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REPORT#: 2015-03 **REPORT DATE:** April 12, 2018

Feller Struck by Tree Limb While Felling Adjacent Tree—North Carolina

INCIDENT HIGHLIGHTS

DATE:
December 2, 2014

TIME:
2:30 p.m.

VICTIM:
61-year old tree feller

INDUSTRY/NAICS CODE:
Forestry/11

EMPLOYER:
Logging

SAFETY & TRAINING:
The company did not have a comprehensive safety program

SCENE:
Forested area

LOCATION:
North Carolina

EVENT TYPE:
Struck by

SUMMARY

On December 2, 2014, a 61-year-old Hispanic feller was struck by a tree limb while felling an adjacent tree and died the next day. The feller dropped a pine tree that caught an adjacent poplar limb on the way down. The poplar limb broke off the standing tree, fell butt first, and struck the feller on the head.... READ THE FULL REPORT> (p. 3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Swing cutting
- Insufficient hinge wood
- Cluttered work area
- Wind speed and direction

RECOMMENDATIONS

NIOSH investigators concluded that, to help prevent similar occurrences, employers should:

- Develop, implement, and enforce a tree harvesting fall plan.
- Ensure that tree fellers use proper directional felling techniques that are based on the tree harvesting fall plan.
- Develop procedures and train fellers on tree assessment, opening the felling face, and identifying, creating, and maintaining clear retreat paths.... LEARN MORE> (p. 8)

Fatality Assessment and Control Evaluation (FACE) Program

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In 1982, NIOSH initiated the Fatality Assessment and Control Evaluation (FACE) Program. FACE examines the circumstances of targeted causes of traumatic occupational so that safety professionals, researchers, employers, trainers, and workers can learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent occupational deaths and are completely separate from the rule making, enforcement and inspection activities of any other federal or state agency. Under the FACE program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program website at **www.cdc.gov/niosh/face/** or call toll free at 1-800-CDC-INFO (1-800-232-4636).

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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SUMMARY

On December 2, 2014, a 61-year-old Hispanic feller was struck by a tree limb while felling an adjacent tree and died the next day. The feller dropped a pine tree that caught an adjacent poplar limb on the way down. The poplar limb broke off the standing tree, fell butt first, and struck the feller on the head. Two of the three coworkers saw the incident happen. A contracted mechanic working on the skidder called 911. The emergency crews arrived 20 to 30 minutes later and transported the conscious feller to the hospital where he died.

INTRODUCTION

On Tuesday, December 2, 2014, a 61-year-old Hispanic feller was struck by a tree limb and died the next day as a result of his injuries. On December 4, 2014, the medical examiner notified North Caronia Department of Labor (NCDOL) of the incident. On September 15, 2015, a health scientist from the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, Fatality Assessment and Control Evaluation program conducted an investigation of the fatality and reviewed circumstances of the incident with the investigating NCDOL safety compliance officer. Photographs of the incident site and statements taken by the NCDOL safety compliance officer were reviewed. In addition, the medical examiner report was reviewed.

EMPLOYERS

The company employed 20 people and has been in business since 1999. The company specializes in logging, tree harvesting, and tree removal. The company works throughout the state of North Carolina. The company was subcontracted to harvest the timber on this property.

WRITTEN SAFETY PROGRAMS and TRAINING

The owner of the company has attended the ProLogger training program. The North Carolina Forestry Association (NCFA) ProLogger program promotes safety, business, and environmental awareness and requires annual refresher training [NCFAa n.d.**]** The company provided employee training but did not have a written safety and health program. Training was presented by the crew leader and was typically held during lunch on Fridays every couple of weeks, but no records were maintained. The employee training covered topics including use of hard hats, fire extinguishers, overhead hazards, and general jobsite safety. Training was provided orally in English and translated into Spanish by the crew leader.

PERSONAL PROTECTIVE EQUIPMENT

Based on the OSHA report, the employer provided safety equipment including work gloves, hard hats, logging helmet with integrated face shield and ear muffs, and logging chaps, but some of the provided equipment was not in good condition. The chaps worn by the feller were torn and previously cut and the gloves were worn through in the finger areas.

