Collision Avoidance Systems and Collision Warning Systems

Reducing Surface Mobile Equipment Accidents Through Technology

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MSHA Technical Support

MSHA Powered Haulage Safety Initiative

Areas of Focus

- Mobile Equipment at Surface Mines
  - Seat Belts
  - Large Equipment Striking Smaller Equipment
  - Highwalls and Dump Points
- Conveyor Belt Safety

MSHA Powered Haulage Safety Initiative

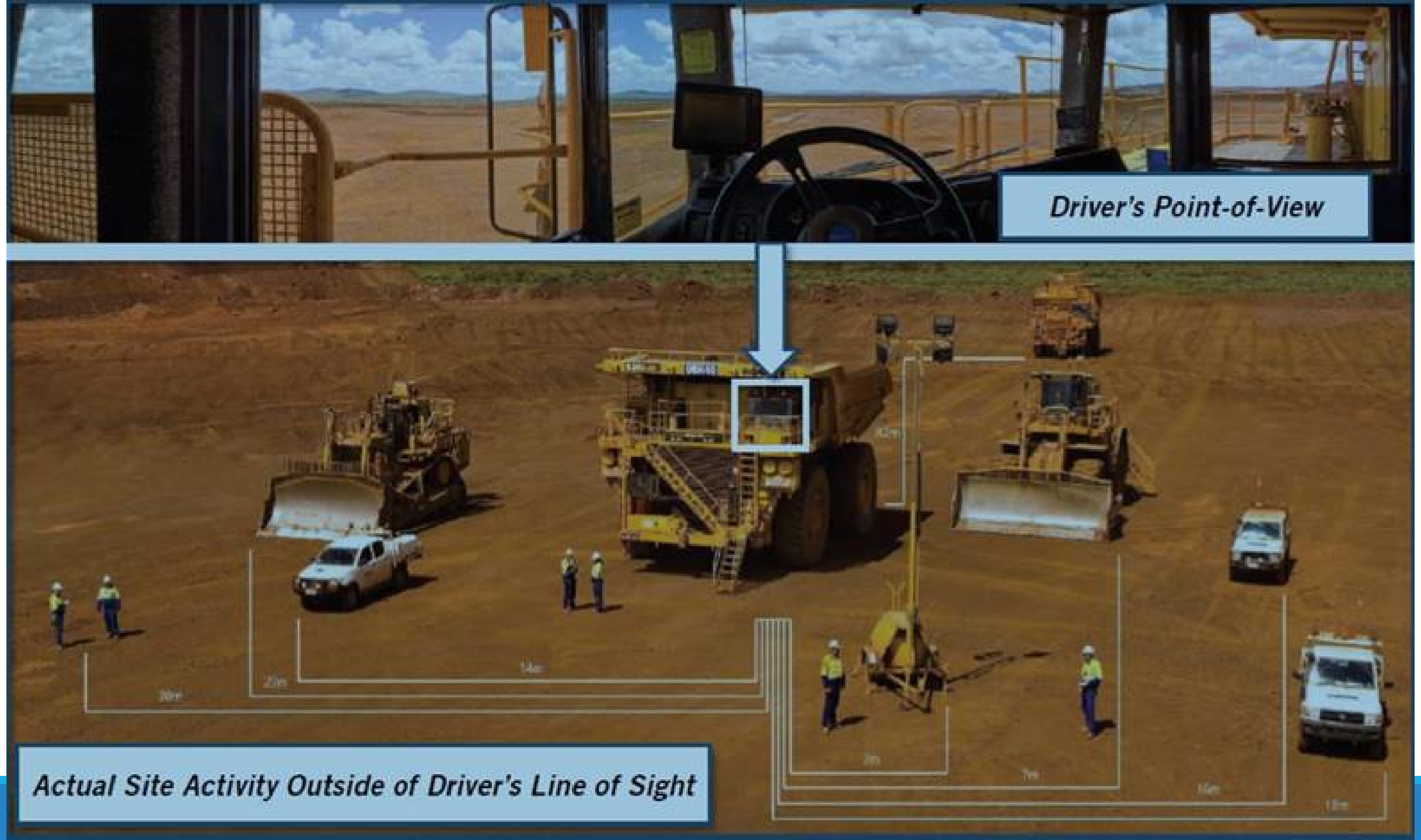
Mobile Equipment at Surface Mines

- Equipment Collisions with Other Equipment
- Equipment Collisions with Pedestrians

