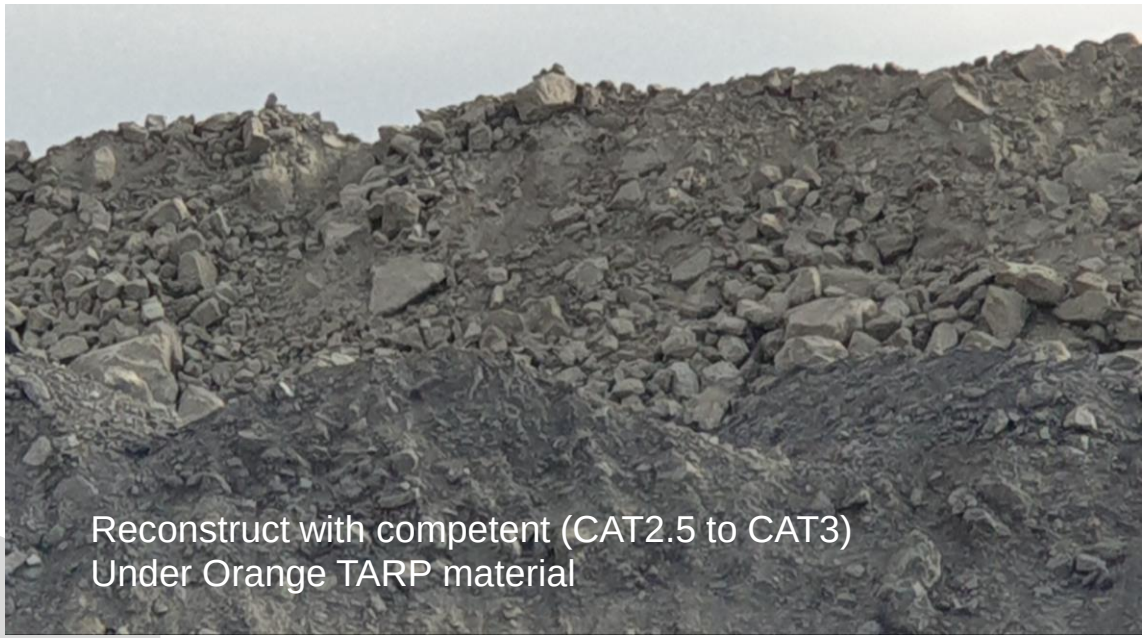


1. Buttress higher lift by progressing lower dump with competent (as designed material);

2. Push down failure below previous push down and reconstruct with competent (Cat 2.5 to Cat 3) material under orange TARP conditions until reinstated area toes in to lower lift / dump;

3. Geotechnical Engineer to assess recovered area and dump stability prior to returning to green TARP (normal operating conditions).


Buttress higher lift by progressing lower dump with competent (as designed material)
Pushing down failure below previous push down


Reconstruct with competent (CAT2.5 to CAT3)
Under Orange TARP material


Reconstruct with competent (CAT2.5 to CAT3)
Under Orange TARP conditions


Under Orange TARP conditions until reinstated area toes in to lower lift /dump.

Learnings

Learnings - Technical

Technical learnings can be summarised as below:

1. Improved planning process for management of low strength material types. Including ratio of material used in dump and rate of movement

2. Spoil category to comply with the design requirement where the factor of Safety is calculated based on spoil CAT 2.5 - effective spoil mapping/monitoring

3. Truck Dump TARP is to be clear and easy to understand. Additional to the shift report: recommendation for a TARP book or tool to make tracking and recording more efficient and well communicated

4. Updated training package to improve knowledge and understanding of TARP requirements (triggers, upgrade or downgrade and responsibilities)

5. Managing the speed of the dump construction to allow material to settle and generate its full-strength potential.

Learnings

Learnings - Operational

Operational Learnings include:

1. Ensure your teams (Supervisors and Operators) are aware of and understand Truck Dump TARP s

2. Have a fundamental understanding of material strength categories.

3. Consider operator knowledge, proficiency and experience when allocating or assigning tasks on dumps with Yellow or Orange TARPS.

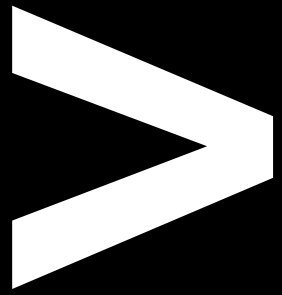
4. When re-establishing a “cut-down” dump consider the speed of the dump construction:

    * Running an Orange TARP (double windrow/ 5m off-set) to assist in allowing material to settle and generate its full strength potential

    versus

    * Running a Yellow TARP (Monitoring windrow conditions) with the truck dumping occurring at the tip head, generating maximum force within the less engineered material.

Questions?



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