WORKER INFORMATION

The Hispanic male feller was 61 and had been working for this employer for 7 years. The feller was from Mexico. At the time of the incident, he was wearing a logging helmet with an integral face shield and ear muffs, logging chaps, felt work gloves, fleece-lined jacket, and cotton-lined nylon hooded sweat shirt. The feller did not have logging boots or steel toe boots, only leather boots.

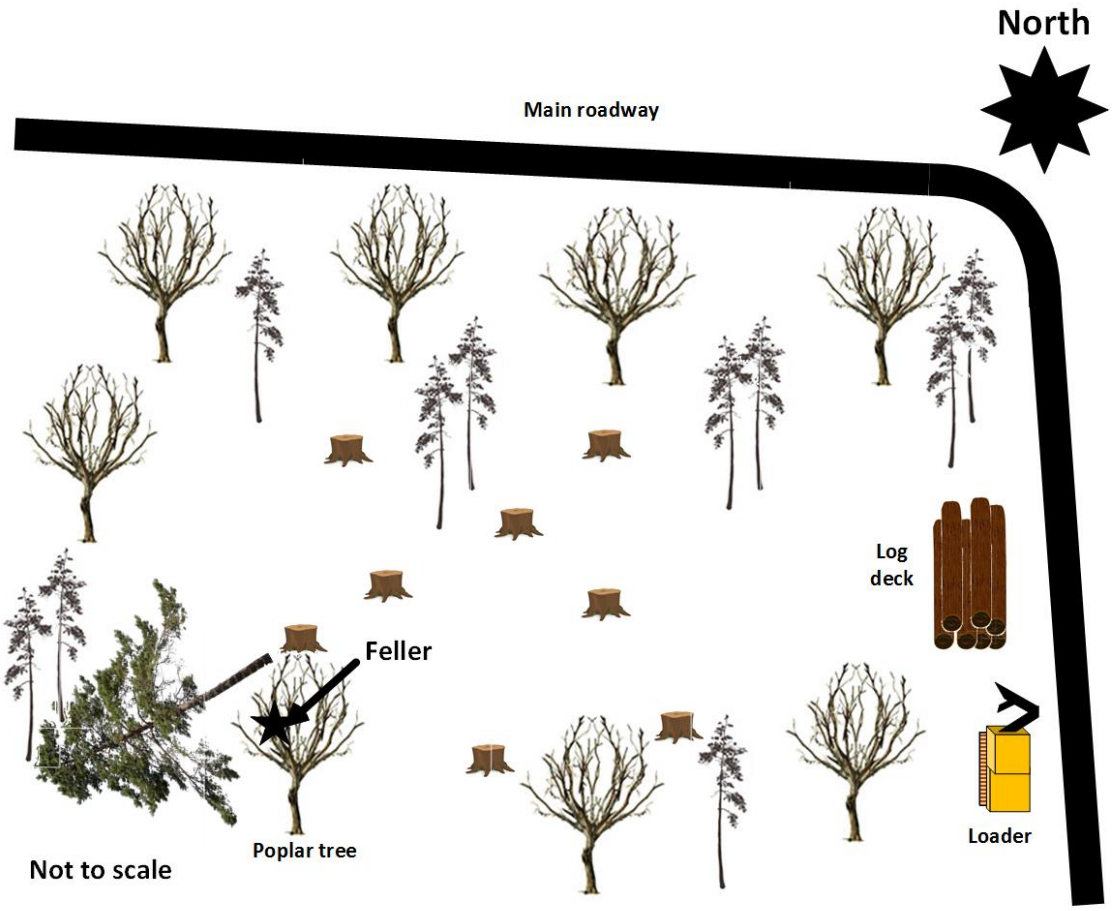

Diagram 1. Incident scene.

PERSONNEL and EQUIPMENT

Four employees were on site: a skidder operator, a feller, a limber, and a crew leader. The crew leader was also a loader operator and had been working in the logging industry for 27 years. A contracted mechanic was also on-site repairing the skidder. The feller and the limber both spoke Spanish. The feller spoke English, but the limber did not understand much English. Work hours were 7 a.m. to 4 p.m., Monday through Friday. On Fridays there was time set aside at lunch for a safety talk. The equipment on site included a skidder and loader.

