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Wells, Nevada M6.0 Earthquake Impact on the Nevada Department of Transportation

by

Michael E. Murphy
Nevada Department of Transportation, District III, Elko, NV

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ABSTRACT

The Nevada Department of Transportation (NDOT) responded immediately to the 2008 Wells earthquake by visually inspecting roadways and bridges for damage in the affected area, conducting any necessary traffic control, inspecting NDOT facilities for damage, inspecting mountain-top communications equipment for damage, and coordinating response communications to a single point-of-contact. There were general response plans in place at state and district levels for this type of emergency, but they did not go to the operational level of detail for an earthquake. Bridges and roadways within 8 miles of the earthquake area were relatively new (<30 years) and experienced little or no damage. A 60-year-old NDOT maintenance shop experienced moderate damage with a toppled chimney and cracked upper parts of the walls near the building's corners. NDOT is improving its potential response to future major earthquakes by training personnel and installing operational-level response planning.



INTRODUCTION

The February 21, 2008 earthquake, referred to as the Wells earthquake, was the first major seismic event to have occurred in northeastern Nevada in many decades. Nevada Department of Transportation (NDOT), like the other state agencies and local governments, did not have any past experience dealing with the aftermath of this type of event. General response plans had been created at both the statewide and district levels to be used in this type of emergency, but the plans did not go into detailed procedures on the operational level or outline what functions needed to be done. Fortunately, NDOT District III staff did have a vast amount of experience in dealing with natural hazards like floods, large wild fires and wind/dust storm events. This experience provided NDOT key supervisory staff with the ability to operate in an incident command structure and to define the mission objectives immediately after the event. The purpose of this paper is to detail how NDOT responded to the event, including sections on notification, initial response, and the integrated incident command response. A section discussing the “after-action review” that was done by NDOT has also been included to highlight what was learned, so that transportation agencies may benefit from this process.

NOTIFICATION

NDOT District III includes most of northeast Nevada and manages all the state-controlled roadways in Elko, Eureka, Lander, Humboldt, White Pine, and portions of several other counties. The district is divided into three operational sub-districts: Elko, Ely, and Winnemucca, with each location having administrative and managerial staff to direct the local operations. A map of the NDOT Districts is shown in figure 1. District III headquarters is located in Elko, sharing the facility with the District III Traffic Management Center (TMC). The Elko TMC is a 24-hour operation and a fully staffed dispatch center is used to monitor and control operations and personnel throughout the district.

At the time of the Wells earthquake, NDOT’s Elko TMC was engaged in normal snow removal operations in northeastern Nevada. A light winter storm was progressing across the district in the Wells area and NDOT’s maintenance employees were actively patrolling or plowing snow.

At 6:16 am PST, the Elko TMC and the district administrative staff felt ground shaking during the seismic event but were not able to learn about the location of its epicenter or the magnitude immediately. At the time of the event, the Elko TMC was not a subscriber on the U.S. Geological Survey (USGS) Earthquake Notification System. The NDOT Bridge Division, located in Carson City headquarters, was a subscriber and was notified immediately.

The Bridge

Division began coordination to activate its inspection personnel to travel to Wells for bridge inspection. Within several minutes of the event, the author received preliminary earthquake information from a Reno TV station broadcasting in the Elko area. This information included the location of the epicenter at some distance southeast of Wells instead of the actual location, and a slightly higher magnitude than was later determined. Most of the NDOT personnel operating in vehicles in the field were unaware of the event occurrence.

INITIAL RESPONSE

Based on this initial information it was determined that NDOT’s first priority was a visual inspection of the roadways and bridges for damage. The area of concern was from Elko on the west to West Wendover on the east and from Jackpot on the north to Lage’s Junction on the south. These locations are shown on the map in figure 2 along with actual and initially reported epicenters. This area covered a 50- to 60-mile distance from the initially reported epicenter and was determined by district administration, since Elko, being 60 miles away, suffered no damage.

