



*A lesson is truly learned when we modify our behavior to reflect what we now know.*



## Dozer and Tractor Plow Lessons Learned

Night line construction on Dido Fire, NV in 1999. Courtesy of Wildlandfire.com

Equipment operators from federal, state, county agencies and private contractors were recently interviewed regarding their notable successes, most difficult challenges, effective practices, and most pressing safety issues in dozer and tractor plow operations with respect to Lookouts/Communications/Escape Routes/Safety Zones (LCES) and Situational Awareness (SA). Special thanks are extended to these dozer and tractor plow operators for sharing their important lessons and practices with the wildland fire community.

### Notable Successes in LCES and SA

#### Customized Dozer Fleet

The Florida Division of Forestry employs a fleet of customized dozers built specifically for firefighting. Upgrades from standard industry machines include increased horsepower, faster walking speeds, and climate controlled environmental cabs that incorporate special charcoal filtering to enhance the operator's air quality. This filtering system reduces the fatigue associated with heat and smoke. According to one Florida dozer operator, firefighters stay more focused and mentally sharp during wildland fire suppression operations.

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#### Sticking to the Basics

A dozer operator with 20 years experience with both Federal and County fire agencies believes his most notable achievements have come when he sticks to the basics of LCES. He first anchors his dozer line before moving forward. He ensures that his lookouts, communications, escape routes and safety zones are in place. Only then can he proceed safely, continuing to update his LCES, as dozer constructed fireline advances.

#### Coordinating Swamper and LCES

Dozer operators performing initial attack often find themselves working alone, out ahead of other resources, and with limited visibility. They rely heavily on their swamper to watch behind them to ensure that the constructed line is holding.

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## DEFINITIONS

### Dozer

Any tracked vehicle with a front mounted blade used for exposing mineral soil.

### Dozer Boss (DOZB)

The individual responsible for supervising the operations of a dozer.

### Dozer Company

A resource that includes a dozer, its transportation unit and a standard complement of personnel for its operation.

### Dozer Line

Fireline constructed by the front blade of a dozer.

### Dozer Tender

Any ground vehicle with personnel capable of maintenance, minor repairs, and limited fueling of dozers.

### Swamper

A worker on a dozer crew who pulls winch line, helps maintain equipment, etc., to speed suppression work on a fire.

### Tractor

A rubber tired or tracked rider-controlled automotive vehicle, used in wildland fire management for pulling a disk or a plow to construct fireline by exposing mineral soil.

### Tractor Plow

Any tractor with a plow for constructing fireline by exposing mineral soil. Also as a resource for typing purposes, a tractor plow includes the transportation and personnel for its operation.

### Plow Line

Fireline constructed by a fire plow, usually drawn by a tractor or other motorized equipment.

*Source: 2005 NWCG Glossary of Wildland Fire Terminology*

When constructing indirect line, a swamper usually works outside the cab of the dozer to act as a lookout. While the dozer is working the line and looking ahead, the swamper is walking at a safe distance behind the dozer, watching the line to make sure it is holding. The swamper may carry a backpack pump to cool down the fire along the line. When the swamper acts as the primary lookout, the operator and swamper must maintain constant communication about the status of the fire and the overall fire behavior.

## Situational Awareness in Dozer Operations

A Dozer Group Supervisor described a significant accomplishment during the 2002 Bouquet Fire in Southern California. The Incident Management Team (IMT) assigned the dozer group supervisor to the head of the fire, with orders for the dozers to construct indirect line. Two dozers worked one flank, while a third dozer worked the other flank. The dozers did not have crew support due to terrain and fuel loading or air support due to heavy smoke.

The dozer group supervisor used the three dozer swampers as primary lookouts and an agency transport driver acted as a secondary lookout. When the fire blew out on a steep slope covered in heavy chaparral and made a run at their pre-constructed major safety zone, the dozers were able to use their lines on either side of the safety zone to stop the fire, with the swampers and driver picking up spots. Because the dozer group maintained constant situational awareness and LCES during the entire operation, they were able to hold this critical piece of line.