WEATHER

At the time of the incident it was 39 degrees F, wind speed was 8.1 miles per hour (mph) from the north, and the skies were overcast [Weather underground]. Wind direction and speed may have been a contributing factor because the trees were being felled toward the west and the pine tree that caught the limb of an adjacent poplar fell to the southwest.

INCIDENT SCENE

Photo 1. Stumps show lack of remaining hinge wood, indicative of the swing cutting technique. *(Photo courtesy of NCDOL)*

The property was a 15-acre, mainly level lot of land about 20 minutes outside of the town. The lot was comprised of mixed hardwoods, and was being harvested for pallet lumber (see Diagram 1). The work crew had been on site for 2 weeks and had approximately 2 days left on the job. Most of the cutting had been completed. The crew typically used mechanical felling (80%), but they used manual felling techniques on this tract because it was small, and had a stream and ecological impact had to be minimal in the area. The goal was to remove all marketable logs from the tract.

INVESTIGATION

The crew arrived at the site around 7 a.m. and were planning to work until 4 p.m. The owner had been on site at 10:30 a.m. on the day of the incident, but left before the incident occurred. The owner had observed that the feller was cutting through the hinge wood (see Photo 1). All the trees were generally felled toward the west, because it was easier to bundle the logs for the logging deck, which was located to the east. The trees were intended to fall 45 degrees from the cut. The work area around the feller was cluttered with brush from previously felled trees (see Photo 2).

At around 2:30 p.m., the feller began cutting a pine tree on the southwest corner of the lot. The feller had been felling trees toward the west. However, the pine tree fell toward the southwest. A poplar tree was located 22 feet southwest of the pine tree. The pine tree caught and snapped a poplar limb that fell 60 feet. The limb fell directly down, butt first, and struck the feller on the head. The limb was 30 feet long, 5 inches in diameter, and weighed approximately 300 pounds. The escape path lined up with the poplar limb (see Diagram 2). The incident occurred 150 yards from the logging deck, which was adjacent to the main road. The crew lead had a view from the logging deck to the incident scene saw the

Photo 2. Feller's worker area. *(Photo courtesy of NCDOL)*

incident. At the time of the incident, the skidder operator was at the logging deck with the contracted mechanic because the skidder was broken. The mechanic was working on the skidder when the incident occurred and he called 911. The response from 911 took 20 to 30 minutes. The feller was transported to the hospital. The feller was awake and responsive when the stretcher arrived. However, he died the next day at the hospital.

CAUSE OF DEATH

The medical examiner listed the cause of death as blunt force trauma, concussive injuries, and fractures.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. NIOSH investigators identified the following unrecognized hazards as key contributing factors in this incident:

- *Swing cutting*
- *Insufficient hinge wood*
- *Cluttered work area*
- *Wind speed and direction*

