Safe Drilling & Blasting

Explosives – What are they !! …

- **Are chemical compounds initiated by shock, heat or impact**
  - Low (black powder and nitrocellulose)
  - High (permitted and non-permitted)
  - Initiating (notably PETN and ASA)

- **Transform rapidly, releasing heat and (mainly) high pressure gases**
- **Create a stress wave and exert pressure**

Explosives – What are they !! …

Oxidiser – A chemical that provides oxygen for the reaction. Ammonium Nitrate is the most common oxidiser

PLUS

Fuel – Reacts with oxygen to provide heat. Common fuels are diesel and aluminum powder

PLUS

Initiation

Explosives are always looking for the easiest way out

High Explosives

Packaged or bulk

ANFO or emulsion

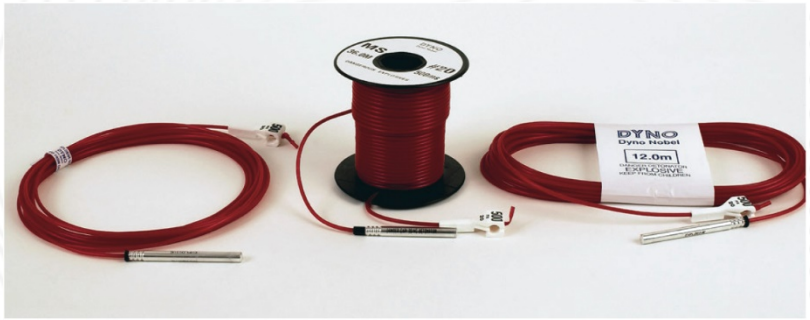
ANFO – Ammonium Nitrate Fuel Oil

- 94% Ammonium Nitrate to 6% Fuel (Diesel, Canola Oil)
- 16kg of Ammonium Nitrate to 1 litre of Fuel Oil
- Pure aluminum powder can be used to increase energy
- Pink dye in the diesel to signify explosive and show mixing

Department of **Natural Resources and Mines**

Queensland Government

Initiating explosives



Detonators, boosters, det cord etc.

Definitions:

- **Detonator**

Device used to trigger an explosive device

- **Delay**

Element within detonator that delays triggering of explosive

- **Detonating cord**

A high-speed fuse which explodes, rather than burns, and is suitable for detonating high explosives

- **Booster**

Boosts initiation to ensure detonation of the main charge

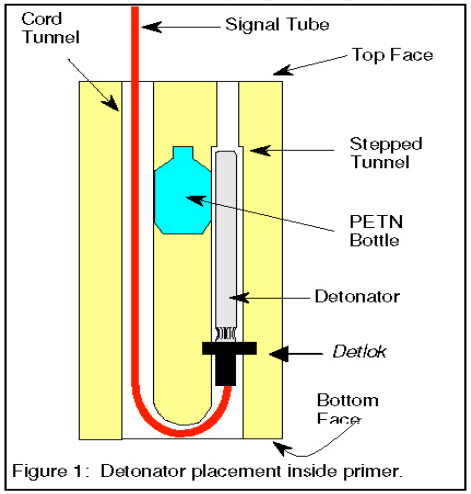


Figure 1: Detonator placement inside primer.

Regulation 86 - Principal hazard management plan for explosives

Plans need to include:

- **the safety of equipment used at the mining operation for manufacturing, storing, transporting, and delivering explosives:**
- **how explosives brought into the mining operation and used at the mining operation will be accounted for:**
- **the establishment of secure storage for explosives at the mining operation, including a system for signing explosives in and out of storage:**
- **the identification and control of hazards that may arise during the charging and firing of explosives; and**
- **the establishment of declared danger zones that no person may enter while blasting operations are taking place:**
- **the procedure to find, recover, and detonate misfired explosives:**
- **a register of people at or providing a service to the mining operation who are approved handlers under legislation**

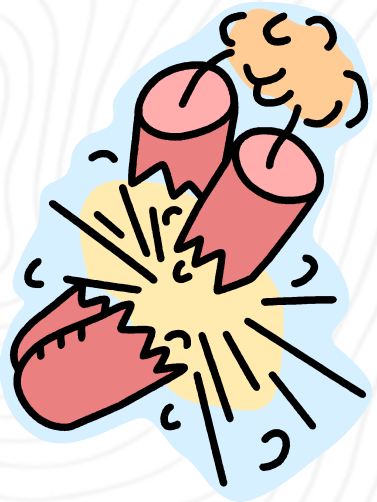
Legislative requirements

Site HSMS must provide for safe and secure handling, storage, and transporting of explosives.