## Locating Safety Zones

A 27-year veteran dozer operator recalls a memorable achievement on the 1993 Green Meadow Fire in Southern California. Firefighters had chased the fire for a week, during which the fire laid down once and made three runs to the ocean. When the fire spotted across a major road, the dozer operator constructed a fireline around his transport vehicle, then started constructing dozer line uphill towards the ridge. He observed where a safety zone was needed and promptly cleared one for two crews and the dozer. He was then able to pinch off the fire while two additional dozers and two crews held the line. All aspects of LCES were adhered to during this operation, leading to a successful outcome.

## Tactics That Incorporated LCES

A district fire management officer on a Mississippi forest cited two incidents where LCES made the difference between success and failure:

On the Blow Out Fire in 2005, the Mississippi Forestry Commission (MFC) requested assistance. MFC already had two tractor plow units assigned to this large incident when the U.S. Forest Service arrived with an additional tractor plow. The two agencies established a common frequency for communications and posted lookouts along a major transmission line corridor. Each tractor plow unit maintained communication and operational coordination, enabling them to safely work three different sections of the fire through containment.

The IC Drop Fire in 2002 started in an area with extremely thick southern rough fuels. Volunteer Fire Departments (VFD) responded, and the Incident Commander instructed the VFD engines to provide structure protection for two threatened homes. The District's helicopter was dispatched



USFWS Dozer Performing Initial Attack on Hippy Fire; Yuma, AZ in 2002  
Courtesy of Wildlandfire.com

to the fire, to serve as a lookout and help direct tractor plows through the dangerous fuels. During the helicopter manager's observations, he fortunately spotted a VFD crewmember that had wandered out between the head of the fire and the burnout operation. A tractor plow operator, along with other firefighters, was able to change tactics and locate the VFD crewmember before an entrapment occurred.

## **WUI Successes**

### **Importance of Mitigation**

Constructing pre-suppression firelines around wildland urban interface (WUI) areas before the wildfire occurs is critical. Firefighters in Florida successfully contained a recent wildfire when it burned to the edge of a line that had been constructed in a pre-suppression mitigation project by tractor plow units. This situation illustrates the importance of pre-suppression dozer action to enhance protection in a WUI environment.

### **Saving Residences**

A tractor plow success occurred when the Florida Division of Forestry was able to stop the head of a wildfire and save residences at the edge of a WUI area. The fire was burning in dense Palmetto/Gallberry, six to eight feet tall, and the fuel was too thick to allow engine access. Fortunately, the Florida Division of Forestry had a tractor plow unit available that could penetrate the dense growth and place a line 75 yards from a home at the head of the fire. The proper equipment saved this residence and three more on the left flank of the fire, and the evacuees were grateful to find their homes intact upon their return.

## **Difficult Challenges in LCES and SA Blow Down Increases Need for SA**

One of the most challenging issues the Florida Division of Forestry faces today is the forest blow down from the 2004 hurricane season. Heavy Palmetto/Gallberry ground fuels, combined with the heavier fuels resulting from hurricane damage, greatly reduce tractor plow mobility. Florida firefighters have increased knowledge of these conditions, and factor this into their efforts to maintain situational awareness.

### **Re-establishing LCES**

Dozer and tractor plow suppression operations are often conducted away from roads on which firefighters might ordinarily quickly egress the fire area. Consequently, operators must remain aware of the limitations of their equipment, fire behavior indicators, current and expected weather conditions, and other critical factors. During fire suppression maneuvers, operators must continuously size-up the situation to determine if current tactics are working and ascertain whether their LCES are relevant and viable. Changing conditions require equipment operators to modify their strategy and re-establish and maintain LCES. Therefore, maintaining and constantly re-evaluating LCES represents a critical task for equipment operators, particularly during the fast progression of dozer/tractor plow line construction.

## **Topography and Soils**

Terrain is always a challenge for a dozer operator. The soil conditions and fuel types add to this challenge. Sandy soil makes it difficult to climb up a slope. The harder the ground, the steeper the slope a dozer can climb. Rocky soils can be very hazardous, both in upslope and downslope line construction. Swampers and other fireline personnel are at risk from rolling materials. Therefore, line construction in difficult terrain and soils can be just as hazardous as the fire behavior aspects of wildland fire. Dozer operators must ramp up their situational awareness when working in these environments.