Mobile Equipment at Surface Mines

Blind Areas

- Mobile Equipment Size and Shape and the Operator's Cab Location can each Create Unique Blind Areas
- Blind Areas have Contributed to Mobile Equipment Operators Driving over Highwalls or Dump Points, Colliding with Other Equipment, and Striking Miners


Driver's Point-of-View
Actual Site Activity Outside of Driver's Line of Sight

Blind Areas

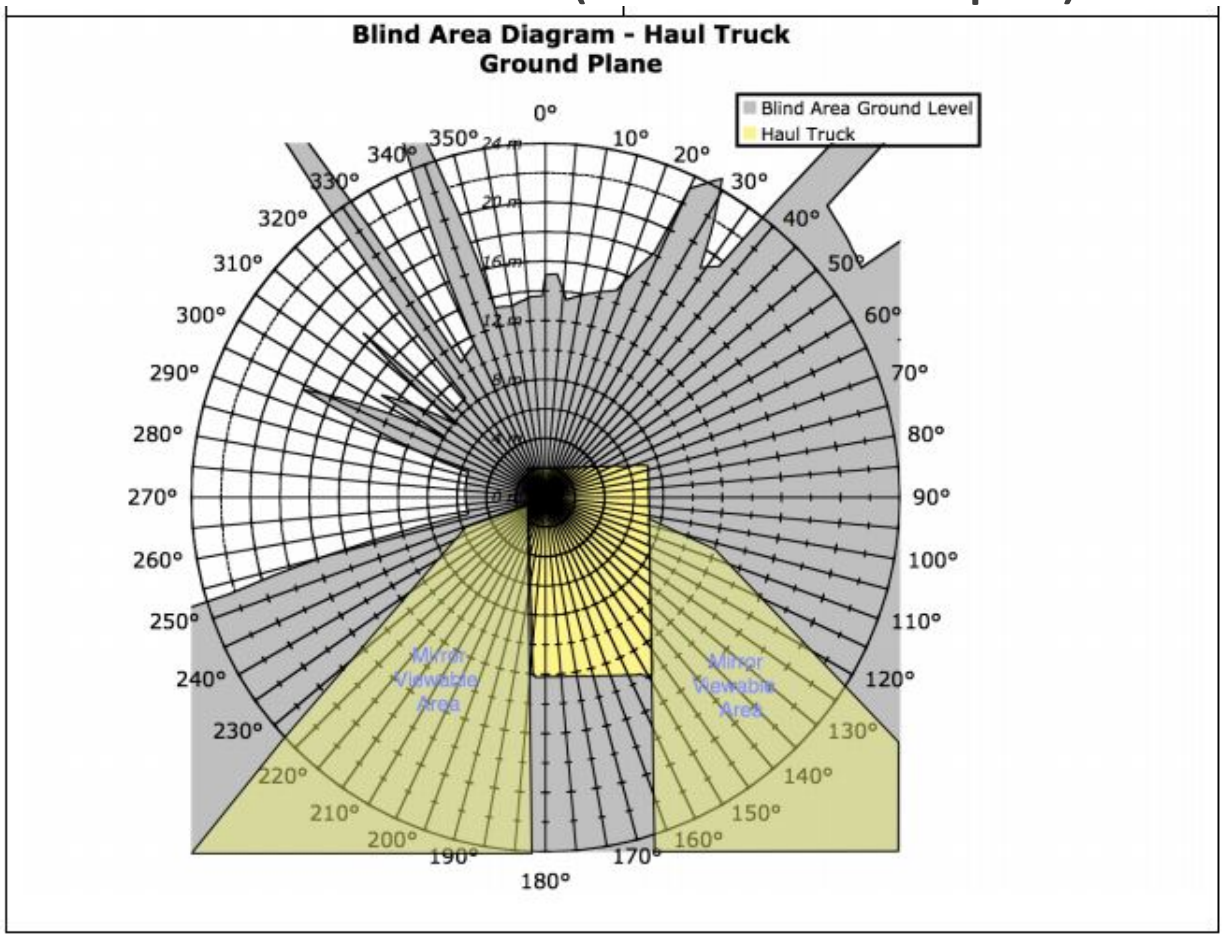
- NIOSH has Developed a Manual Method of Evaluating Mobile Equipment Blind Areas