- Must cover use, handling and transporting
- Security of explosives must be included

Risk management process required to identify hazards associated with drilling and blasting.

- Have you identified all hazards associated with blasting ?
  (lightning, sympathetic detonation, unstable ground etc.)



The person in control of explosives must ensure:

- Use of explosive is accounted for,
- Surplus explosive is accounted for,
- Explosives are secure while being transported,
- Appropriate records are kept.

Legislative requirements

Site *must* have a written procedure for dealing with misfires.

Safe Working Action Plan

Given that one hole has been identified as misfiring, it is expected that the following should be recovered:

- 1* 400g booster and 1* detonator (At floor level or below).

Item	Hazard	Controls	Who
1	Loading out shot rock and contacting explosives	Establish a demarcation line across the shot muckpile, this line is to include a buffer between the estimated explosives and the extraction limit for the quarry workers.	
2	Employees and Contractors unaware of the incident or associated risks.	Conduct a communication meeting with all employees and contractors	
3	Unauthorised access to misfire area	Construct bunding and erect signage warning of Authorised Persons Only to enter demarcation area	
4	Extraction of rock when demarcation line reached	Extraction of rock to be completed by an excavator with a spotter. The position of the spotter should be such that he never places themselves under loose and/or unstable faces.	
5	Unplanned detonation of unfired explosive while extracting rock	Install additional guarding to the front of the excavator to protect operator from potential fly-rock. A loader bucket or some other form of physical barrier will be employed as protection for the spotter. This should be positioned on the floor behind the excavator. Communication between the spotter and excavator operator will be via UHF two-way radio. The spotter will inspect the working face periodically when the excavation has ceased for any sign of explosive residue or explosives accessories.	

Contractor Management

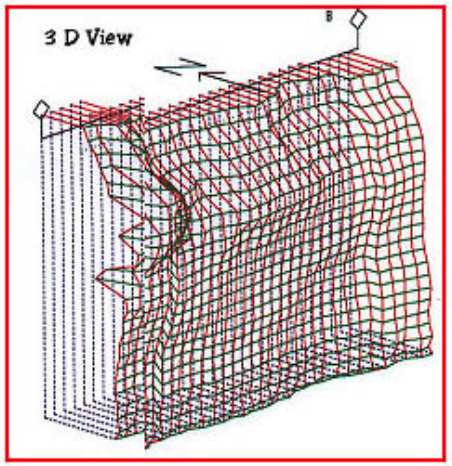
The Health and Safety in Employment (Mining Operations and Quarrying Operations) Regulations 2016

