Quarry Planning and Metrics

QUARRY ACADEMY

Improving Processes. Instilling Expertise.

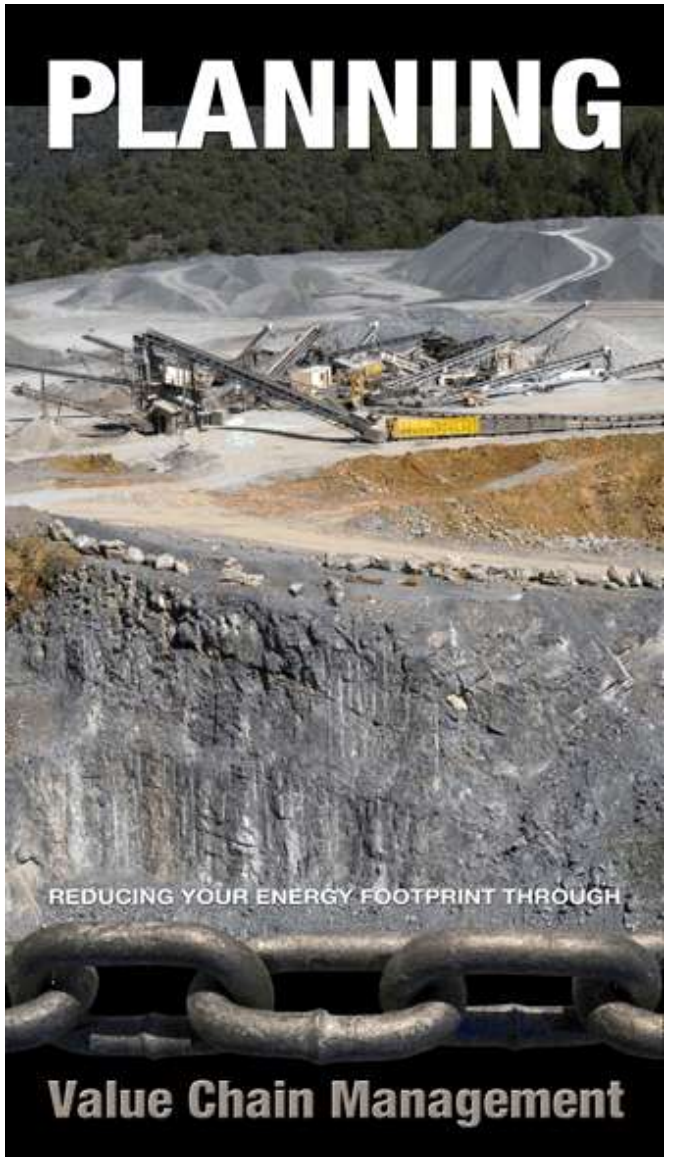
DYNO Dyno Nobel

SANDVIK


• SUSTAINABILITY •
• PROFITABILITY •
• PRODUCTIVITY •
BREAK ROCK
Chemical Crushing
MOVE ROCK
Load and Haul
SIZE ROCK
Mechanical Crushing and Screening
• PLANNING AND METRICS •
• SAFETY CULTURE •

Topics to Be Covered

- Benefits of Planning
- Key Factors Affecting Quarry Planning
- Annual Plan Review
- Characteristics of Good Plans



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What is Quarry Planning?

Quarry planning is about making a deposit *profitable* while *managing* the production requirements and geologic/physical constraints.

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Quarry Planning – the approach?

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Quarry Planning – the results?

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Key Benefits of Quarry Planning

- Less re-work (Lean Process Thinking)
- Less interruption to production
- Improves utilization of equipment
- Improves ability to provide consistent products
- Allows for control on quality of products
- Improves financial control over operation (reliable expense forecasts)

