

Able to reconnect

Warm mix plays big role in Colo. flood recovery

By Tom Kuennen
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When torrential rains unprecedented in memory wiped out miles of roads and bridges in Colorado's populated Front Range last September, state, city and county road agencies joined with road contractors and civil engineers in an extraordinary public-private-sector effort to reopen the roadways before winter.

The public-private-sector response to the flash floods—which took place during monsoon rains Monday through Sunday Sept. 9-15—was so productive that the last major highway was reopened the day before Thanksgiving 2013, when Colorado Gov. John Hickenlooper and the Colorado Department of Transportation (CDOT) cut the ribbon on S.H. 7 between Raymond and Lyons. It was the last of 27 highways damaged or destroyed by the September floods.

"The united effort of the Colorado DOT and its road-repair partners has been remarkable," Hickenlooper said. "After the flooding, we faced the daunting task of restoring 485 miles of damaged or destroyed highways. CDOT, its contractors and local partners should all be proud of this tremendous accomplishment that repaired roads and reconnected communities."

The effort to provide temporary road repairs to reopen access to homes and towns before winter was daunting. For example, just to complete the temporary repairs along S.H. 7, 60 pieces of equipment were utilized to help crews move approximately 171,000 cu yd of reclaimed on-site materials, which

would fill 17,000 single-dump trucks. S.H. 7 also required replacement or repair of 27 culverts totaling nearly 1,300 linear ft, and approximately 27,000 tons of aggregate road base and 14,600 tons of asphalt.

Front is center

In Colorado's Front Range, the route to higher elevations always takes the path of a creek, which tumbles down a mountain valley or canyon. Roads are skillfully positioned on one side of the ravine or the other, with occasional crossings to take advantage of the terrain.

But when swamped by up to 17 in. of rain in just a few days, these creeks became turbulent torrents, which wiped out bridges, culverts and undermined road bases, causing the collapse of pavements into the creeks. Homes and entire communities were cut off from downslope amenities, and some had to be serviced by National Guard helicopters.

Prairie communities just east of the Rockies such as Loveland and Greeley also were flooded as the water surged out of the mountains. Because urban asphalt and aggregate plants often are located in alluvial river bottoms close to sand and gravel deposits, some were compromised just when they were needed the most for emergency road rebuilding.

Four major state corridors in the Front Range were most heavily damaged:

- U.S. 34 (Big Thompson Canyon) connecting Estes Park with Loveland;
- U.S. 36 between Estes Park and Lyons (northern route);
- S.R. 7 between Estes Park and Lyons (southern route); and
- S.R. 72 in Coal Creek Canyon.

The effort to provide temporary road repairs to reopen access to homes and towns before winter was daunting. The last major highway was reopened in November. Photo courtesy of MWV Evotherm.





To maintain asphalt workability, forces of Coulson Excavating pave U.S. 34 between Loveland and Estes Park with warm-mix asphalt due to long hauls of up to three hours, low ambient temperatures at the end of the season and high elevations. Photo courtesy of MWV Evotherm.

"On U.S. 34 the water surged down a very narrow canyon, and when the river came out of the canyon it wiped out everything in its path, including vegetation, pavement and culverts," said Thomas Peterson, P.E., executive director of the Colorado Asphalt Pavement Association (CAPA).

"The devastation wasn't only in the mountains and along the Front Range," he said, "but extends all the way to the eastern state line, where the Platte River crosses into Nebraska. There are corridors all the way across the eastern Colorado prairie where millions worth of damage has happened. Entire crops were flooded and wiped out."

In addition, numerous county roads were heavily damaged, which fell on county officials to remedy.

"We had severe flooding throughout the watershed canyons to the west," said Mike Thomas, P.E., county engineer, Boulder County.

"Nobody was prepared for this type of rain for every single canyon in the county," he said. "Over a period of four to five days

we had 17 in. of rain, heavier to the north to Larimer County, which also suffered extensive damage to its roads. And it all flowed to Weld County to the east, which also experienced flooding. The bases were saturated; the rivers rose and began undercutting the bases and washing around the bridges. We lost up to 100 centerline miles of county roads, we lost four bridges entirely, and in three other places we lost the road on either side of a bridge."

Assisting the state DOT were consulting engineers, which were drafted into the effort.

"We were selected to do inspections on different highways," said Dennis Murphy, construction inspector, RockSol Consulting Group Inc., Westminster, Colo. "We supplied inspectors to oversee construction on S.H. 7, one group with Skanska at one end, and another with Wadsworth at the other, with both contractors working toward the middle."

Rush of response

"Our first response was utter shock at the damage," said Tom Clayton, S.E.T., director

of training and member services, CAPA.