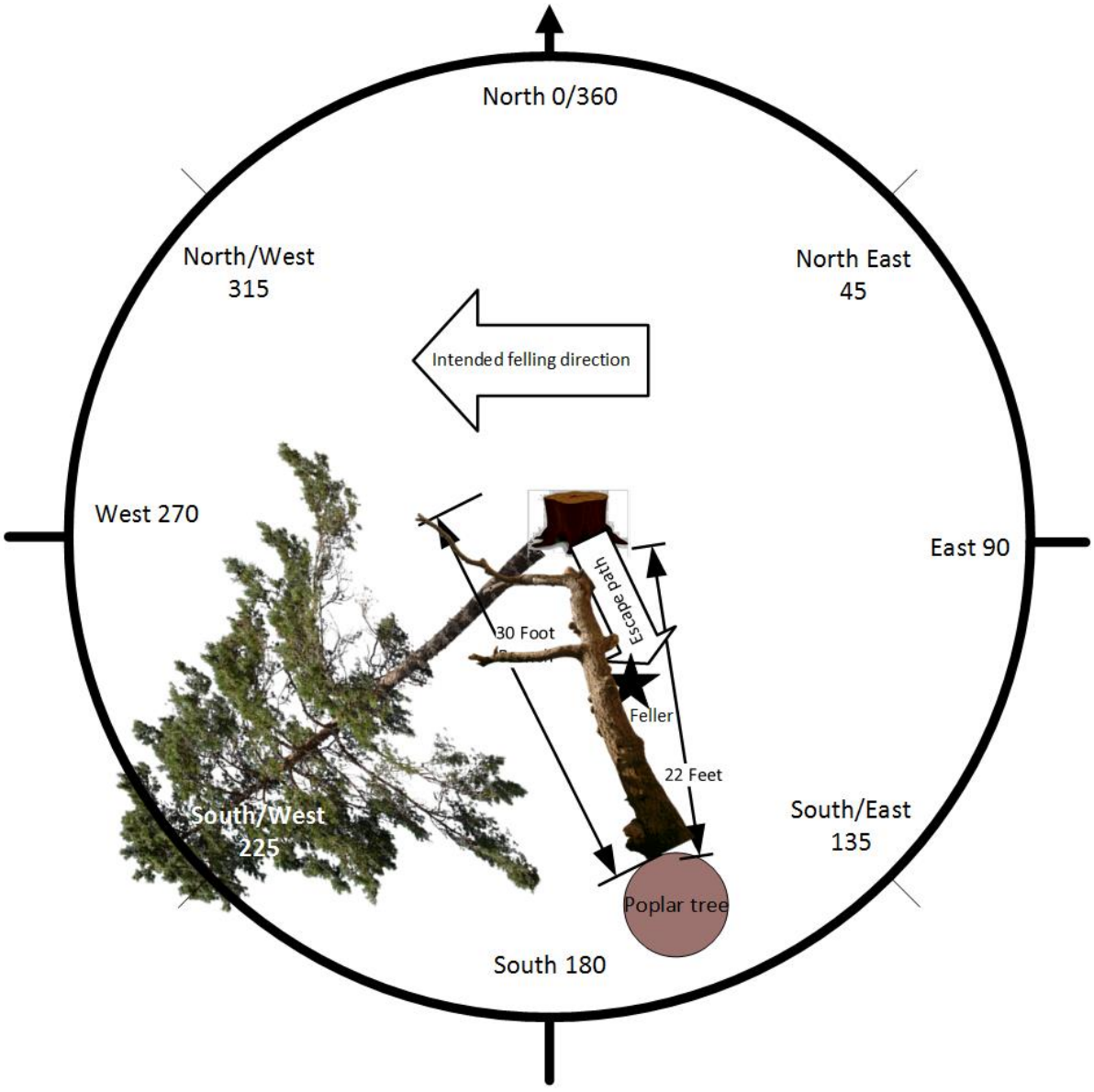

Diagram 2. Incident location, tree felling direction, and poplar limb proximity.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should develop, implement, and enforce a tree harvesting fall plan.

Discussion: Employers should develop, implement, and enforce a tree harvesting plan before work begins on a jobsite or cut block. At the time of the incident, the employer did not have a harvesting plan in place. Supervisors should develop a tree harvesting fall plan to address the hazards associated with a specific logging site, and communicate the plan to fellers and other affected workers [BCFSC 2012]. As part of the harvesting plan for a site, there should also be a faller safety plan, which takes into account the hazards discussed below, and includes these five components: assessing the area; assessing the tree; establishing a safe work area; appropriate felling techniques for the site conditions; and getting in the clear [OR-FACE 2007].

OSHA and the Forestry Safety Council recommend employers to develop a tree harvesting fall plan, which should consider the following hazards and address [FSC 2012; OSHAd n.d.]:

- *Communication, first aid, and accountability*
  - *Adequate separation of operations while maintaining visual or audible contact, so that each employee performing a logging operation is positioned and located within visual or audible contact with another employee*
  - *Develop and maintain procedures and methods for checking in with employees at regular intervals, so that assistance can be rendered if necessary*
  - *Each employee must be accounted for at the end of each work shift.*
  - *Each employee should be trained on first aid.*
- *Terrain and other related hazards*
  - *General environmental and working conditions*
  - *Establishing access and egress trails*
  - *Overhead hazards including electric lines*
  - *"Danger trees" including stubs, spring poles, wind blown trees, and widow makers*
  - *Felling boundaries and site map*
- *Weather*
  - *Assess and limit hazards associated with electrical storms, strong winds that may affect the fall of a tree, heavy rain or snow, extreme cold, dense fog, fires, mudslides, and darkness.*
- *Harvesting methods*
  - *Make sure that trees are felled in a manner that does not create a hazard to employees (i.e., work areas must be assigned so that trees cannot fall into an adjacent occupied work area).*
  - *To limit the hazards associated with the rolling or sliding of logs or trees, felling must be done uphill from or on the same level as previously felled trees.*
  - *Ensure safe opening of the felling face*
- *Maintain minimum distance of 2 tree lengths between fallers*
  - *Employees must be positioned and the duties of each employee must be organized such that the actions of one employee will not create a hazard for any other employee.*
  - *Generally, employees must not approach a feller or mechanical felling operation any closer than two tree lengths of the trees being felled, until the feller or felling machine operator has acknowledged that it is safe to do so.*
- *Crew transportation to and from job sites*
- *Problem areas and special procedures.*

