

# A successful adaptation

Transforming Washington state's I-90 into a wider, safer, more reliable transportation corridor

By Meagan Lott  
Contributing Author

I-90 is the main east-west transportation corridor in the state of Washington, connecting the large population and business centers of the western half of the state with the agricultural industries and recreational areas that comprise the eastern portion.

The uninterrupted movement of people, freight and business over the I-90 Snoqualmie Pass is essential to the economic vitality of the state. However, travel along Snoqualmie Pass is not always reliable due to miles of standstill traffic during busy summer weekends and closures in the winter due to avalanche control work.

In 2005, the Washington State Legislature approved \$551 million for the Washington State Department of Transportation (WSDOT) to improve five miles of a 15-mile-long section of I-90 east of Snoqualmie Pass by adding new lanes, replacing deteriorating concrete, extending chain-up and -off areas and replacing a snowshed with two new avalanche bridges. Moreover, this project addressed wildlife connectivity by replacing bridges and culverts with new structures that facilitate the movement of wildlife both under and over I-90.

## Phasing it in

The topography, geology, weather and traffic constraints along the I-90 corridor presented unique engineering challenges. The first five miles of the project ran along a narrow corridor between the shores of Keechelus Lake

and the steep mountain slopes of the Central Cascades. The Central Cascades produce extreme temperature fluctuations, severe seasonal rains, and heavy snowfall during the winter, which limits the construction window to approximately seven months of the year. In order to work around these challenges, the five-mile project was divided into three major construction contracts—Phase 1A, 1B and 1C. In addition, WSDOT committed to keeping two lanes of traffic open to the public throughout the course of each phase during peak travel times. The only exceptions to the lane openings were during blasting and tie-in work.

Not only were engineers faced with landscape challenges, but I-90 is located in a national forest and the I-90 project area is part of the 212,700-acre Snoqualmie Pass Adaptive Management Area (SPAMA). It is one of ten adaptive management areas in the western United States. When SPAMA was established in 1994, it marked an important change to federal land management in the area. In place of an earlier emphasis on timber production, the goals of SPAMA were to provide mature forests and habitat connection for species moving north and south.

In order to meet requirements of SPAMA, WSDOT created an interdisciplinary team (IDT) made up of the U.S. Forest Service, U.S. Fish and Wildlife, U.S. Department of Ecology, U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, along with local agencies.

"The IDT developed solutions to ensure the I-90 project complied with SPAMA while still meeting the needs of the traveling public," said Bill Sauriol, WSDOT environmental manager.







Atkinson Construction proposed a Cost Reduction Incentive Proposal by which an existing snowshed was to be removed and replaced with two new avalanche bridges.

## Blasting away

For the past six years, WSDOT and contractor crews have been successfully transforming a 60-year-old stretch of I-90 into a modern, wider, more dependable transportation corridor.

The transformation started in spring 2009 when WSDOT's contractor, KLB Construction, built a temporary detour bridge at Gold Creek to use during the next phase of construction (Phase 1B). Crews spent the summer excavating over 250,000 cu yd of material from Keechelus Lake.

"Keechelus Lake is one of several irrigation reservoirs in a system where water rights are over-allocated, so WSDOT was careful to not impact lake storage volume levels," said Brian White, WSDOT assistant regional administrator for construction and development.

To mitigate lake storage volume impacts, WSDOT had a no-net loss commitment with the U.S. Bureau of Reclamation, by which WSDOT would excavate materials from Keechelus Lake to allow for the expansion of I-90. The excavated materials, consisting mostly of gravel and soil, were hauled to the Crystal Spring Sno-Park to be stockpiled and processed into crushed surfacing base course. The material was recycled back into the project and used over the different phases of the project.

Phase 1A was finished in fall 2009, two years ahead of schedule. The following spring, construction started on Phase 1B, comprising the first three miles of the five-mile project. In 2010, the contractor, Max J. Kuney Construction, started building a new six-lane highway, bridges, slope stabilization, and chain-up and -off areas.