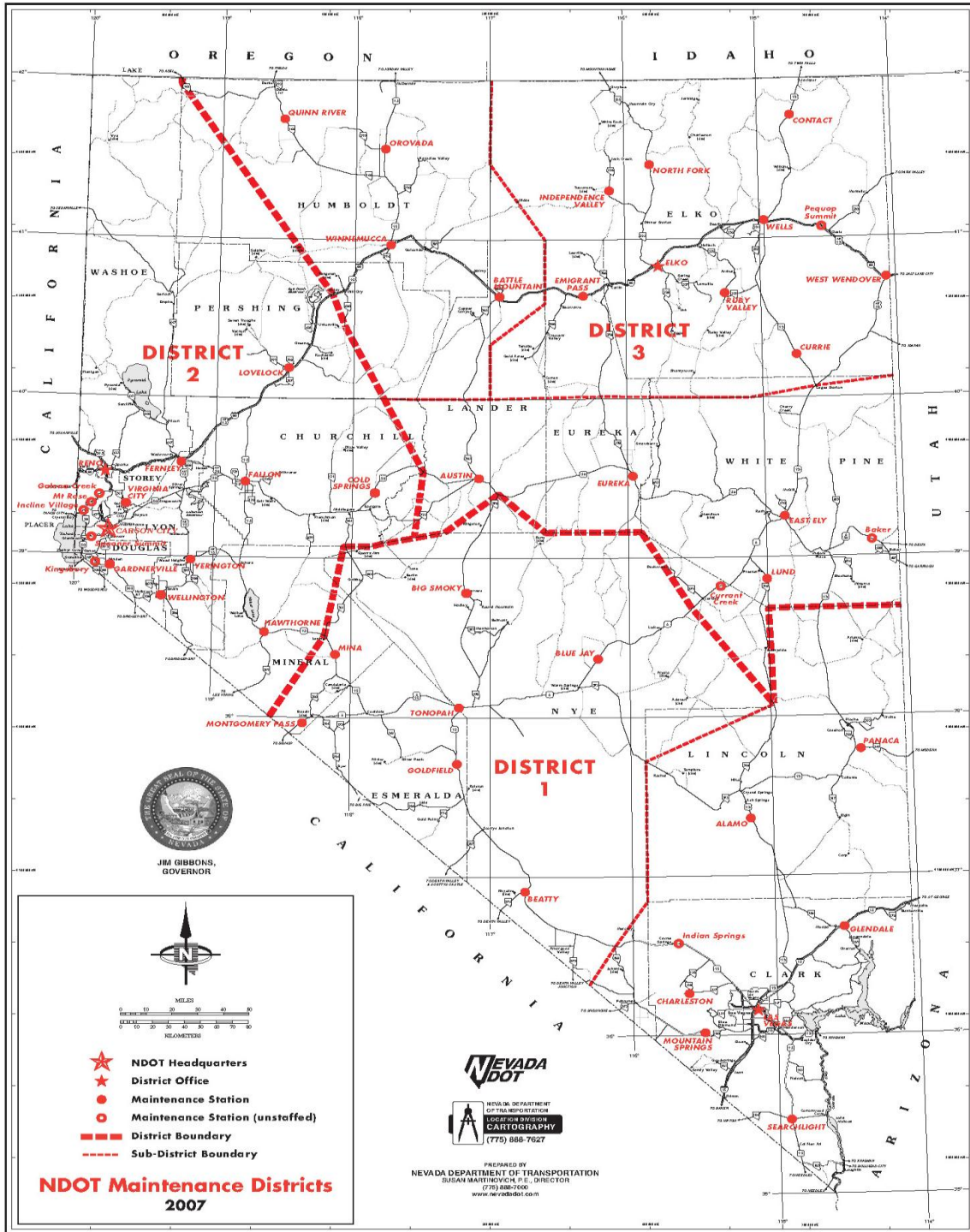


Figure 1. State map showing maintenance and sub-district boundaries.