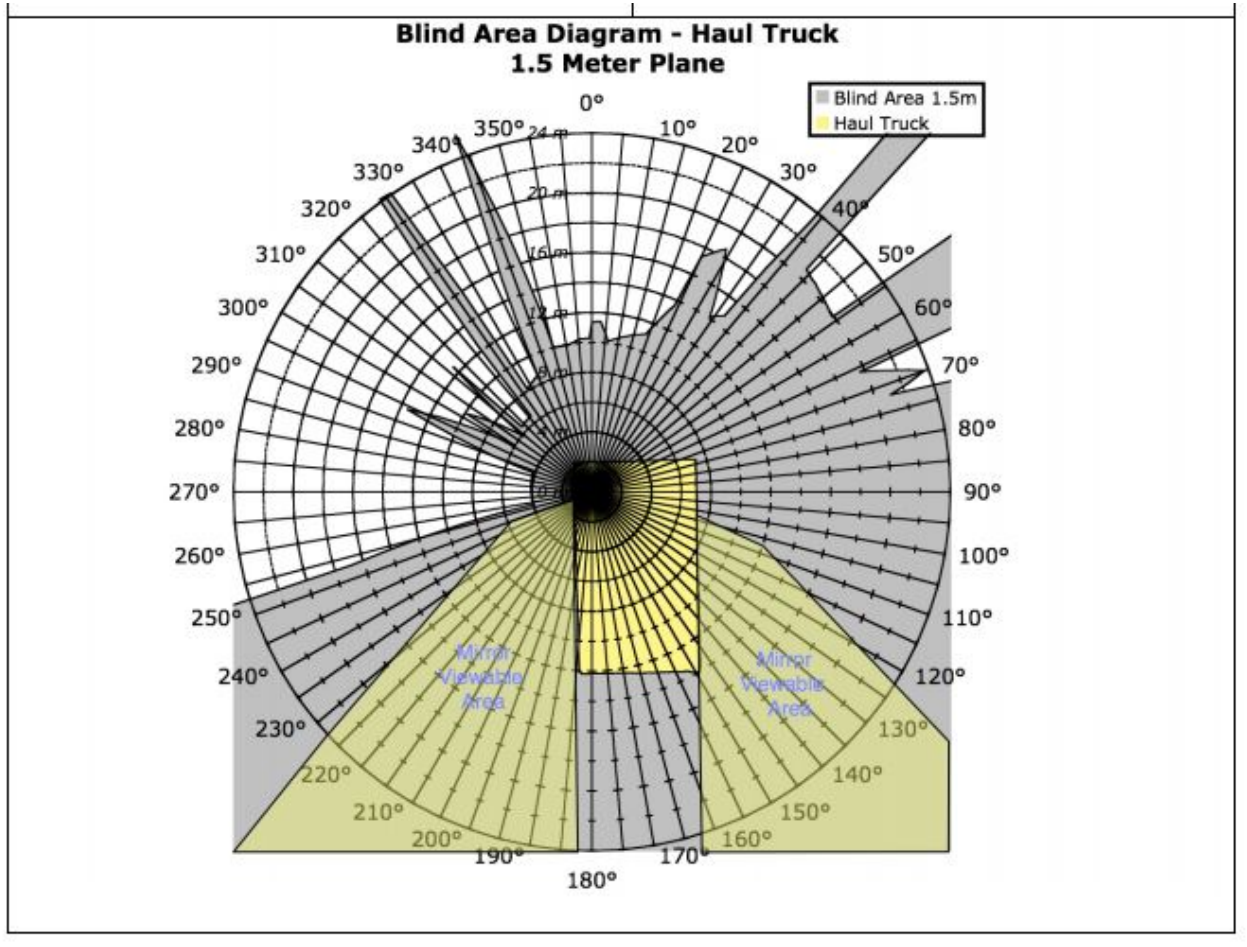
- Simplified Version of ISO Method Used by OEMs to Enable End Users to Perform Evaluations

