Advanced Integration Of Geospatial Technologies In Mining and Reclamation

December, 2004

GPS Aided Blasting

Steve A. Weber, P.E.

VP R/D Carlson Software

Carlson

Carlson

Carlson

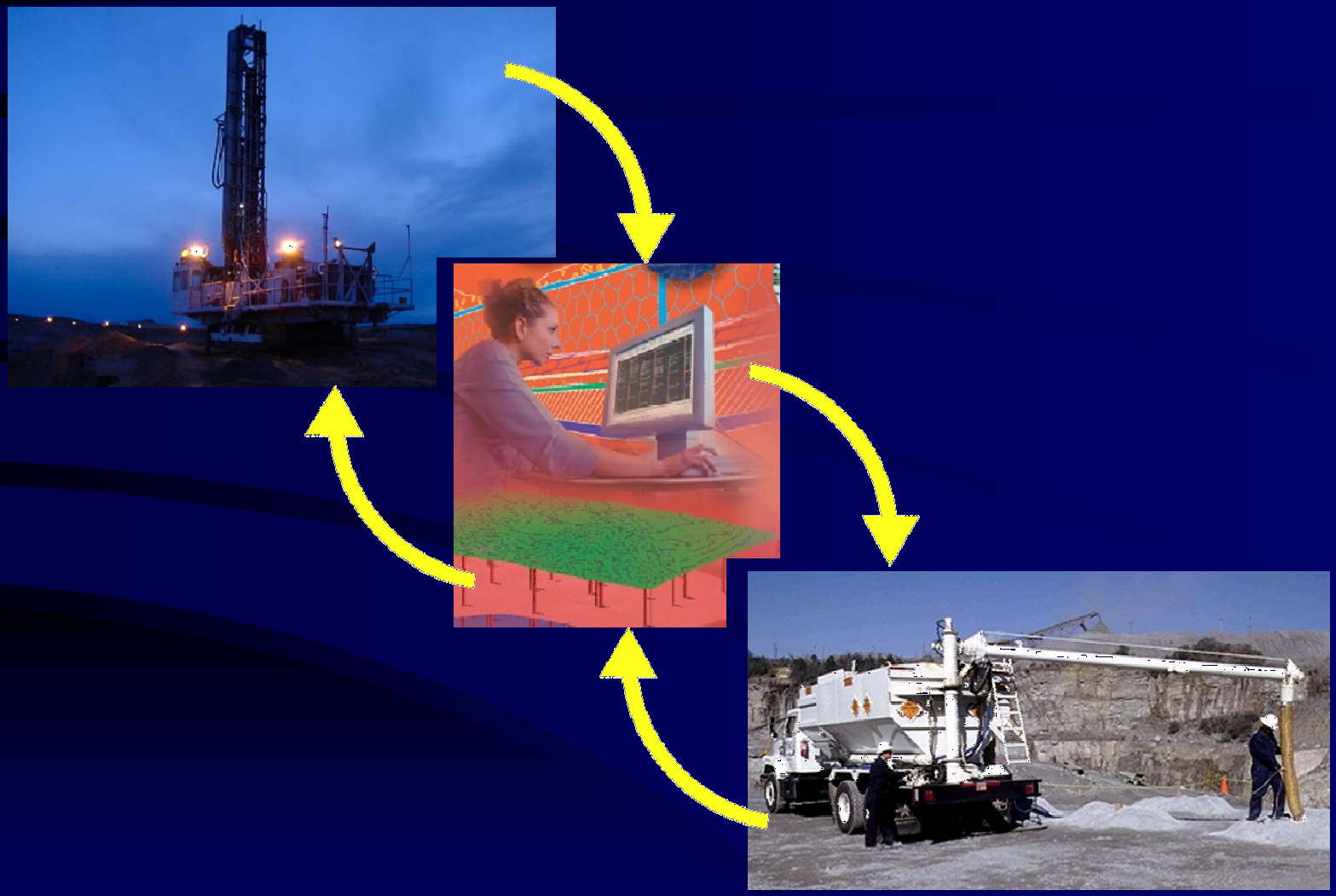
Carlson

Use Of Blasting Data

- Is the location data to be used for documentation purposes?
- Is the location data to be used for vibration control?
- Are uncontrolled structures at a relatively large distance?
- Is the location data to be used for staking of the holes?
- Is the location data to be used for drill guidance control?
- Is the location data to be used for locating a hole?
- Are the holes tightly spaced?
- Are the hole locations pre-determined by design, or made on a case-by-case basis?
- Does blasting data flow office to field, and back?
- Will down-hole data be used to update a geologic model?
- Is the blast area in a deep hole?

Carlson

Data Flow



Carlson

4 Keys To Optimized Blasting

- Energy Level
- Energy Distribution
- Precise Timing
- Energy Confinement

Carlson

Distribution & Confinement

- Geologic structures
- Distance from open face
- Pattern burden and spacing

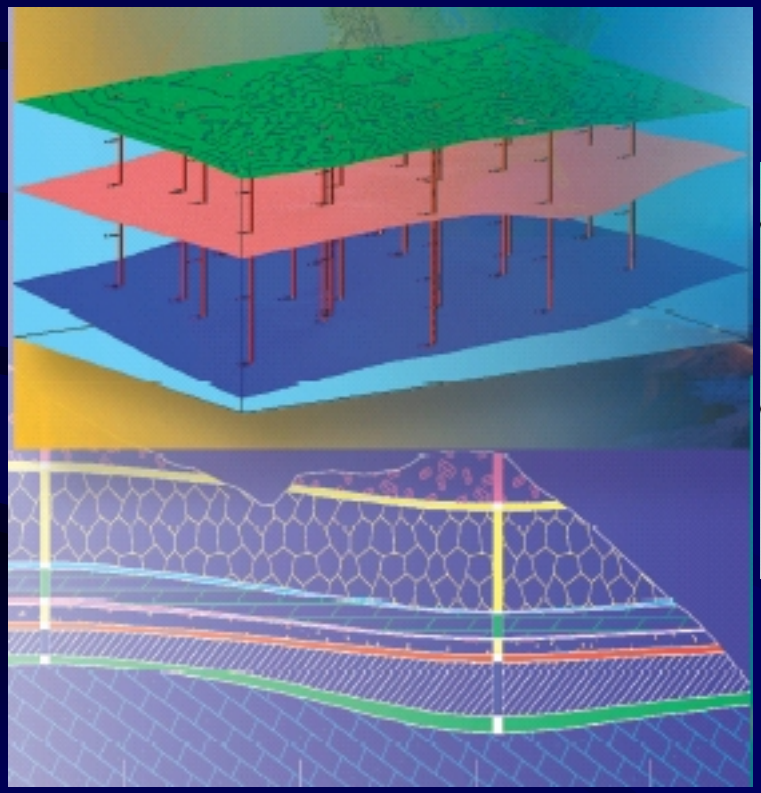
Carlson

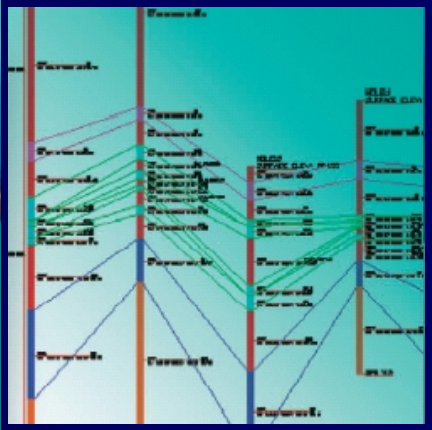
Drilling & Blasting Products

- Office Software – SurvCADD XML^2
  - Mining & Advanced Mining Modules
  - Blasting Module
  - Hole Manager
- Blasthole Data Collection
  - Blast-CE
  - E-Logger
- Machine Guidance - DrillStar

