

South Carolina Vibrator Accident and Extraction

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Date of Accident:
February 11, 1996

Location of Accident:
Near Kingstree, South Carolina

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Open-file Report

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South Carolina Vibrator Accident and Extraction

The vibrator arrived in South Carolina on Thursday afternoon, February 8, 1996, and was unloaded at a plantation operated by the Oliver brothers and located about 1/2 mile east of the intersection of US Highway 52 and South Carolina Highway 375. Ron Marple of the University of South Carolina directed Elmo and OB of IVI to the plantation where the machine was unloaded from the semi-trailer flatbed. The vibrator was inspected and checked out. A problem discovered in Lawrence and reported shortly before shipping that prohibited communication between the radio trigger unit and computer controller was studied and diagnosed. The 5 volt trigger pulse delivered to the computer from the SIB box ribbon cable blew an internal 1 amp fuse located on the control card within the vibrator computer. Elmo determined this problem was one that could not be easily fixed on-site with existing tools and documentation. The problem was handled in the interim by extending the fused position outside the computer chassis into an exterior fuse holder. A power up sequence was designed by Elmo which should have reduced the likelihood of the recurring voltage surges responsible for the blown fuse. The source of the power surge will be determined in the Tulsa office of IVI.

The KGS crew arrived on site Friday morning and after brief discussions with Elmo concerning source and receiver layout, began laying cables and phones at the edge of the north road shoulder. The survey was designed for the vibrator to run along the south shoulder for the first half (4 miles) of the profile. On the average the shoulders were approximately 10 to 12 ft wide with everything from no ditch to a canal style dug ditch. These canal style ditches were a maximum of 5 ft deep and 12 ft wide with very steep sides. Around 12:00 after it was determined the vibrator seemed to be well tuned and running effectively, Elmo left for the airport to fly back to Tulsa. At about 1:30 OB called on the radio and requested we get in touch with Elmo before he left on a plane. OB thought Elmo should return to the site because of the large number of fuses the vib was blowing while the machine was being operated exactly as Elmo had instructed. Elmo was never successfully contacted and fortunately the fuse problem did not accelerate. For two of the half-dozen shot-points east of the railroad tracks at the start of the line the pad was placed so about 1/3 of the pad was on the asphalt. After the three sweep sequence recorded at each shotpoint a marked depression was evident on the road surface. To avoid any more road damage and to keep the vibrator as far from the road ditch as possible, guidelines for pad placement were established. The pad was to be located as close to the

asphalt as possible without touching the white line that separates the driving lane from the shoulder. This location can be monitored by the driver by keeping the outside edge of the road-side tire immediately along the ditch-side edge of the white line. This procedure was suggested to OB as safest and with the least potential for road damage throughout the data acquisition phase of this project.

Operation of the vibrator was the responsibility of the IVI-provided driver/operator. The KGS staff at various time made observations and suggestions based on the enforced operating procedures of the KGS MiniVib. The most noteworthy incident where vibrator operation strayed from KGS procedure was while sweeping at a shotpoint early in the project (Friday) the two uphill wheels on the Birdwagon left the ground. By the end of the three-sweep sequence the front tire was about 6 to 12 inches off the ground and the rear tire was more than 18 inches off the ground. At this point OB was notified by KGS staff that his tires were leaving the ground, at which time OB expressed a lack of concern and a complete awareness that the tires had left the ground. On several occasions after this incident the tires left the ground but OB was not notified as a result of his response when it was brought to his attention earlier. The deep ditches and soft shoulder conditions were a topic of conversation initiated by KGS staff at various times the first three days with little apparent concern expressed by OB. After the first day, KGS staff only notified OB when the vibrator pad was in contact with the asphalt road in a situation where damage could result from repeated sweeps. Attempts were made at various time to notify OB of KGS staff concerns about the operation and placement of the vibrator.

During routine operations on Sunday afternoon (2/11/96) OB expressed concern about having the tire that was consistently losing air on the downhill side of the vibrator while acquiring along the roadside ditch. He was troubled by the roll-over potential created by shifting the center of gravity when the tire got excessively low. At no time was any concern voiced by OB about the softness of the shoulder or the width of the shoulder. This is likely due to the fact that he had been driving and shaking on a shoulder with extremely similar characteristics for more than 4 miles. He voiced this concern at about shotpoint 450, at which time the KGS staff moved the vibrator to the south side of the road. With the geophones already on that side of the road, placing the pad between the geophones, cables, and the edge of the asphalt was not possible at several stations. This minimal space situation resulted in part of the pad placed on the asphalt in three places, which of course produced visible damage. During vib operations near geophones on the south shoulder, KGS

staff made efforts to keep the vibrator off of the cable and off the road, but this was not always possible.