https://www.cdc.gov/niosh/motor-vehicle/constructionequipmentvisibilitydiagram/manual-method.html?CDC_AAref_Val

Blind Areas

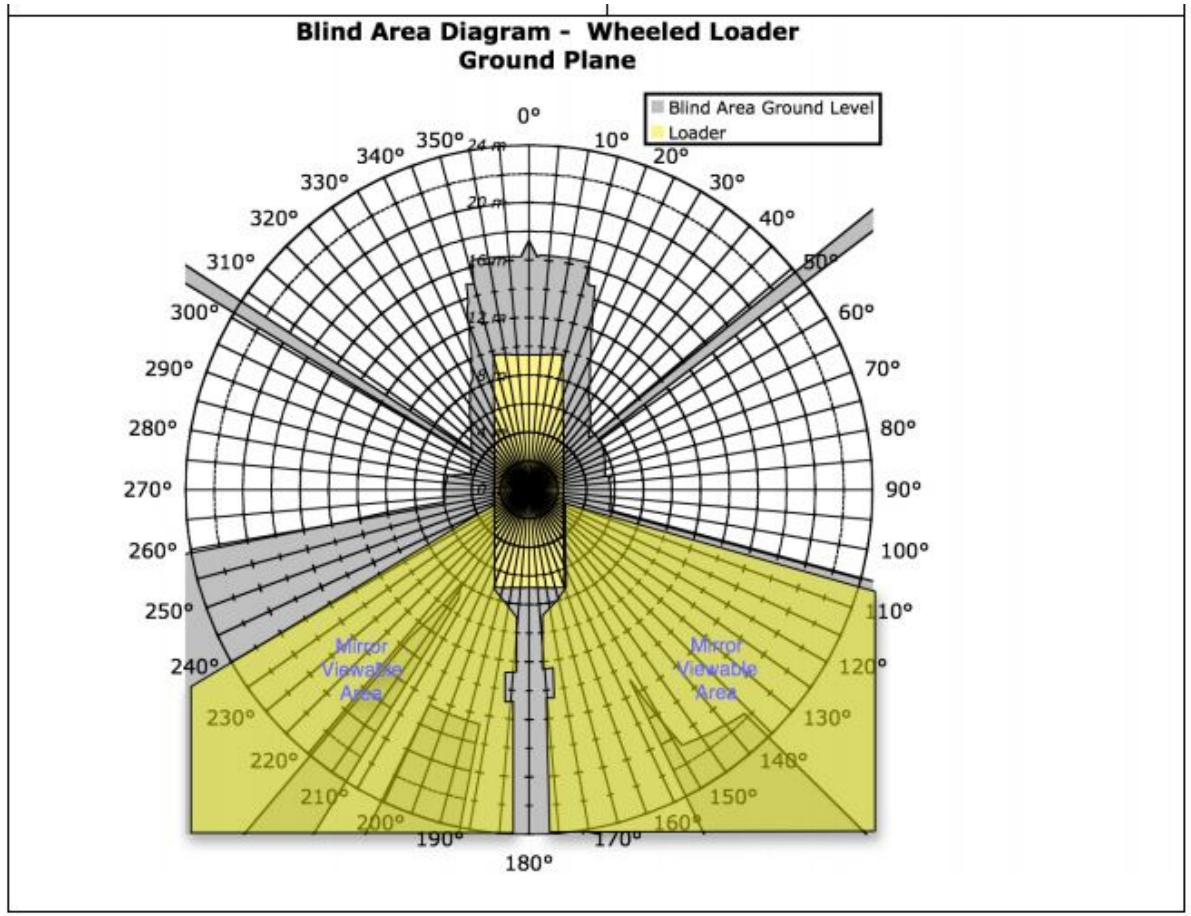
- Haul Truck (NIOSH Example)

