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Engineering Field Notes
Guidelines for Authors

Proposed articles should be double-spaced text in 10- or 12-point Arial or Helvetica type fonts, left margin justified. To ensure that design layout conforms to Forest Service publication standards, submit graphic elements, such as tables, charts, and photographs as separate files. Submit manuscripts as Microsoft Word documents (either Macintosh or Windows format) on 3.5-inch floppies, Iomega products (ZIP 100), or recordable CDs, or send by e-mail.

When soliciting photographs for your document, encourage photographers to capture the sharpest image possible by moving close to the primary subject, so that it fills at least three quarters of the frame. Request vertical and horizontal photos in at least three different exposures for each subject to allow maximum design flexibility. (For cameras that lack adjustable f-stop lens settings, use the +/- exposure adjustment for different exposures.)

Photographers must use digital cameras that provide print or publication quality images. Provide 1-megabyte .jpeg files (for electronic use) or 5-megabyte .tif files for print publications. Designers can convert .jpegs into .tif files for professional page layout.

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3. **Prints** (4 by 5 inches or larger, glossy finish, black and white format) preferred for *Engineering Field Notes* and other one-color publications

For additional information on preparing documents for the Engineering Management Series, contact Sandy Grimm, Engineering Publications. Phone: 703-605-4503, E–mail: Sandra Grimm/WO/USDAFS@FSNOTES or sgrimm@fs.fed.us.

Deadline for January-June 2003 EFN article submissions: March 16, 2003

EFN Goes Electronic

The July-December 2002 issue of *Engineering Field Notes* (EFN) will be the last issue available in a hardcopy print version. It will become an electronic-only publication in 2003. The January-June 2003 issue will be posted electronically for subscribers.

We look forward to using electronic links to better serve our reading audience. Linking articles to the wealth of publications available through the Washington Office and detached units will expand information access and resources for EFN's readership.

We will now be able to showcase our authors' color images. Although digital images will need to retain their quality with the prescribed 300-dots-per-inch resolution, color images can be retained in the electronic version.

EFN will maintain the tradition of serving as a forum for exchanging valuable engineering-related ideas and information for engineers Servicewide.

Juggling Resources to Maintain and Improve Engineering Excellence

Vaughn Stokes
Director of Engineering
Washington Office

We continue to be impressed with the quantity and quality of work that is performed by all of you. Despite diverting funds to support fire needs, we made significant progress in completing our workloads. We must all recognize that the fire effort is a vital part of our jobs. Engineering reallocated our construction and Working Capital Fund (WCF) resources to help the Agency avoid violation of the Antideficiency Act. Breaking any law is not an option for any of us.

In this issue, we recognize more quality workmanship by announcing the award winners for the three best *Engineering Field Notes* (EFN) articles from 2001. Readers voted for a wide array of articles so the competition was especially tough.

To further improve the quality and efficiency of Federal agencies, the Office of Management and Budget (OMB) mandated an A-76 process review of the potential to contract for work that is currently performed inhouse. Federal agencies must complete public/private competition studies or direct conversion on at least 5 percent of the full-time equivalents (FTE) reported according to their approved Federal Activities Inventory Reform (FAIR) Act reports by the end of fiscal year 2003.

We are committed to providing public service that is efficient, effective, and affordable. The A-76 process will help us focus on this commitment. I believe we have very good people that provide quality public service, however, this process requires us to ensure that we have the most efficient organization and are doing inherently Government activities. The A-76 process recognizes the need to maintain core competencies and to retain individuals with valuable skills and experience in the organization. Implementing the A-76 process is our opportunity to proactively seek solutions, not to quietly avoid participation or passively await changes.

Another aspect of the day-to-day process was repeatedly emphasized in a recent meeting with the Chief—process predicament or process gridlock. Line officers rely on Engineering to be actively involved in the planning and decisionmaking process. Engineering possesses the training and the skills to equip line officers with information to make scientifically sound decisions. I encourage you to actively participate in the planning process for projects and for forest planning.

To improve our information exchange and to better equip each of you to actively participate in project planning throughout Engineering, EFN will be posted electronically for the January-June 2003 issue and future issues. This issue will be our last printed, paper version. We will continue to rely on your support in providing worthwhile articles to share engineering information and insights.

In providing efficient and effective public service, we must remember that safety is a key component of our jobs—it cannot be taken for granted. Recent accidents within the Agency have reminded us that we must re-emphasize seatbelt use in all Government vehicles. We urge you to establish good safety habits in and out of the workplace—including the use of safety belts in your personal vehicles.

2001 Engineering Field Notes Award Winners

Thanks for voting for your favorite *Engineering Field Notes* (EFN) articles from 2001. We appreciate your efforts to let our authors know that their articles are read and valued.

Putting your thoughts and experiences on paper takes time, energy, and dedication, so we especially appreciate our authors' willingness to submit articles. To remain a valuable resource to our field personnel, we rely on people willing to share their time, knowledge, experiences, successes, and even their failures. Your articles help save the United States Department of Agriculture (USDA) Forest Service time and resources.

Here are the winning authors who will receive cash awards for EFN articles for 2001:

- Bill Hamele for "Choices: Composting or Installing a Vault Toilet"
- Marina S. Connors for "Evaporator Vault System—An Innovative Alternative for Waste Disposal"
- John R. Kattell for "Transformers: From Student Vision to Engineering Marvel"

Congratulations to our winners and to the authors who make this publication possible. We encourage you to keep those articles coming. For tips on how to submit your article to EFN, see the inside front cover.