"The agencies had to barricade roads to keep people from driving in even as the rivers were rising. As the damage was occurring motorists had no idea what they were driving into. Some were driving into what they thought was standing water, when underneath the surface there was no roadway. Initially the agencies kept drivers out while they went in to assess the damage."

The Colorado National Guard was first on the scene, rescuing people and providing helicopter service for evacuation. The guard also blazed trails, reconstructed roadways and put in temporary bridges where necessary.

The state DOT moved quickly to survey the needs and created a temporary command group to coordinate the response.

"The Wednesday after the flood, CDOT had an all-hands meeting with contractors and divided the work into corridors," Clayton said. "That Friday proposals were due and contractors were selected on the basis of past experience, and whether they had the available resources to start as soon as possible, given the potential demands from the towns, the cities, the counties and Union Pacific Railroad. CDOT partnered very quickly with industry to get it done."

Major contractors involved included Kiewit Infrastructure, Skanska-Wadsworth Group and



Just to complete the temporary repairs along S.H. 7, 60 pieces of equipment were utilized to help crews move approximately 171,000 cu yd of reclaimed on-site materials.



In late October, prepared base for U.S. 34 emergency repair registered at 22° F. Photo courtesy of MWV Evotherm.



Corrugated metal culvert is installed to restore drainage as part of emergency reconstruction of highways in Colorado's Front Range. Photo courtesy of RockSol Consulting Group Inc.

Lawrence Construction, with paving subcontractors like Coulson Excavating (Loveland), APC Construction (Golden) and Aggregate Industries (Denver).

"There is a lot of praise to be given [to] these guys," Clayton said. "They dedicated a lot of time and effort and manpower, and pulled people off other projects—in some cases delaying them past their contract date—feeling that the need to get roads rebuilt so people could get on with their lives was more important than the risk of suffering liquidated damages. We at CAPA are very proud to have them as members."

Local residents responded in-kind. One woman brought cookies to the workers. A man retrieved a damaged rest-area sign, set it up on his lawn and provided bottles of water and lawn chairs where workers could take a break. Another put up a banner that read, "Thank You Hard Hat Angels."

"It showed the appreciation of those who lived along the corridors," Peterson said.

Asphalt fast

And once road foundations were rebuilt mostly using local materials found in situ, hot-mix asphalt was the paving medium of choice for a quick turnaround.

"Obviously, asphalt is the fastest response method," Clayton said. "It lets you get in

there and get the roads built, as people were cut off in their homes. People live up and down the canyons, and after the roads were cut off, they were either stranded in their house if they were lucky to be high enough, or they couldn't get back to their houses after they evacuated. The governments wanted to provide access as soon as possible, and trying to do that with any other pavement but asphalt would not have worked."

An initial question raised was whether enough asphalt would be available under the circumstances, but CAPA's Peterson said the real challenge was getting enough aggregates. "We quickly realized that we had to worry about getting enough rock, base material and structural fill to put in place before being capped with 3 to 4 in. of asphalt. It was the skill of the contractors in each of the corridors, which had the equipment, the ability, the know-how and the manpower to get it done."

In the corridors, crushers were hauled up to process the rock, cobbles and boulders that had tumbled down the creek.

"They had all this material that they had to get rid of," Clayton said. "On the S.H. 7 job, they crushed the materials to create their own product. Hundreds and hundreds of yards of flowable fill went in. A deep layer of rock would be placed, then the flowable fill—a very lean concrete mix—was pumped in to

fill voids." This process was repeated in layers until the base was built up to grade.

While the initial goal of the state was installation of "pioneer roads" or gravel trails up to their destinations by Dec. 1, the actual product as-built was much more serviceable.

"I would like to think that the DOT would be pleasantly surprised at the quality of the work that was done," Peterson said. "The actual construction is very impressive, more like a normal highway, because of the superior quality of work done by deadline by each of the contractors."

"The work was amazing," said Ken Coulson, president, Coulson Excavating Co. Inc., Loveland. "On U.S. 34 we finished the pavement over a week earlier than they hoped. They were just hoping we would get a gravel road up that might all not get paved by winter. But we had the whole thing paved, striped and opened early, and the state really won't have to do a lot more work to make it a permanent road."

Steady in unsteady temps

In some instances, long haul distances during which mixes would cool, low ambient temperatures due to high elevations, and work late in the paving season dictated use of warm-mix asphalt (WMA) to ensure workability. For example, WMA was used extensively

on reconstruction of U.S. 34 through Big Thompson Canyon.

"Warm mix has proved to be an aid in marginal-weather paving," Peterson said. "And up in those canyons, with the winds and high elevation in November, the marginal weather there is ideally suited for warm mix. It gives the contractor mixes that will stay workable while meeting the spec requirements. Evotherm warm-mix technology provided the quality and ability to place the material successfully in marginally cold weather."