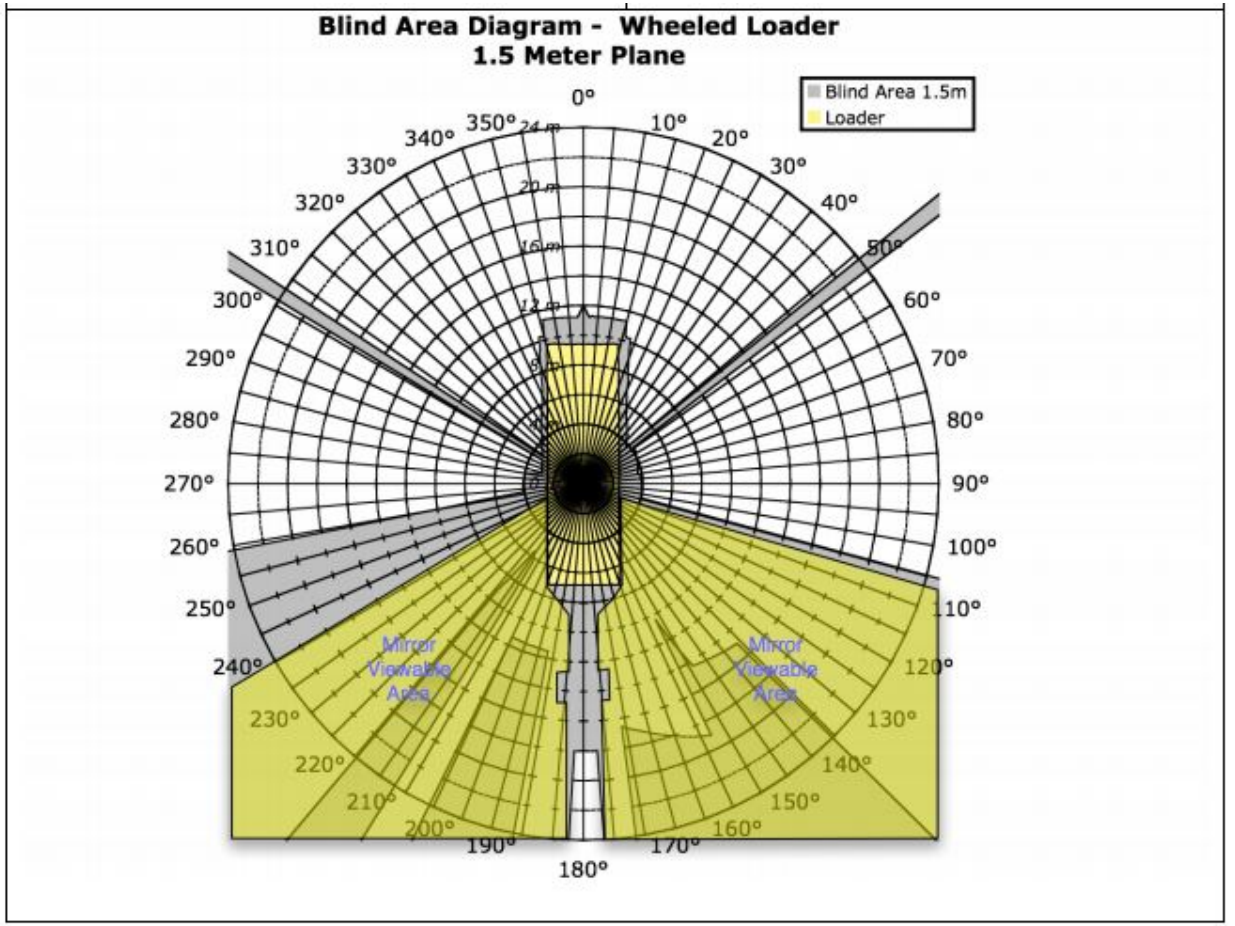




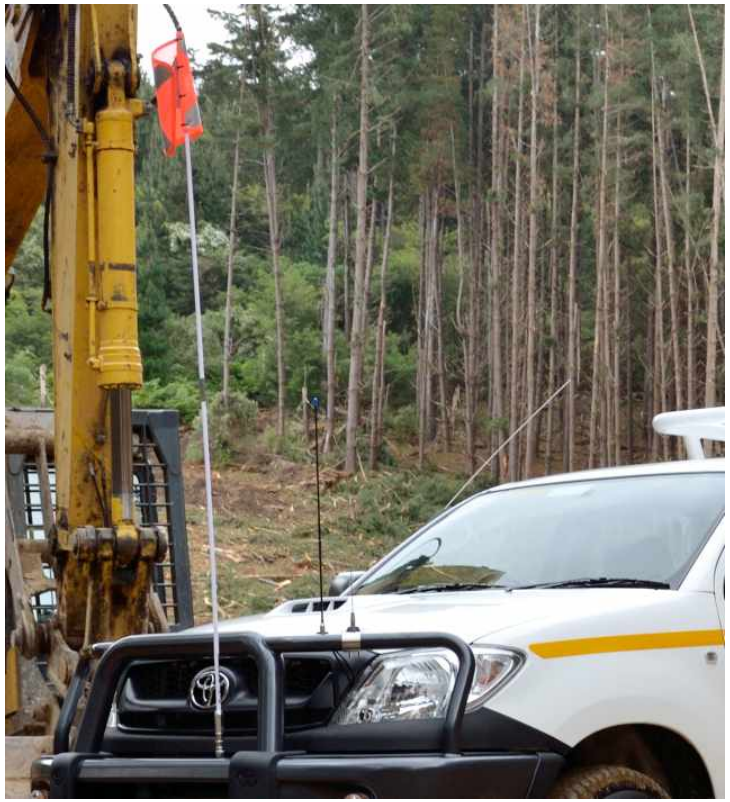
Blind Areas

- Front End Loader (NIOSH Example)





Low Tech Technology Solutions



Collision Warning / Collision Avoidance

Collision Warning System (CWS)

- Provide Equipment Operators with an Awareness of the Location of Nearby Personnel, Light Vehicles, Stationary Structures, and Other Pieces of Equipment through Display Screen in the Operator's Compartment and through Audible and Visible Alarms

Collision Avoidance System (CAS)

- Operates the Same as CWS Except that CAS can take Control of the Mobile Equipment to Slow Down or Stop it Before an Accident can Occur

Collision Warning / Avoidance Technology

Global Navigational Satellite System (GNSS)

- GPS in United States
- Systems Track Equipment in Relation to One Another
- Ability to “Geo-Fence” Areas to Restrict Equipment to Set Boundaries

Collision Warning / Avoidance Technology

RADAR

LIDAR

Ultrasound

- Units Installed on Mobile Equipment to Detect Other Equipment and Objects, including Pedestrians Using Time of Flight Measurements

Collision Warning / Avoidance Technology

Electromagnetic

Radio Frequency Identification (RFID)

- Units Installed on Mobile Equipment to Detect Sensors Mounted on Other Equipment and Objects, Including Pedestrians