"In order to make room for the new lanes, crews had to remove close to 1 million cu yd of material," said White. "In order to remove that much material, we had to blast it with explosives. Some of the material was directly embanked into the new roadway, while some material was hauled to the Crystal Springs Sno-Park to be processed."

For three summers, crews closed I-90 every night for about an hour to blast rock and other material from the hillside. By the time the new section of roadway opened to traffic in 2013, crews had used more than 400,000 lb of explosives and stabilized the rock slopes with over 1,500 rock dowels.



## A change in design

In 2011, Guy F. Atkinson Construction was awarded the Phase 1C contract, which finished the remaining two miles of the five-mile project. Before construction started in 2012, Atkinson proffered a Cost Reduction Incentive Proposal (CRIP).

"WSDOT encourages contractors to be innovative in planning and performing their work," said White. "If a contractor identifies a portion of the project where there can be a cost savings and their product is equivalent to our product or better, we both share in the savings, which is then implemented through a change order."

Atkinson's CRIP proposed replacing the snowshed WSDOT described in the 2008 Final Environmental Impact Statement (FEIS) with two elevated avalanche bridges. The bridges would separate the highway from the hillside, stabilize loose material and allow avalanches and debris to pass beneath the bridges. A series of engineered avalanche chutes would direct snow, rock and debris away from the bridge piers.

The bridges would be built using standard engineering designs and approved construction practices, reducing risk compared to the techniques and components required for the proposed snowshed. Ultimately, the new bridges would eliminate the long-term cost of operating and maintaining a new snowshed, and along with all of its electrical, mechanical, and fire and life safety systems savings, a cost savings of approximately \$650,000 a year was to be realized.

Since Atkinson's CRIP proposed a design modification different from the selected alternative in the Record of Decision for the I-90 project, the Federal Highway Administration (FHWA) and WSDOT determined a limited-scope Supplemental Environmental Impact Statement (SEIS) was required in order for the new avalanche bridges to be considered.

After additional environmental analysis and public involvement, FHWA and WSDOT approved the limited-scope SEIS in March 2013.

"Atkinson was given the green light to build the new avalanche bridges in place of the proposed snowshed," said White.

## More challenges

As part of the Phase 1C contract, Atkinson was contracted to build a new bridge just east of where the new avalanche bridges were to be built. The purpose of the bridge was to take eastbound traffic over a portion of Keechelus Lake. In 2012, Atkinson's subcontractor started

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# Making the complex understandable

By Ron Jones

The Visual Engineering Resource Group (VERG) at the Washington State Department of Transportation (WSDOT) is a complete visual communications group, consisting of four visual communication engineers who create 2-D and 3-D visualizations, animations, full video productions and commercial photography.

The most extensive visualization we have produced to date is a recent animation for the I-90 Snoqualmie Pass East project. It covers the first seven miles of a project that will ultimately extend for fifteen miles, from Snoqualmie Pass to Easton, Wash. The I-90 project team asked VERG for an animation that could be shown to decision-makers, community leaders and the public to help explain this portion of the project in a very approachable and understandable way.

Visual quality and accuracy were very important for this project. WSDOT used Bentley MicroStation as its CAD software and Bentley InRoads as its roadway design package. The 3-D roadway surfaces, barriers and walls and 2-D channelization were provided to us by the I-90 design team. They also included detailed terrain models created by the WSDOT Photogrammetry team. The rest of the 3-D environment evolved directly from the roadway design work. I modeled the bridge substructures, luminaires, walls, VMS sign structures and the animal overcrossing based on the plans provided by the design team and bridge architect. Additional terrain, outside of the project limits, was augmented by the USGS through its online National Map Viewer.

For the look of the project, the Cascadian design theme was developed in keeping with National Scenic Byway and U.S. National Forest Service guidelines. The theme uses stone and wood textures that fit into the mountain environment. To ensure an accurate visual representation, I used digital photos of the actual Cascadian surface treatments to create materials for the 3-D model surfaces. This was also done for rock faces and avalanche slopes, using photos taken from a helicopter.