Carlson

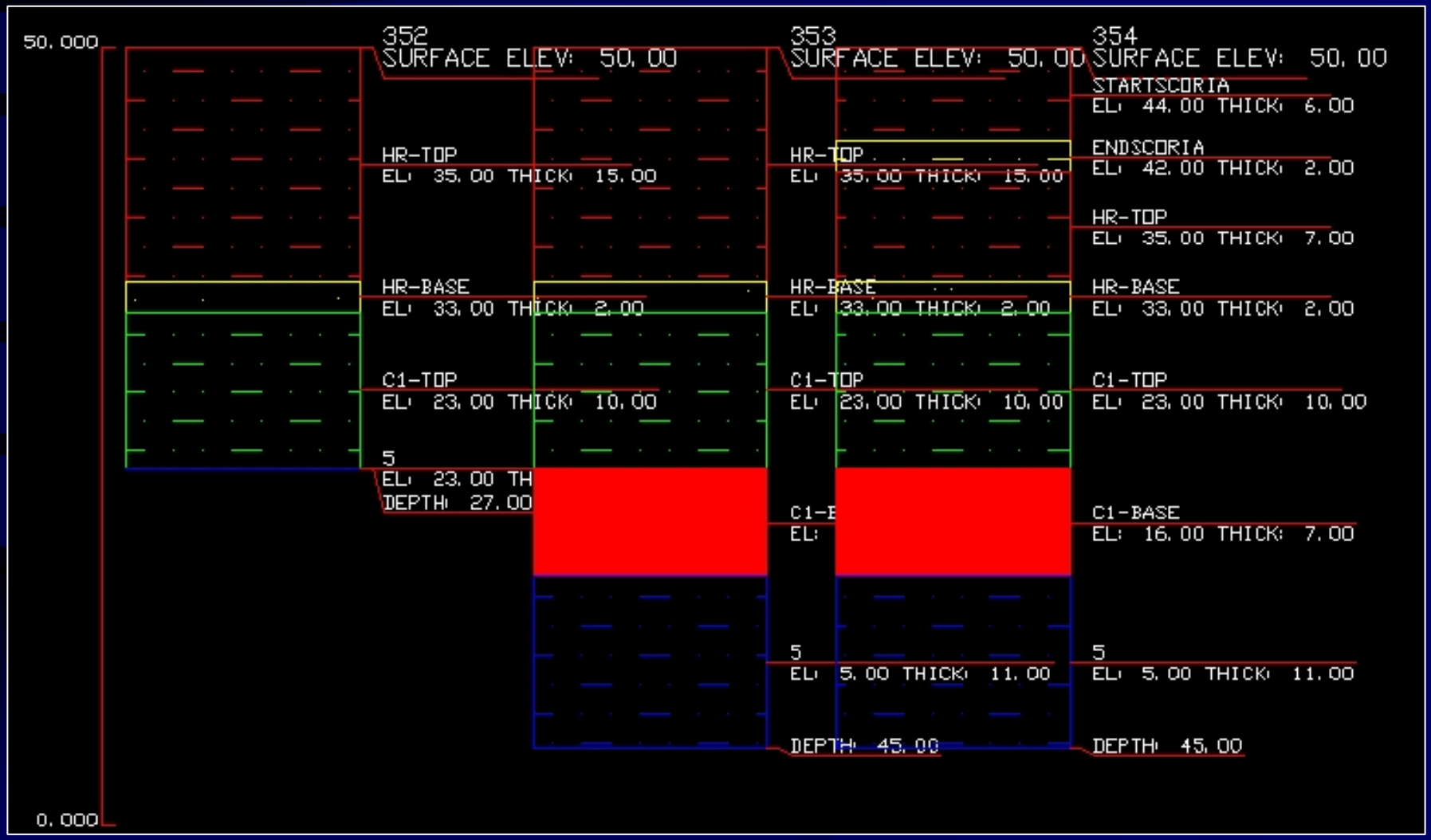
Mining & Advanced Mining Geologic Modeling