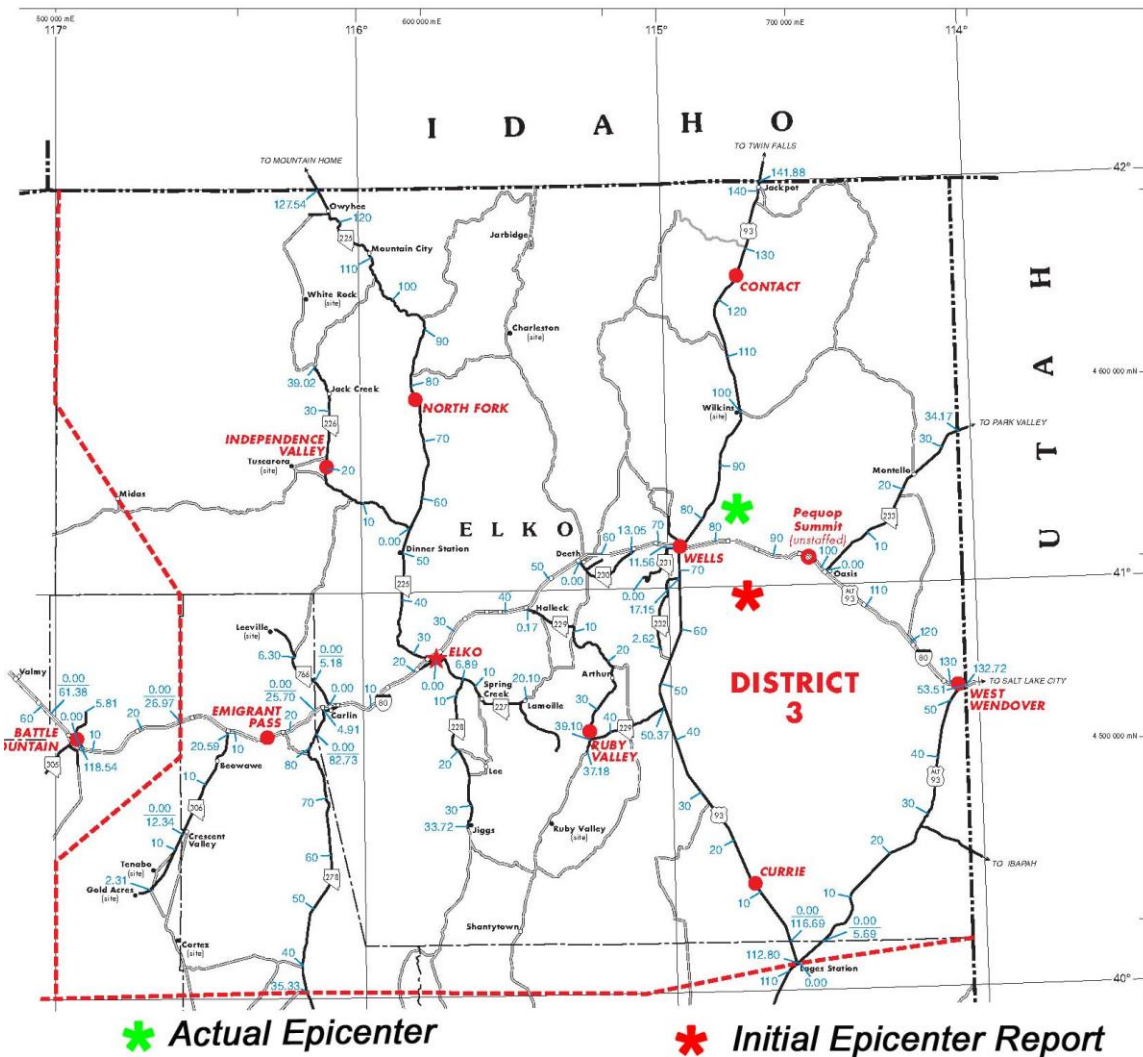


Figure 2. Map showing initial response area.

To accomplish the first mission, the Elko TMC was directed to contact all personnel operating in field plowing or patrolling to inspect roadways and bridge structures in their maintenance sections. We also had the TMC notify area maintenance crew supervisors to coordinate additional staff for assistance if needed. The initial inspection was directed toward identifying rocks/debris, cracks, and changes in the pavement surface. Bridges were to undergo a quick visual inspection for any damage, including cracks or isolated concrete failures and specific checks at joints between the approach pavement surface and bridge deck. Areas along roadways where rocks could have been dislodged required inspection and removal of rocks from the pavement if necessary. Figures 3 and 4 are pictures of an area where this occurred, but did not impact any road.