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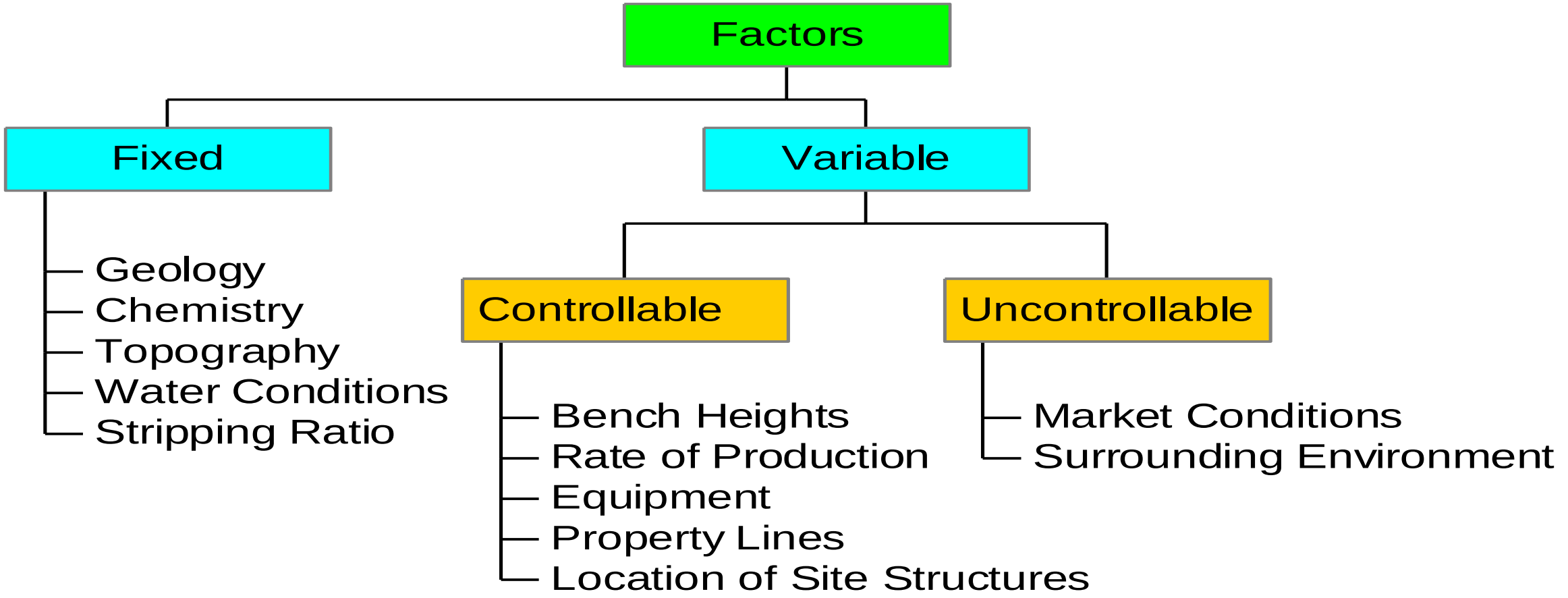
Key Factors Affecting Quarry Planning



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Fixed Factors

<u>Understand the factors</u> - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Geology**
  - ✓ Directional structures – considered in pit development?
  - ✓ Variation between benches/areas of pit?
- **Chemistry**
  - ✓ Consistent or highly variable?
  - ✓ Blending of chemistries – desirable or to be avoided?
  - ✓ What to blend, how much of each, where will it come from?

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Fixed Factors (continued)

Understand the factors - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Topography**
  - ✓ Can topography assist in haulage routes?
  - ✓ What are the surface drainage considerations?
- **Water Conditions**
  - ✓ Where does water exist and what is its source?
  - ✓ Is groundwater flow directional?
  - ✓ Can water flow be redirected?

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Fixed Factors (continued)

Understand the factors - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Stripping Ratio**
  - ✓ **Does the stripping adequately meet seasonal production requirements?**
  - ✓ **Is the overburden material placed in a location that will not interfere with future development?**

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Variable Factors (controllable)

<u>Understand the factors</u> - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Bench Heights - Uniformity produces consistency**
  - ✓ **Do bench elevations consider geologic/chemistry changes?**
  - ✓ **Bench heights optimized for equipment used?**
- **Location of Structures – Sumps/fines retention ponds, ramps, crushers**
  - ✓ **What are the affects of the location(s) on production?**
  - ✓ **Are future relocations required and if so where?**
  - ✓ **Are the relocations justified with production benefits?**