## **Communicating with Overhead**

A Dozer Group Supervisor with 32 years of heavy equipment experience reports that his biggest challenge is maintaining communication as one moves in and out of divisions while overseeing multiple dozers. He recalls the 2003 Simi Fire in Southern California when he had to hold flanks on multiple divisions while moving from ridge top to ridge top, talking to the dozers by radio with the Helicopter Coordinator providing a current aerial perspective. He stressed the importance of having competent dozer bosses and dozer strike team leaders in these situations. A Group Supervisor can maintain LCES with a span of control of no more than eight dozers and four strike team leaders.

## **Locating Safety Zones**

According to a veteran dozer operator with 27 years experience, his biggest challenge is working on a ridgeline in Southern California where it is difficult to find enough room to construct a safety zone. Locating a safety zone without chimneys or chutes leading up to it adds to the dilemma. He reflected back on the Paradise Fire in 2003, where resources had to deploy in a safety zone that had been constructed just above three chutes. One firefighter was injured during the deployment. The swamper proves critical in these types of situations because they can assist the dozer operator in locating adequate safety zones.

## **Challenges in the Southeast**

Tractor plow operators in the Southeast report some difficult challenges that affect their ability to maintain LCES:

- a) Establishing lookouts for tractor plows proves nearly impossible in flat, brushy terrain without the use of aircraft. The tractor plow operator is in the most dangerous position on a wildland fire on the lower Coastal Plain. Therefore, coordination and communication with other firefighters is critical,
- b) Hearing the radio is sometimes difficult when the dozer is operating unless the dozer has an environmental cab,
- c) In thick swampy terrain, operators usually have only one good escape route - back down the line they just plowed. Few options remain if that escape route is compromised,
- d) Bogging down in swampy areas is common. Experienced operators are priceless, and
- e) Safety zones for tractor plow operators are typically in the black as the backfire is carried behind the dozer. Again, experience and good communications remain key.

## **An Operational Challenge**

One dozer operator reports that his greatest challenge is getting overhead personnel to remember that dozers are like other fire suppression tools. Just as with other firefighting resources, anchor, flank and hold remain the basics for a dozer. When he can, this dozer operator makes it a point to remind overhead personnel that dozers are not invincible. Sometimes dozers are requested to go out far ahead of other resources to construct line. This dozer operator strongly suggests that dozers construct fireline on the flanks just ahead of the handcrews whenever possible.

## **Effective Practices:**



D6 Dozer · Courtesy of FL Division of Forestry

## **Maneuvering in Boggy Terrain**

One of the best tactics learned over the years by a tractor plow operator was passed down to him by his father, a retired U.S. Forest Service firefighter. In some situations it is not suitable to have the plow directly attached to the drawbar of the dozer, such as when punching through a swamp or other boggy terrain. In these incidents, the operator can detach the plow from the dozer, set the plow depth, and hook the winch to the plow. This allows the dozer to have greater traction in boggy terrain. The operator can then walk the dozer out, while free-spooling the winch cable. Once the cable is out of the drum, the operator winches the plow to the dozer, repeating the process until a firebreak is created through the boggy terrain. This process takes more time, but improves maneuverability and greatly reduces the chances of disabling the dozer.

## **Practice, Practice, Practice**

A Michigan Department of Natural Resources (DNR) tractor plow operator stresses the importance of getting to know what you can and cannot do with your equipment. The time to get to know your equipment is not when you are assigned to a fire, but by completing project work. The operator becomes more familiar with the equipment by building roads, planting seedlings, and performing stump removal in campgrounds. Each year DNR personnel participate in an equipment and operations annual refresher which includes practicing LCES. Personnel review communications, safe driving practices, equipment operations, fire shelter refresher, and share personal experiences to enhance their skills.

## **Air Attack and Helicopter Coordinator Support**

When available, air attack and/or Helicopter Coordinator (HLCO) resources may serve as a secondary means of look-out. These resources are accessible to the dozer operator via assigned air-to-ground frequencies. Air attack/HLCO can then provide the latest real-time status of the fire to the initial attack dozer operator. Quite often, this information can be used by the operator to develop not only a direct attack plan, but to assist in secondary line and safety zone construction considerations as well.