Direct contact was made with local emergency response agencies to obtain information on the types of damages being reported in the Wells area. District administration was also able to monitor the radio traffic from Nevada Division of Forestry (NDF), Elko Fire Department (EFD), and the Elko County Sheriff's Office (ECSO) to obtain additional information. It was obvious that the damage to the private structures was extensive (or significant). However, information received from NDOT crews indicated no obvious damage on the transportation system. The initial damage information was also conveyed to NDOT Bridge and to the Maintenance and Operation divisions so that single points of contact could be established between Carson City and the incident in order to reduce redundancy in communications.



Figure 3. Rock slides near Turner Hill.



Figure 4. Large rock that became dislodged near the same area.

At 7:00 am on the day of the event, the majority of the NDOT staff began arriving at their normal duty stations throughout the district for work. By then, the district administration had a good amount of general information regarding the event and basic understanding of some of the problems and began assigning staff to address these problems. A revised set of NDOT objectives was quickly developed and put into process as follows:

1. **Traffic Control:** To close or restrict access in areas where necessary for public safety, but work to reopen as soon as possible. Keep all other roadways open in order to provide access to the area, including snow removal throughout the district as necessary.
2. **Bridge Inspection:** Begin a hands-on inspection of all bridges within the 60-mile area with Construction Division staff until Bridge Division structural inspectors arrive in the area.
3. **Facility Inspection:** Inspect the Wells NDOT yard to determine damage and ensure that facilities were safe to be used.
4. **Communication:** Ensure NDOT radio system (Nevada Shared Radio System) remained functional and that staff involved in the incident had adequate communication capabilities.

Traffic Control

NDOT was aware that U.S. Hwy. 93 had to be closed from the intersection of the I-80 interchange to one mile south, approximately MP EL 73, because of a large propane leak. The area had been closed by law enforcement at the request of the Wells Fire Department and the propane supplier. The Elko TMC was working to move the road closure to the intersection of U.S. Hwy. 93 and U.S. Hwy. 93A at Lage's Junction, about 70 miles south of Wells, so that traffic could be directed toward Wendover instead of Wells.

Bridge Inspection

District contacted the available members of the three construction management crews stationed in Elko to prepare for additional bridge inspections. Multiple two- or three-person teams were created and specific routes and areas were assigned to each team to perform more detailed bridge inspections. The results were radioed to the Elko TMC as inspections were completed. The information was then logged by additional staff working at the Elko TMC. The TMC also tracked the inspections completed in the master bridge list so that no structure was inadvertently missed by the teams.

Facility Inspection

The NDOT Elko Facility Maintenance staff and Safety /Training personnel were assigned to the Wells NDOT yard to inspect the entire NDOT facilities for problems or damages. When damage was found, they were directed to isolate or restrict the facility to prevent occupancy or use and coordinate any necessary minor repairs that would allow the facilities to be used as soon as possible.

Communications

The District Communication Section was also alerted and one staff member was sent to Wells with a radio cache for emergency operations to help coordinate field communications among the various agencies. The remaining communication staff member was assigned to assist the TMC, coordinate for any possible statewide communication problems, and monitor the NDOT radio control equipment located in the Elko facility.

INTEGRATED INCIDENT COMMAND RESPONSE

At approximately 9:00 am on the day of the event, NDOT made contact with the unified incident command established to manage the event. This command was formed with two commanders sharing control, Rich Harvey, NDF Type II Incident Command Team and Dale Lotspeich, Elko County Sheriff. District III representatives worked as advisers to the incident commanders concerning NDOT's operational objectives and roadway system status. The author was assigned to the incident operation section as a functional transportation division supervisor.

Incident command integrated NDOT's objectives into the Incident Operational Plan, allowing NDOT to support the other incident objectives outside of transportation. NDOT supplied professional staff and equipment to the incident command team throughout the four days of event management. In addition to these special duties, NDOT forces continued their normal maintenance functions, including snow removal for two major snow storms that occurred on February 22 and 24 after the earthquake.