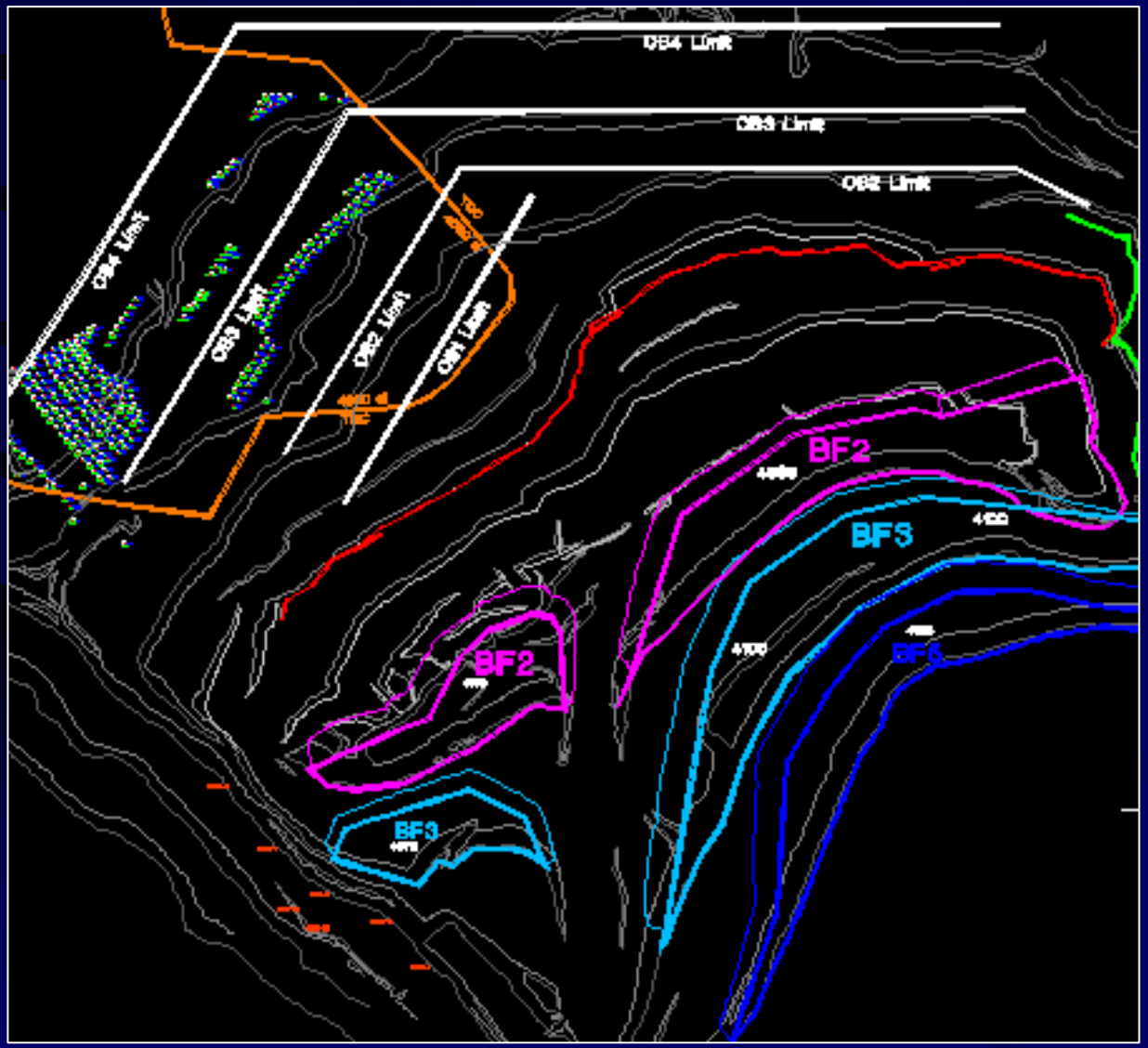
Carlson

Geologic Modeling



Carlson

Mining & Advanced Mining Blast Pattern Layout



Carlson

Mining & Advanced Mining Blast Pattern Layout

- Square or staggered patterns
- Angle or vertical holes
- Top and bottom surface files
- Inclusion perimeter
- ASCII or CRD export

Carlson

Energy Level & Confinement

- Hole depth
- Decking
- Load
- Detonation sequencing
- Stemming

Carlson

Blasting Module

- Event information
- Uncontrolled structures
- Seismic information
- Regression analysis
- Reports

Carlson

Database Details

DATABASE

- Database Path and Name
- Project
- Mines/Pits/Areas
- Explosives/Materials
- Seismographs
- Drillers Names/ License
- Initiation System
- Cord Types
- Primers/Detonators
- Uncontrolled Structures ▸

HOLE DESIGN

- Design Standard Hole
- Layout Grid
- Insert New Grid Hole(s)
- Insert New Random Hole(s)
- Delete Hole(s)
- Edit Holes
- Database to Drawing
- Update D-base from Drawing
- Draw Hole to Hole Delays
- Erase Hole to Hole Delays

EVENTS

- Define New
- Set Current
- Edit Current
- Edit Event Blast/Seis Data
- Zoom to Current Event
- Freeze All Events
- Thaw Select Events
- 3D
- Animate Event

HANDHELD

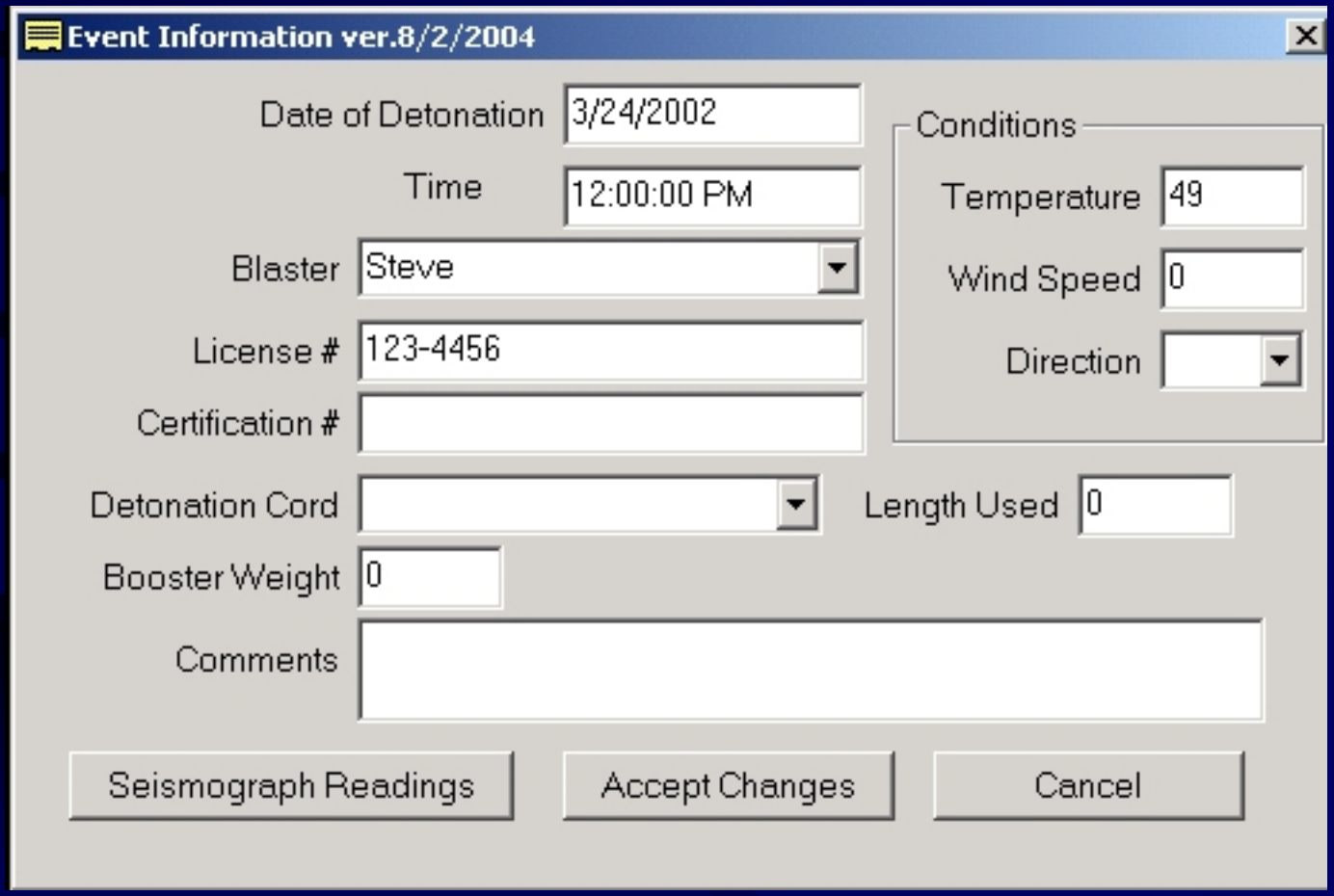
- Export Materials List
- Export to Handheld
- Simulate Handheld
- Import From Handheld