Collision Warning / Avoidance Technology

Cameras

- Video Screens Display Camera Feeds from Blind Spots Around the Equipment

CWS Preventable Fatal Accident Analyses

EXAMPLE #1

- Front End Loader Backs into Pickup Truck that had Parked Behind it

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #2

- Van Pulled Up with 9 Miners along side Haul Truck
- 2 miners were killed

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #3

- Pickup Truck Parked in the Haul Truck Traffic Path

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

EXAMPLE #4

- Truck Driver Ran over Portable Toilet

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Possibly	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses

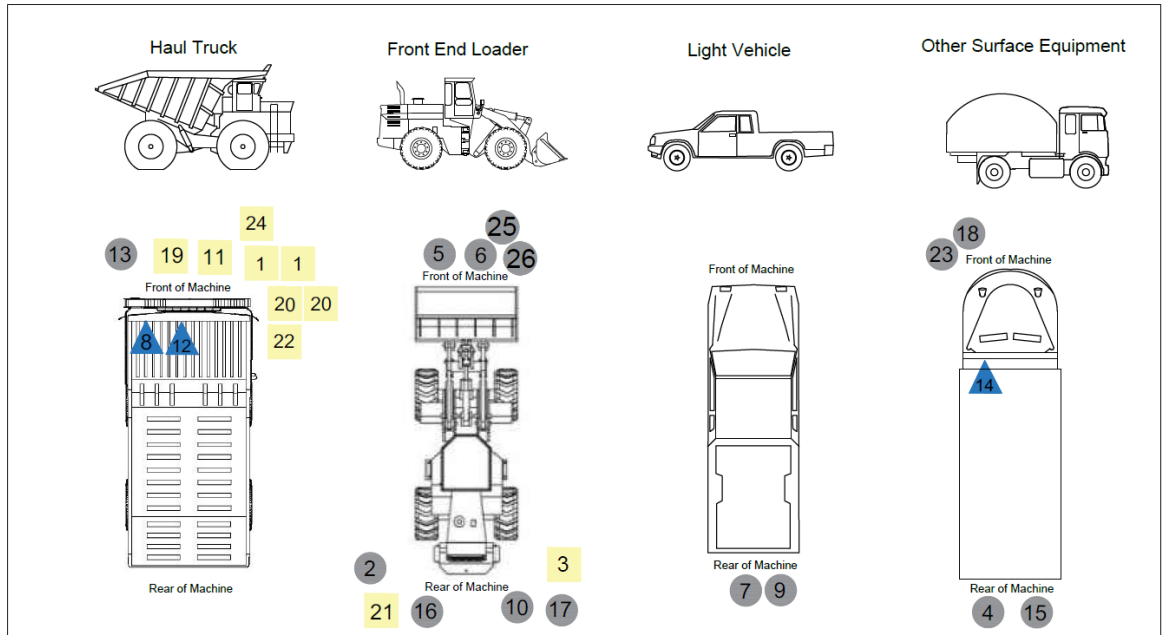
EXAMPLE #5

- Scraper and Fuel/Grease Truck Collided on Haul Road

Potential of Save by Available CWS Technologies

GNSS	Radar/Lidar	Electromagnetic	RFID	Cameras
Yes	Yes	Yes	Yes	Possibly

CWS Preventable Fatal Accident Analyses



CWS Preventable Fatals 2003 - 2025	
Pedestrians	15
Light Vehicle Occupant	10
Equipment Operator (Machine-Machine Contact)	3

CWS Preventable Fatal Accidents 2003 - 2025

Fatals by Equipment Type	COAL	MNM
Haul Truck	4	7
Front End Loader	0	10
Light Vehicle	1	1
Other Equipment	1	4

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FIGURE 1

Victim's Physical Location
In Relation to Surface Equipment

- Pedestrians
- Light Vehicle Occupant
- Surface Equipment Operator