Traffic Control



Figure 5. USGS staff installing a seismic instrument after being transported to a location near Turner Hill Station by a state Sno-Cat.

Working through incident command structure, the closed section of U.S. Hwy. 93 was reopened at 9:30 am on February 21 when the propane leak was contained and the area was declared safe for traffic. Traffic control using staff from NHP, NDOT, and local law enforcement agencies was then used to prevent access into the City of Wells. Numerous closures were established along U.S. Hwy. 93 and at the I-80/West Wells exit off-ramps to prevent direct access into the city by the public. With I-80 and U.S. Hwy. 93 open, as well as the I-80/U.S. Hwy. 93 off-ramp, all NDOT-maintained roadways were functioning normally. The remaining off-ramp closures and restrictions to the various city streets were all reopened by 10:00 am February 22.

Bridge Inspections

Bridge inspections by the district level construction division staff continued throughout the morning and were completed by 1:00 pm on February 21. No significant damage was found in any of the bridges in the designated area and closures or traffic restrictions were not necessary. Some minor cracks were found on three bridge structures that appeared to be earthquake-related. The following structures had possible damage:

1. I-922E – I-80 @ Moor interchange eastbound
2. I-922W – I-80 @ Moor interchange westbound
3. G-229 – U.S. Hwy. 93 @ Union Pacific Railroad overpass

The structures located at Moor interchange had very small cracks at the top of the mid-span support columns and the railroad overpass structure on U.S. Hwy. 93 had cracks in the slope paving. This information was conveyed to incident command and NDOT Bridge Division. When structural inspectors arrived at 2:30 pm that same day, information from the previous inspections enabled concentrated and detailed inspections on the proper bridges. All bridges in the Wells area were reinspected by the structural inspectors and no additional damage was found. The bridge division inspections were completed by mid-day February 23 and the entire group returned to Carson City the same day.

Facility Inspections

The review and inspection of the NDOT Wells yard facilities showed relatively minor damage, with the exception of the Wells yard equipment repair shop. The obvious rearranging of interior furnishings was noticed, including tipped-over book shelves and unsecured items fallen on the floor. These facilities were cleaned up and returned to normal function within hours of the event.

All utilities were in full operation. Fuel/hot asphalt-dispensing facilities were not damaged. The list of facilities that were determined to be safe by midday included two truck storage buildings, one office building, and two modular commercial offices trailers.

The equipment repair shop was found to have moderate structural damage that prevented use until after inspection and environmental testing indicated safe conditions as discussed below.



Figure 6. Failed chimney on the Wells Shop.



Figure 7. Cracks inside the Wells Shop.

Damage to the equipment repair shop included the following:

1. Several concrete or reinforced masonry headers located over openings in the masonry walls were found to be cracked at various locations where the header ties into the walls (see figure 7).
2. Cracking occurred in several locations in the various corners of the building.
3. The abandoned brick masonry chimney failed at the point where it projected through the exterior roof system. The chimney broke in several large pieces and damaged a portion of the roof system. A couple of pieces went

completely through the roof and the ceiling, landing on the interior floor of the facility (see figure 6).

4. One of the interior unit heaters had been racked out of place during the event and the vent pipe had been disconnected.
5. Several pieces of the ridged cornice and fascia pieces located at the edge of the roof near the connection to the masonry walls had been damaged or broken loose. The damage occurred at various locations on the exterior of the shop building.
6. The interior spaces also had possible asbestos contamination due to damage to the roof system. The building's roof system was composed of large tile panels with encapsulated asbestos as a major component. It was feared the encapsulated asbestos fibers were released to the building's interior atmosphere when the pieces broke through the roof and the ceiling.

The Wells shop returned to normal use within three to four weeks following the earthquake. Temporary repairs were made to the roof and ceiling. The cracks in the headers were determined not to be structurally significant and no asbestos contamination was found in the interior space.