## **Using a Track Chain**

All dozers in Florida carry a "track chain." Firefighters use the chain for multiple purposes, including uprighting a plow that has flipped over, freeing a "stumped" (high centered off the ground) dozer, or chaining out a stuck dozer. If a dozer is disabled, a track chain allows the firefighter the ability to attach the chain to each track, put the dozer in gear, and pull the dozer off the stump. If stuck, the chain can be hooked to one track and attached to a tree or other suitable anchor, and as the track moves, it will pull the dozer forward and free it. This is a technique that all Florida firefighters are required to learn and be proficient in as part of their training.



Freeing a Stumped Dozer · Courtesy of FL Division of Forestry

## **Scouting the Line**

One tractor plow operator, who works in the most populated county in Florida, always tries to scout a fire for any man-made or natural barriers that can be used to aid line construction. Scouting can be done either from the tractor plow or on foot. This experienced operator looks for changes in fuel types and tries to stop the fire in areas where the fuels are lower to the ground. He noted that areas of heavier fuel often need to burn anyway. Constructing line in the lighter fuel types usually results in less environmental impact to the fire area from the mechanical equipment.

## Tactics and LCES

Another dozer operator stresses that best practices for dozer operations always include adhering to LCES, plus the key tactics of anchoring, flanking and holding. This is especially critical because dozers often work in inaccessible terrain and remote areas of a fire. According to this operator, all tactical decisions should be based on LCES.

## Direct Attack Preferred

Most dozer operators expressed a preference for direct attack line construction because going direct provides a safety zone in the burned area (black) directly alongside where they are working. They also prefer to work in tandem, with one dozer supporting the other. Using this tactic, if one dozer gets in trouble, the other is readily available to assist. This practice is particularly useful when holding critical pieces of line, such as saddles and corners. In light fuels, the second dozer can proceed with rehab work such as water bar construction and spreading out berms and cat piles.



Dozers Backing Out Due to Increased Fire Activity; Foothill Fire, 2004  
Courtesy of Los Angeles County Fire Dept

## Day and Night Operations

Night operations can be effective for dozers, but must be performed only when conditions are favorable and lend themselves to productivity. In making this decision, the overhead must give thought to how the dozers can best contribute to operational goals, and when and where they can best accomplish these tasks. When night dozer operations cannot safely contribute to operational goals and overall productivity,



Tractor Plow with Enclosed Cab  
Courtesy of FL Division of Forestry

the dozer operators should be bedded down to prepare them for day operations. In this way, operators are rested and have the advantage of working during daylight conditions. This method works well when the operators do not have qualified relief. Working 12 hours on (daylight) and 12 hours off (night) ensures continuous dozer functions during crucial operational periods as apposed to 24 hours on and 24 hours off.

## Tractor Plow Practices

A veteran FMO and Type 3 Incident Commander in Mississippi offered what he considers to be essential tactics to follow: 1) Always carry a backfire torch on the tractor for use only in emergencies, 2) Always have a swamper/lookout/scout with each tractor plow, 3) Utilize aircraft as a secondary lookout whenever possible, and 4) The Incident Commander should ensure that the plowed line never gets too far ahead of the back-firing operation, and that the back-firing never get too far ahead of the holding crews.

## Pinching Technique Effective

In the Coastal Plain of North Carolina, fire is controlled almost exclusively by tractor plows. The dense and volatile fuel "Pocosin" that blankets the local region requires specialized techniques and experienced operators. Pocosin fuels are comparable to the chaparral fuels of Southern California. "Pinching" is a method of plowing where the operator peels off the flank when the fire gets too hot and doubles back on their own plowline, catching spots and widening the fire break with additional lines. This process is repeated as necessary. Due to the vegetation and soft organic soil, two tractors will plow in tandem on each flank. If all is equal, the flank facing the typical southeast sea breeze is attacked first.

In this part of the country, it is policy that a tractor does not leave the road without its swamper, who carries the blackline. This policy provides another benefit of the pinching technique: when the fire flares up and the operator turns around, they are close to the safety zone that the swamper created with their burnout. This technique was used effectively during the 1994 Fish Day Fire to successfully contain a 24,600 acre plume-dominated fire burning in Pocosin.

