



## MineCycle™ Survey

Rapid and Accessible Survey Intelligence

MineCycle Survey is an underground and surface mine survey application that accelerates data processing and visualization to deliver more timely information to planning and operations. The software's unique open data architecture provides unmatched flexibility and freedom to share survey intelligence across the enterprise, enabling mine owner-operators to make faster, higher-quality decisions that improve mine performance.

### Industry-driven Development to Ensure Robust Capability

Bentley designed and developed MineCycle Survey with formal cooperation and direct input from industry leaders including Lonmin Plc, AngloGold Ashanti Limited, Anglo American Platinum Limited, and Royal Bafokeng Platinum. The industry-driven approach ensures inclusion of the features, capabilities, and workflows needed for efficient survey operations.

### Open Architecture for Information Mobility

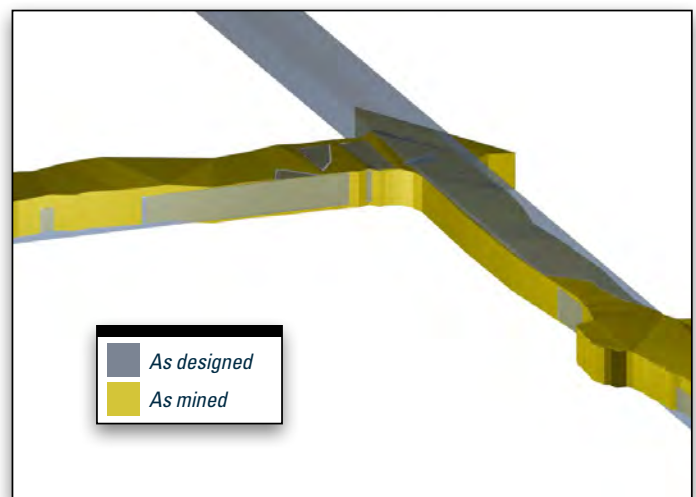
MineCycle Survey uses native formats to operate with desktop and enterprise-level implementations of Oracle and SQL databases. The open architecture enables unmatched flexibility and freedom to share accurate mining progress anywhere it is needed by eliminating the difficulty, time, and expense of working with complex, non-native formats. The resulting information mobility enables novel reporting and analysis for more agile and informed responses to market fluctuations and unexpected events.

### Consolidated Survey Capability for Greater Efficiency and Lower Costs

MineCycle Survey includes comprehensive underground and surface survey capabilities including pegs, offsets, adjustments, stockpile volumes, progressive open cast surveys, notes, and more. The consolidated capabilities save time and money by eliminating the workflow inefficiency and redundant overhead of multiple survey applications. The software also helps maximize survey workforce utilization by enabling the flexibility to assign staff without regard to the type of mine.

### Standards Enforcement for Consistent High-quality Deliverables

MineCycle Survey includes tools to easily apply and share standards for survey codes, symbols, colors, levels, line styles, cells, and more. Integration with ProjectWise, Bentley's information management and collaboration software, enables standards enforcement through the application of global definitions for the project workspace, DGNLib, and Bentley Map schema. These capabilities



*A 3D model, automatically created from raw instrument data, enables rapid analysis of planned versus actual for a more continuous mine planning cycle.*

reduce errors and promote consistency to enable efficient interpretation of survey deliverables across the organization.

### Support for a Variety of Sensors to Accurately Combine Survey Data

The software can ingest data directly from a variety of sensors, instruments, file formats, and collection techniques including manual field book data, total stations, GPS devices, laser scans, and point clouds. This allows the user to combine diverse sets of data in one survey without time-consuming intermediate conversions that increase the risk of data corruption.

### Automatic 3D Model for Rapid Analysis of Planned Versus Actual

MineCycle Survey generates a 3D model of the mined volume, compliant with company standards, directly from the raw data of all leading survey instruments. This eliminates the time, difficulty, and data integrity risks associated with using multiple applications to process disparate sources of data, manually join the dots, and change symbology. Integration with MineCycle Designer allows the 3D model to be quickly compared to the mine plan for calculation and visualization of under-blast, over-blast, and other variances. Together these capabilities enable an accelerated and more continuous mine planning cycle that increases the ability to maximize profits and respond quickly to unexpected events.

## System Requirements

Refer to the 'Requirements' section of the MineCycle Survey ReadMe file:

[www.bentley.com/  
MineCycle\\_Survey-Spec](http://www.bentley.com/MineCycle_Survey-Spec)

## Find out about Bentley at: [www.bentley.com](http://www.bentley.com)

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# MineCycle™ Survey At-A-Glance

## Native Spatial Database Publishing

- Oracle or SQL
  - » Enterprise and desktop versions
- No proprietary schemas, tables, or fields
- Powered by Bentley Map
- Support for DGN and native DWG formats

## Direct Upload to and from Leading Sensors and Instruments

- Trimble
- Topcon
- Leica
- Total Stations
- GPS
- Laser scanning
- Digital photographs

## Underground Survey

- Electronic survey from paper field book data
- Re-Survey (check surveys) with data retention
- Adjustments
  - » Least Squares
  - » Compass Rule (Bowditch)
  - » Crandall
  - » Transit
- Zoom to peg by name
- Obsolete peg marking with comments
- Obsolete offset marking
- Tape and offset tool to enter multiple tapes with matching offsets
  - » Stope panel offsets
  - » Drift offsets
- Tape and offset approvals
- Compliance check report for any peg in the database
- Peg register report of all pegs stored in the database
- Semi-automated reports for development, holing and stopping, and Stope survey notes
- Rapid longitudinal section along any mine element

## Surface Survey

- Adjustments
  - » Least Squares
  - » Compass Rule (Bowditch)
  - » Crandall
  - » Transit
- Open pit progressive survey
- Stockpile survey
  - » Store to database with date, surveyor name, and material type

- » Report volumes over any period with graphical representation
- » Include multiple stockpiles in a single survey
- Basic haul road design
- Rapid longitudinal section along any mine element
- Place clipped terrain boundary using any graphical polygon
- Terrain editing including copy and vertical offset
- Coordinate transformations

## Surface Terrain Modeling

- Terrain import from various applications and formats
  - » InRoads
  - » GEOPAK
  - » MXROAD
  - » ERDAS
  - » LiDAR
  - » LandXML
  - » ASCII
- Terrain construction from existing data
  - » Graphical elements
  - » Text interpolation
  - » Point clouds
  - » Survey elements
- Terrain model merge and append with data integrity
- Clipped and delta terrain models
- Feature addition and removal
- Terrain volume analysis
- 3D cut-and-fill volumes
- Geometry tools
- Civil corridor modeling
- Horizontal geometry
- Vertical geometry
- 3D geometry

## Standards Enforcement

- Company-defined standards
- Templates with integrated survey codes
- Bentley Map schema
- Enforcement via ProjectWise integration

## Automatic 3D Model Generation

- Processing and storage of raw sensor data
- No intermediate data processing required
- Feature, DTM, and mesh model creation
- Volume creation
- Calculation and adjustment directly on the 3D model
- Integration with MineCycle Designer to compare actual versus planned