Rising From the Ashes

Note: The following article is reprinted with permission from the *Missoulian*, Missoula, MT, "Rising from the Ashes," by Sherry Devlin, July 4, 2002.

Sherry Devlin
Reporter for the Missoulian
Missoula, MT

When the historic Sula Peak lookout burned to its foundation in the fires of 2000, the decision to rebuild was an easy one

SULA PEAK - For generations now, moms and dads in Sula have sent children out to play with the same admonition: "Just don't lose sight of the lookout tower."

So everyone in the little southern Bitterroot Valley community felt the loss when, during the early August firestorms of 2000, Sula Peak lookout burned to its cinder-block foundation.

"We had lost our lighthouse, our beacon," said Linda Reiche, the fire lookout assigned to the tower, then and now.

Smoke still hung low in the valley, in fact, when the first calls came to rebuild atop Sula Peak. No one disagreed.

"It was a pretty easy decision to make," said Jack Kirkendall, the Bitterroot National Forest's fire management officer. "We all recognized the value of Sula Peak to the community and to the Forest Service."

The lookout was, in fact, absent but a year so hasty was the decision to rebuild, and this week Reiche moved a summer's worth of paperback novels, T-shirts and Windex into the new Sula Peak lookout and turned on the lights.

"How far do you think kids can go and still see this tower?" she wondered, looking down on the smattering of ranch houses. "Wow …"

Reiche evacuated Sula Peak on Aug. 3, 2000, believing one of the dozen wildfires burning in the surrounding mountains had jumped Highway 93, four miles below her post.

She got on the radio to the district ranger. "You'll need to get out quick," he said.

There was no time to pack her belongings or any of the maps, log books or artifacts in the old 14-by-14-foot cabin, Reiche said. She grabbed the radios and headed down the mountain, hesitating only to take one last look at the tower, all wrapped up in fire shelters.

“It won’t burn,” she thought. “There’s nothing up here but rocks.”

Flames reached the peak Aug. 6, during a windstorm that pushed one wildfire into another and then another, creating a single mammoth fire that burned into September. Firefighters saw the building intact and untouched on the 6th, after the surrounding forest had burned to black. When they looked back on the 7th, it was gone.

“I am thoroughly convinced that a spark got underneath the fire shelter,” Reiche said, “and since it had a shake roof and was a really old tinder-dry building, it only took one little spark and it was gone.”

“It was hard to lose the building,” said Reiche, who has spent her summers in the Bitterroot forest’s 10 lookout towers since 1986. “All the old lookouts had written their names inside the drawers of the kitchen table. They had left little pieces of themselves up here - old maps and photographs and sentimental things. One lookout had labeled every feature on the horizon. Every drainage, every peak. Every bit of it was gone.”

Sula Peak got its first lookout in the 1920s, a guard station that sat flat on the ground. In the 1930s, when Missoula architect Clyde Fickes designed the first hip-roofed, pre-packaged lookout, Sula Peak got one of the first square-timbered cabins - an “L-4” in Forest Service parlance.

For 30 years, Sula’s L-4 sat atop a tower built of lodgepole timbers - Reiche calls them “stilts.” In the 1960s, the poles gave way to a sturdier cinder-block tower.

When the order came to rebuild the Sula lookout, Forest Service architect **Jane Kipp** was told to copy Fickes’ 70-year-old design. But she had been in the old square cabins, “and there was just no room at all.”

“I thought I should try to improve the fire lookout’s life a little,” Kipp said. “I thought they needed more windows and more space. And those old walkways around the outside were so tiny. I wanted to give them enough room for a deck chair. I just thought it would be nice.”

Kipp started with a square, then rotated it. “And the rotation turned out to be eight-sided,” so she drew an octagonal cabin with “plenty of person room.”

The resulting Sula Peak lookout is one-of-a-kind, an earth-toned top-knot that blends with the surrounding rocks. “I went up there and grabbed a pocket full of rocks, then went around to different places in town until I found matching concrete blocks for the tower and paint for the cabin,” Kipp said.

Firefighters are a tradition-loving bunch, though, and Kipp saw more than a few raised eyebrows when she walked in with her eight-sided lookout. “Hey, this is an octagon,” they said. “Where’s the square?”

“But no one said no, so I kept going,” said Kipp, who already has requests for blueprints of her design from Alberta and Idaho.

Reiche still kind of misses the old cabin and doesn't quite know what to do with all the extra room. But her also-new dog, a Weimaraner named Bruno, loves the futon. And Reiche's already positioned a pair of chairs on the wider-than-usual deck, with views to the rising sun.

"Isn't it a gorgeous building?" she asked. "The design is beautiful."

Inside, the cabin is all pine and glass. Bruce Bailey, who runs the union carpenter shop at Trapper Creek Job Corps, designed and built a new kitchen table, with a drawer where Reiche will renew the tradition by signing her name inside. A Bitterroot Valley rancher donated and milled a piece of pine for a new stand on which Reiche perched the Osborne Fire Finder she uses to locate each puff of smoke she spies.

The Fire Finder itself came from an abandoned lookout tower on the Idaho Panhandle National Forest. "They don't make these anymore," she said.

"They did some special things for me," Reiche said. "They put a lot of little touches into this building - to bring it back for tradition."

And these days, it seems like everything's coming back to Sula Peak. Nearly two years after the firestorm turned them to black, most of the pines and firs in forest below the lookout tower still stand.

But it's not the black, or even the leopard spots created by birds pecking the dead trees for insects, that catch the eye. It's the green.