Employers should train fellers on the proper precautions when removing "danger trees" from the felling area. Each danger tree must be felled or removed using mechanical or other techniques to minimize employee exposure before beginning work around a danger tree. Before felling or removing a danger tree, remove loose bark and damage or make sure it can be held in place. If the danger tree cannot be felled or removed, it must be marked and no work shall be allowed within 2 tree lengths of it, unless the employer demonstrates that a shorter distance will not create a hazard for an employee. When cutting a spring pole or other trees under stress, no employee other than the feller is permitted to be within 2 tree lengths of the tree when the stress is released. [OSHAd n.d.]

At the time of the incident the wind was blowing from the North, which may have affected the direction the tree fell. Although the tree that was struck during the incident was not considered a “danger tree”, without a tree harvesting plan in place, precautions such as open felling face, felling method, or weather considerations, were not implemented to prevent the felled tree from striking near-by or adjacent trees.

Recommendation #2: Employers should ensure that tree fellers use proper directional felling techniques that are based on the tree harvesting fall plan.

Discussion: Employers should ensure that tree fellers use proper directional felling techniques that are based on the tree felling assessment. Directional felling is a manual technique used to help ensure that a tree falls in the chosen direction (see Diagram 3). Directional felling uses a directional cut, notch, or wedge-shaped piece and a felling cut on the opposite side (see Photo 3 and Diagram 4). The directional cut should be made into the tree trunk no more than 15% to 20% of the diameter at breast height (DBH). The hinge wood keeps the tree under control as it falls (a good hinge will help the tree fall perpendicular to the front face of the hinge). The hinge wood should have uniform thickness, and its length should be 80% of the tree DBH, and the width should be 10% of tree DBH [Demrow 2011; Husqvarna n.d.]. Never cut the hinge wood all the way through; maintain the proper thickness of hinge wood. When performed correctly, directional felling is one of the safest manual felling methods for getting trees on the ground. CFR 1910.266h(2)(v) requires that a directional undercut be made, and 1910.266(h)(2)(vi) requires that a back cut be made, leaving sufficient hinge wood to hold the tree to the stump during most of its fall, so that the hinge can guide the tree's fall in the intended direction [OSHA 2014].

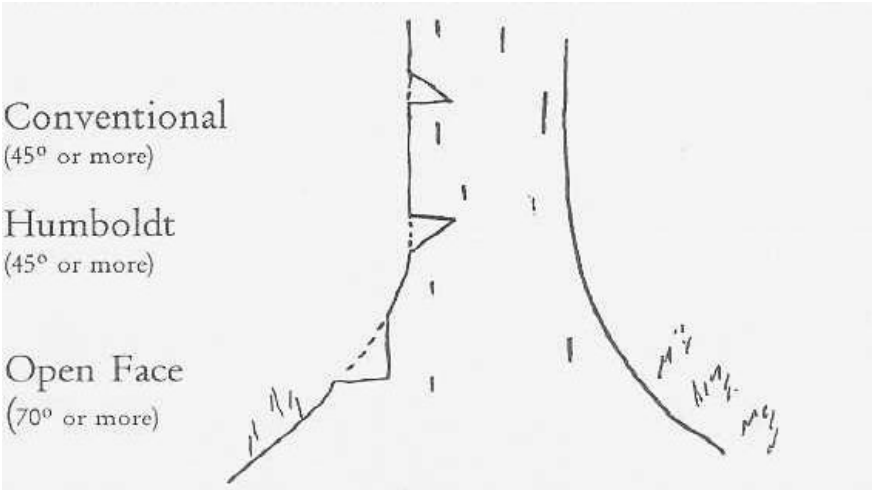

Diagram 3. Standard directional cuts. [FISTA n.d.]

