

Best Practices for Road Weather Management

Version 2.0

South Carolina Hurricane Evacuation Operations

In September 1999 roughly three million people were evacuated from coastal areas in Florida, Georgia, North Carolina, and South Carolina prior to landfall of Hurricane Floyd. Over 500,000 South Carolinians evacuated from six coastal counties. Because managers with the South Carolina Department of Transportation (DOT) and the South Carolina Department of Public Safety had not agreed on a lane reversal plan prior to Hurricane Floyd, contraflow (i.e., lane reversal) was not employed during the evacuation. Consequently, there was severe congestion on Interstate 26 between Charleston and Columbia. Traffic and emergency managers quickly developed a contraflow plan for reentry operations after the hurricane.

System Components: Managers utilized storm track, wind speed, and precipitation forecast data in combination with population density and topographic information to identify areas threatened by storm surge and inland flooding. Emergency managers consulted various information sources including the National Weather Service, the National Hurricane Center, the Federal Emergency Management Agency, as well as decision support applications such as HURREVAC (www.hurrevac.com) and HurrTrak (www.weathergraphics.com/ht/). Traffic managers monitored traffic flow with two permanent vehicle detection sites along the highway and portable detection equipment on other road facilities. During reentry operations, portable Dynamic Message Signs (DMS) and Highway Advisory Radio (HAR) transmitters were positioned along the interstate to alert drivers of contraflow operations.

System Operations: DOT managers worked closely with Highway Patrol personnel during evacuation and reentry operations. Traffic and emergency managers also coordinated with other local, state, and federal agencies. Before traffic flow on westbound lanes could be reversed for reentry (i.e., contraflowed from Columbia to Charleston as shown in the figure), DOT and DPS personnel were mobilized and equipment was prepositioned. Lanes to be reversed were cleared of all traffic, and traffic control devices and barricades were erected. Access ramps to westbound lanes and some minor interchanges were closed. Highway Patrol personnel staffed all closed ramps and patrol vehicles were stationed along the 95-mile (152.7-kilometer) contraflow route to manage incidents. Traffic managers continuously polled vehicle detectors to monitor traffic operations.



South Carolina DOT Contraflow Operations

Transportation Outcome: On Tuesday, September 14th the Governor issued a voluntary evacuation order at 7:00 AM followed by a mandatory evacuation order at noon. In response, over 350,000 people evacuated on Tuesday and roughly 160,000 departed on Wednesday. The timing of evacuation orders, the public's response to the orders, the lack of lane reversal operations, and unmanned traffic signals in small towns contributed to severe congestion on Interstate 26 between Charleston and Columbia. Travel time, which is normally 2½ hours, ranged from 14 to 18 hours during the evacuation. The maximum per lane volume on the interstate was 1,445 vehicles per hour.

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Version 2.0

The Governor ordered contraflow operations to minimize travel times during reentry. Traffic and emergency managers quickly developed a contraflow plan to accommodate reentry traffic in reversed westbound lanes. DMS and HAR were deployed to notify travelers of closures and alternate routes. As a result of contraflow, the maximum volume during reentry was 2,082 vehicles per hour per lane—a 44 percent increase over evacuation volumes. Contraflow operations and dissemination of traveler information significantly improved mobility by increasing roadway capacity and traffic volumes.

Implementation Issues: When planning contraflow operations managers must designate routes, determine initiation and termination points, select a contraflow strategy, establish criteria for implementation, arrange enforcement and incident management, promote institutional coordination, as well as communicate with political officials and the public. Geometric modifications to the roadway or special traffic control patterns may be required at contraflow initiation and termination points. After Hurricane Floyd, the South Carolina DOT constructed an X-shaped median crossover with a 45-mph (72-kph) design speed. During normal traffic operations, a water-filled barrier prevents vehicles from crossing into the wrong lanes. The barrier can be drained and removed by two people when lanes are reversed. Short connecting roads may have to be constructed between ramps and freeway lanes to facilitate access in the opposite direction. In Charleston, the DOT constructed a short road segment between a ramp from Interstate 526 to Interstate 26 in order to provide outbound traffic access to inbound lanes.

Other geometric and operational considerations include the condition and width of shoulder lanes, bridge widths, guardrail treatments, and separating traffic flows at termination points to prevent congestion caused by merging normal and reversed lanes. Where contraflow terminates in Columbia, traffic in normal lanes will be detoured onto Interstate 77. After the Interstate 26/Interstate 77 interchange, traffic in reversed lanes will cross the median to access the normal westbound lanes of Interstate 26.

After initiation and termination points are designed, one of four contraflow strategies must be selected. The first strategy reverses all coast-bound lanes. The second contraflow strategy reverses all but one coast-bound lane for use by emergency and patrol vehicles involved in incident management. In addition to emergency and patrol vehicles, the third contraflow strategy allows passenger vehicles to use the single coast-bound lane. The fourth strategy utilizes an inbound shoulder lane for evacuating traffic and reverses all but one coast-bound lane.

Traffic control devices and law enforcement officers should be positioned at initiation points, termination points, and closed facilities to ensure roadway safety. The National Guard may be activated to assist with these duties. Construction work zones should also be removed and shoulders should be cleared of debris before contraflow operations begin.

Traffic volumes and speeds should be monitored throughout contraflow operations. This information may be useful in determining when lane reversal should be terminated or when alternate routes should be considered. Vehicle detection devices on reversed lanes and processing software must be capable of counting vehicles and calculating speeds in the opposite direction.

Best Practices for Road Weather Management

Version 2.0

Criteria and procedures for implementing and terminating contraflow must be established prior to hurricane season. Implementation criteria may include mobilization time, minimum traffic volumes, and daylight hours. Contraflow must be terminated in time to clear the route of all traffic prior to landfall, secure or remove susceptible equipment, and ensure the safety of personnel in the field. Lane reversal operations typically end two hours before hurricane landfall is expected.

Dissemination of pre-trip and en-route traveler information, as well as institutional coordination are other considerations. Emergency and traffic managers at county and state levels must communicate effectively. Multi-state coordination is also critical. During the Hurricane Floyd evacuation managers in South Carolina worked with managers in Georgia to facilitate smooth traffic flow across the state boundary.

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