At station 460 it became evident the vibrator must operate on the north side of the road. OB did not want to run the vibrator with the low tire on the downhill side and requested KGS staff replant about 2 miles of geophones and move an equivalent amount of cable over into the ditch. This of course was not a realistic option. It was suggested that he back the vib down the north lane of the highway with KGS staff directing traffic and then pull into each shotpoint. This would accomplish two different objectives: first, it would eliminate OB's concern for the downhill placement of the rear tire losing air, and second, this placement would put the operator on the ditch side of the vibrator, giving him much better awareness of the ditch location and condition. OB thought about that suggestion for a minute and then said it would be "too much of a hassle" and indicated he would just keep an eye on the tire, airing it up when necessary. So at shot point 461 the vibrator was moved back in the north shoulder. The operation of the vibrator (which by this time was somewhat routine) continued as it had for the previous 450 shotpoints down the road shoulder opposite the geophones.

Vibrator operations were very smooth for sweeps recorded on the north shoulder between 461 and 478 (since each shotpoint was separated by 55 ft, this represents 935 ft). The vibrator was consistently being operated with about 1 ft between the pad and edge of the asphalt. The shoulder conditions were very similar to those present across most of the line. The three sweep sequence at shotpoint 478 was successfully completed at 5:30 PM, the pad was raised to a carry position about 1 foot off the ground, and the vibrator was driven toward shotpoint 479. Based on a clear set of lugged tire tracks, the vibrator strayed from the edge of the asphalt by more than 2 ft, 35 ft west of station 478. This direction change occurred about 10 ft prior to the point where the right rear tire slid into the ditch. This slide did not result from a cave-in, but from the tearing of sod and the upper few inches of soil beneath the right rear tire.

Once the right rear wheel had dropped into the ditch, the vibrator was stopped. The KGS staff member escorting the vibrator called OB on the radio and asked him if he could get the vibrator out of the ditch without assistance. OB responded yes by nodding his head. The KGS staff member also told him the pad was against the ground, high centering the machine. At this point OB engaged the park brake, changed the transmission into low gear, and enabled the four-wheel drive. The KGS staff member cleared traffic and indicated to OB road traffic was

clear. OB began to apply power to the wheels. The wheels turned slightly and the vehicle started to slowly roll over on its right side. At no time did the vibrator seem to be moving forward. As the vibrator slowly began to roll onto its side, it appeared OB turned the steering wheel to the left while continuing to put power to the wheels. This oversteering actually shifted the center of gravity toward the ditch even more, allowing the vehicle to continue leaning toward the ditch. Soon the up-slope wheels left the ground and the vibrator rolled onto its side. This roll-over was relatively slow, as evidenced by the minimal damage to the ground contact points.

From the position of the seismograph operator (about 100 ft ahead and across the road), once the vibrator came to rest on its side, OB fell from the drivers seat across the computer and electronic control units and landed on the passenger side door. He immediately stood up and hit the kill switch on the dash. The KGS staff member escorting the vibrator climbed onto the left side of the vehicle and opened the driver's door. Being first aid and CPR certified the staff member began to evaluate OB's physical condition. Once it was determined that OB did not need immediate medical treatment, the staff member called on the radio for assistance.

Once the accident had been reported on the VHF communication radio, all the KGS staff were on-site to assist with the incident. Since OB could not climb out of the cab using the cab fixtures, an aluminum ramp used to load ATVs was lowered into the cab. The rungs were sufficiently close together that OB was able to climb out onto the cab top and then with the assistance of two KGS staff members he stepped on the north bank of the ditch. Once securely on the north bank of the ditch OB indicated he could not walk any further and the decision was made to call for emergency medical assistance. A KGS staff member then called 911 on a cellular phone, asking for ambulance transport of an apparent back injury. This was completed and all KGS staff were back at the accident site by about 6:00 PM. Sundown on Sunday, February 11, was about 6:10 PM. The highway patrol arrived about 6:30 and controlled traffic while some assistance was given by a volunteer fireman who had been traveling the road. The ambulance arrived around 7:15 or so. A backboard was used to transport OB to the ambulance. Assistance moving OB the 150 yards through a plowed field to the waiting ambulance was given by two KGS staff members, the volunteer fireman, and one of the paramedics. Once OB was securely in the ambulance the KGS staff secured the site and left for the hospital to check on OB's status. After the ambulance was called and the site was being monitored by the highway patrol, KGS administration was contacted requesting assistance in tracking

down Jay and Nancy Bird. OB was released from the hospital at about 10:00 PM on Sunday evening.

A meeting was established with Jack Ard of Ard's Garage in Kingstree based on recommendations by both the highway patrol and a local merchant. Once the various options for getting the vehicle out of the ditch had been discussed between Jack Ard and KGS staff, the following day (2/12) contact was made with Jay Bird of IVI. Jay decided to send Jim Hannon to the site to assist with the extraction of the vibrator. Jack Ard had recommended the use of a 100 ton crane to lift the vehicle out, but it was the decision of IVI to use several wreckers to upright the vehicle, then start the vibrator and try to drive it out. A meeting between Jack Ard, Jim Hannon, and Rick Miller at Ard Garage on Tuesday (2/13) resulted in the decision to take all three of Jack Ard's wreckers to the site and try to pull the machine upright, start the engine, then use the wreckers to stabilize the vibrator so it could be driven out of the ditch.