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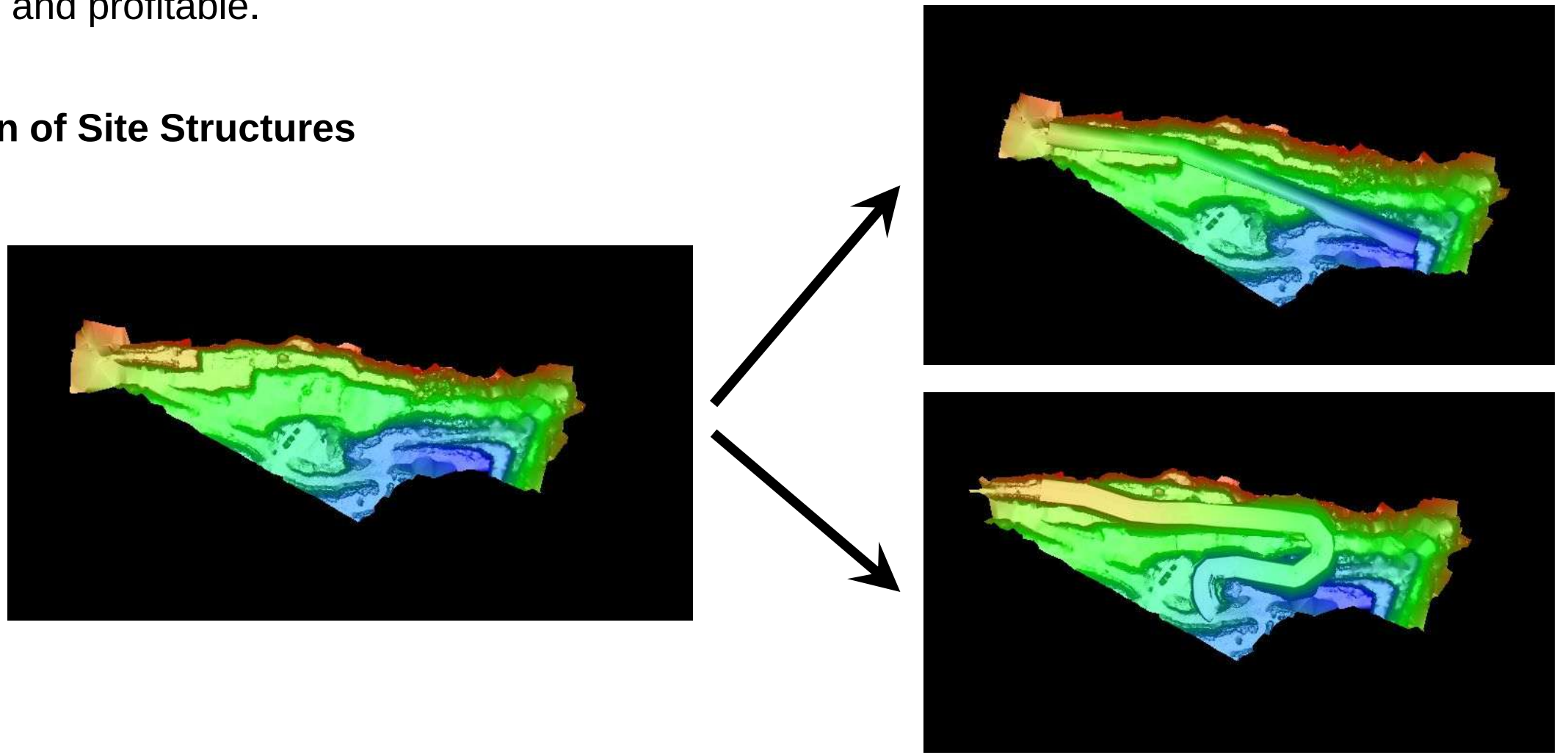
Variable Factors (controllable)

<u>Understand the factors</u> - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Location of Site Structures**



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Variable Factors (controllable)

<u>Understand the factors</u> - design, evaluate, create and manage an excavation sequence that is sustainable and profitable.

- **Rate of Production**
  - ✓ **Can the pit layout adjust to increases in production?**

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Variable Factors (uncontrollable)

- **Market Conditions**
  - ✓ **Have a contingency plan(s)**
- **Surrounding Environment**
  - ✓ **Urban environments offer unique challenges compared to rural settings.**

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Annual Quarry Plan Review

“It’s hard to get from here to there if you are unclear about here.

And haven’t thought much about there.”