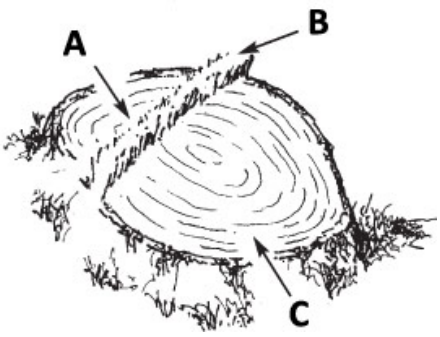

Diagram 4. A. Correct hinge length - 80% of D.B.H. B. Correct hinge thickness - 10% of D.B.H. C. Level back-cut
[Demrow 2011]

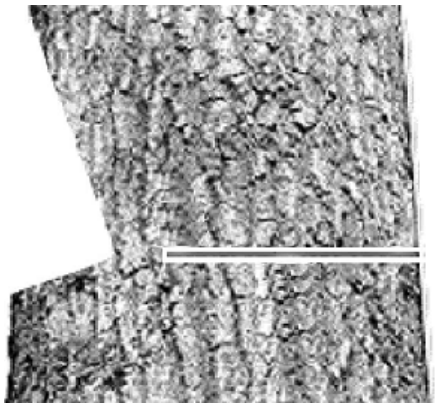

Photo 3. Open face notch directional cutting
[OSHA 2010]

The following should be considered prior to felling [OSHAb n.d.]:

- *Identify any hazards that are present in the area where the logger will be working*
- *Determine the felling direction and how to handle forward lean, back lean, and/or side lean*
- *Provide a retreat path so the logger can reach safety while the tree is falling*
- *Determine the proper hinge size to safely guide the tree in its fall*
- Use proper felling methods that allow the logger to safely fell the tree.

Based on the information gathered in the investigation, it is presumed the feller intended to fell the pine tree toward the west at 262 degrees; however, it fell southwest at 230 degrees (Diagram 2). Because the poplar tree was only 22 feet from the pine tree and to the southwest at 142 degrees, the pine tree caught the branch of the poplar tree. The felling technique being used during this incident did not leave adequate hinge wood to utilize the directional felling technique. The felling technique being used was an international Dutchman (swing cutting) and the feller had no control of which direction the tree fell (see Photo 4). This method allows the tree to swing around the axis of the tree stump. If a sufficient amount of hinge wood had been maintained, it may have helped ensure the tree fell in the intended direction and not caught the limb on the adjacent tree. The employer has since implemented steps to inspect stumps for sufficient hinge wood.

Recommendation #3: Employers should develop procedures and train fellers on tree assessment, opening the felling face, and identifying, creating, and maintaining clear retreat paths

Employers should conduct a comprehensive site assessment, develop procedures, and train fellers on tree assessment and felling preparation. Fellers should be trained on how to:

- *Assess trees from the crown to the base, first from a distance, and then when approaching and walking around each tree if possible.*
- *Look for hazards including overhead (e.g., power lines, hung-up trees), on the ground (e.g., stumps, debris, steep slope), tree defects (e.g., splits), and other worksite hazards (e.g., road/harvesting crews).*
- *Formulate a plan on how to fall the tree safely by avoiding the identified hazards.*

Photo 4. Photo shows lack of hinge wood in cut *(Photo courtesy of NCDOL)*

- *Determine the high side of the tree so the faller is positioned above the fall line of the tree and the lean of the tree.*
- *Identify the appropriate felling direction in order to determine the felling technique and control the direction of the fall.*
- *If at any time during felling preparations there are concerns the work cannot be performed safely and according to the falling plan, stop work and discuss concerns with the supervisor.*
- *Fell tree according to tree harvesting fall plan.*
- *Choose a safe place to fell the tree that is open and clear and avoids brushing other trees.*
- *Avoid rocks, stumps, windfalls, or gullies that may cause the tree to roll or break when it lands, which may create bucking hazards.*
- *Avoid brushing adjacent trees by allowing trees to fall free of any obstructions and to land in a safe area.*
- *Modify the tree harvesting fall plan if the terrain or other site conditions prevent a safe tree felling.*
- *Remove any obstructions to the free fall of trees, e.g., trees with large limbs or multiple tops, dangerous trees and saplings.*
- *Remove dangerous trees before falling other trees. Follow these steps when opening a felling face. [FSC 2012; OSHAd n.d.]*