Once on site at about 9:15 AM on Tuesday (2/13) traffic was controlled by the KGS staff while the folks for Ard's Garage hooked onto the front and rear of the machine, pulling it off its side and spinning it around so the rear wheels were off the ground and over the road shoulder. The weight of the vibrator was on the pad and front wheels. A tire company from Summerville had been contacted and was on-site to repair the tire, so while the rear tire was fully off the ground the tube was replaced and the tire was inflated. This process required about one hour and began about 10:00 and was completed shortly after 11:00. While the tire was being changed Jim readied the engine for starting. It was clear a restriction from the bent radiator cowling would not allow the fan to turn. The fan belts were loosened and the machine was prepared for driving. After the tire was repaired, Ard Garage personnel attached to the rear of the vibrator cab and assisted the machine backing out of the ditch. After Jack Ard had the machine on the road he stated it was very clear to him that the vibrator had been driven into the ditch.

Once the vibrator was fully on the road the wreckers were disconnected and the machine was driven to a grassy parking lot about 100 yards from station 479. The vibrator was shut down and damage assessed. It was determined jointly by the IVI and KGS personnel that a leak in the cooling unit would require repair or replacement before routine operations could continue. A complete cooling unit was stripped from a machine in Tulsa at IVI and driven by courier to the site. The part arrived Thursday evening and by Friday noon the vibrator was fully functional and was being used to acquire data.

The data acquisition portion of the project was completed in just under two days following the repair of the vibrator. Approximately 420 shotpoints were recorded between Friday noon (2/16) and Sunday (2/18) at 10:00 am. This completed the project with a total of just under 900 shotpoints across the 9.2 miles. After the final shotpoint Sunday morning, Jim returned the vibrator to the plantation house and prepared it to be shipped out on Monday. The electronics furnished by the KGS from the KGS-owned MiniVib that were necessary to establish compatibility between the Birdwagon Vibrator and the existing KGS recording system were removed and returned to the KGS staff on site. The data acquisition portion of this project included 5 recording days (including testing and production), 5 days of downtime, and 4 days of travel.

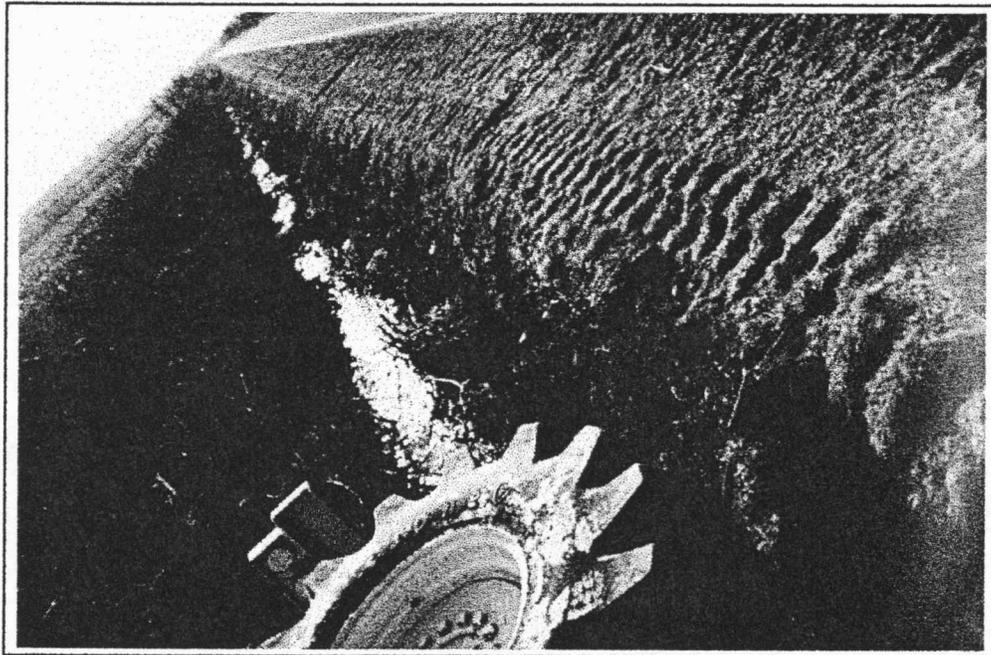
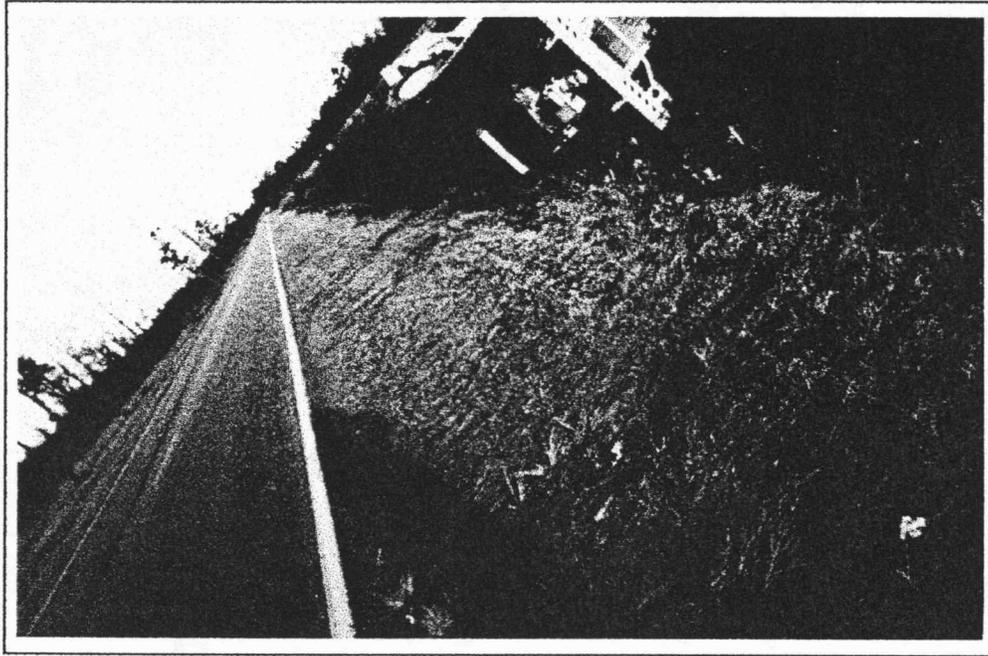