Mine workers =

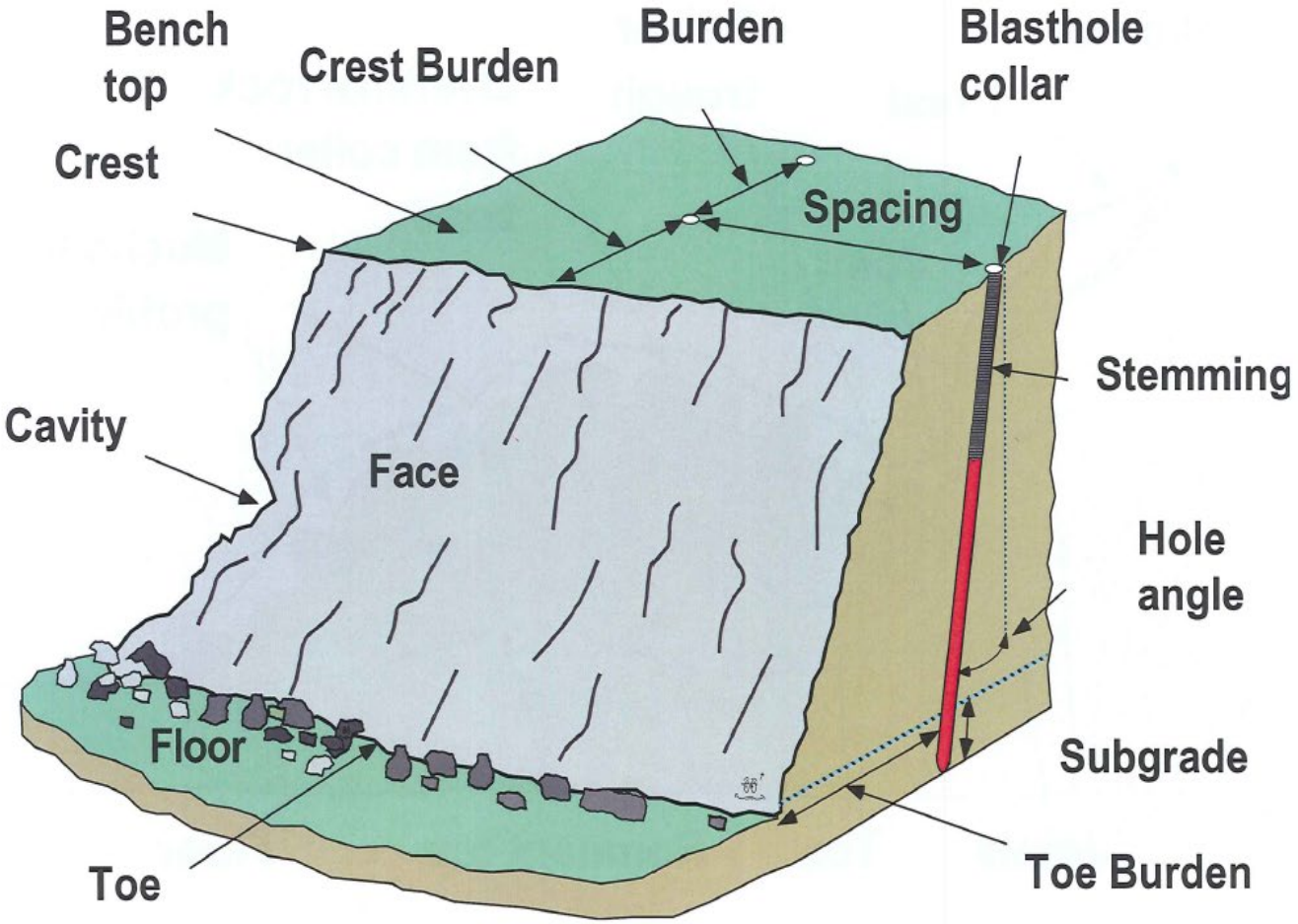
- **Employees of the mine operator, and**
- **Contractors and their employees while they are working on the mine operator's site**

All contractors are both good and not so good.

What makes the difference is the way you manage them.