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Annual Planning Review

- **Designed to improve your operational results.**
  - ✓ use practical quarry plan engineering
  - ✓ improve safety and financial outcomes
- **Practically applied**
  - ✓ monitor current production activity
  - ✓ monitor middle / long term development requirements and objectives.
- **Provide a more disciplined planning effort:**
  - ✓ Borrows from traditional mine planning programs
  - ✓ Borrows from Lean-Six Sigma concepts

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Planning Reduces Operational Costs

Traditional Planning

Proper Planning

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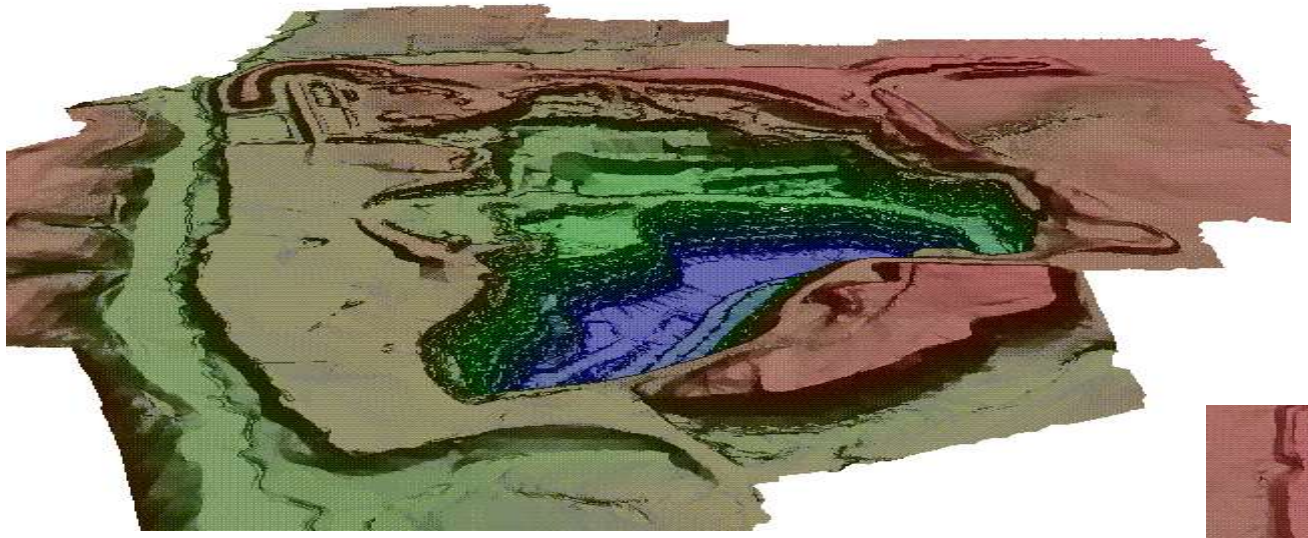
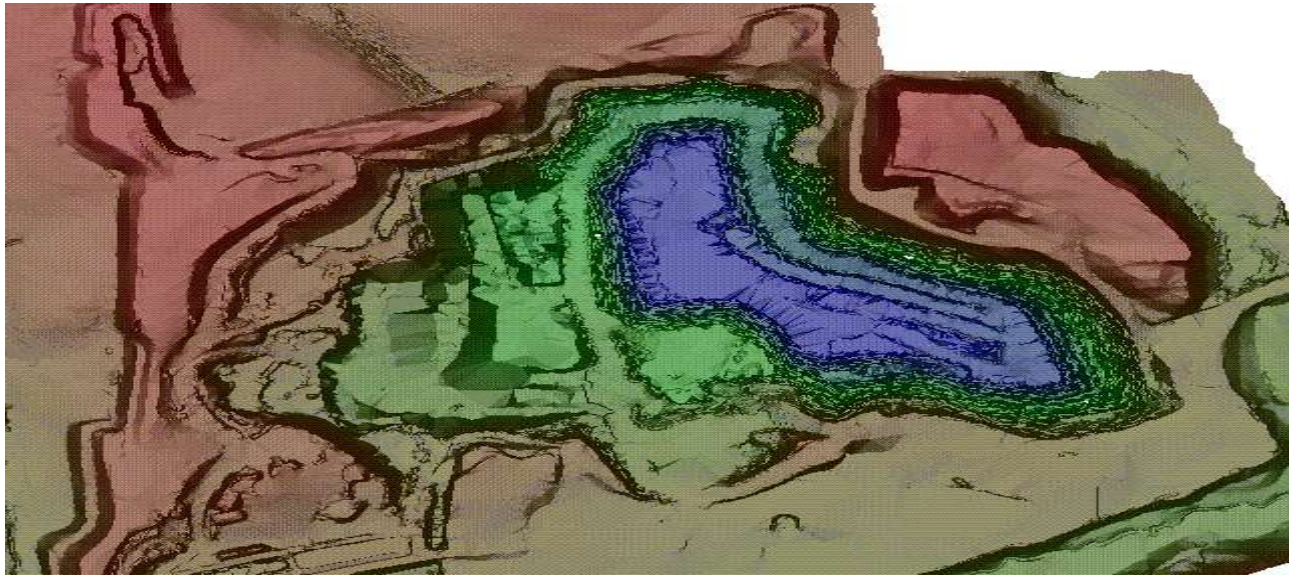
Annual Quarry Plan Review