Figure 1

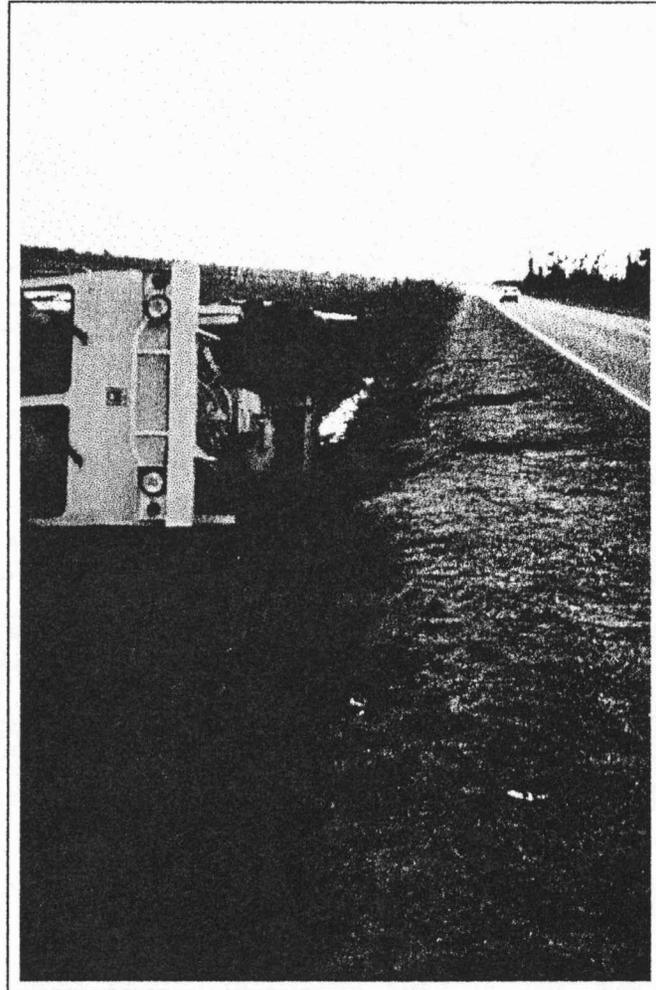
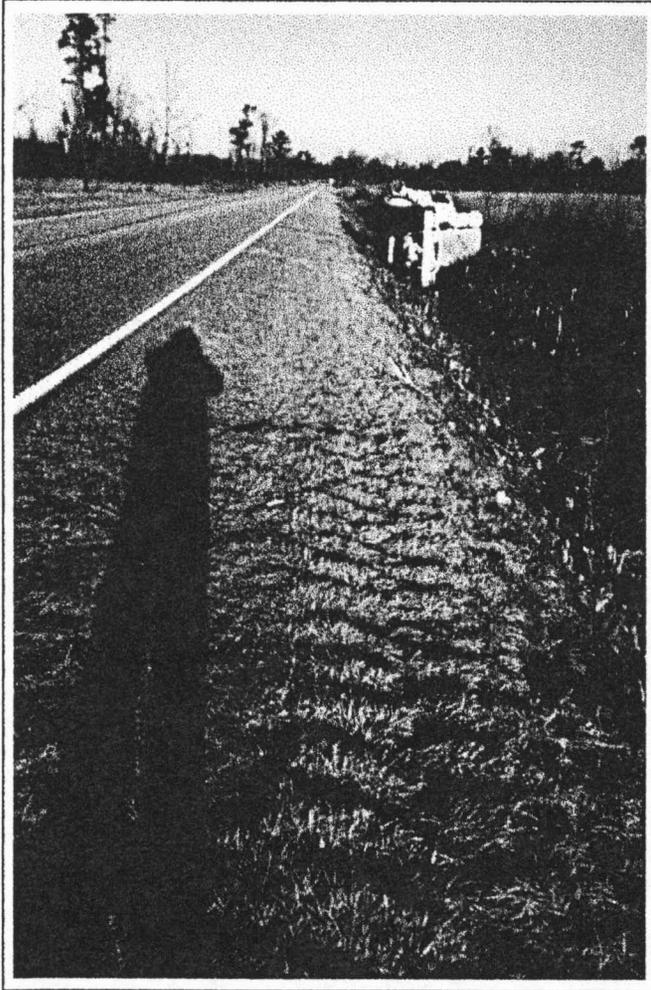