REPORTS

- Explosives Record
- Seismic Record
- Regression Analysis
- Hard Copy Shot Report

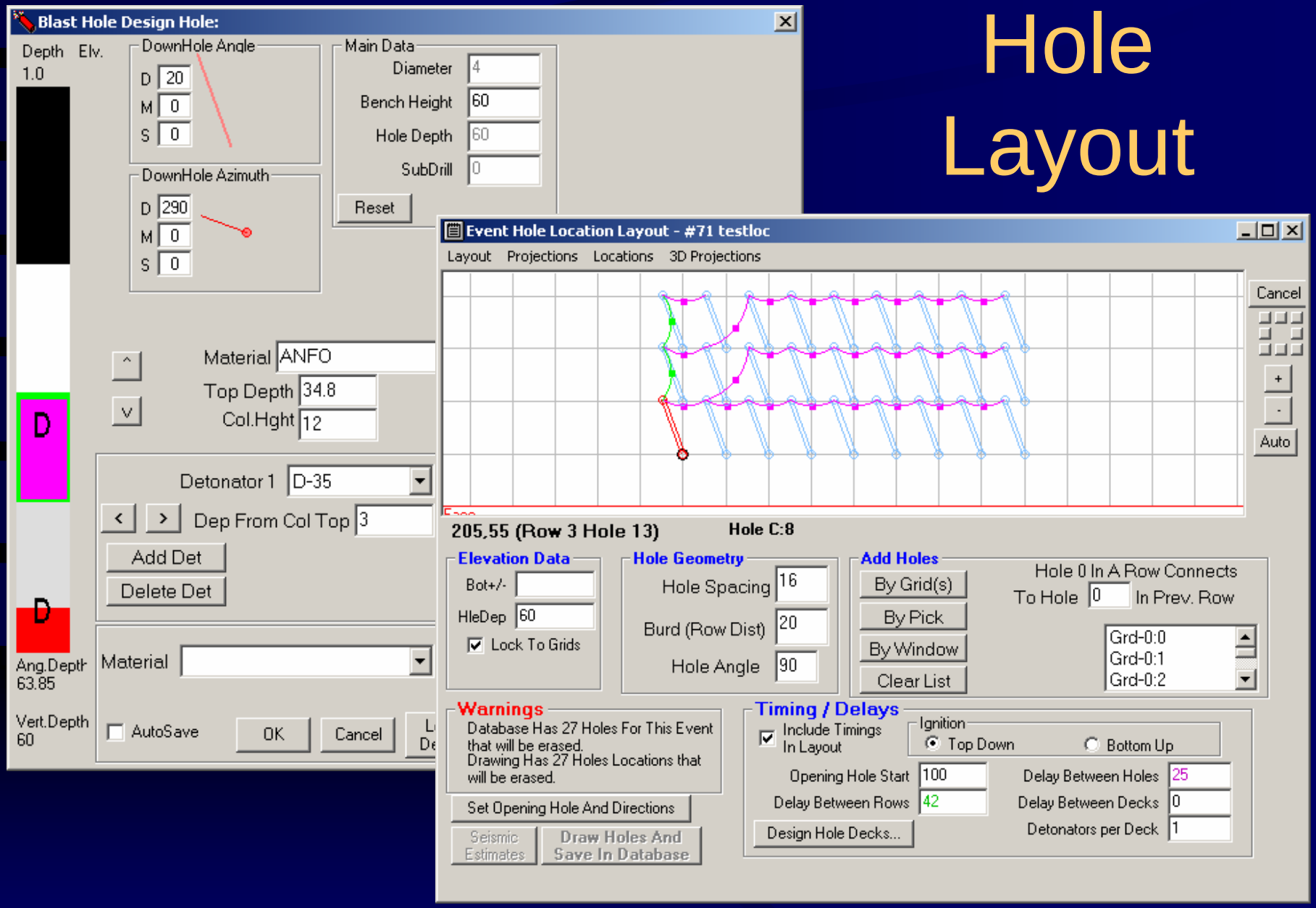
Carlson

Blasting Event Information



Carlson

Hole Layout



Carlson

Seismic Report

Seismic Report Event EX14 ver.8/2/2004

Total Explosives Used		1479.5 #
Burden Moved		0 CY
Powder Factor		
Length of Event (mSec)		408 mSec
Maximum Explosives in One Deck		246.6 #
Maximum Explosive	8 mSec	986 #
Maximum Explosive Delay Occurs at		250 mSec
Nearest Uncontrolled Structure		Church
Distance to Nearest Uncontrolled		920 Ft
Direction to Nearest Uncontrolled		205d19'16.4"
Actual Scale Distance		29.3
Maximum Expl. Wght Allowed For	65 Scale Dist	200.2

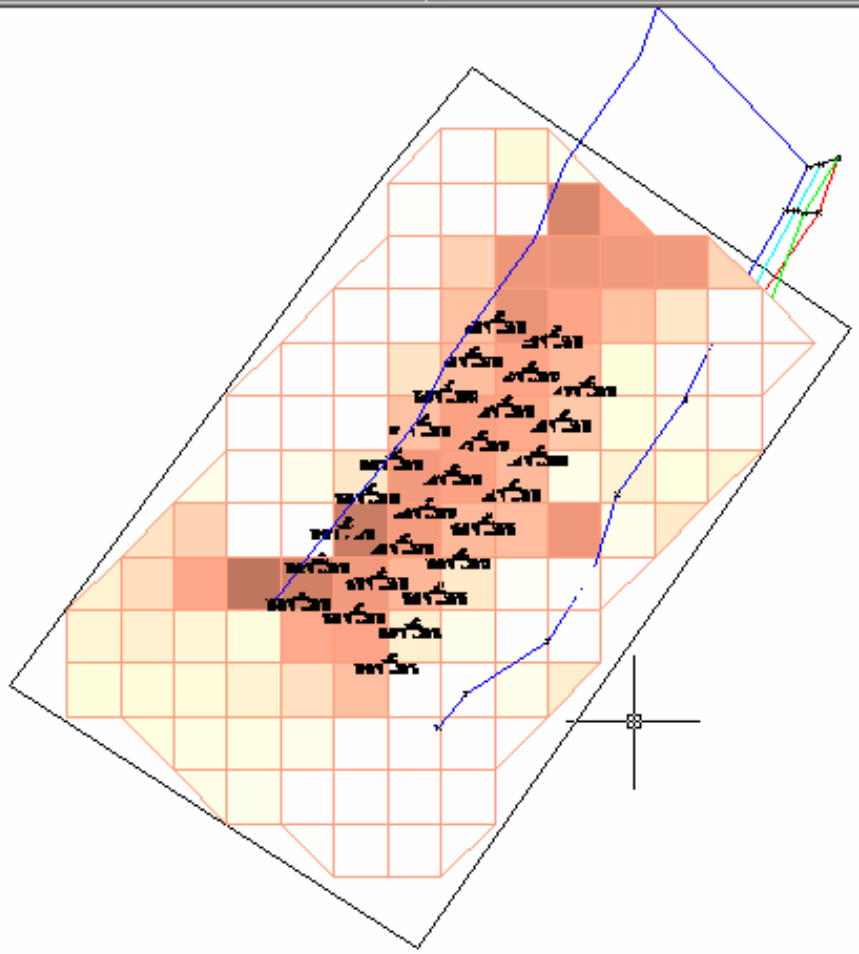
Exit Report

Carlson

AutoCAD with SurvCADD XML Release 2 - [CRD: NONE] - [C:\scadxml2\blasting\blasting.dwg]

