Western Highlights of the Interstate System

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Congress created the Interstate System fifty-five years ago. Missouri claimed the title of *first* in terms of both signing a contract to build an Interstate highway and starting construction on another Interstate route. Kansas proclaimed itself the first state to complete an Interstate construction project (all 8 miles of it). Pennsylvania and New York argued over which of them had built the first road to be absorbed into the Interstate System; the Pennsylvania Turnpike had been finished in 1940, and a section of New York’s Grand Central Parkway had been built in 1936 but had to be upgraded to Interstate highway standards. Nebraska, Arkansas, Rhode Island, and North Dakota all claimed to be the first to complete their statewide Interstate highways.

The Western states may not have been in the running for those titles, but they certainly made significant contributions to making the Interstate System into what the American Society of Civil Engineers called one of the “Seven Wonders of the United States.” The five longest Interstates (I-90, I-80, I-40, I-10, and I-70) all start in the West. This paper identifies some highlights achieved by each of ITE’s Western District states. Some are amusing; some are amazing; and some are, well, the only things we could find.

Alaska

Contrary to popular myth, Alaska *does* have officially designated Interstate highways—four of them, in fact, with a total length of 1,082 miles. The Federal-Aid Highway Act of 1981 directed that Alaskan routes be added to the Eisenhower System of Interstate and Defense Highways. However, those roads are not required to meet all of the Interstate System design standards. Except for sections near Anchorage, most of the four highways have only two lanes and no access control. Their numbering system is also nonstandard. Normally, Interstate routes running north-south have odd numbers, increasing from west to east across the country (I-5 runs up West Coast states, and I-95 runs up the East Coast). East-west Interstate routes have even number designations, increasing from south to north (I-10 runs through southern states, and I-90 runs through northern states). Alaska’s routes, however, are designated A1, A2, A3, and A4; the sequence reflects the order in which they were funded, not what their directions are.

A1 extends northwest from the Canadian border to Tok, where it connects to A2, which continues northwest to Delta Junction and on to Fairbanks. The combined length incorporates sections of two historic roads. The southeastern leg, from the state line to Delta Junction, follows the Alaska Highway (also known as the ALCAN Highway). The US Army built that 1,500-mile section of road in less than eight months, between March and October 1942. Japanese invasions of two Aleutian Islands added to the urgency of constructing the road, which linked important military installations in Alaska. The road served its purpose, but it was not paved and open to public traffic until 1947.

The other portion of A2, from Delta Junction northwest to Fairbanks, follows the Richardson Highway route. Originally a pack trail during Gold Rush days in the 1890s, US Army General Wilds Richardson upgraded the route to accommodate wagons in 1910, after the discovery of gold in Fairbanks increased traffic. In the 1920s, the highway was improved enough to allow automobile traffic, but it was not paved until 1957.

Arizona

While Alaska's Interstate route A2 begins at the Canadian border, Arizona's Interstate 19 begins at the Mexican border. The 63-mile freeway (the nation's fourth shortest two-digit Interstate) links Tucson with Nogales, Mexico. It was completed in 1979, four years after the US Congress passed legislation encouraging the conversion from English measurement to the metric system. In that spirit, the Federal Highway Administration used I-19 as a test site for installing metric signs. The test had a split personality, with destination distance, exit numbers, and "mileposts" given in kilometers but speed limits posted in English units. In 2004, the Arizona Department of Transportation decided to replace the metric signs with English equivalents because the original signs were not reflective enough for clear visibility at night. Federal stimulus money, which became available in 2009, would be used to pay for the changeover. But an unexpected outcry from the business community stalled the project. The conversion would have changed the exit numbers (to miles, rather than kilometers, north of Nogales), and businesses had been advertising and identifying their locations by the metric exit numbers for three decades. Arizonans are still waiting for a final decision.

Another Interstate route in Arizona also has an interesting story. I-15 crosses the northwest tip of the state in a distance of just under 30 miles. It is separated from the rest of the state by the Grand Canyon. To take advantage of spectacular scenery, the route parallels the Virgin River and winds through the Virgin River Gorge, which at one point was only 150 feet wide. Expenses for the Vietnam War led the federal government to cut highway funding in December 1966, and Arizona stopped working on I-15. Although the route brought no real benefit to Arizona, Utah was anxious to get it built because it would link Salt Lake City to Los Angeles. In 1969, Utah loaned Arizona some its federal highway money so the road could be finished. I-15 opened in December 1973, after the most difficult segment through the 500-foot-deep Virgin River Gorge was finished. That 3.8-mile section cost $13.8 million—an Interstate cost per mile figure that set a record at that time.