The "ghost forest" - as Reiche christened it - is lush with new growth, thick with knee-high bunches of grass and a collection of wildflowers rarely seen in recent, drier years.

Bitterroots are abundant on the rocky knobs just south of the tower. Mountain globemallow blooms in the draw. The blackened forest is loaded with Indian paintbrush, glacier lilies, lupines and miner's lettuce.

"What better job could there be than watching the wildflowers grow?" Reiche said, hopping from rock to rock to avoid the bitterroot bloom.

"This is a great job," she said. "I enjoy working by myself. It's peaceful and quiet, and locating the fires is challenging. I don't have a flush toilet or running water, and there's a rattlesnake in the outhouse. But I get up in the morning and a lot of times there'll be a band of sheep down there on the old trail. Or a band of rams. And sometimes I'll see a black bear coming across the saddle. And I get to be a part of it all."

Besides, she said, "I'm never alone." There's always Bruno, lolling away the afternoon in the sun.

And, of course, there are the children. All looking up at the lookout, from down below.

Reiche evacuated the old tower on August 3, 2000. By August 7, it was gone.
Photo by Kurt Wilson/Missoulian

"They put a lot of little touches in this building to bring it back for tradition"
Photo by Kurt Wilson/Missoulian

The Osborne Fire Finder in the new tower came from an abandoned lookout in the Idaho panhandle.
Photo by Kurt Wilson/Missoulian

McClain Creek Landslide

Installation of Drainage Systems, August to October 2001

Terri Anderson
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Background and Project History

The McClain Creek Landslide is located on National Forest Service lands in the Bitterroot Mountains in the upper drainage area of McClain Creek. The landslide is more than one-half mile long and 200 feet wide (figure 1).

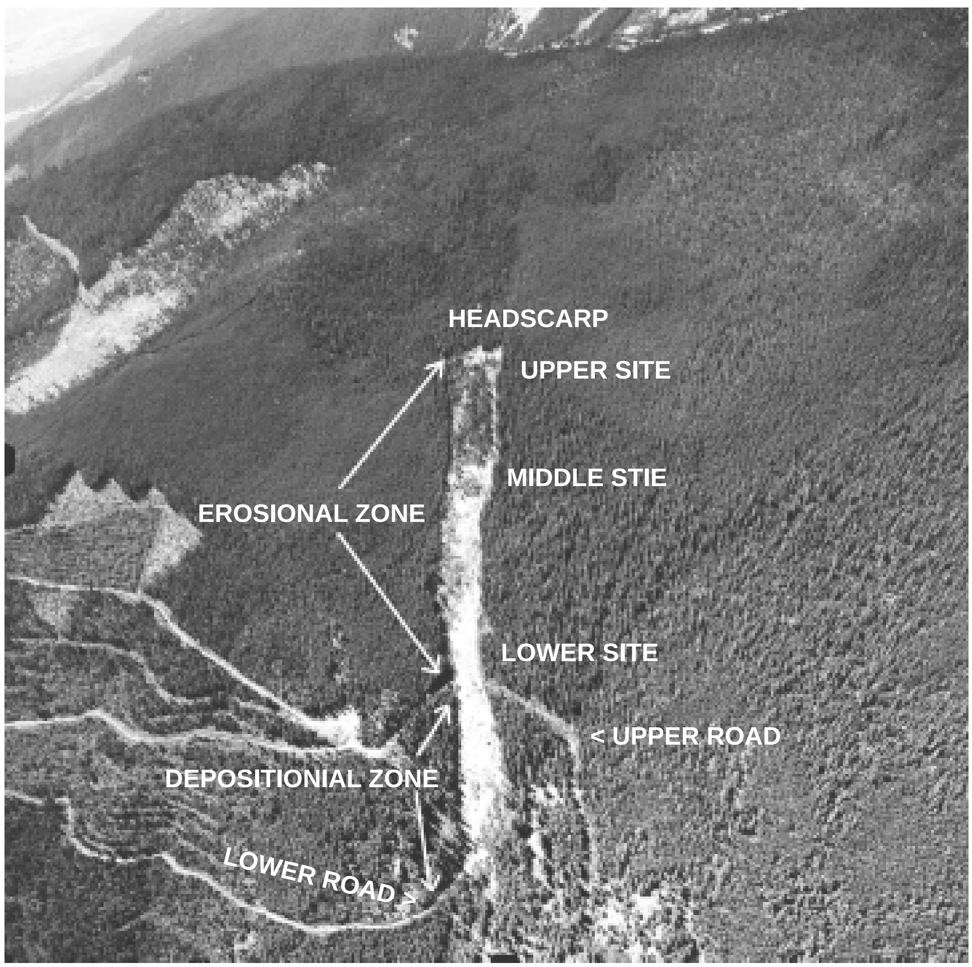

Figure 1. *Aerial view of McClain Creek landslide.*

A significant amount of the slide material consists of decomposed mica schist and gneiss within a silty sand matrix. The mica schist has a plate-like structure and a relatively low shear strength when saturated. Although the landslide may have been reactivated by road construction in 1963, evidence of ancient landslide activity exists within the current boundaries of the present slide. Previously existing pressure ridges occur along both sides of the landslide. These pressure ridges consist of material pushed up laterally as the main slide mass moves downslope.

In 1994 a tort claim was filed against the Forest Service by adjacent landowners alleging damage to their property as a result of the McClain Creek landslide. The alleged damages included the deposition of sediment into the landowner's irrigation system. A settlement agreement was reached in November 1998 between the plaintiffs and the Forest Service. The Forest Service agreed to develop and execute a project to remove surface water from the landslide, revegetate the landslide surface area, and abate the heavy sedimentation flowing into McClain Creek and the landowner's irrigation system. The parties agreed that it would take through 2005 to evaluate the effectiveness of the project.

