GREEN SHEET

California Department of Forestry and Fire Protection

CDF Fire Bulldozer Rollover
Moderate Injuries to Operator
Substantial Equipment Damage

August 28, 2006

Plymouth Incident
Incident Number 06-CAAEU015367

Accident Investigation Incident Number CACNR000044

A Board of Review has not approved this Summary Report. It is intended as a safety and training tool, an aid to preventing future occurrences, and to inform interested parties. Because it is published on a short time frame, the information contained herein is subject to revision as further investigation is conducted and additional information is developed.

SUMMARY

The following information is a preliminary summary of an incident that occurred on a vegetation fire in which a CDF Fire Bulldozer received substantial damage as a result of a rollover. The Heavy Fire Equipment Operator suffered moderate injuries.

CONDITIONS

Location

The incident occurred on the west side of Highway 49, 1 ½ miles north of Plymouth. Legal description is SEC14 8N 10E, on a large undeveloped parcel. The physical address of the property where the accident occurred is near 23500 Highway 49, in Amador County, California, south of the El Dorado County line.

Fuel

Type: Grass/oak with transitional elements after 400' upslope to heavy chamise and manzanita stands

Loading: Fuel Model 1 and 2 (annual grasses/annual grass and woodland overstory) is .75 – 1 ton per acre
Fuel Model 4 (heavy brush including chamise up to 12') is typically 10 tons per acre

Continuity: Contiguous fuels

Live Fuel Moisture: New growth 62%, old growth 51%, recorded @ Tonzi Road, Amador County, 08/23/06

Dead Fuel Moisture: 50%

Weather
Temperature: 97% F
Relative Humidity: 18-21%
Winds: Light

Fire Behavior Discussion for the Plymouth Fire

The Plymouth Fire started as a roadside ignition from metal and asphalt friction in light grass along the western edge of State Highway 49 along Big Indian Creek. Weather observations at Ben Bolt RAWS indicated the temperature reached 97º F and relative humidity dropped as low as 18%. Relative humidity at the ignition site was likely 2-3% higher due to aspect and position at the bottom of the canyon near a stream with standing water. The fire area was entirely an east aspect. Winds were not a significant factor with respect to fire spread. The fire can be characterized as slope and fuels-driven with moderate consumption in the brush fuels.

The terrain along Highway 49 starts out fairly mild with slopes ranging from 0-30% for a distance of approximately 400' in grass and oak woodlands. Rate of spread in this area was moderate/rapid prior to the fire entering the heavier fuels.

The fuels and slope quickly transition to that of heavy brush over slopes that range between 30-60%. Slopes are broken by rock outcroppings and isolated steep pitches near 70%. Brush fuels are comprised of 40+ year old chamise and manzanita with heavy dead fuel accumulations. Brush fuels are in excess of 12' in height and in some locations the dead fuel component is as high as 50%. As the fire transitioned to the brush fuel type the rate of spread decreased and intensity increased with spotting up to 200'.

The fire finally reached the ridge top where fuels again transition to grass and oak woodland. The head of the fire slowed significantly upon reaching the milder ridge top slopes and gel treated grass.

Slope calculations using direct measurement with a hand held clinometer are 51% at the site of the incident. Shale and rock outcroppings can be found throughout the area. Fuels at the incident site are entirely that of heavy brush, mostly chamise, in excess of 12' in height.

SEQUENCE OF EVENTS

Dozer 4541

On August 28, 2006, at approximately 1110 hours, Dozer 4541 was dispatched to a vegetation fire in the Plymouth area. As the operator traveled along Highway 49 he heard a request for a second dozer to be dispatched Code 3 to the incident. Upon arrival, the operator of 4541 was directed to contain the fire's progress along the left flank, later called Division A. Fireline construction progress began in light fuels, in slopes of 30%, with the support of handcrews from Pine Grove and Growlersburg Camps. The fuels and slope began to transition to a Type 2 fuel load and inclines approached 40%. As the bulldozer was conducting a direct suppression effort, conversation between the operator and an Amador El Dorado fire engine crew began, identifying hazards of machinery and loose rocks. As the bulldozer continued to construct line the fuel transitioned into a Type 4, mostly consisting of contiguous 12' chamise at slopes approaching 51%. Dozer 4541's forward progress was halted at a 51% slope, after encountering a large rock shelf at the fire's edge. After discussion with fire line personnel about inherent dozer hazards the dozer was backed down the line.