Figure 2

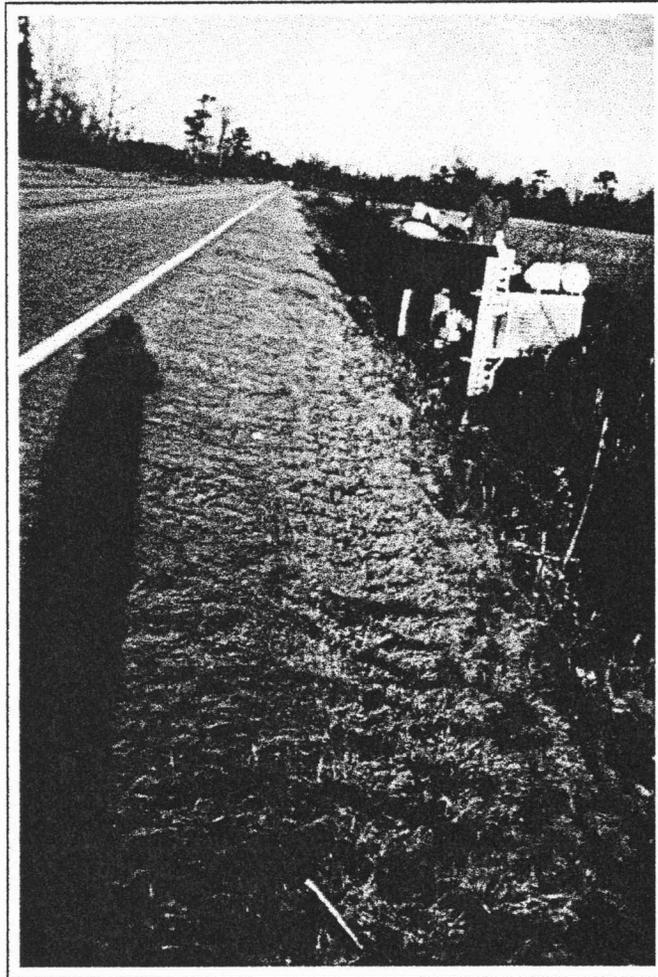


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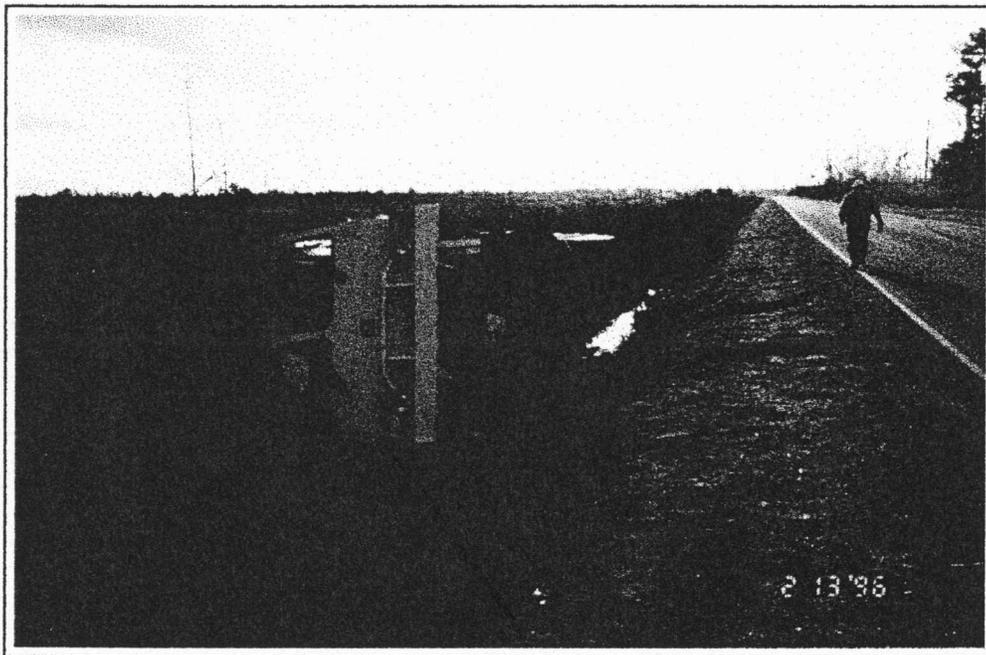
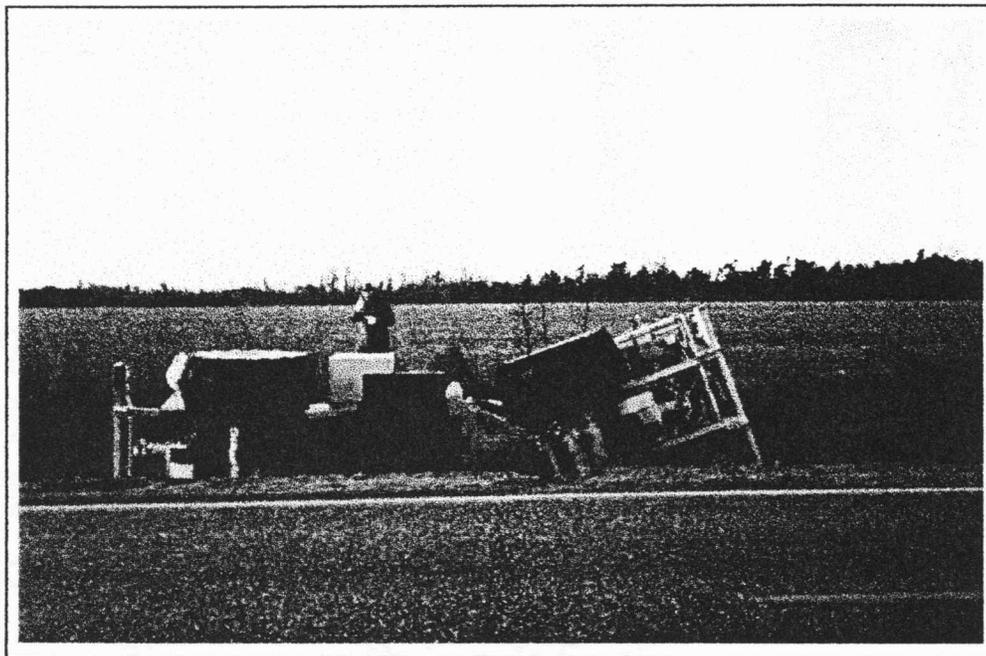