File Edit View Draw Inq-Set Points 3Dpoly D T M Contour Site Misc Map Help Window

Event-71-3DHoles- | ByLayer | ByLayer | ByLaye



Model Layout1

Command: orbit

5.057424E+03, 5.332117E+03, 0.00000000 SNAP GRID ORTHO POLAR OSNAP OTRACK LWT MODEL

Carlson

AutoCAD with SurvCADD XML Release 2 - [CRD: NONE] - [C:\scadxml2\blasting\blasting.dwg]

File Edit View Draw Inq-Set Points Definitions Holes Events Handheld Report Misc Map Help Window

Event-71-3DHoles- | ByLayer | ByLayer | ByLayer | ByColor

testloc

Go | Exit

mS=21

Faster | Slower

Ang + | Ang - | Rot - | Rot +

Left | Right | Up | Down

Zoom Out | Zoom In | Zoom Win

Zoom Ext | Zoom Prev

Z Y X

Model | Layout1

4.980956E+03, 5.651311E+03, 0.00000000 SNAP GRID ORTHO POLAR OSNAP OTRACK LWT MODEL

Carlson

Machine Guidance - DrillStar

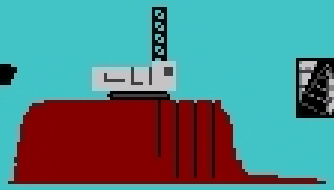
- Combines blast pattern, plan map, and multiple design surfaces to provide a complete real-time 3-D view of the drillhole and surrounding blast area
- Guides drill to hole and tracks depth, location, operator, drillability, and any user-defined information desired
- Blast designs can be given to the drill, designed in the field, or completed on-the-fly one hole at a time

Carlson

DrillStar inside the cab at Buckskin Mine (Wyoming)

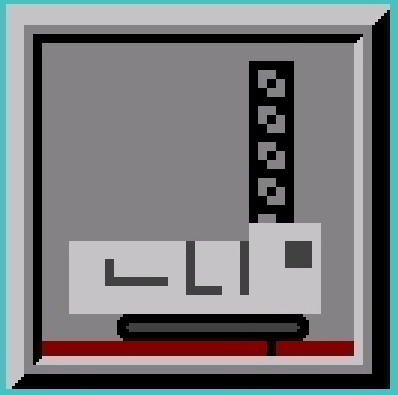
Carlson

DrillStar



Powered by: Carlson Software

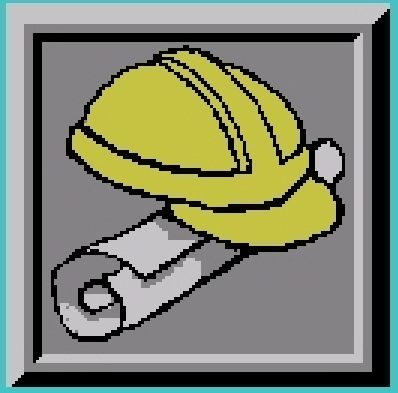
DRILL



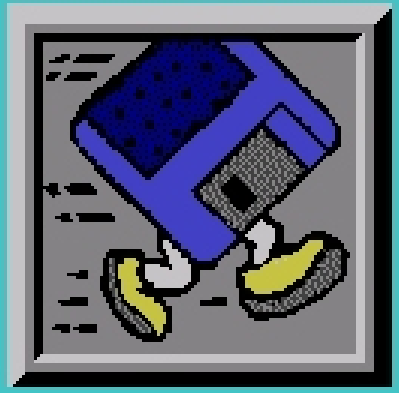
MONITOR

TOOLS

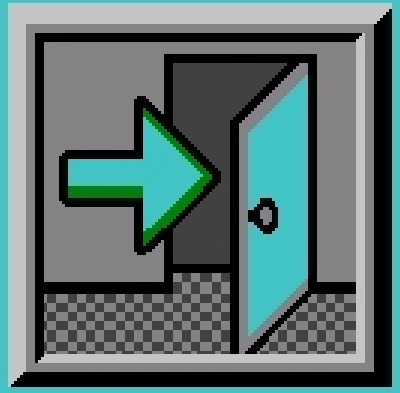
PROJECT



TRANSFER



EXIT



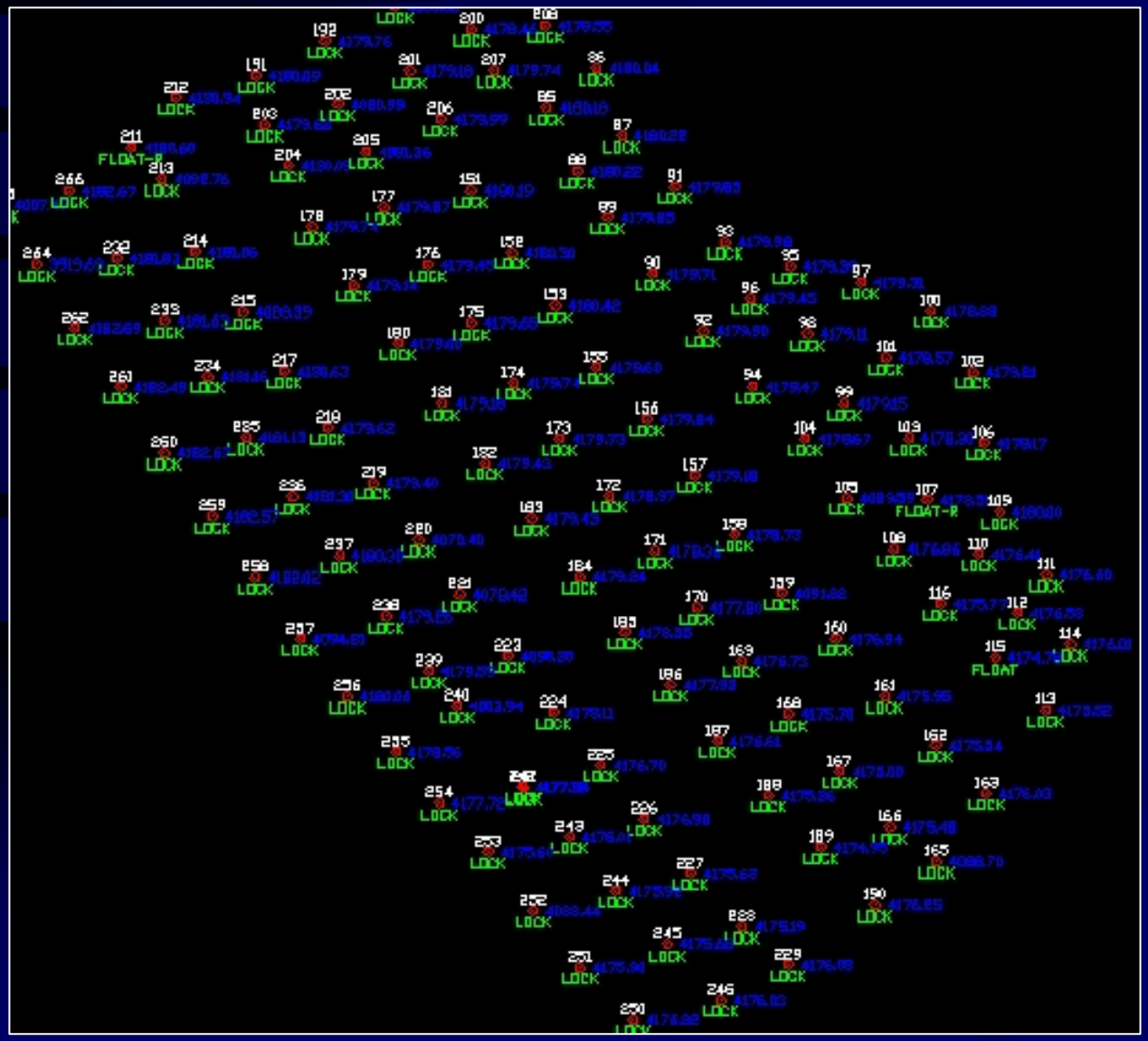
DrillStar navigation screen with pattern layout guides displayed