Practical quarry planning is about; understanding exactly your current position and situation, then thinking very carefully about future outcomes and engineering the best process to get there.

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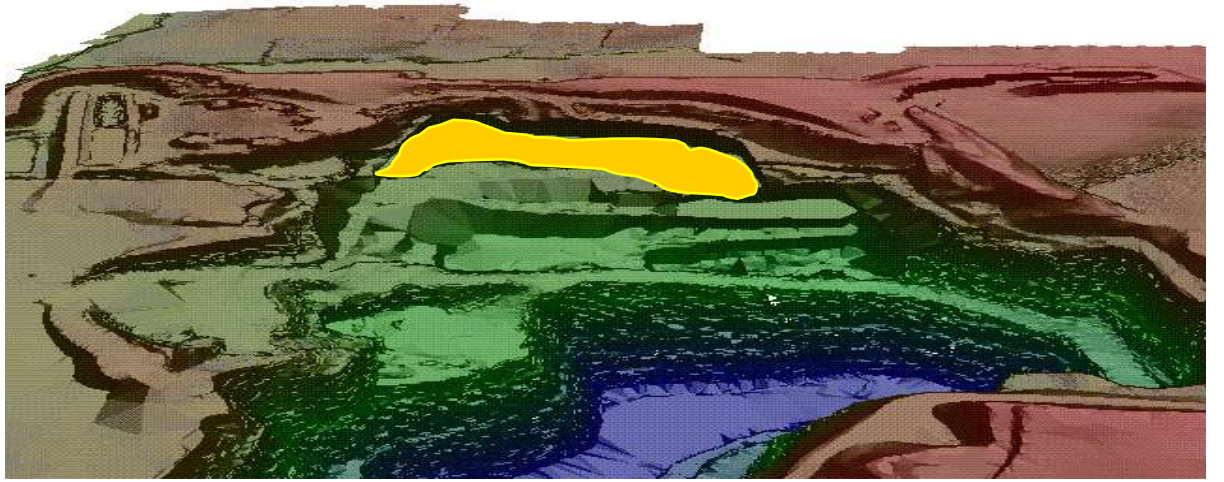
Bench 1 – 767,750 Tons



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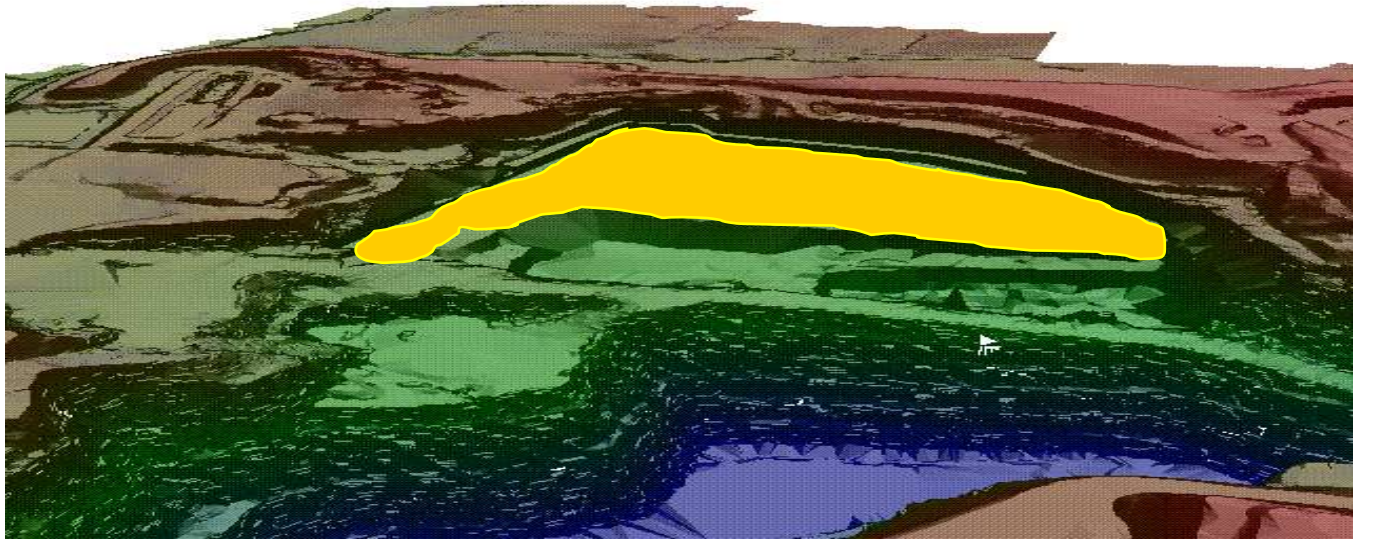
Bench 2 – 780,300 Tons