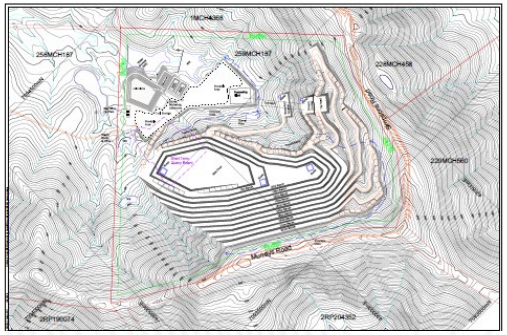


Terminology

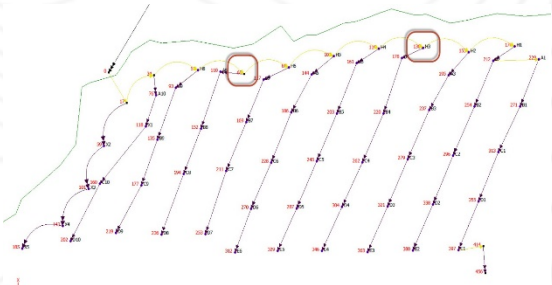


Blasting cycle

Quarry Planning and Design

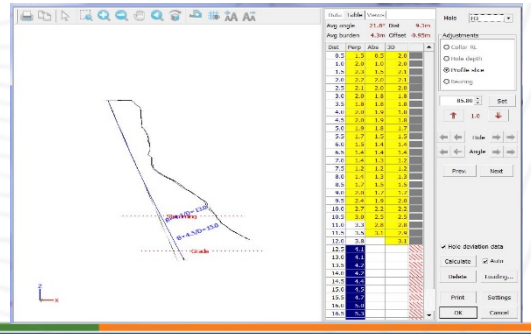


Face survey and blast design



Drilled shot

- *Bore tracking*
- *Drill logs*
- *Driller info*



Loaded shot

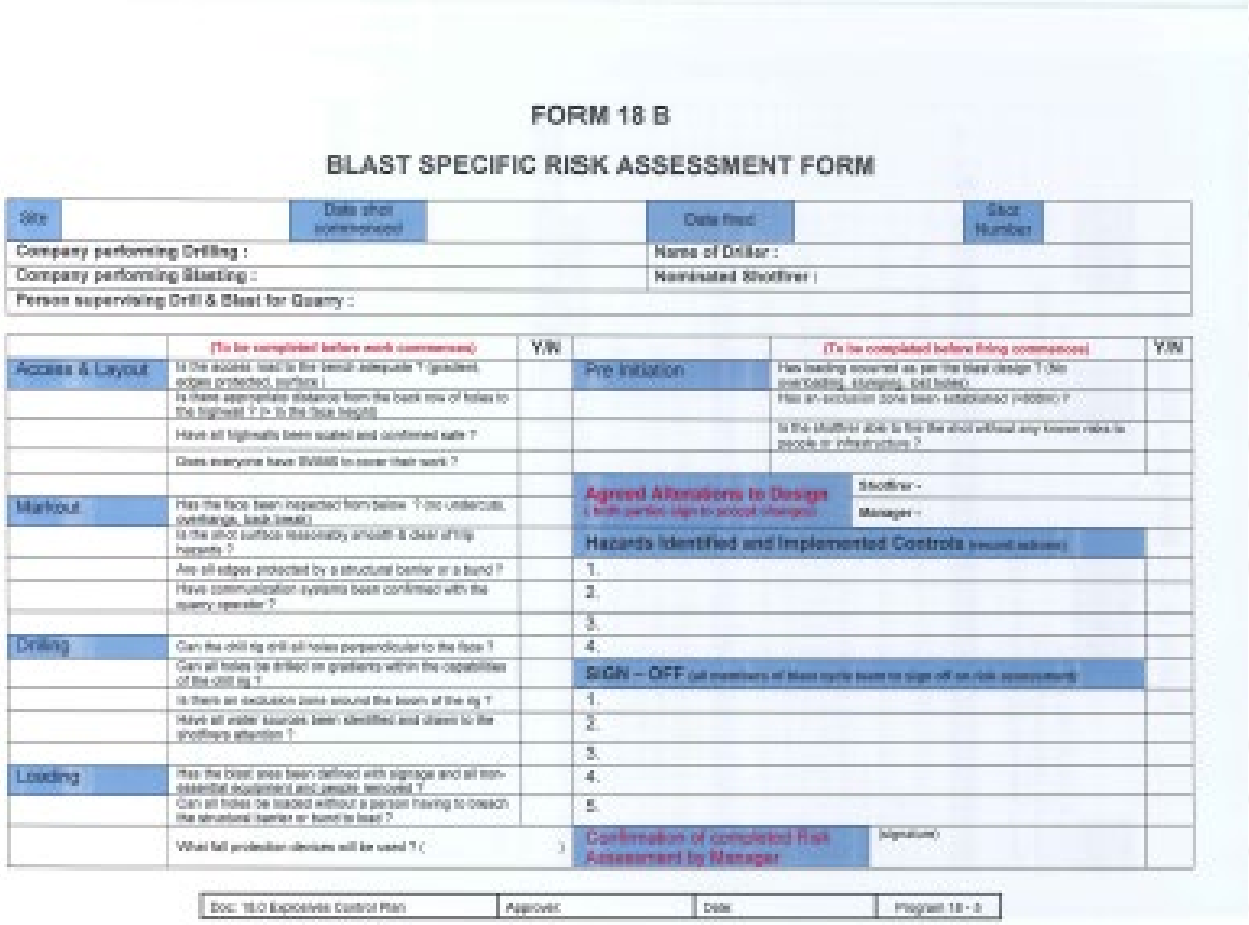
- *Risk assessment*
- *Explosive reconciliation*
- *Shot firer feedback*