"The WMA component in this was very important," Clayton said. "CAPA was involved early on, and one thing we offered was technology. We could help the agencies and contractors through technology issues. Because of the time of year, and the expected cold weather, with the work getting down in the 20s and 30s at night, and highs in some canyons only in the 50s with very little sunlight, we were able to respond to questions of whether warm mix would be appropriate for this situation.

"We told them WMA would be perfect, as the contractors needed to get in, place the

material and compact it very quickly," Clayton said. "Going up in those canyons with very little sunlight, and three-hour hauls, there is no way they could heat the asphalt high enough to retain workability without burning the light ends of the binder off, making the material virtually useless."

In this case, the asphalt would have to leave the plant at 350°F to 360°F, which would contribute to binder premature aging.

"The light ends are what keep the asphalt binder flexible," Clayton said. "In general the state specification allows the use of WMA on any project. Some products are limited by tonnage. Use of Evotherm [which was used on U.S. 34, U.S. 36 and S.H. 7] is unrestricted and can be used on any project at any time, provided the project engineer will allow it. And cities and counties are even more receptive; we feel they are leading the way with WMA in Colorado."

When it was nothing

U.S. 34 from Loveland to Estes Park through Big Thompson Canyon was an example of effective reconstruction. Early on, Coulson Excavating was the prime contractor

for the first 3 miles at the east, and then Kiewit for the remaining 18 miles of U.S. 34, for which Coulson served as paving subcontractor to Kiewit.

"Following aerial pictures, CDOT estimated that 70% to 80% of the road had been damaged," Coulson said. "There were no trails, no nothing. Quite a few of the residents had to be helicoptered out."

The flood had completely wiped out U.S. 34 in some places.

"The roadbed had been scoured down to bedrock," Coulson said. "We had to put in a bridge and rebuild 2,500 ft that was totally gone that ran by the Loveland's water line and were done by Sunday night. By that time Kiewit called and asked if we could start with them Monday morning."

First up was a fleet of dozers and backhoes that was hauled up to damaged areas, where it would go to work with haul trucks.

"For fill, we used material that had washed down the canyon," Coulson said. "We went into the river with dozers to pile up the material and use backhoes to load it on haul trucks. We also hauled a lot of fill



material out of a quarry 4 or 5 miles away.”

On U.S. 34, CDOT estimated more than 200,000 cu yd of material would be required to rebuild the roadway.

“We did up to 20,000 cu yd of material while Kiewit did the rest up above,” Coulson said. “Our part was called The Narrows, with a concrete-retaining wall, which had to be rebuilt.”

The 1- to 4-ft-sized fill rock initially was compacted using dozers, followed by smooth drum soil compactors on top, Coulson said. “We then put a 4-in. lift of CDOT Grading S asphalt which was anticipated to be temporary, but will last quite a while.”

The 22,000 tons of bituminous pavement placed by Coulson Excavating contained ¾-in.-minus aggregation in a 75-gyraton Superpave mix.

“Out of that total 22,000 tons, some 19,000 contained the Evotherm warm-mix additive,” Coulson said. “The 4-in.-deep pavement was placed in one lift. It turned out so good that they may never mill it out.”

The mix was produced by one of Coulson’s plants, with liquid binder already

containing Evotherm from Suncor Energy in Commerce City.

But the flooding complicated the suppliers’ work as well as the contractors’.

“We had supply disruptions ourselves,” said Norb Schreiber, manager, asphalt sales, Suncor Energy Inc., Denver. “The main crude-oil pipeline coming into our refinery was washed out, and we were very low on inventory right after the floods, and had to truck asphalt in from our outlying facilities within Colorado to make sure paving was not disrupted. The work was not disrupted, but we had to move a lot of asphalt around to accommodate the pipeline shutdown.”

Coulson Excavating did not use WMA the first few days, but then temperatures took a dive.

“The temperatures got really marginal,” Coulson said, “19°F to 25°F in the morning. The best it got was 65°F in the midafternoon. We also had a lot of wind; it was cold, and nearly everything was in shadows. In addition, we had a very long haul for 10,000 tons of the work, 58 miles to come up the other way, taking a load about three hours. I thought it would be a good idea to try

Evotherm WMA and see how it worked. It kept the mix pliable, and we had no problems whatsoever getting density.”

“We provided Coulson with the PG 64-22 performance-graded binder, with Evotherm already incorporated,” Schreiber said. “We think it’s an excellent way to improve the quality of the asphalt mix, enabling it to be compacted more efficiently under conditions that are not always ideal.”

Despite Evotherm WMA making the work easier, getting the highway open took great personal sacrifice on the part of Coulson’s employees.

“Qualified help and equipment was hard to come by at the time we needed it,” Coulson said. “We had some people who had one day off in two months. Everyone was tired by the time we finished. But the road is open now, the push is over, and we’ve got a pretty darn good-looking road going through there.” **R&B**

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