California

Looking for a way to shorten the route of I-40 across the Mojave Desert, California Division of Highways engineers thought they might help the US Atomic Energy Commission in its quest to find peaceful uses for nuclear weapons. From 1963 until 1965, they worked on plans to vaporize a section of the Bristol Mountains between Barstow and Needles. They figured burying twenty-two bombs totaling 1.73 megatons in the mountains and setting them off simultaneously would do the trick. The explosion would instantly move 68 million cubic yards of earth, creating a 325-foot-wide, 11,000-foot-long channel for the freeway and a Santa Fe Railroad line. They calculated the cost savings over conventional excavation to be $8 million. They even figured out where to build a viewing platform for dignitaries and reporters at an elevated site 10 miles away.

The big stumbling block was predicting the effects of fallout on Kingman, Flagstaff, and Phoenix, and figuring out how long it would take for radiation levels at the blast site to decrease to safe levels for highway construction crews. They finally gave up on the idea and used conventional blasting techniques to cut through the mountains. The road opened in 1973.

Interstate 80 through the Sierra Nevada Mountains also has a historical context. In the winter of 1846–1847, a wagon train was stranded by snow near Truckee Lake. Nearly half of the eighty-five or so pioneers died from the freezing weather and lack of food; some reportedly survived by cannibalizing their deceased companions. In their memory, the mountain pass they were trying to cross is now called Donner Pass. The route for I-80 runs over Donner Summit, 2 miles north of Donner Pass and 150 feet higher at an elevation of 7,239 feet. Winters there can be brutal. During the winter of 1951–1952, snow accumulated at the Summit to a depth of 68 feet. Construction of the 10-mile section of I-80 over the Summit was completed in 1964, and ASCE named it one of the two best engineering feats of that year (the other was NASA’s Cape Kennedy).

In addition to some challenging grades and mountain crossings, California also has the lowest elevation on the US Interstate System: 52 feet below sea level on I-8 near El Centro.

Colorado

The snowy Donner Summit is an impressive obstacle, but I-70 in Colorado rises to the highest elevation on the entire Interstate System (more than 11,000 feet). And it does it in a pair of tunnels that are the longest and highest on the Interstate System. Construction began on the first to be bored, later named the Eisenhower Memorial Bore, in 1968. The mountain rose as much as 1,470 feet above the planned tunnel, so the first phase of construction was to drill and blast a 10-foot-diameter pilot tunnel that would reveal the geologic structure of the mountain. During that process, engineers measured a water flow of 300 gallons per minute pouring out of the pilot tunnel during spring runoff. In response, they designed a drainage system for the vehicle tunnel. The pilot bore revealed that only one-fourth of the rock would be self supporting. After finishing the pilot bore, workers began carving out the 45-foot-diameter vehicle tunnel with a tunnel boring machine (TBM). Geologic conditions turned out to be somewhat different than in the pilot bore, and the mountain squeezed down around the TBM, bringing it to a halt. Tunneling experts then began the laborious process of drilling a series of thirteen “stacked drifts” around the TBM’s path and filling them with concrete to form a supporting shell for the machine.

The Eisenhower Tunnel was opened to traffic in 1973, carrying one lane of traffic in each direction. Then construction began on its companion bore, named the Edwin C. Johnson Tunnel in honor of a former governor and US Senator from Colorado who had promoted the highway’s construction. When it was finished in 1979, it began carrying all of I-70's eastbound traffic. Each of the tunnels is over 8,900 feet long, making them the longest on the Interstate System.

Another section of I-70 in Colorado, west of the twin tunnels, also provided substantial challenges. Building the Interstate highway through the steep-walled, 12-mile-long Glenwood Canyon took forty bridges and viaducts, three tunnels, and 15 miles of retaining wall. The large number of sharp curves required an FHWA waiver to set a 50-mph speed limit through the canyon. Environmental preservation of the canyon's spectacular scenery called for innovative design. The eastbound and westbound road decks are offset vertically to minimize the footprint. They were built using a "balanced cantilever" construction method that allows bridges to be built from above. By the time it was finished in 1992, I-70 through Glenwood Canyon had cost $40.8 million per mile, far out-pacing the previous Interstate record holder, I-15 through Arizona's Virgin River Gorge.