Carlson

DrillStar depth screen - multiple surfaces can be entered

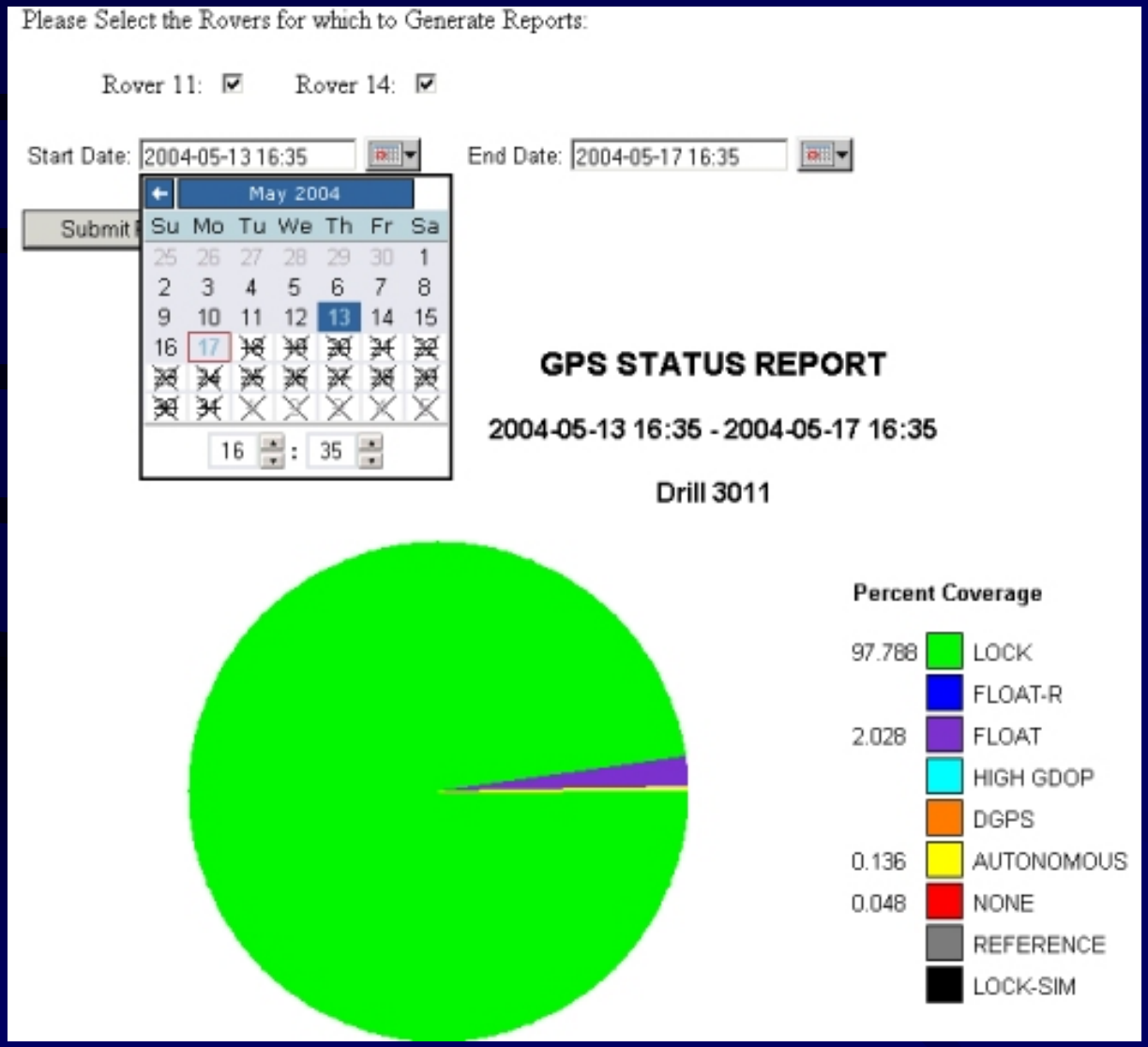
Carlson

DrillStar “As-Drilled” Holes



Carlson

DrillStar GPS Status Report



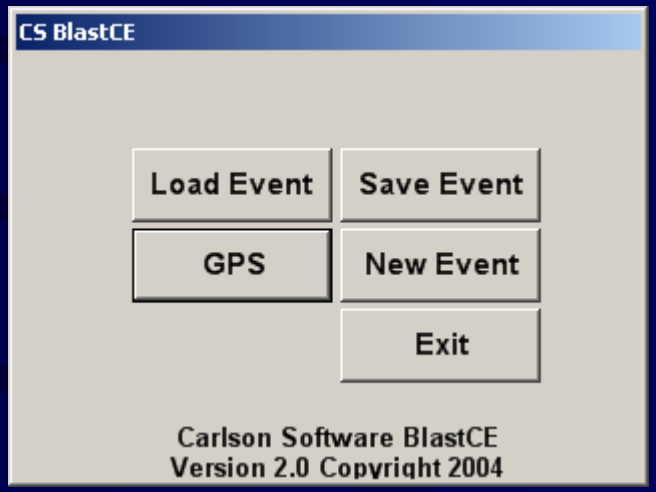
Carlson

DrillStar Benefits

- Real-time positioning information provides immediate performance feedback and real-time “as-built” surveys
- Real-time geologic modeling
- Increases productivity, eliminates staking, and satisfies regulatory requirements
- Work can continue in poor visibility