Things to consider with each shot

- Stability of faces
- Overhanging rock
- Water on benches (adequate drainage)
- Bench cleaned and level for drilling
- Edge protection
- Security of blast zone
- Access to shot
- Faces clearly visible

(muck pile from last shot moved)

Blast Specific Risk Assessment



FORM 18 B

BLAST SPECIFIC RISK ASSESSMENT FORM

Site		Date shot commenced		Date fired		Shot Number	
Company performing Drilling :				Name of Driller :			
Company performing Blasting :				Nominated Shotfirer :			
Person supervising Drill & Blast for Quarry :							

	[To be completed before work commences]	Y/N		[To be completed before firing commences]	Y/N
Access & Layout	Is the access road to the bench adequate ? (gradient, edges protected, surface)		Pre Initiation	Has loading occurred as per the blast design ? (No overloading, stumping, bad holes)	
	Is there appropriate distance from the back row of holes to the highwall ? (> ½ the face height)			Has an exclusion zone been established (radius) ?	
	Have all highwalls been scaled and confirmed safe ?			Is the shot/s in close to the shot without any known risks to people or infrastructure ?	
	Does everyone have SHANE to cover their work ?				
			Agreed Alterations to Design (both parties sign to accept changes)	Shotfirer :-	
Markout	Has the face been inspected from below ? (no undercuts, overhangs, back breaks)			Manager :-	
	Is the shot surface reasonably smooth & clear of trip hazards ?		Hazards identified and Implemented Controls (record actions)		
	Are all edges protected by a structural barrier or a bund ?		1.		
	Have communication systems been confirmed with the quarry operator ?		2.		
			3.		
Drilling	Can the drilling drill all holes perpendicular to the face ?		4.		
	Can all holes be drilled on gradients within the capabilities of the drilling ?		SIGN – OFF (all members of blast crew/ team to sign off on risk assessment)		
	Is there an exclusion zone around the boom of the rig ?		1.		
	Have all water sources been identified and drawn to the shotfirers attention ?		2.		
			3.		
Loading	Has the blast area been defined with signage and all non-essential equipment and people removed ?		4.		
	Can all holes be loaded without a person having to reach the structural barrier or bund be lost ?		5.		
	What fall protection devices will be used ? ( )		Confirmation of completed Risk Assessment by Manager	(Signature)	

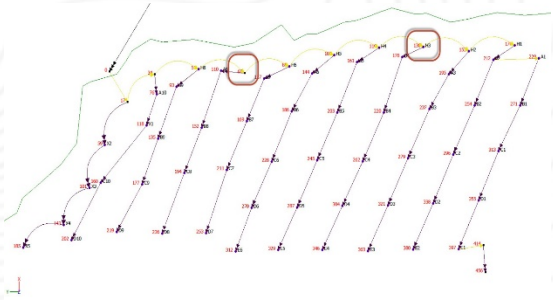
Doc: 18.0 Explosives Control Plan	Approved:	Date:	Program 18 - 3

Before you mark out and drill shot

- **Have all potential hazards been considered?**
  - Face profile
  - Edge protection