Geotechnical Investigations and Alternatives Considered

Prior to the settlement agreement in 1998, a seismic survey and reconnaissance survey were conducted in 1978 and 1980, respectively. In 1994 a geotechnical review by Landslide Technology (January 2, 1994) provided the initial geotechnical evaluation by an outside source. Lynne Dickman, Bitterroot NF geologist, documented a case history of the landslide.

In 1999 Aquoneering Inc., in conjunction with Womack & Associates, prepared a report for the U.S. Department of Justice (DOJ) to advise the DOJ and the Forest Service of potential alternatives to stabilize the slide. This report also included the first comprehensive field assessment of the hydrologic, hydraulic, and geotechnical aspects of the slide. Their basic plan involved the collection of surface and ground water from the top of the slide, then diverting it through lateral piping to the base of the slide. Directly below the toe of the slide, they proposed a sediment dam to collect sediment from the landslide.

In the fall of 1999, Doug McClelland, USFS Northern Region Geotechnical Engineer, implemented an independent peer review of the Aquoneering and Womack proposal. Four independent experts in geotechnical and landslide technology were hired. They included Landslide Technology (Portland, OR), Klohn-Crippen (Richmond, B.C., CN), G.N. Richardson & Associates (Raleigh, NC), and Don Hyndman (Professor of Geology, University of Montana). In these independent reviews, significant problems associated with the surface water diversion and collection system and sediment dam in the Aquoneering/Womack proposal were identified. The major problems included: 1) inaccurate hydrologic estimates for the drainage area, which led to an overdesigned, impractical water diversion and collection system; 2) the sediment dam location at the toe of an active slide mass which could saturate the toe of the slide and potentially increase the risk for unstable conditions; 3) costly and difficult maintenance of the sediment dam; and 4) difficult maintenance of the lateral piping system because of potential ground movement and the high probability of debris plugging the pipe.

However, some success was accomplished by the installation of Womack's experimental drainage systems, which were installed in fall 1999. Two prototype elements of their proposed drainage system were installed including 1) a subsurface geocomposite (Eljen) drain above the headscarp of the slide and 2) a geotextile-reinforced embankment and drainage sump. In addition, three surface-water diversion ditches, constructed of geotextile liner and vertical log posts, were installed at the request of the Forest Service to divert surface-water laterally off the slide through the pressure ridge on the west edge of the landslide. During his May 2000 field review, Doug McClelland noted that the experimental drainage systems installed in the fall of 1999 appeared to have some beneficial effect, and removing the surface water with the three diversions through the lateral pressure ridge reduced potential sediment generation by significantly drying out the surface of the landslide.

Rodney Prellwitz, P.E., former USFS geotechnical research engineer, was hired by the Forest Service to serve as a technical advisor for the installation of the monitoring wells. Also, he was to assist with the development and implementation of a monitoring program to better understand the ground water and surface water characteristics affecting the stability of the slide. The monitoring program included installation of state-of-the-art instrumentation to continuously record ground water levels. Monitoring results will be used to determine the effectiveness of mitigation measures to control ground water and surface runoff. For example, following the installation of ground water observation wells, it was noted that the Eljen drain located above the headscarp appeared to have some drawdown effect on ground water levels, observed during the installation of 11 ground water-monitoring wells in July 2000 (Installation Report, Prellwitz, November 2000).

Ground water observation wells were installed in July 2000 using a tripod and motorized cathead to advance the holes by standard penetration test (ASTM D1586) techniques. The drilling equipment was sling-loaded to the top of the slide by helicopter. Holes were cased with 1.5-inch-sch 40-PVC pipe, which was slotted in the anticipated aquifer zone. Continuous monitoring of ground water levels in 10 of the observation wells was initiated in October 2000 and will continue for the duration of the project. Standard penetration tests were conducted from the ground surface to the bottom of each well. Soil samples throughout the entire well depth were collected and analyzed. Depths to ground water also were recorded for each well. This subsurface information helped to more accurately define characteristics of the slidemass failure in the stability analysis. Using this analysis, the critical depth of ground water (at which failure of the slidemass is expected to begin) was determined.

A resistivity survey had been conducted by EchoTech Geophysical (August 2001) prior to the installation of the wells. Resistivity surveys, or profiles, are geophysical surveys used to delineate subsurface saturated zones and other geological characteristics. These profiles were useful in optimizing the location of the ground water monitoring wells and provided additional information for the stability analysis.

Prellwitz was recruited to advise in the development of alternatives and, eventually, the final drainage system design. He completed a new, more thorough slope stability analysis. The new analysis, based on additional investigation and data from drilling the ground water monitoring wells, reflected a more accurate evaluation of the slide mass geotechnical properties, such as soil shear-strength parameters, density, depth to failure surface, and so on (*Stability Analysis Report*, Prellwitz, January 2001). He describes the failure mode as primarily translational. The mode is characterized by the downslope displacement of slide mass material moving on a surface that is generally parallel to the general ground surface with little rotational movement. Ground water characteristics of the landslide include both confined and unconfined aquifers.

The resistivity subsurface profiles and hydrographs from the first year of ground water monitoring indicate that more than multiple aquifers are feeding ground water into the slidemass at different locations. The Aquoneering and Womack plan addressed only one unconfined aquifer at the main headscarp. This aquifer would have been drained and collected in a closed piping system running from the top of the slide to the sediment dam near the toe of the slide. Prellwitz recommended installing additional subsurface drains throughout the upper two-thirds of the slide to pull the ground water levels down below the critical level. This would control ground water levels not only at the top of the slide, but also in other locations not necessarily recharged completely by the aquifer located at the top of the slide.