Communications

Generally, the NDOT (NSRS) system operated with no major problems during the entire incident and subsequent response period. As most of the radio and microwave equipment is located at various remote mountain-top locations, it was not easily inspected. Helicopters and Sno-Cats like the one shown in figure 9 were used to gain access to various sites during the 7 days following the event as weather permitted. All communication sites were inspected for problems or damage.



Figure 9. NDOT Sno-Cat at one of mountain-top communication sites.

Only three significant problems were found during the inspections that were believed to be caused by the earthquake:

1. Several small exterior propane leaks were found at the Spruce Mountain communication site.
2. A bolted connection on the steel support structure for the solar panels on the Spruce Mountain site was no longer in normal alignment.
3. The anchor bolts holding a large battery rack at the Turner Hill Station had broken loose and the rack displaced itself on the interior of the building.

Fortunately, none of these problems were serious enough to cause additional damage as they were found and repaired before causing disruption of service.

AFTER-ACTION REVIEW

When the incident response was complete, an after-action review (AAR) was initiated with the other state and local agencies assisting in the event. To prepare the review, NDOT asked staff to evaluate NDOT's performance. Written summary evaluations were prepared and presented during the multiagency review. The evaluation and review process documented approximately 10 items or problems needing improvement. Suggested solutions were also developed and presented with the written report created from the review. A summarized copy of the 11 items that were identified to needing improvement has been listed in appendix 1 at the end of this paper.

In the time period since the after-action review, most of the items of concern have been addressed or solutions are in process.

CONCLUSION

Although the earthquake was of a relatively large magnitude, most of damage seemed to be localized at a distance of 6 to 8 miles from the epicenter in the City of Wells. The transportation system managed by NDOT, including bridges and roadway items within this 8 mile radius from the epicenter, experienced essentially little or no damage. The NDOT buildings and support facilities located within the same radius did suffer some damage, but everything except equipment repair shop was cleaned up and returned to normal function within hours of the event.

The NDOT roadway infrastructure and bridges within the 8-mile area from the epicenter are relatively new, less than 30 years old, and they withstood the seismic forces exerted by this event. The NDOT buildings and facilities in the same 8 mile area included some structures more than thirty years old. The oldest building in the Wells maintenance yard, the sixty year old equipment repair shop, did suffer moderate damage. The damage experienced in the NDOT's facilities, structures and roadways seemed to correlate to the damage found in the City of Wells. The older masonry structures that were built with no or very limited reinforcement suffered the most damage. Fortunately, NDOT has an active program to re-evaluate its structures and facilities for seismic events and is continuously funding retrofit improvements on existing critical structures to improve their seismic capabilities. The Wells yard equipment repair shop is scheduled to be replaced 2010 with a more suitable facility.

In review, the establishment of the original four objectives in the first hour after the event was very important to NDOT's ability to perform successfully. The objectives for Traffic Control, Bridge Inspection, Facility Inspection and Communications were evaluated in the after-action review. The review team felt that they were very proactive and established a good standard for future events. In general, the review showed the NDOT staff did meet the objectives, but not without problems. The review also revealed additional objectives were necessary with the primary being establishing a local public information officer to deal with media and requests for information from the public. This would be a great benefit to Traffic Management Center staff, as they were forced to deal with these requests along with all their other responsibilities.

Since the damage of this event was localized to a relatively small area, District III was able to support the event primarily with its own staff and equipment. If the event had been a higher magnitude or located in or near a larger urban area, this would not have been the case. NDOT is also improving its abilities to respond by incorporating training exercises requiring a statewide response. These exercises will help illustrate where additional improvements are needed and to provide the NDOT staff with valuable experience in preparation for the next real event.



Figure 10. One of the severely damaged structures on Front Street in downtown Wells.

APPENDIX 1 — NDOT'S AFTER-ACTION REVIEW

Areas of Improvement

Contracted Personnel:

Improvement Area: The group of private structural engineers that was eventually sent to perform building inspections did not meet the expectation of the district response personnel.

Suggested Solution: Prior to another emergency/disaster, the architecture section should clarify the expectation of contracted personnel during an emergency.