Hawaii

Environmental concerns also dictated the design of Interstate route H-3 on the island of Oahu. The route, along with Hawaii's other two primary Interstate highways, were included in federal legislation in 1960, the year after it became a state. Following enactment of the National Environmental Policy Act in 1970, Hawaii spent twenty years conducting a series of environmental studies, producing a stack of reports more than 3 feet thick. Finally, a 15-mile-long alignment through the Haiku Valley, twin tunnels through the Koolau Mountains, and through the North Halawa Valley was chosen. In the remote northern portion of the route, surveyors were airlifted to their posts every day, and part of their day's work was to prepare a landing pad for their retrieval.

The two tunnels through the Koolau Mountains are nearly a mile long. They were excavated by drilling and blasting. A waterproof membrane sandwiched between the initial shotcrete lining and the final 14-inch-thick concrete shell keeps groundwater from seeping into the tunnel.

H-3's most spectacular features are the viaducts that carry the highway above the scenic valleys. The parallel sections southwest of the tunnels are more than a mile long, making them the longest segmental bridges in the United States. Constructed from above, they rest on columns ranging from 27 feet to 105 feet above the ground as they wind sinuously along the valley wall. Column spacing reflected the need to avoid disturbing lands considered sacred to traditional Hawaiians.

Construction of H-3 began in the late 1980s but halted several times because of environmental protests and legal challenges. When it opened to traffic in 1997, it had set a new record for Interstate construction cost—about $80 million per mile.

Idaho

The natural environment is important to the citizens of Wallace, Idaho, nestled as they are in a narrow valley. But it was their built environment that spearheaded their opposition to the construction of I-90 through their town. The silver mining community had rested there peacefully since 1884, and they weren't about to have a swath of freeway wipe out a large portion of their physical history. As recently as 1991, Wallace proudly operated the only traffic signal on the I-90 route between Boston and Seattle. Their long, protective battle began in earnest in 1971, when local businessman Harry Magnuson obtained an injunction against FHWA and the Idaho Transportation Department, stopping freeway construction. During the next eight years, he succeeded in getting the entire downtown business district listed on the National Register of Historic Places, protecting it from destruction.

ITD regrouped, redesigned, and ultimately built a curving viaduct that passes over parts of town—an expensive but effective solution to complete I-90 from coast to coast. Two days after the viaduct opened to traffic in 1991, the jubilant citizens of Wallace ceremonially buried the town's only traffic signal and put it on display in the local museum.

Montana

Montana (Spanish for "Mountain") has 1,192 miles of Interstate, including 1,130 on rural highways, on I-15, I-90, and I-94. With only 62 miles of urban Interstate, Montana has the distinction of having the highest proportion (94.8%) of its Interstate in rural areas; this even exceeds Alaska with 93.6% classified as rural. Montana also has the distinction of having the shortest spur route in the Western states: I-315 in Great Falls (0.83 miles).

Montana completed its Interstate highway system at a cost of $1.22 billion in 1988, a large amount for the sparsely populated "Big Sky" state. However, at an average cost of $1.03 million per mile, this was near the low end among all the states. At the beginning of the federal-aid highway program in 1916, the state did not have any funds to match the federal monies; the initial matching funds came from the proceeds of county bond issues. In 1926, a three-cent gasoline tax was approved, with all the funds devoted to matching federal dollars for road construction.

In the Spring 1955, the Montana legislature established a Fact Finding Committee on Highways, Streets, and Bridges. The purpose of this committee was to evaluate alternative methods for financing the reconstruction of existing roads and the construction of new roads throughout Montana. At the time of the study, the state had 73,000 miles of roadway, but only 5,900 miles were on the state system. Because of the large amount of public lands in Montana, the normal 50/50 matching for federal-aid highways was actually 56.91% federal; for the same reason, the projected federal share of the Interstate funding was 91.4%.

In 1955, Montana's gasoline tax was seven cents per gallon and the diesel tax was nine cents per gallon. Of the revenue for road improvements and maintenance, 68% came from road-user taxes, 29% came from the federal government, and the remaining 3% came from miscellaneous sources. The Fact Finding Committee examined various alternatives for funding future highway improvements, including the expected Interstate highway system, which in 1955 was projected to be 1,246 miles in length, or 54 miles longer than its finished length. The revenue options examined included bonds, a weight-distance tax on commercial vehicles, and an increase in the fuel tax by four to ten cents per gallon to cover the expected deficit. The Committee's report was submitted in November 1956 and presented to the legislature in January 1957. It provided the state with a good plan for funding the Interstate and other highway projects.