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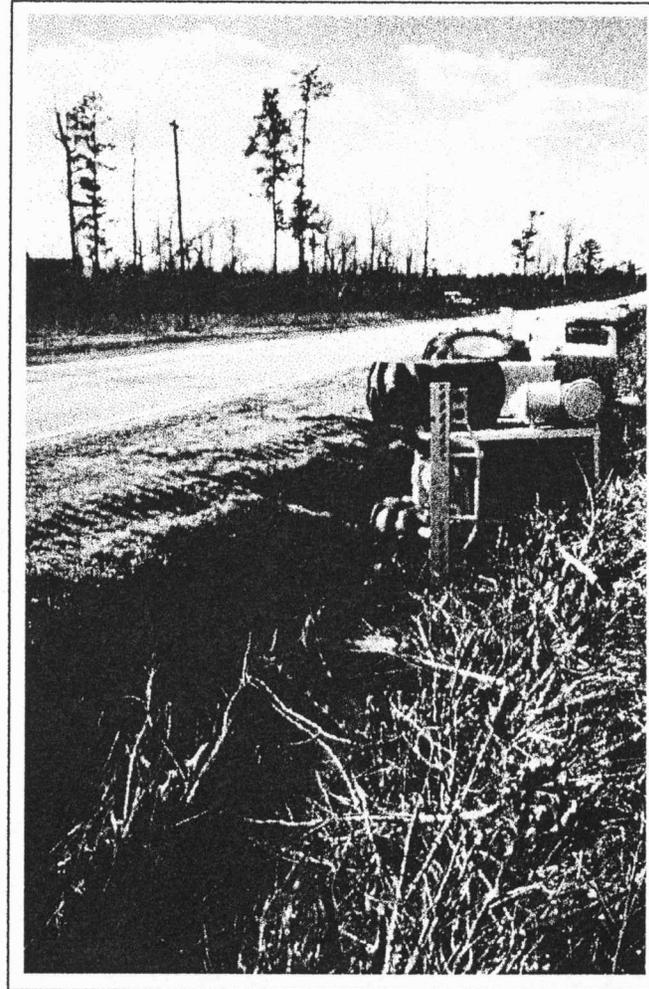
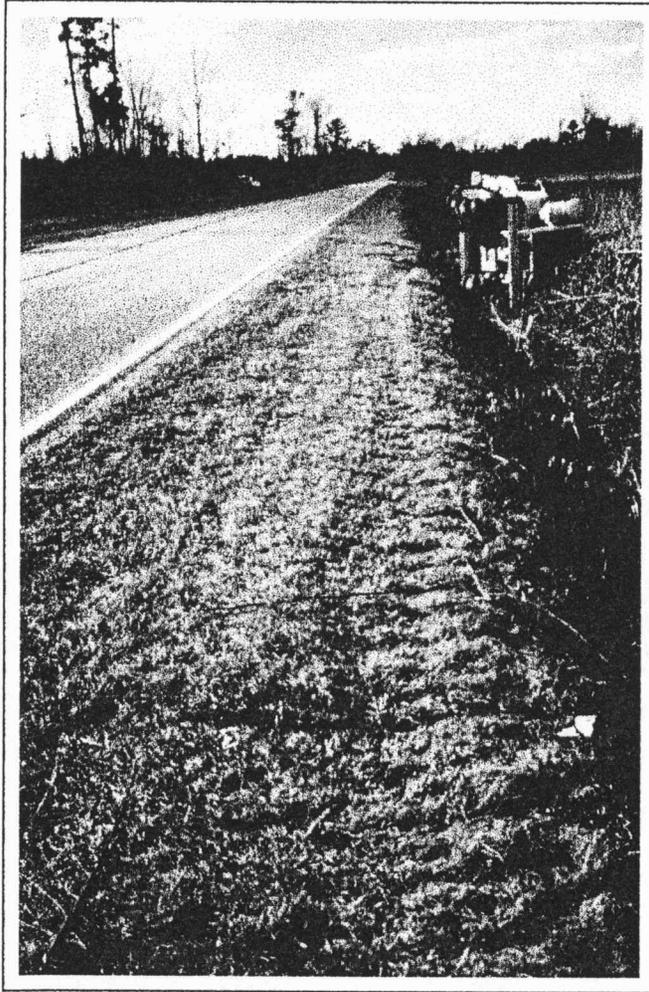