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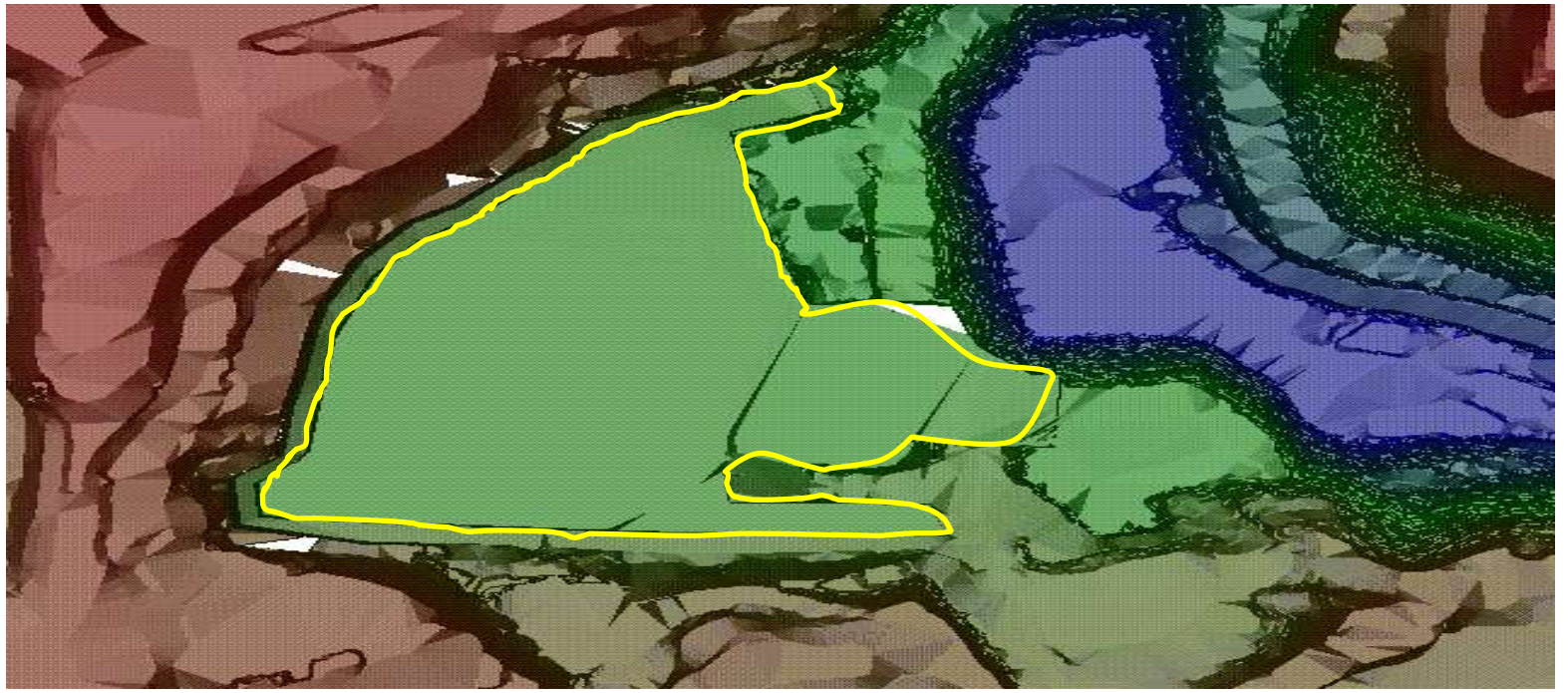
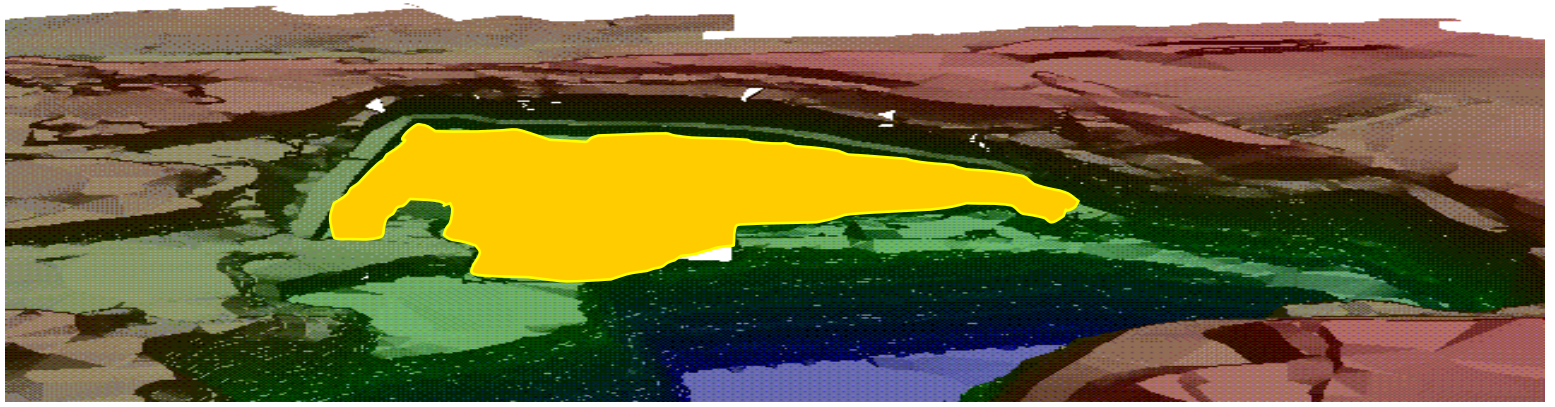
Bench 3 – 1,810,300 Tons