The settlement agreement requires the removal of surface water from the landslide and abatement of heavy sedimentation from McClain Creek. The drainage plan (*Drainage Analysis Report*, Prellwitz, January 2001) included lined ditches at several locations across the width of the landslide to direct the surface water and sediment outside of the west pressure ridge to the forest floor. A lined ditch was designed over the top of a subsurface drain to minimize the amount of excavation and ground disturbance.

During the environmental assessment process, concerns arose about the potential risk of erosion caused by diverting flows to the forest floor west of the slide. McClelland addressed these concerns in several internal memorandums, including a December 12, 2000, memorandum to Betsy Ballard, Project NEPA (National Environmental Policy Act) Coordinator. He pointed out that the forest floor was already saturated, and mass stability was unlikely to be decreased with additional water because the phreatic surface would not be significantly increased. McClelland also pointed out that the forest floor was very porous and adsorbed water readily, and he hypothesized that the forest floor remained essentially the same from the end of the wet Pleistocene, when the original landslide occurred, creating the large lateral pressure ridges. Thus, the existing forest floor adjacent to the landslide had probably been exposed to numerous 100-year flood events, and many 1,000-year flood events, that generated flows far in excess of the 50-year design criteria for the McClain landslide stabilization project.

Based on initial observations of the experimental drainage systems and recommendations from Doug McClelland and Rodney Prellwitz, the interdisciplinary team selected the proposed alternative that included the installation of subsurface drains to lower ground water levels in conjunction with surface water drainage systems to control runoff and erosion.

The landslide is located in steep, unstable terrain. Because approximately two thirds of the landslide is located above the upper road, the majority of the slide is inaccessible by road. The portion of the slide located between the upper and lower roads (see figure 1) is extremely steep and inaccessible by conventional excavating equipment. After considering the terrain and potential for encountering high ground water, the team decided to eliminate conventional excavating equipment, and instead, use a spider hoe excavator with an experienced operator. All Terrain Excavating from Polson, MT, was selected because of the company's qualifications and past experience working in steep, rough terrain and difficult conditions, including wet and boggy terrain.

Description of Drainage Systems

The project included the installation of ground water drainage systems, surface water drainage systems, and monitoring stations. Geocomposite drains were selected as the subsurface drains because they are more lightweight and more easily transported by helicopter than conventional trench drains (constructed of graded aggregate and perforated pipe wrapped in geotextile). The relative characteristics of geocomposite drains were discussed by McKean and Inouye (*Field Evaluation of the Long-Term Performance of Geocomposite Drains*, December 2000). In 1999, Womack installed 100 feet of experimental Eljen drain on this landslide. Based on the continuous satisfactory performance, Eljen drains were selected for the geocomposite subsurface drains. On the McClain Creek landslide project, a total of 2,190 feet of Eljen drains were installed at 14 locations. Drain lengths varied from 50 to 260 feet with a typical trench depth of 6 feet (figure 2). In addition, about 2,000 feet of lined ditches were constructed at 9 locations to divert surface water off the landslide. The Eljen drain panels used were 4 feet high by 10 feet wide. They were folded and transported, two panels per package (about 2.5 feet by 1 foot by 4 feet), and weigh about 30 pounds. The heat-sensitive panels had to be stored in a shady location until installation.

Figure 2. *Installation of Eljen drains in depositional zone.*

To assemble the Eljen drains, 4-inch perforated ADS (Advanced Drainage Systems) pipe was run through the bottom of the 4- by 10-foot panels, and the panels were pinned together. Typically, the entire assembly was dropped in the trench, and staked at the proper grade for backfilling operations (figure 3). A section of HDPE (high-density polyethylene) liner overlapped the Eljen panels to intercept and direct the flows above the panels into the Eljen drains. The downstream ends of the Eljen drains were connected to 4-inch solid ADS piping, or “collector pipes” (figure 4). The collector pipes were then routed to a location where the outflow could be monitored and directed off the landslide. For design purposes, the total drain length for any single collector pipe was limited to 300 feet. The surface water drainage systems were constructed by berming up the sides of the ditch after backfilling operations, then placing a 20-mil HDPE liner over the shaped ditch (figure 5). Initially, the HDPE liner was cut to 6-foot widths, but using 9-foot widths made the installation more efficient.

Figure 3. *Eljen drain panels staked at grade, middle site.*

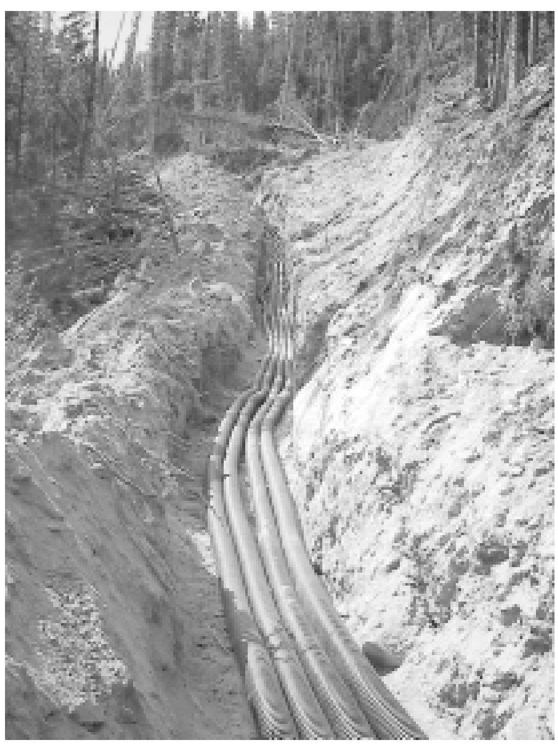

Figure 4. *Collector pipes that drain upper site, located along west pressure ridge.*