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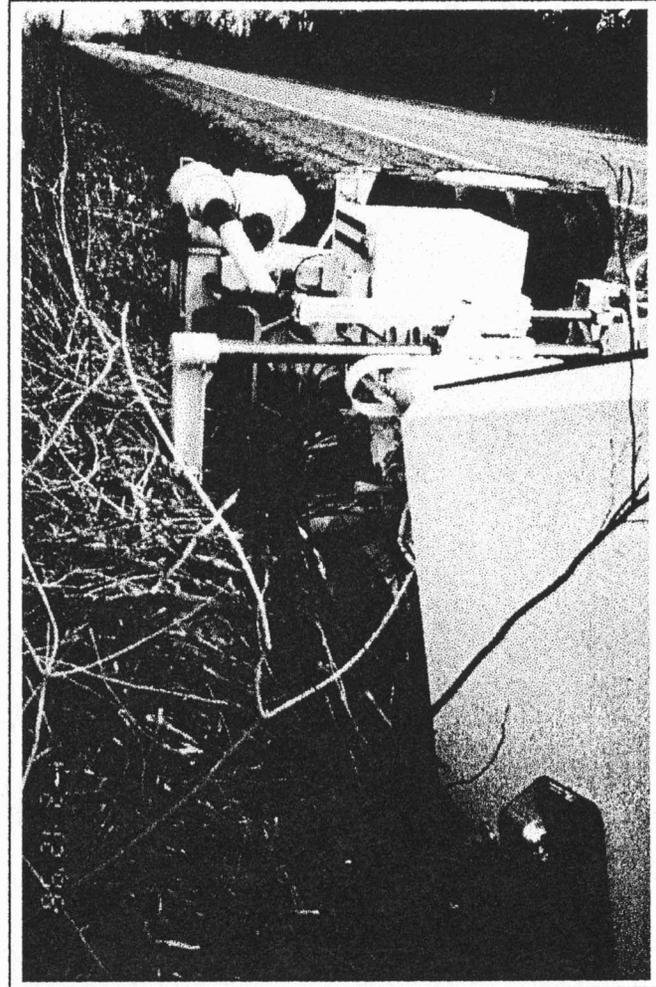
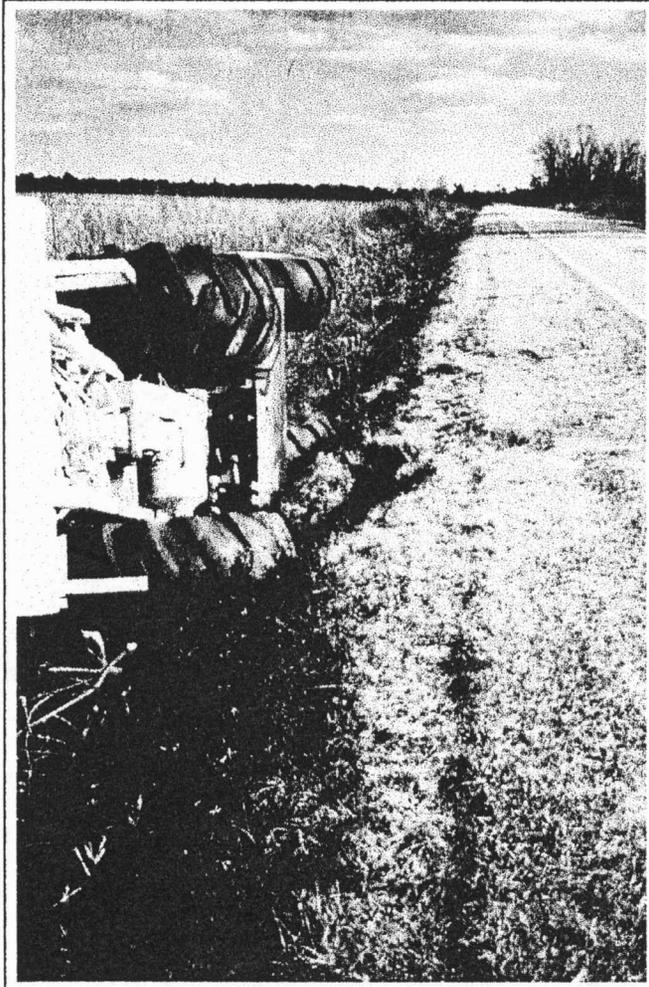