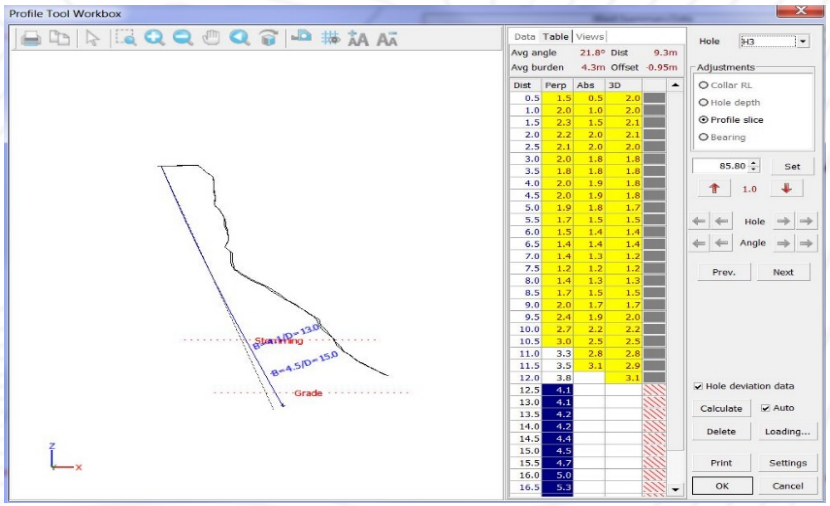
- **Have you agreed outcomes to be achieved?**
  - Firing direction
  - Muck pile shape
  - Fragmentation

- **Has the Blast designer given you?**
  - A drill plan
  - Risk assessment



Things to check post drilling

- Drill logs received and reviewed
- Review includes discussion with driller and review of bore tracking results
- Drilling accuracy considered in finalising loading plan with shotfirer (check back markers)
- Loading plan reviewed prior to loading
- Shotfirer Risk Assessment received and reviewed