Carlson

BLAST CE



Carlson

Blast-CE

- Blast Pattern Layout
- Angled holes/staggered patterns
- Arbitrary holes
- Real-time detonator timings
- Supports electronic detonator IDs
- PDA support for field data collection
- Material tracking

Carlson

New Event

Name test

Blstr steve

Delays Between:

Rows Holes Dks

25 17 8

☑ Top Down Ignition

Start Time 100

Cancel Next

New Event

H.Dep H.Dia Stem

55 8 20

Burden Hole Spacing

25 20

☐ Staggered

Cancel Back Next

New Event

NAMING

Number Of Rows 3

Holes Left Of Init 0

Holes Rgt Of Init 9

Done (Freeform Holes)

Cancel Back Next

New Event

Init Hole Loc. GPS

E 5000 N 5000

Pnt Rgt Of Init. GPS

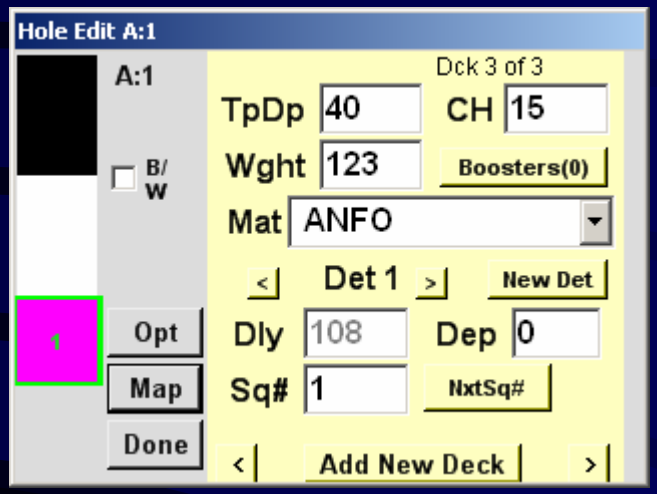
E 5004 N 5003

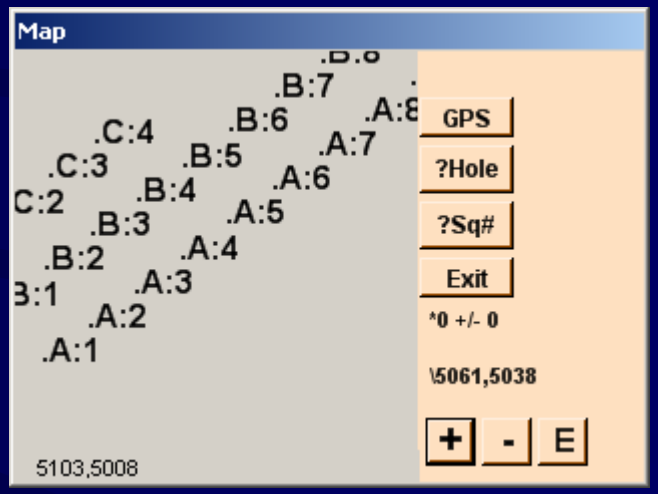
☐ Setting Back Row GPS Cfg

Cancel Back Done

Carlson

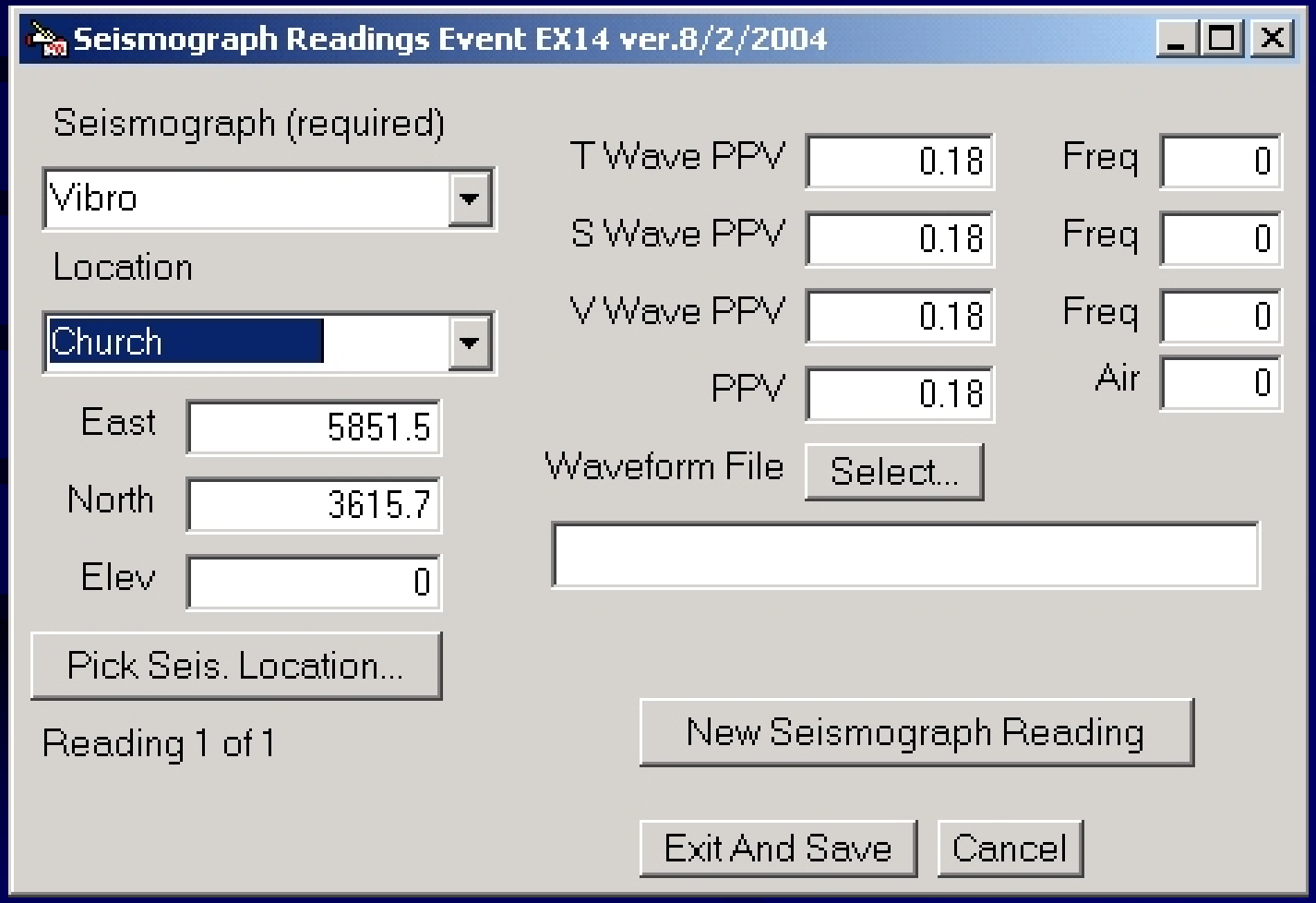
BlastCE Hole Entry





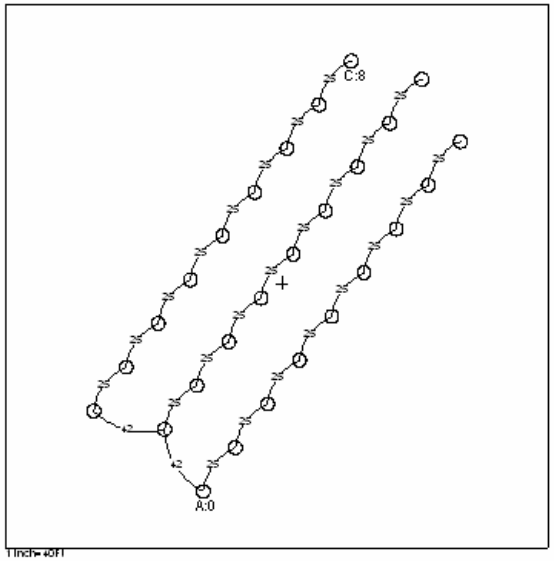
Carlson

Seismograph Readings



Carlson

Shot Report



Event Date-Time:
N 5415, E 5007

Project: Test Mining
Location: 123 Main Street