Figure 5. *Installing HDPE liner over bermed ditch to divert surface water runoff from the landslide.*

The settlement agreement required a monitoring program to evaluate the effectiveness of the overall project. Monitoring stations were installed throughout the landslide, mainly along the west perimeter of the slide (figure 6). These stations allow measurements of the subsurface ground water collected by the Eljen drains, the surface water being diverted off the landslide by the lined ditches, and the total flow in the various channels, which eventually feed into McClain Creek.

Figure 6. *Monitoring station to measure ground water and surface water flows drained from the middle site.*

Brief Construction Summary

Prior to startup, all construction materials had been procured by the Forest Service and delivered by helicopter to various sites throughout the slide. Materials delivered onsite included Eljen drains, ADS piping and fittings, and several rolls of HDPE liner. The contractor's fuel for the spider hoe was also delivered by helicopter in three 55-gallon drums.

Work was started on the lowest Eljen drain (between the upper and lower roads). This location was the steepest section of the slide in terrain and would have been difficult to excavate under adverse weather conditions. Trenching operations were relatively straightforward for this drain because the ground conditions were dry throughout the length of the trench. The Eljen drain panels were installed on the uphill side of the trench, then backfilled on the downhill side, in accordance with the manufacturer's specifications (figure 2). After backfilling, the spider hoe excavator was used to shape the surface drainage ditch, and a 6-foot wide HDPE liner was installed over the shaped lined ditch. Finally, the excavator was used to place rock and excavated material to key in the sides of the ditch liner.

Upper Site

The upper site is located at the top of the slide within the vicinity of the headscarp (figure 1). Excavating a trench, through the pressure ridge, between the two monitoring stations for the 8-inch outlet pipe was the first stage. More than 200 feet of 8-inch-diameter solid ADS pipe was installed, then trenching proceeded up the hill for the four 4-inch diameter collector pipes. This piping drains the existing Womack structures and all Eljen drains at the upper site (figure 4).

Trenching operations were difficult for three of the Eljen drains at the upper site because of cave-ins caused by saturated ground conditions and groundwater pooling in the bottom of the trench. Therefore, shorter sections of trench were opened, and the Eljen drains were installed immediately and then backfilled. Extremely wet ground conditions and cave-ins from the old slide debris were also encountered during the excavation for an Eljen drain located directly below the headscarp of the slide. McKean and Inouye (December 2000) discussed similar cave-in problems at wet locations at their evaluation sites and recommended Eljen-type drains so they could be preassembled and installed quickly after excavation. This proved to be correct advice for this project, with one additional observation. Cave-in of the trench wall at saturated locations was almost always on the uphill side of the trench (the direction of ground water flow). To maintain drain alignment, it was necessary to abandon the manufacturer's recommendation and place the drain panels on the downhill side of the trench and backfill on the uphill side over the cave-in debris (figure 7). In deeper trench sections, laborers tied off Eljen panels with bailing twine and lowered them into the trench to maintain their position and grade during backfilling.

Figure 7. *Excavation for Eljen drain located directly below headscarp. Note trench cave-in onto Eljen drain, mid-photo.*

Middle Site

The middle site is located approximately 600 to 1,000 feet downhill of the headscarp below the section of toppled trees and undergrowth (figure 1). This site was selected for additional drains because it still has local unstable slidemass, apparently affected by a different aquifer than the one at the upper site.

Lower Site

The lower site included drainage systems between the middle site and the upper road (figure 1). In addition to Eljen drains extending the entire width of the landslide, lined ditches were installed at closer intervals across the width of the slide to ensure that sufficient surface water is diverted off of the landslide before it reaches the steeper slope below the upper road. After a Parshall flume was located along the upper road, the original work was completed on October 10, 2001.

Additional Work in Depositional Zone

The depositional zone is located between the upper and lower roads. This section contains the steepest slopes on the slide—more than 45 percent. These steep slopes were caused by the eroded material from above, which was deposited in a "bulging" shape near the toe of the slide, hence the name "depositional zone" (figure 8). To control erosion in this steeper section, 15 check dams, constructed from native materials (rocks and dead trees), were added to the original work. This phase of work was completed October 17, 2001.

Figure 8. *Spider hoe excavator in depositional zone, located between the upper and lower roads.*

Project Data

Total Length of Eljen Drains Installed:	2,190 feet
Total Length of Lined Ditches:	2,100 feet
Engineer's Estimate:	$93,000.00
Contractor's Bid:	$74,188.09
Final Construction Cost:	$89,651.28
Materials Cost:	$24,950.72 (purchased by Forest Service)
Contractor:	All Terrain Excavating, Inc., Polson, MT
Contract Time Began:	August 21, 2001
Contract Completed:	October 17, 2001
Contract Days Allowed:	60 Calendar Days (actually used 58 calendar days)

Changes were made during construction to the lengths and locations of some of the Eljen drains and lined ditches in the original plans and specifications. The final constructed lengths and locations of drainage systems are reflected in an as-built drawing in the final construction report. To obtain a copy of this report or more information related to this project, contact Terri Anderson at the Bitterroot National Forest, 406-363-7112.