## Pressing Safety Issues

### Equipment Maintenance and Inspections

Dozer and tractor plow firefighting usually occurs a long way from a hard road, and operators are extremely dependant on the performance of their equipment. The machine represents the operator's lifeline, and understanding the machine's mechanics is critical to their success and safety. Adequate maintenance, upkeep, and thorough inspections can prevent some of the most serious safety issues associated with dozers and tractor plow breakdowns. Therefore, being a dozer/tractor plow firefighter not only requires a complete understanding of fire behavior and weather, but also knowing what signs to look for when inspecting their equipment. A slightly worn hydraulic hose can disable a dozer during initial attack or during a critical operational period. If equipment should become disabled, the operator must fall back on their training, and react quickly and effectively to first protect themselves, and then protect their disabled equipment.

### Over Dependency on Aircraft

A safety issue can arise when working with an aircraft trying to guide a dozer through heavy fuels and rough terrain to the main fire or to spot fires. The aircraft pilot has a different perspective of what the ground fuels and terrain are like than the dozer operator does, so it is up to the dozer or tractor plow operator to always establish and maintain their own LCES, and ensure that the aircraft knows what ground conditions are being encountered. The dozer operator must also keep in mind that winds can change direction at any time, because when the wind shifts, the aircraft may temporarily lose visual contact with the dozer. The aircraft may also be diverted or need to refuel at a critical time.

### Assigning and Supporting Dozers

Support to dozer operations represents the most pressing safety issue according to one California dozer operator. Dozers are often committed as the only resource on a division, usually on a crucial piece of line. Pressing safety issues include (1) assigning dozers to construct indirect line ahead of the fire, and (2) working dozers on narrow ridgetops that do not allow the construction of safety zones. Safety zones should be constructed every ¼ to ½ mile when possible. In addition, if a dozer operator is constructing indirect line, they must avoid getting too far ahead of other resources. The need to coordinate operations is important because often one helicopter drop can make a big difference in slowing down the fire for the dozer constructing line. One handcrew can also be a significant help in supporting a dozer by securing the line and putting out spot fires.

### Standards for Dozers and Tractor Plows

No national standard exists for interagency and contract dozer operator training. According to a major contractor of firefighting dozers, it is critical that national training standards are adopted and required so that all operators receive consistent training needed to perform their job. There are too many dangers in dozer work to not have required standardized training. Some government agencies have realized the safety value of environmental cabs, but it is time to extend this requirement to all private contract dozers. Along with environmental cabs, there must be a communication requirement if dozers and tractor plows are to be in complete compliance with LCES.

### Maintaining Current Communications

A vital safety issue for one Southern California dozer operator is keeping current on identifying who the Division Supervisor is as the dozer moves into new areas. He explained how, during one incident, he was in an area where backfires were being lit below the dozers constructing indirect line. LCES was definitely not in place in this situation. Dozer operators must maintain radio contact with crews, particularly when dozers are working on a ridgetop or slope because the rocks and debris that dozers loosen while they are constructing line can seriously injure or kill a person on the ground below. All resources need to coordinate their assignments and keep each other informed of their activities.



### California Dozer Operator's Group

*The California Dozer Operator's Group (DOG) is a state-wide, non-profit organization consisting of full-time paid fire dozer operators and related support personnel, with participating factions extending into Oregon and Nevada.*

*DOG promotes and develops safe fire fighting techniques and camaraderie in an "All Risk" environment. It has been instrumental in the development of tactical procedures and instructional programs on a State and National level.*

*Frequently during the year, DOG provides fund-raising barbecues, raffles and educational activities to various governmental and private organizations. Proceeds generated from these activities are donated to the Grossman Burn Center.*

*DOG was organized in May 1976. It became affiliated with the California Fire Chiefs Association in May 1985. The organization is currently developing a Web site. DOG Web site information will be posted on the Lessons Learned Center Web site at: <http://www.wildfirelessons.net/> in the near future.*



**Crown Fire, Los Angeles County and Angeles NF, CA in 2004  
Courtesy of LA County Fire Department**