Maysville KY 41056

Blaster: ssss
License:

Weather:

Temperature: 0 Wind: 0

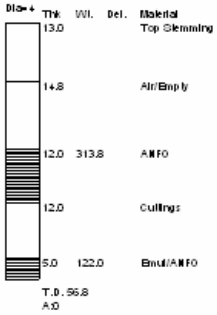
Init. System:
Cord Type:
Length Used:
Det. Types:

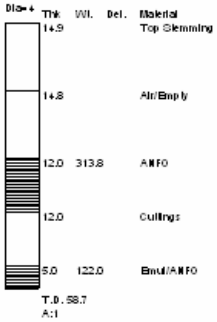
Seismic Data

Total Explosives Used:	11766.6
Max. Expl. / Deck:	313.8
Max. Expl. / 8Ms:	872
Allow. Expl at SD=65:	286.1

0 Seismograph Readings Taken

Nearest Structure:	Johnson
Distance:	1099 250d51'2.9
Actual Scale Distance:	37.2





CSBlast 2.0 Copyright 2003,2004

Carlson

Blasting Module & Blast-CE

- The data will be available to support costing analysis over any period of time
- Always have TRUE records of distance from shot to uncontrolled structures (litigation)
- Automated Shot Reports

Carlson

GPS will be on the bulk handling truck, so as the truck sets up on the hole -- the hole design will appear on the screen

Carlson

www.carlsonsw.com

1-800-989-5028

Maysville, KY

1-617-393-2300

Boston, MA

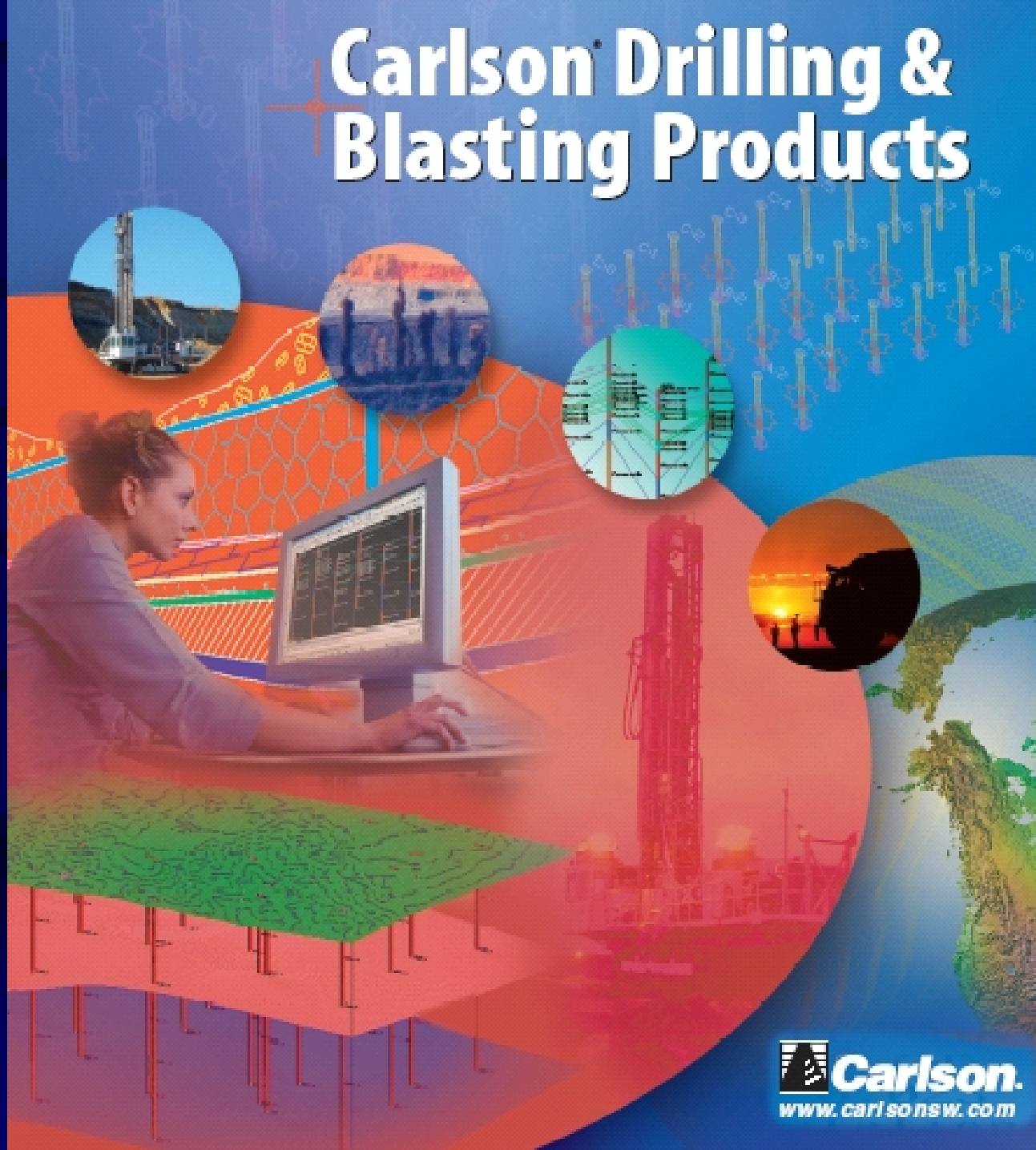
Atlanta, GA

Los Angeles, CA

Fort Collins, CO

North Carolina

Florida

Texas

Australia