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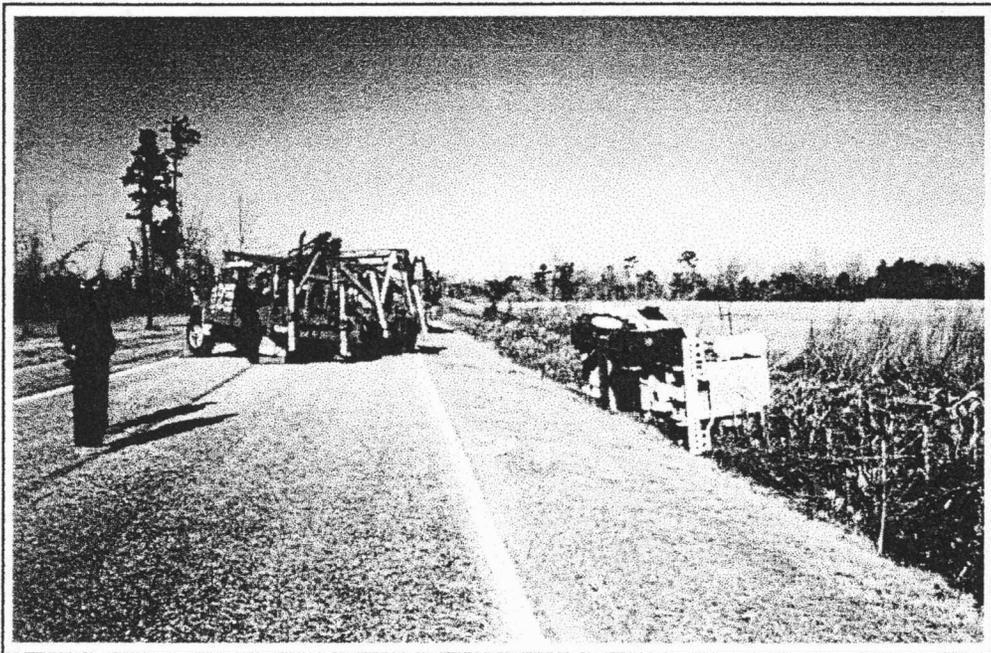
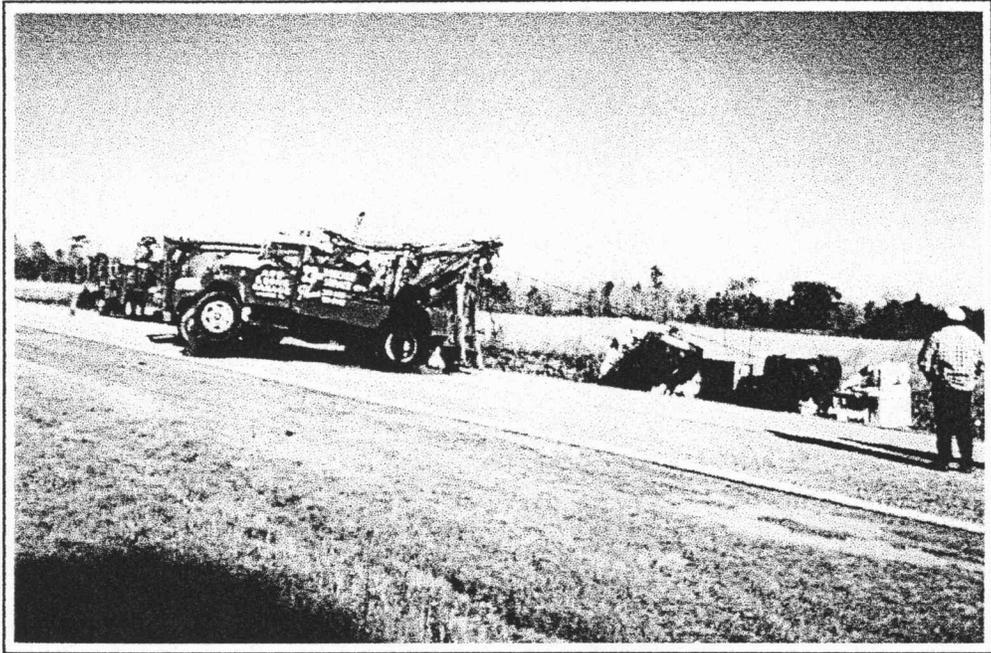


Figure 7



Figure 8



Figure 9