Nevada

They say that "what happens in Vegas stays in Vegas." It seems that what happens with the Interstate System in Nevada stays in Nevada. The most noteworthy item seems to be that I-580, now under construction will connect the state capitol, Carson City, with the Interstate System. That leaves Juneau, Alaska, as the only other Western state without such a connection.

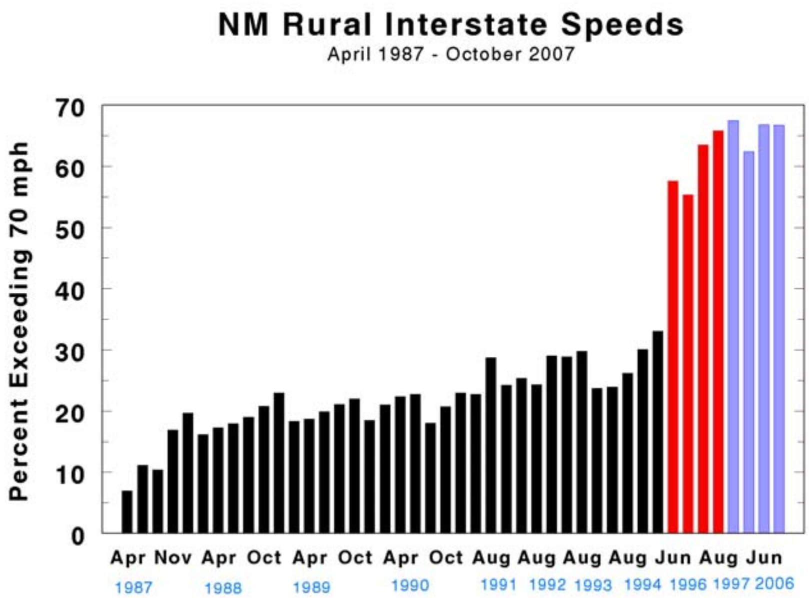
Actually, Nevada does have another unique status among the Western states: it is the only one with less than three primary Interstate routes; it has two. You have to go east to Delaware, Maine, or Rhode Island with fewer.

New Mexico

New Mexico Interstate highways cross the Continental Divide in two interesting places. On I-40, east of Gallup, the crossing at an elevation of 7,275 feet is the second highest Interstate crossing of the Divide. Only Eisenhower/Johnson tunnels on I-70 are higher, at an elevation of 11,158 feet. I-15 and I-90 cross the Divide in Montana, at elevations of 6,368 feet and 6,375 feet, respectively. I-80 crosses the Divide twice in Wyoming—on either side of a 50-mile-wide basin that has no external drainage—at elevations of 6,930 feet and 7,000 feet. The signs at the I-40 crossing in New Mexico almost appear to be a joke, as the terrain is distinctly non-mountainous.

I-10 also crosses the Continental Divide in southern New Mexico, between Deming and Lordsburg. At an elevation of 4,585 feet, this is the lowest Interstate crossing of the Divide. It looks even less hilly than the I-40 crossover.

On Friday, April 2, 1987, the US House of Representatives and Senate overrode President Ronald Reagan's veto of the Federal-aid Highway Act of 1987. One of the provisions of this Act permitted states to increase the speed limit on rural sections of Interstate highways. The speed limit regulations in New Mexico's Rules of the Road provided that when the federal government cancelled the National Maximum 55 mile per hour speed limit, the state's limit would automatically increase to the new limit without any legislative action. That very afternoon, the New Mexico Governor and Transportation Secretary, along with television crews, were on Interstate 25 south of Santa Fe placing a 65 mile per hour speed limit sign; the footage made both the local and the national news. The following Tuesday, Jerry Hall was contacted by an engineer for the Insurance Institute for Highway Safety (IIHS) who inquired about the possibility of conducting a study of New Mexico's rural and urban Interstate highway speeds. The initial study was conducted at two rural and two urban sites the following week. Six studies were conducted between April 1987 and April 1988. Studies continued at three per year through 1994, and then intermittently after the rural Interstate speed limit increased to 75 miles per hour in 1996; the final study was conducted in October 2007. The accompanying figure shows the percent of vehicles on rural Interstates that were exceeding 70 miles per hour.