The operator of Dozer 4541 stopped the machine, informed the fire engine crew in the immediate area of his lack of success in direct suppression efforts and indicated the transition benefit to begin indirect efforts in order to obtain forward progression upslope. The operator of Dozer 4541 stated he would have better success in traveling south, along the slope in the hopes of finding a path between the large rock outcroppings at the edge of the fire. This process, commonly known as "crabbing" involves the practice of keeping the bulldozer blade pointed upslope and moving the machine back, forth, and sideways in subsequent order.

Dozer 4541 continued to make attempts at line construction to no avail. Soils under the machine ranged from loose dirt to large rocks, boulders, and shale. Aerial photographs show the continuation of the rock outcroppings and document the progress of Dozer 4541.

In order to get a clearer picture of the obstacles in front of his machine, the operator began to uproot brush, move backwards, allow the brush to fall away, and look at the area directly in front of the machine. As he was stopped, pointed uphill on a 51% slope, the dozer slid suddenly off the edge of a large rock, and quickly overturned. Later inspection reveals the machine slid downhill to the left, jarring the machine onto its left rear corner. Where it had been facing uphill, it was suddenly almost parallel and falling onto the left rear corner of the machine. The bulldozer began to roll downhill, violently overturning four complete times, for a distance of 100'feet. The force of the accident caused the blade to break off of the machine and travel another 30' downhill beyond where the dozer stopped. The machine came to rest on its left side, facing south. It is believed the machine rolled sideways as opposed to end over end.

Due to the indirect suppression efforts being conducted by Dozer 4541, there were very few witnesses to this event. One firefighter standing on Highway 49 saw a glimpse of the machine as it overturned, even though the machine was approximately one quarter mile away. Other incidental auditory witnesses mentioned hearing the machine as it rolled downhill.

The operator was conscious, turned off the machine, and radioed a request for rescue. Pine Grove Crew 3 and fire engine crews from AEU extricated the operator where he was air lifted for subsequent medical treatment.

INJURIES/DAMAGES

Heavy Fire Equipment Operator

Injuries

Patient complained of general soreness and experienced moderate injuries.

Dozer

Damage

Dozer 4541 received substantial damage to the safety rollover protection system (ROPS), environmental cab, blade, window screens, hydraulic system, cab interior, swing frame, equalizer support system, and assorted sheet metal. It is unknown whether the machine suffered engine or transmission damage as a result of the rollover. The machine is considered a total loss.