Plans for Revegetation and Continued Monitoring

To develop a plan to meet the revegetation requirements in the settlement agreement, Thomas Parker of Bitterroot Restoration Inc. prepared a draft proposal, dated July 2001, to revegetate the McClain landslide within 5 years. His proposal included establishing native vegetation and fixing soil nutrients, providing for soil surface protection using erosion control blankets, and controlling runoff by using contour wattles, rock fill, or log cribs. In late summer and fall of 2001, the Forest Service botany crew started implementing this plan by planting 700 shrubs in bare areas throughout the slide, installing straw wattles, and strategically scattering logs to control surface erosion. The crew also installed two experimental erosion-control-blanket test plots in a raw area of the slide directly above the upper road. The revegetation plan implementation is likely to continue through 2005, with evaluation and modification of revegetation and erosion control measures each field season to improve their effectiveness and ultimately meet the settlement agreement objectives.

A plan to monitor the effectiveness of the Forest Service in meeting the requirements in the settlement agreement was developed and a general outline of the plan was included in the Environmental Assessment, March 2001. The results of this monitoring program will provide the basis for determining project effectiveness, and help determine whether or not additional mitigation measures are necessary.

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United States District Court, District of Montana, Missoula Division, November 1998. *CV 96-61-M-CCL, STIPULATION FOR COMPROMISE SETTLEMENT AND RELEASE OF FEDERAL TORT CLAIMS ACT CLAIMS PURSUANT TO 28 U.S.C. 2677.*

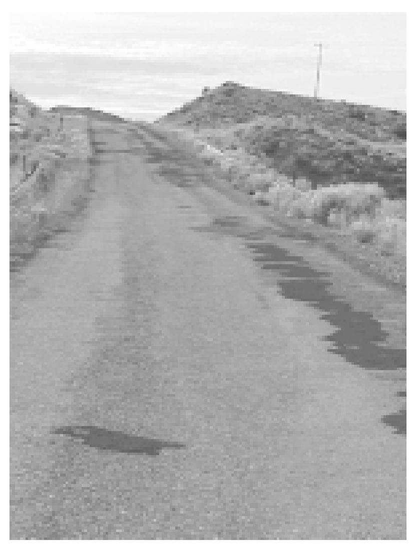
Public Forest Service Roads— A "Service First" Approach To Managing Our National Forests

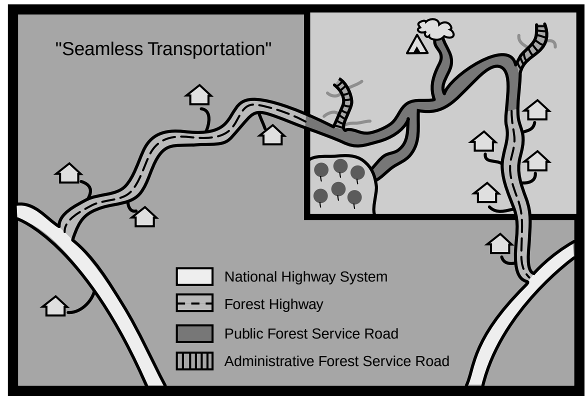
Thomas L. Moore
Transportation Development Program Manager
Washington Office

Every now and then a unique opportunity arises that can dramatically improve the United States Department of Agriculture (USDA) Forest Service's ability to provide true customer service for millions of people. These opportunities usually require a dramatic change in the way Forest Service professionals think and behave and generally involve an element of risk; both to the Agency and to its staff. Although adherence to time-tested concepts and ideas are low risk, in order to realize true measurable gains, Forest Service professionals must consider new ways of doing business. The Public Forest Service Roads concept provides one of these unique opportunities that can truly improve service to the public.

More than 200 million people visit the National Forests each year. Whether skiing, hiking, fishing, hunting, or touring backcountry roads access is required for all of these activities. People are habitual by nature, usually returning to their favorite recreational location time and time again. Most of the public assumes that access, and the quality of their journey, will remain unchanged throughout time.

Unfortunately, due to changes in agency programs and declining budgets, many of the 81,000 miles of roads now available for use by passenger cars are rapidly decaying to the point that the public is finding it difficult to negotiate the potholes and ruts, thus jeopardizing a safe and enjoyable experience that most take for granted. In fact, recent estimates indicate that access for passenger cars on the National Forests is declining at the rate of 1,000 miles per year. Roughly half of the existing National Forest transportation system is now in "poor" condition. This is substantially higher than the current national average of 10 percent in poor condition, which includes State, county and other Federal agency roads. Recent studies show that by the year 2020, assuming static budget levels, road conditions will further deteriorate to the point that the majority of the main access roads will be in poor condition.





"Seamless transportation" is a concept that many transportation organizations are attempting to achieve, promulgated by recent public demands for providing quality access; both in urban and rural areas. Seamless transportation involves providing a safe, efficient, and enjoyable transportation experience for the public from their place of origin to their destination, irrespective of who owns or manages the roads. In many areas of the country, this goal is mostly achieved until reaching the boundaries of the National Forests, where road conditions often decline dramatically. Today's transportation organizations and professionals are seeking to practice seamless transportation more often than in years past. The public's opinion of the quality of the journey is based upon the total trip, not just their travel on the most highly used roads. This change in opinion affords land management agencies such as the Forest Service new opportunities for pursuing funding sources and seeking permanent access to realize the goals of seamless transportation.