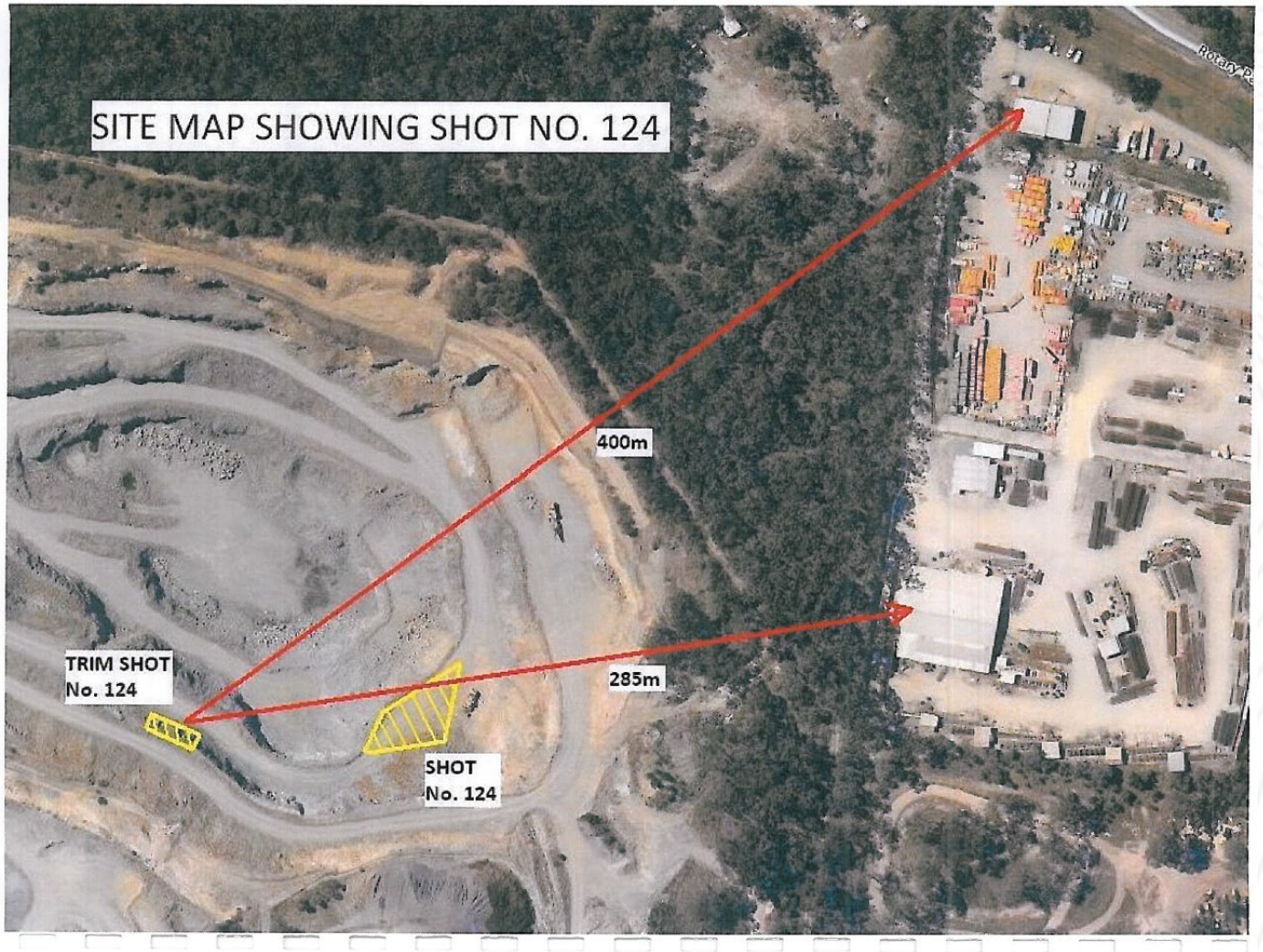
And now for the shot

- Notifications
  - Firing time
  - Neighbours
  - Communication

- Exclusion Zone
  - Calculate appropriate zone
  - Documented map
  - Security of blast zone
  - Blast guards in place

- Blast monitoring
- Tie up inspection
- Weather conditions
- Firing procedures

- Flyrock travelled 600metres
- Nearest building was 285 metres
- Damage to buildings, no-one injured
- Trim shot burdens unknown
- Hole deviation contributed



Conduct post-blast checks

- **Re-entry checks**
- **Examine blast site & product**
- **Determine any requirement for secondary blasting**
- **Treat misfires**
  - Hook-up again and re-fire
  - Remove stemming, re-prime, re-stem and re-fire
  - Wash out explosives and recover det and booster. Re-drill another hole and fire
  - Misfire procedures

FORM 18 C – Managers Blast Checklist

Site		Date shot commenced		Date & Time fired		Shot Number	
Company performing Drilling :				**Name of Driller :**			
Company performing Blasting :				**Nominated Shotfirer :**			
Person supervising Drill & Blast for Quarry :							

Preparation:	or n/a
A copy of the drillers SWMS and/or contractor management plan has been obtained and reviewed	
A copy of the Shotfirers SWMS and /or Contractor Management Plan has been obtained and reviewed	
All persons have been inducted onto site	
A face & bench stability inspection has been conducted to identify any issues	
The blast design has been completed in consultation with the shotfirer and agreed upon	
A blast specific risk assessment has been completed (FORM 18 B)	
Edge protection is in place prior to mark out (fencing with structural capability or bunded)	
Drilling :	
Drilling equipment has been inspected and confirmed 'fit for purpose'	
If the shot is laser profiled, the results have been reviewed and accepted	
If the shot is bore tracked the results have been reviewed and accepted	
A copy of the final drill log has been supplied and reviewed with the shotfirer	

Blasting :	or n/a	Neighbours Names	"How Notified" (verbal, mail etc)
All neighbours have been notified as per DA or agreed requirements *(record details)*		1.	
Environmental monitors have been positioned		2.	
Is the blast going to occur between allowable hours		3.	
Weather conditions are confirmed O.K to blast		4.	
Blast camera is in position to record shot		5.	
Sentries have been positioned		6.	
All persons on site have been accounted for and are outside of exclusion zone (> 800 m minimum)			
Control handed over to shotfirer		Monitor Locations	
All audible warning sirens have been sounded prior to blast		1.	
		2.	
Post Blast Inspection:		3.	
No misfires have been identified			
Misfires have been identified, recorded and dealt with in accordance with an approved 'misfire' procedure			
Shotfirer has handed site back to 'mine operator'			
No environmental exceedances identified		Regulatory Notifications	
Any blast concerns are noted on the blast plan & report		1.	
Regulators have been notified of reportable incidents or exceedances *(flyrock, misfire, faulty product, exceedances)*		2.	
A copy of the blast plan & record has been provided to the Quarry Operator			

Questions?

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