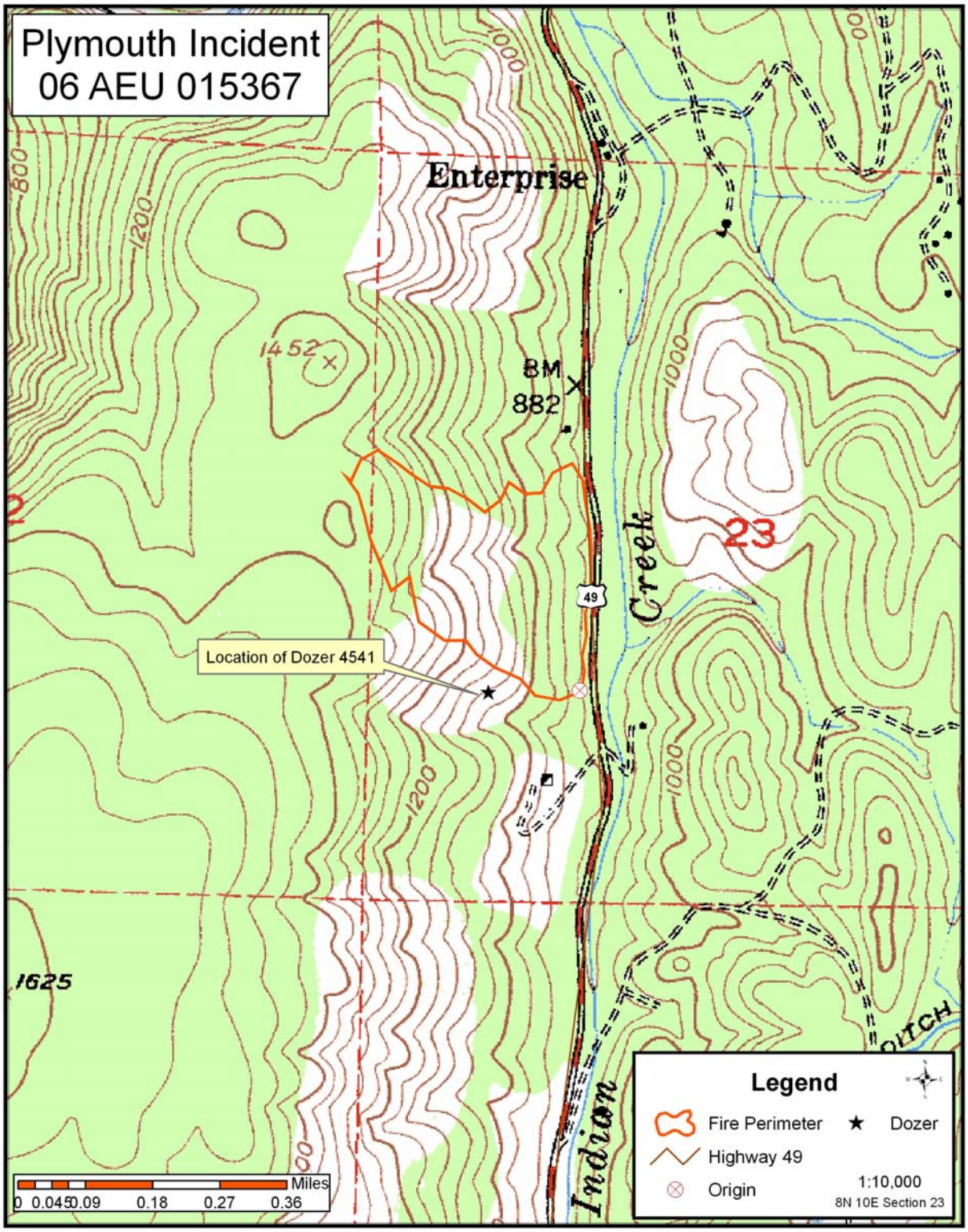
As a result of the violent rolling action during descent, the ROPS has been compromised. The safety features of the ROPS system are designed to protect occupants during a slow, gentle, rolling motion. The machine, during descent, rolled up to four complete turns in a