Oregon

Completed in 1966, Interstate 5 traverses the state between California and Washington. At its southern end, the road passes over the Siskiyou Summit at an elevation of 4,310 feet—the highest point on I-5's entire 1,380-mile length. A 6-mile stretch of I-5 forged a new route through the mountains, combining 6% grades with tricky curves and difficult weather conditions. *DieselPower* magazine rates the Siskiyou section as the fourth toughest tow in America, behind Colorado's Wolf Creek and Loveland Passes and Alaska's Atigun Pass (with grades up the 12%).

At the northern end, Oregon's section of I-5 crosses the Columbia River at an elevation of about 50 feet. The crossing uses 3,500-foot-long, parallel bridges referred jointly to as the Interstate Bridge. The structure now carrying northbound traffic, built in 1917, was the first automobile bridge linking Oregon and Washington. In 1958, a similar steel, through-truss bridge was built to carry southbound traffic. Both of these structures have vertical-lift spans to accommodate large ships sailing underneath. An average of 10–20 times each month, the spans are raised for ten minutes to provide 176 feet of clearance below. The entire Interstate System includes only a handful of drawbridges.

Utah

On August 22, 1986, the first coast-to-coast Interstate route (I-80) was completed just west of Salt Lake City, Utah. Numerologists will note with interest the connection to the 1869 completion of the first transcontinental railroad at Promontory Point, about 65 miles to the northwest, across the Great Salt Lake.

In 1880, the founder of the Denver and Rio Grande Western Railroad decided to lay track on another transcontinental rail line through Utah. One of two proposed routes ran from Denver to Green River and continued west before turning southwesterly toward Los Angeles. Work began on this route but came to a halt when very rugged terrain in the isolated San Rafael Swell proved too formidable. Another route from Green River to Ogden was built instead. In 1957, FHWA planners decided to extend the new Interstate 70 west from Green River to Cove Fort, Utah, where it would join I-15 to link Denver with Los Angeles. The new highway made use of some of the preparatory work completed by the failed railroad construction, and the San Rafael Swell again proved formidable. Spotted Wolf Canyon, for example, was so narrow that a man could stand in it, stretch out his arms, and touch both walls of the canyon. To widen the cut enough for four lanes of Interstate highway, 3.5 million cubic yards of rock were excavated along an 8-mile stretch. Construction was expensive but was partially offset by right-of-way costs in the remote area, most of which had belonged to the Bureau of Land Management.

Routing I-70 through the sparsely populated center of Utah brought it many distinctions. The state’s 232-mile section of I-70 does not pass through any urban areas; Richfield, the largest town on the route, had a population of 4,500 when the Utah section was completed in 1970 (the road was not expanded to four lanes until 1990). A 110-mile stretch between Green River and Salina is the longest Interstate section in the country without any motorist services. No other paved roads had existed through that desolate part of the state, and this section of I-70 became the longest highway built over a completely new route since the Alaska Highway was constructed during World War II. It was also the longest section of Interstate highway to be opened at one time.

Washington

Seattle is characterized by water and hills. Bringing traffic into the city from its eastern suburbs on I-90 entails crossing Lake Washington and running right into 262-foot-tall Mount Baker Ridge. Innovative historic solutions and modern expansions established a continuous link between Boston and Seattle.

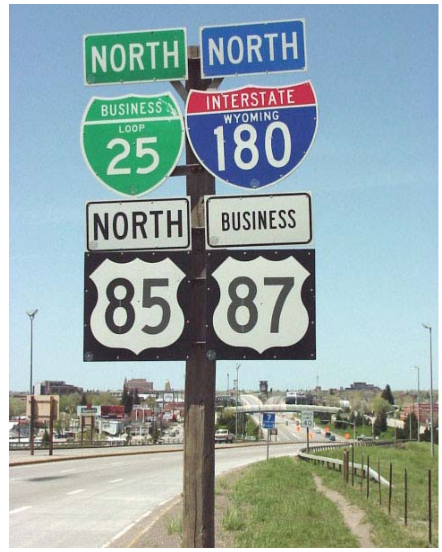
The first bridge between Seattle and Mercer Island in Lake Washington was built as a WPA project in 1940 to carry US10. It had to cross 1.5 miles of water as much as 200 feet deep, and the resting on the lake bed was a layer of soft soil 100 feet thick—a daunting challenge for bridge design. The solution was to build a four-lane concrete bridge that would float on the lake surface. Twenty-five sections comprised the bridge, each of them 14.5 feet thick; half of the thickness consisted of water-tight pontoon compartments. Sixty-four 65-ton anchors, connected to the bridge by cables nearly 3 inches in diameter, held the bridge in place. In 1989, when I-90 was being completed along the US10 alignment, a five-lane, parallel floating bridge was built to provide additional capacity. In 1990, while the original bridge was undergoing renovation work to bring it up to Interstate lane-width standards, a storm sank about half of the structure. A replacement floating bridge was completed in 1993. It is the second longest floating bridge in the world, behind only the 7,500-foot-long Evergreen Point Floating Bridge, which crosses Lake Washington 4 miles to the north.