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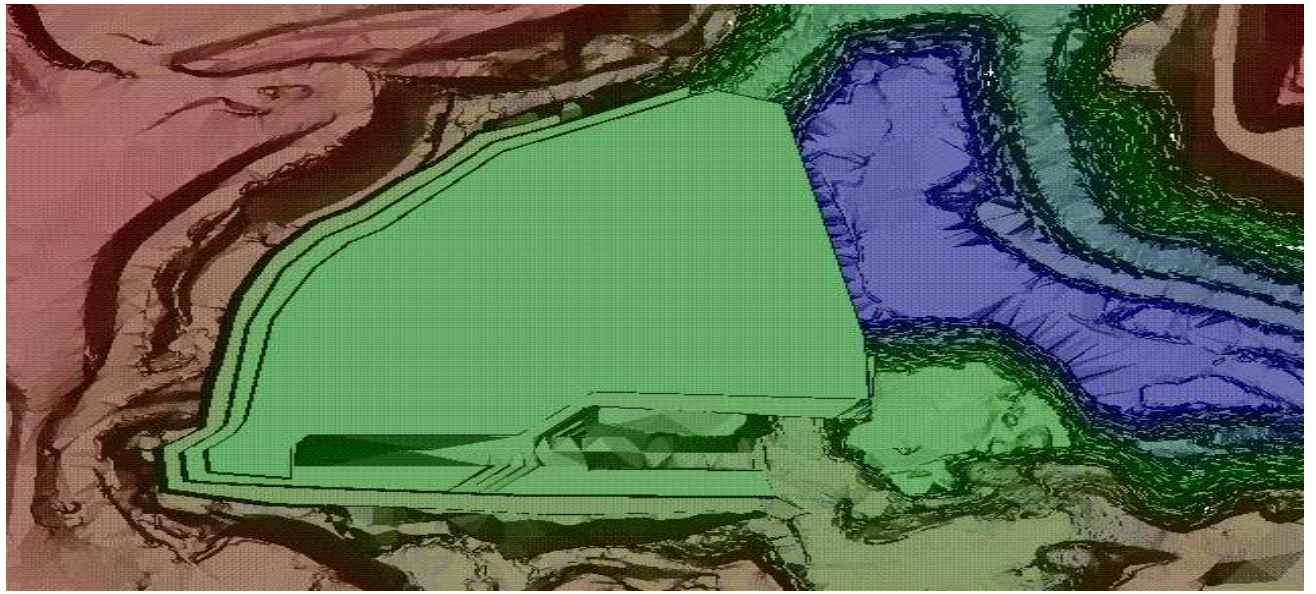
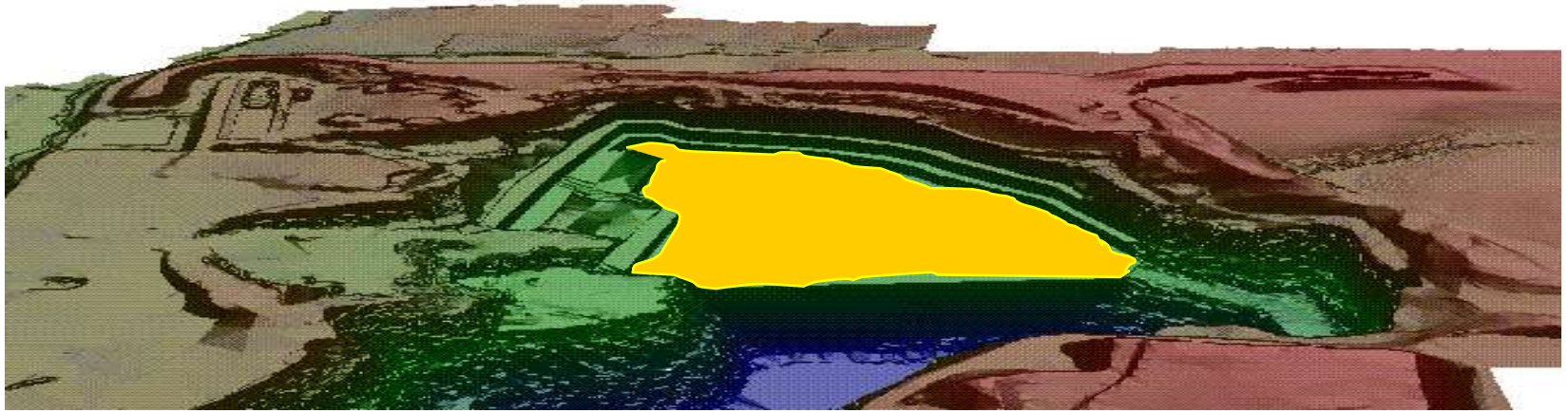
Bench 4 – 1,733,400 Tons