I used the software tools to “paint” the terrain with what objects it bears in actual life, in this case 3-D trees. For the more distant hills and peaks, I used a technique that carpets the terrain with simple vertical



**Top:** Animal crossings were planned for over the new Pass roads.

**Middle:** Avalanche bridges were visualized as an alternative to snowsheds.

**Bottom:** Traffic was added to give viewers a “realistic” virtual look.

images of trees, similar to blades of grass in a lawn; I then took the 2-D channelization and applied it to the 3-D roadway surfaces. About 28,000 vehicles travel through this area on a daily basis, so showing traffic was also very important, in order to give viewers as accurate a digital look as possible into what the completed project would ultimately offer.

The software’s rendering capabilities allowed us to render photo-realistic views of the project. However, the animation required the rendering of nearly 9,000 frames, and as each frame took about 7 minutes to render, it would take about 43 days, 24/7 to render the animation. A different solution was needed. For this, we turned to the WSDOT IT Server Support team. They were able to set up a “render farm,” which consisted of 14 blade servers dedicated solely to working on the rendering job. It only took about six days.

Once the frames were rendered, the animation was edited and made presentation-ready. Some pre-animated wildlife was added to the animal crossing as a finishing touch.

The I-90 team has been very happy with the results. The virtual model allowed crews to see the endgame and thus perform in an exacting way. It also reassured both decision-makers and the public that the I-90 project was a viable and necessary improvement to our state’s infrastructure. We are looking forward to providing further visualizations for the final eight miles of the project.

*Editor’s note: This animation was selected as one of the top three finalists in the Innovation in Roads category at Bentley System’s 2014 Be Inspired Awards competition.*

Jones is a visualization engineer with the Visual Engineering Resource Group of WSDOT.



Piers go into the waters off Snoqualmie Pass for new avalanche bridges.

building a soil nail wall, which would provide access for crews to start building the foundations for the bridge. However, during construction of the soil nail wall, crews experienced excessive grout loss. Multiple drilling and grouting methods were tried, but the voids were too large to construct a stable soil nail wall. WSDOT immediately stopped operations and worked with Atkinson to find a solution.

Atkinson brought in Jacobs Engineering to work with WSDOT to develop a new design that would eliminate the need for the bridge.

"The design team we hired to help with the CRIP was asked to help with the new design since they were knowledgeable of the project requirements and goals," said Jason Streuli, Atkinson project manager. "This allowed us to help WSDOT redesign the project area quickly and cost effectively without adding more construction seasons to the overall project schedule."

The new design shifted the roadway closer to the hillside and away from the lake. The slope along the lake would be stabilized with a 30-ft-high retaining wall and the westbound lanes would be elevated to minimize rock cuts. Construction started in summer 2014 and was completed in the fall of the same year.

"Jacobs and Atkinson worked with us closely to develop a solution that was designed and implemented in a timely manner," said White.

## The future of the I-90 corridor

In 2015, contractor crews will break ground on the next two miles of the I-90 project known as Phase 2A. WSDOT is using \$108 million in project savings from Phase 1 to widen the highway from four lanes to six, add a new chain-up area, build six new bridges and the first wildlife crossing in the corridor over the highway.

By 2020, seven miles of the 15-mile I-90 corridor project will be complete. As more funding becomes available, WSDOT plans to transform the remaining eight miles of the corridor into a wider, safer and more reliable stretch of I-90. The remaining eight miles will include the continuation of a new six-lane highway, new truck climbing lanes at Easton Hill and will address issues with wildlife and hydrologic connectivity.

"We will continue to work with our partners and communicate with the public to ensure I-90 is a primary statewide and national corridor. We will keep Washington moving by operating efficiently, adding capacity strategically and managing demand," said White. **R&B**

Lott works in the south central region communications division of WSDOT.

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