Employers should train fellers on identifying, creating, and maintaining clear retreat paths. Escape routes or retreat paths are cleared paths to move to a safe cover (i.e. standing tree, natural outcropping, or rock bluff) that:

- *Allow escape for at least 10 ft and/or to safe cover, preferably to high side at a 45 degree angle (see Diagram 5)*
- *Remove tripping hazards (e.g., loose debris, sticks, and rocks).*
- *Several escape routes may be required with dangerous trees.*
- *Walk route(s) before cutting*
- *Remove saplings, brush, ground cover, or debris that could fly back and strike you, to create routes and around the tree. [FSC 2012; OSHAa n.d]*

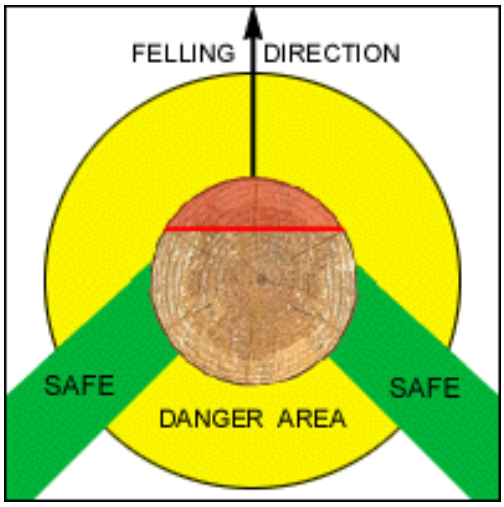

Diagram 5. Felling retreat path [OSHAa n.d.]

At the time of the incident the brush and ground debris from previously felled trees cluttered the ground, which may have obstructed the feller's escape paths. It may have helped to have chosen an escape path 45 degrees from the cutting face. Additionally, the positioning of the log deck affected the feller's direction of felling, into standing timber, instead of into the opening.

Recommendation #4: Employers should develop, implement, and enforce a written safety program that includes, but is not limited to, training in hazard identification, avoidance, and abatement.

Discussion: Employers should develop, implement, and enforce a written safety program in the language and literacy level appropriate for all employees. At the time of the incident, the crew leader provided training on Fridays, orally in English and translated into Spanish by the crew leader. The training covered topics including hard hats, fire extinguishers, overhead hazards, and general jobsite safety. However, the company did not have a written safety and health program and did not maintain training records.

A written safety program is broader in scope than the site-specific tree harvesting plan and faller safety plan, and should describe all company policies, the potential hazards of the worksite, training in hazard identification and the avoidance and abatement of these hazards, and controls and work practices selected to minimize those hazards. The program should also address the steps to be taken when a worker fails to follow the company's established safe work practices. Safety program implementation requires management's commitment to provide adequate resources for training, accountability, self-audits, and employee involvement

Topics to be included in a site safety and health plan [OSHAc n.d.]:

- *Tree harvesting plan*
- *Daily safety checks and surveys*
- *Personal protective equipment (PPE) Program*
- *Equipment maintenance program*
- *Training and training records*

- *Assignment of responsibilities for carrying out the safety plan*
- *Hazard communication program*
- *Lockout/Tagout*
- *Bloodborne pathogens*
- *Hearing conservation*
- *Accident investigation*

The North Carolina ProLogger program provides a safety checklist booklet that helps employers and safety managers maintain the proper documentation and training related to logging safety [NCFAb n.d.]. Many trade associations offer logging safety certification programs: American Loggers Council, North Carolina Forestry Association, The Ohio Forestry Association, Virginia Tech Department of Forest Resources and Environmental Conservation, Wisconsin Certified Master Logger. These programs include annual recertification requirements. Employers should consider enrolling employees in these programs to supplement internal employee training. The logger safety programs are readily available in English, although the availability in Spanish is limited. Research is being conducted in the Pacific Northwest to address this important need [UW 2017].