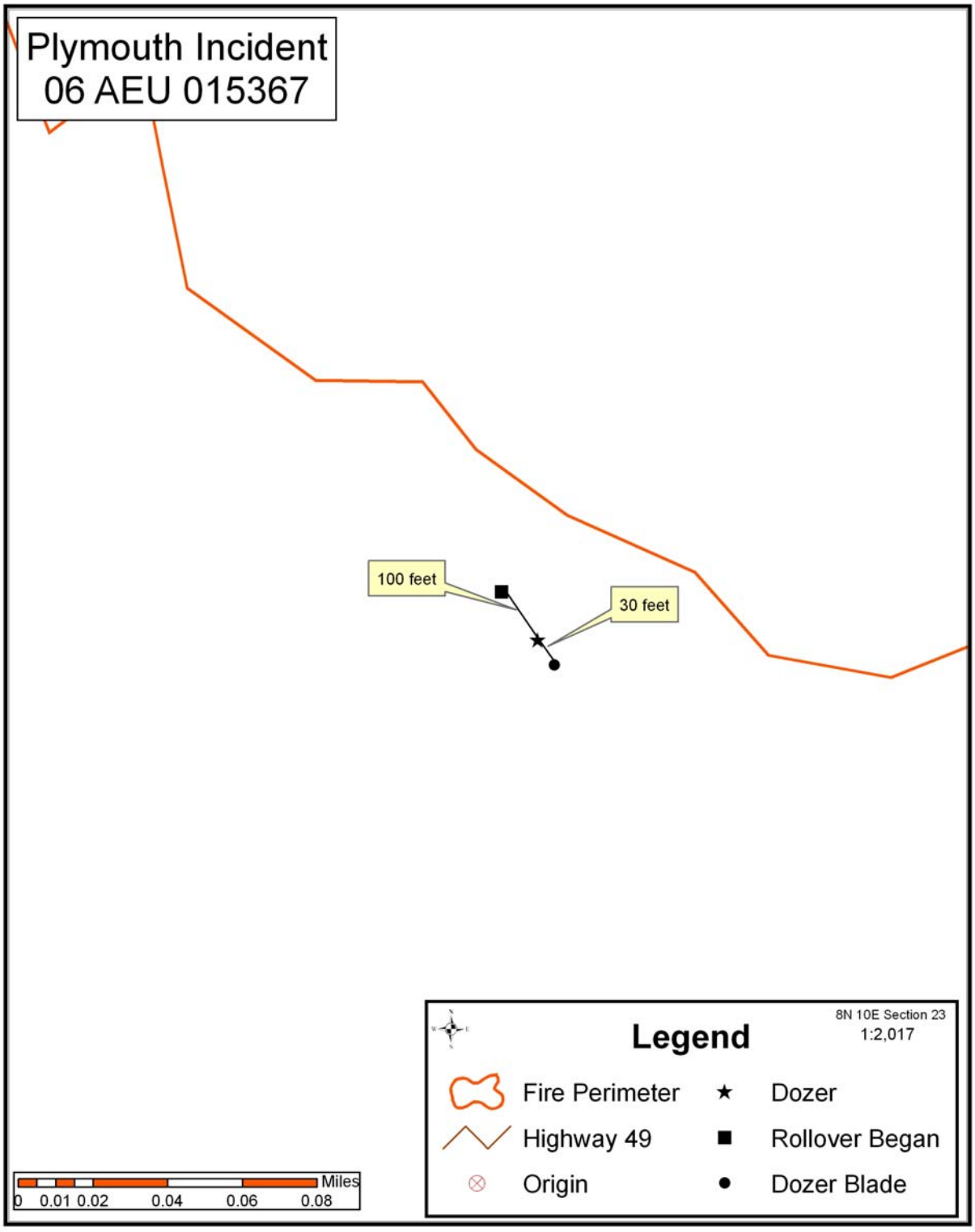
violent manner. The ROPS systems, highly effective in slower instances, are not designed to withstand inertia forces as seen in this incident.