When the 1940 floating bridge was built, the west end of it transitioned into a pair of new, two-lane tunnels through the Mount Baker Ridge. Workers dug the 1,466-foot-long tunnels through clay, installing timber bracing every 3 feet of progress to support the soft soil. At the time, the 29-foot-wide, 23-foot-high tunnels were the largest soft-bore tunnels in the world. With the upgrade to Interstate capacity in 1989, the two existing tunnels were dedicated to eastbound traffic, and a companion tunnel was constructed to carry three lanes of westbound traffic on a main deck, two reversible HOV lanes on a lower deck, and pedestrian and bicycle traffic on an upper deck. The tunnel was constructed through clay, sand, and silt by digging a series of twenty-four adjacent drifts that together formed a circular shell. Each 9.5-foot-wide drift was temporarily supported by 4-foot-sections of precast liner; when the entire drift was dug and lined, it was backfilled with concrete. After all twenty-four drifts were completed, the soil was excavated from the center of the 63-foot-diameter tunnel. The new Mount Baker Ridge tunnel is now the world’s largest diameter soft-bore tunnel.

Wyoming

With 5.8 residents per square mile, Wyoming has the second-lowest population density in the country, ahead of only Alaska (with 1.2 inhabitants per square mile). Three primary Interstate routes pass through the state: I-25, I-80, and I-90 for a total of 915 miles. Wyoming has 1.53 miles of rural Interstate highway per 1,000 population—the highest of any state (Alaska is next with 1.48). With the completion of I-90 from the Montana state line to Ranchester in October

1985, Wyoming became the first Western state to complete its Interstate mileage.



Wyoming's other Interstate route, I-180, is a 1.1-mile-long spur from I-80 into downtown Cheyenne. It is unique on the Interstate System in that no part of it is a freeway. It is a divided highway, but there are traffic signals at its exit from I-80 and at Fifth Street, Ninth Street, and the route's end at Lincolnway. These signalized intersections are euphemistically called the "exits" from I-180. Originally planned to be up to Interstate standards, the road's character was changed in the early 1970s for two reasons. Making it an at-grade expressway gave better access to south Cheyenne by allowing local traffic to cross the Union Pacific Railroad tracks on I-180's overpasses (both of which have pedestrian sidewalks). Furthermore, the at-grade design was far less expensive than an elevated freeway. FHWA gave the route a waiver and funded it like any other Interstate route. I-180 was completed in 1984. It is the only section of Interstate in the country to be co-signed as an Interstate business loop (for I-25), a US route (US85), and a US business route (US87). The speed limit on I-180 is 40 mph.

Wrap-Up

ITE's Western District boasts notable achievements on its Interstate System—historic innovations, environmentally sensitive designs, and difficult construction accomplishments. As engineers devise modern techniques and strategies for repairing and rebuilding these vital roads, they will be well served to remember their predecessors' creativity in meeting similar challenges.

At the 2006 Western District ITE meeting in Honolulu, on the 50th anniversary of the National System of Interstate and Defense Highways, Jerry and Loretta Hall presented a paper entitled "The Interstate Highway System: 50 Years of Perspective, " highlighting some historical events in the development of the backbone of the nation's highway transportation system. Perhaps desperate for article submission, the editor of *WesternITE* contacted the authors and requested followup articles on issues associated with the planning, design, and operation of the Interstate highway system. The 15 articles, with Loretta as the primary author, appeared in *WesternITE* from Fall 2006 to the Fall 2009; if you're interested, you can find them on line at http://www.unm.edu/~jerome/Interstate.htm.
The current paper simply expands on our previous efforts by emphasizing those unique features that we can identify for Western states.

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