ADDITIONAL RESOURCES

BC Forest Safety [n.d.]. Faller certification. Nanaimo, BC, Canada: British Columbia Forestry Safety Council.

This website provides information on how to apply and be certified to safely fell trees based on British Columbia standards. In British Columbia, all manual tree fallers in forestry operations must be trained and certified. The BC Forest Safety Council (BCFSC) is authorized to administer faller certification in the Province of BC. According to the British Columbia Occupational Health and Safety Regulation (OHSR) 26.22 (2) (a), new fallers are required to take basic training in falling trees by working one-on-one with a qualified faller or trainer for a period of not less than 30 days. This training must be conducted through an approved administrator.

BC Forest Safety [2012] Feller Training Standard, Part 1, & Part 2 . Nanaimo, BC, Canada: British Columbia Forestry Safety Council.

These documents provide information on clothing and personal protective equipment, protection from musculoskeletal injury, chainsaw maintenance, filing and handling information, crew transport, dangerous tree indicators, and procedures for dealing with various falling scenarios, alternative falling methods, limbing, adverse weather, bucking hazards and windthrow.

NIOSH [1995] Preventing Injuries and Deaths of Loggers. DHHS (NIOSH) publication no. 1995-10.

This Alert describes six incidents resulting in the deaths of six workers who were performing logging operations. In each incident, the death could have been prevented by using proper safety procedures and equipment and by following the provisions of the OSHA standards.

North Carolina Forestry Associates [2016]. Pro Logger. Raleigh, NC

In cooperative effort directed by the NCFA, Forestry Mutual Insurance Company, the North Carolina Department of Labor and the North Carolina Forest Service share teaching responsibilities during the base ProLogger course. The base course promotes safety, business and environmental awareness. All loggers who want to become a ProLogger must take this base course that includes two days of classroom discussions and one field day.

DISCLAIMER

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sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

REFERENCES

ALC [2017]. Wisconsin master logger certification program. Florence, WI: American Loggers Council.

FISTA [n.d.]. Standard directional cuts. Rhinelander WI: Forestry Industry Safety & Training Alliance, INC.

FSC [2012]. BC Faller Training Standard 1. British Columbia, Canada: Forestry Safety Council, Work Safe.

Demrow C [2011]. Bore cutting basics. Corinth, VT: Northern Woodlands.

Husqvarna [n.d.]. Directional felling. Charlotte, NC: Husqvarna.

NCFAa [n.d.]. ProLogger. Raleigh, NC: North Carolina Forestry Association.

NCFAb [n.d.]. Logger safety checklist booklet. Raleigh, NC: North Carolina Forestry Association.

OFA [2017]. Master Logger Company Program. Zanesville, OH: The Ohio Forestry Association.

OR-FACE [2007]. Fallers logging safety. Portland. OR: OHSU - Oregon Institute of Occupational Health Sciences.

OSHA [2014]. 29 CFR 1910.266(h)(2)(i–vii) Logging operations. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHA [2010]. Logging Operations. Grant Number: SH-20868-10. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHAa [n.d.]. Logging eTool, Felling trees. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHAb [n.d.]. Logging eTool, Manual operations: felling trees. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHAc [n.d.]. Logging eTool, Safety and health plan. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

OSHAd [n.d.]. Logging eTool, Tree harvesting plan. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

UW [2017]. Safety and health of Latino immigrant forestry services workers in the Pacific Northwest. Seattle, WA: University of Washington.

VT [2016]. SHARP Logger Program. Blacksburg, VA: Virginia Tech, College of Natural Resources, Department of Forest Resources and Environmental Conservation.

Weather Underground [2014]. Weather history for KSVH, December 14. Atlanta, GA: The Weather Channel Interactive, Inc.

WIMLC [n.d.]. Tree felling techniques manual. Florence, WI: Wisconsin Master Logger Council.

INVESTIGATOR INFORMATION

This investigation was conducted by Jennifer E. Lincoln, Health Scientist, Fatality Investigations Team, Surveillance and Field Investigation Branch, Division of Safety Research.

ACKNOWLEDGEMEMENT

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