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Production From Benches

- Bench 1 – 767,750 tons
- Bench 2 – 780,300 tons
- Bench 3 – 1,810,300 tons
- Bench 4 – 1,733,400 tons

Mineable Reserves Available – 5,091,750 Tons

Sounds Good – Right?

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Tons Currently Available From Benches

- Bench 1 – 767,750 tons
- Bench 2 – 12,550 tons
- Bench 3 – 1,030,000 tons
- Bench 4 – 500,000 tons

Does It Still Sounds Good?

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Characteristics of Good Plans

- **Based on reliable market forecasts**
- **Flexible to adjust to changing market conditions**
  - ✓ Contain if-then scenarios
- **Consider current pit configuration & equipment**
- **Outline sequence of activities necessary to achieve plan**
  - ✓ Realistic expectations and timeline (considers dependencies)
  - ✓ Identify what is needed at each stage (work breakdown structure)
- **Structured to maximize revenue**
  - ✓ Efficient usage of available resources (labor and equipment)
- **Identify risks in achieving the plan**
  - ✓ Offers contingency plan(s)
- **Communicated to stakeholders**

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Metric Considerations

- **Implement Survey and Elevation Control programs**
- **Become Engaged with Drill and Blast Designs**
  - ✓ Don’t just accept the current drilling practices
  - ✓ Don’t just accept the current blasting practices
- **Monitor the Drill and Blast Pattern Outcome**
  - ✓ Pattern layout
  - ✓ Seismograph results
  - ✓ Blast video analysis
  - ✓ Size gradation such as oversize %, fines %, excess back break, or micro fracturing
  - ✓ Diggability, cycle times, or fuel costs per finished ton
- **Apply Lean-Six Sigma tools that are fundamental to program management:**
  - ✓ base lining, data control, process monitoring, information sharing

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