# **NE ADA** G O L D M I N E S

## Automation of Mining Equipment

#### Matthew Majors Open Pit Operations Superintendent Carlin Surface

#### Cautionary Statement on Forward-Looking Information



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# The Autonomous Journey at NGM



#### **P** Open Pit

- Drilling
- Hauling

Drilling

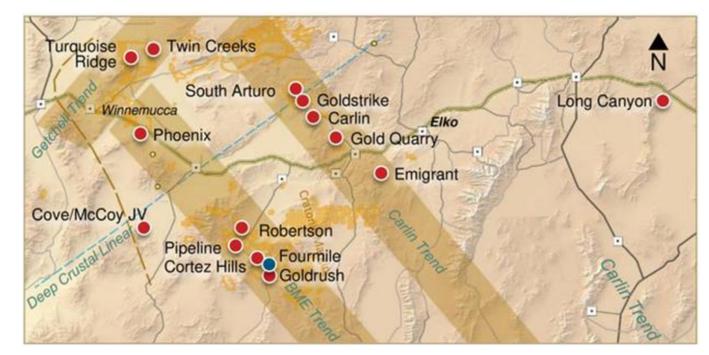
Loading

Hauling

#### Processing Plants

MillsPlants

- Underground
  - Remote Operations







#### Why

- Safety; removing people from the hazards associated with operation of haulage equipment
- Labour; reduce utilization impacts to labour turnover across all equipment production equipment
- Production; increasing production averages and lowering costs

#### How

- Match current system functionality with improvement opportunities in the mine plan
- Work with OEM and non-OEM vendors to develop proper cost models that take into account evaluation periods, systemic and operational growth, and scalable plans

#### **Automation at Nevada Gold Mines**

- Multiple underground evaluation deployments
- Surface drilling OEM evaluation
- Non-OEM surface production haulage



# **Executing Autonomy**



#### **People**

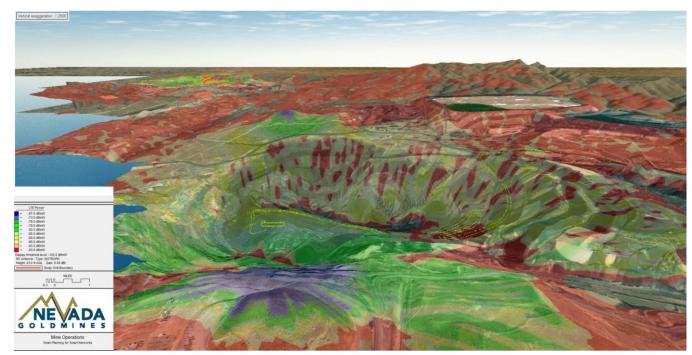
- Strategy and Vision
- Communication & Engagement Plan
- On-Going Communication and Project Evaluations
- Training and Evaluations

#### Processes

- Regulatory Statutes
- Operational Polices & Procedures
- Engineering Standards & Planning Processes
- Change Management

#### Technology

- Vendor Evaluation
- Communication Infrastructure
- Autonomous Safety & Control Systems
- Performance Management and KPI's



Modeled LTE Power Curves with User Equipment Latency Traces Overlay

# **Measuring Performance**

#### Autonomous Availability

- Installation & Commissioning
- Control Testing
- On-Going Communication and Project Evaluations

#### Communications Availability

- Network and Last-Mile Communication
- Server Upgrade
- High Availability

### Production Utilization

- Don't stop the trucks!
- Hot change control room and loading equipment
- Maximize blast pattern size
- Standardize road design and manned interactions



2019 Trial System Performance



Nov

0% Jan Mar Apr May Jun Jul Sep Oct

2019 Autonomous System Performance, Months system not used omitted.

50%

40%

30%

20%

10%

## In Summary

- System and expectation alignment
- Employee engagement
- Measure positive engagement
- Planning and operation execution to plan are keys to productivity
- Wireless communications are no longer a "support" function





# GOLDMINES

# Thank you!