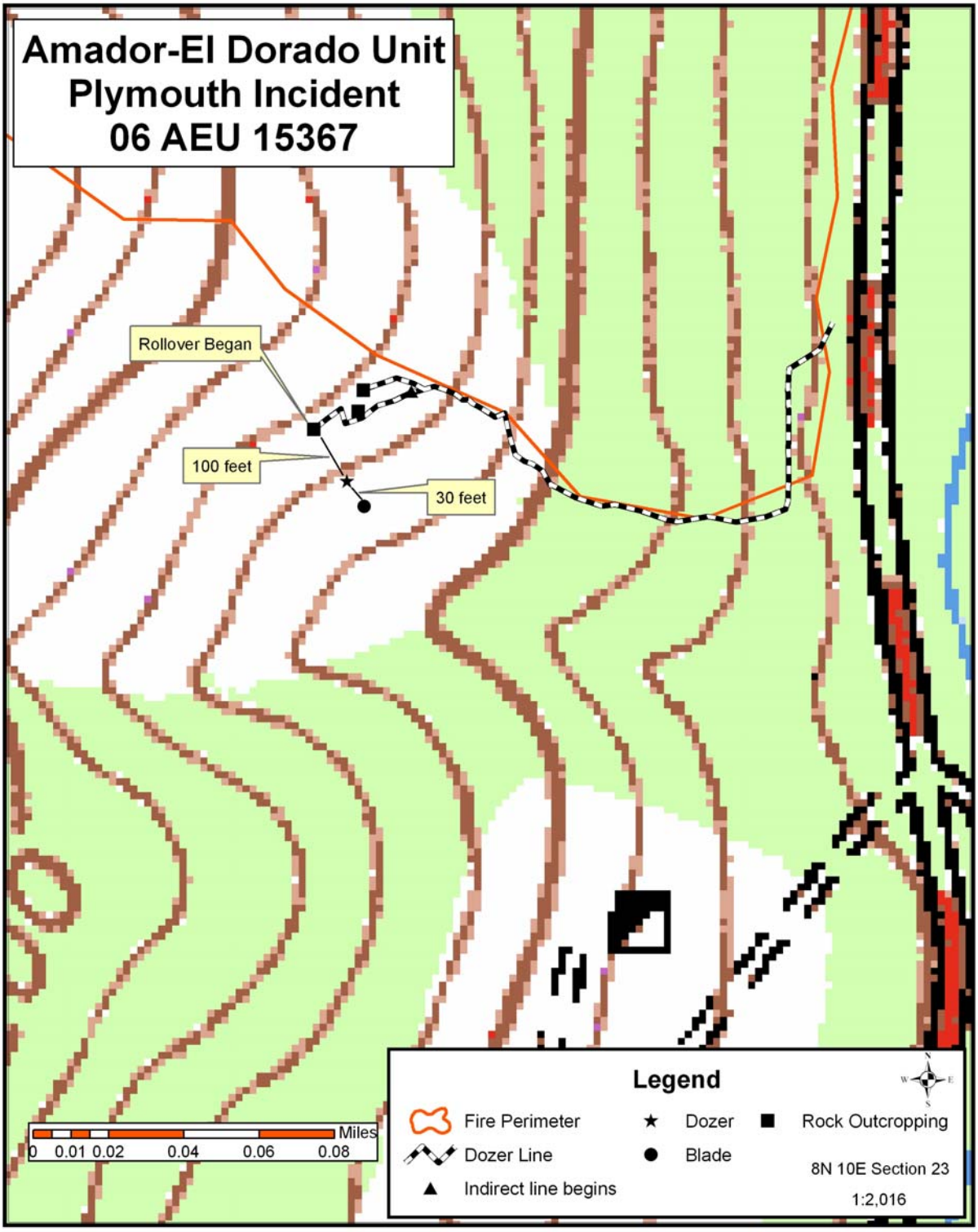
SAFETY ISSUES FOR REVIEW

(The bullet points below are merely safety reminders when working on wildland fires around dozers and are not intended to be reflective of final findings)

- All firefighters need to continually weigh risk versus benefit in their strategy and tactics.
- Heavy Fire Equipment Operators need to continually evaluate tactics and slopes when conducting direct or indirect line construction.
- Dozers should maintain constant communication with personnel on foot to assist in monitoring slope and terrain.
- Hand crews, fire engine crews, and other personnel on foot during fire line suppression efforts must remain aware of rolling rocks, debris, machinery and other hazards.


Plymouth Incident
06 AEU 015367
Enterprise
1452
BM
882
23
49
Creek
Location of Dozer 4541
1625
Indian
DITCH
Legend
Fire Perimeter
Dozer
Highway 49
Origin
1:10,000
8N 10E Section 23
Miles
0 0.045 0.09 0.18 0.27 0.36


Plymouth Incident
06 AEU 015367
100 feet
30 feet
Legend
8N 10E Section 23
1:2,017
Fire Perimeter
Highway 49
Origin
Dozer
Rollover Began
Dozer Blade
Miles
0 0.01 0.02 0.04 0.06 0.08


Amador-El Dorado Unit
Plymouth Incident
06 AEU 15367
Rollover Began
100 feet
30 feet
Miles
0 0.01 0.02 0.04 0.06 0.08
Legend
Fire Perimeter
Dozer Line
Indirect line begins
Dozer
Blade
Rock Outcropping
8N 10E Section 23
1:2,016