Suggested Solution: A list of potential engineering firms with respective agreements should be developed. The agreements should include performance measures and minimum time commitments.

Response Coordination:

Improvement Area: Notification procedures for headquarters personnel should be clarified and improved.

Suggested Solution: The Maintenance and Operations Division will clarify notification procedures for headquarters personnel. These clarifications will be included in the next update of the NDOT State Level Emergency Operations Plan scheduled for July 2008 following the "Operation Northern Watch" tabletop exercise in May and the "Vigilant Guard '08" full scale exercise in June. The update will include procedures to be followed by the district engineers when notifying the chief maintenance and operations engineer when a significant event takes place. Also addressed will be the designation of responsibility for notifications to the director regarding significant events that do not lead to the activation of the NDOT SEOP.

Improvement Area: Maintenance and Operations Division and the district operations centers should have an earthquake notification system.

Suggested Solution: The Maintenance and Operations Division and district operations centers should sign up for the USGS Earthquake Notification System as several key personnel have done in the Bridge Division.

Improvement Area: NDOT headquarters bridge inspectors should have reported to the Incident Command Post (ICP) upon arrival. The inspectors were not aware of the command setup, did not have 800-MHz radios, and were not aware of the 24-hour Elko Road Operations Center. As a result, the inspectors were difficult to locate while in the Wells area. Knowledge of the command setup and possession of 800-MHz radios would have expedited communications with Mike Murphy.

Suggested Solution: The Maintenance and Operations Division should provide training for NDOT personnel in the ICS which is the current standard for all response activities.

Sustainable Operations:

Improvement Area: The NDOT maintenance yard in Wells never lost power so obtaining fuel was not a problem. However, the generator assigned to cover the Wells fuel pumps is actually a welder/generator combination unit that is assigned to Wells maintenance crews and provided to maintenance projects as necessary. Significant problems could have arisen if power had been out at the Wells Maintenance Station and the generator had not been available.

Suggested Solution: A dedicated backup generator should be provided for every maintenance station providing fuel. The Maintenance and Operations Division should research federal grant funding to provide these generators.

Inspection Capabilities:

Improvement Area: NDOT engineers are not currently trained for post-earthquake building inspections although NDOT is the state's primary resource for inspection of damaged buildings and transportation structures.

Suggested Solution: NDOT engineers should take the ATC (Applied Technology Council) -20 class for post-earthquake building inspection. This class is occasionally provided by the Nevada Earthquake Safety Council and the Division of Emergency Management.

Communications:

Improvement Area: Cell phone communications are difficult during an emergency due to the volume of calls being placed.

Suggested Solution: The Maintenance and Operations Division should research enrollment in the Government Emergency Telecommunications Service (GETS) for priority calling during an emergency.

Improvement Area: NDOT's present emergency communications satellite phones have extreme difficulty picking up a signal due to the degradation of the satellites from the service provider.

Suggested Solution: A new satellite phone provider is currently being researched.

Improvement Area: An interagency agreement should be provided for patching communications.

Suggested Solution: The Information Services Division should work with emergency responders to ensure interoperable communications in an emergency. This should include Nevada Department of Public Safety, Nevada Division of Emergency Management, Sierra Pacific Power, Nevada Power, Nevada Division of Forestry, and all local law enforcement and fire agencies.

Improvement Area: Mountaintop communications stations are susceptible to damage from disasters. Nevada Shared Radio System (NHP, NDOT, Sierra Pacific Power, Nevada Power, Washoe County, and others) relies on these stations for radio communications. The sites should be laid out and built to be hardened against damage from disasters.

Suggested Solution: The Information Services Division should work with the Department of Information Technology to incorporate disaster resistance into the design and construction of mountain-top communications stations. Standards should be developed to ensure all equipment meets the requirements and funding should be sought for noncompliant sites and/or equipment.

Improvement Area: Radios are the primary method of communication during a disaster or emergency and are therefore in short supply.

Suggested Solution: A cache of radios should be created and maintained within the various NDOT districts/divisions to facilitate response to incidents within the state. Each district should also have unassigned radios available for NDOT personnel who are sent to assist in disaster areas.