To achieve seamless transportation, additional funding and a renewed commitment to ensuring access to the National Forests are necessary. The Public Forest Service Road (PFSR) program is an obvious answer. Designating main access roads as "public roads," guarantees that roads will remain open and available for generations of users without hindering the Forest Service's ability to temporarily close roads for important reasons, such as emergencies, extreme weather conditions, to protect wildlife or to protect the road facility. Designating roads as "public roads" allows for new funding sources using Highway Trust Funds (HTF) similar to how most State and many county roads are funded and provides new opportunities beyond just highways. Transit funds can be used to build turnouts for buses, bicycle staging areas, bicycle lanes, ferries and terminals, and a variety of other transit-related opportunities along National Forest System roads that are public roads. To compete for these funds, the facility must be designated as a "public road" and managed according to the same laws and regulations as State highways.

In 1998 the Forest Service was designated as a public road authority. Inclusion of PFSRs in the next Highway Bill, with designation of many of our roads as "public roads," would provide new and guaranteed sources of funding that are currently unavailable, thereby allowing for significant improvements to the National Forest road system. It would also require that we develop corresponding transportation management systems for road and bridge condition, and safety and congestion systems for monitoring our roads that are required by the States and many counties. The cost to perform these functions would be funded by HTFs. In all respects, the Forest Service and its road system would be on an equal footing with State Department of Transportation roads. As a result, the Forest Service's ability to meet the public's goal of seamless transportation would be enhanced immeasurably.

As stated in the opening paragraph, most unique ideas are not without an element of risk; or at least perceived risk. Also, additional responsibilities exist for the Forest Service, some which may be difficult to fulfill. Three of the most often cited potential risks or areas of additional responsibilities specific to implementation of a PFSR Program are:

- **Possible Increased Tort Liability** – designation of a National Forest System road as a "public road" may induce increased tort liabilities. Consultation with the Office of General Counsel suggests that there should be no difference in litigation outcome whether a road is designated public or remains administrative. However, the degree or validity of risk will not be clear until many years after the program is implemented.

- **Increased Management Responsibilities** – designation of public roads requires a heightened responsibility for maintaining the system at tolerable safety and environmental standards. When HTFs are involved, the United States Department of Transportation (DOT), Federal Highway Administration (FHWA) is required to provide oversight for how the facility is managed and maintained. Since most of the 60,000 miles of potential PFSRs are the most highly used roads in the National Forest System, this should not be a deterrent.

- **Resource Management Implications** – Roads designated as public have certain restrictions and cannot be managed in the same manner as administrative roads. Public roads must remain open except for emergencies, extreme weather conditions, or scheduled closures. However, annually scheduled wildlife closures, such as for goshawks or Peregrine Falcons, are permissible. Because most candidate public roads are high-use arterial and collector routes, where unscheduled road closures rarely occur, such roads are unlikely to conflict with forest plans and road management objectives. However, if or when resource objectives change for the road, it can be removed from public road status and returned to administrative status. If HTFs have already been spent on the road facility while designated as a public road, the funds may have to be returned to the FHWA.

Although there are some potential risks and concerns with the program, the benefits are numerous. A few of the benefits that can be cited are:

- **Additional Funding Sources** – as stated earlier, designation of roads as public roads qualifies them for receiving Highway Trust Funds that are generated by Federal gas taxes. Opportunities for eligibility are numerous.
  - **Reauthorization of Highway Bill** – The USDA Forest Service is attempting to secure $2.4 billion over 6 years through reauthorization of the next Highway Bill in 2004. Whether these efforts will be successful should be apparent by mid-2004.
  - **Public Land Discretionary Fund** – PFSRs are eligible to compete for HTFs through this FHWA-sponsored program and managed through the States. The USDA Forest Service was successful last year in getting two Kentucky PFSRs funded through this source.
  - **Surface Transportation Enhancement Funds** – designation as public roads would improve the Forest Service's ability to compete for funding opportunities for fish passage structure rehabilitation,

construction of recreational kiosks and scenic overviews, and other eligible enhancements.
  - **Highway Safety Funding** – States currently receive funding for developing and maintaining broad safety programs resulting in products such as videos and brochures for the public dealing with safety issues. Designation of a large amount of public roads would help qualify the Forest Service for receiving a fair portion of these funds.
  - **Transit Funding** – Public Roads are eligible to receive transit funding. This funding source is rapidly growing due to changes in demographics and the public's desire to use mass transit. Eligible activities include parking lot construction, ferries and terminals, bus turnouts, brochures, signage, bicycle lanes adjacent to forest roads, and so on.

- **Partnerships with States/FHWA** – Designation of public roads provides a "place at the table" with other transportation organizations. This can include better tools for managing the transportation system, better partnerships with State DOTs and local governments in pursuit of seamless transportation, admittance as full team members in development of transportation policy issues that affect the road facility as well as environmental efforts, such as streamlining, fill-and-dredge permitting processes, use and application of wildlife crossings, and other priorities. Improved relationships with other transportation agencies would have a myriad of intangible benefits, including the ability to persuade States to recognize transportation issues that affect National Forest System Lands, more fruitful discussions on controversial issues, and the ability to share resources between State and Federal agencies.

- **Protection of Resources** – no matter how you cut the cards, the only way to reduce surface sediment into streams and keep roads from falling off hillsides is to keep roads well-maintained and correct impending failures before they occur. Because currently we do not receive enough funds to do proper maintenance, the resources will continue to suffer until additional funding sources are found. In addition, new requirements for mitigation of resource impacts caused by roads, such as fish passage and wildlife crossings, will require additional funding sources.

- **Economic Stabilization and Diversification of Rural Communities** – although this is difficult to validate, the FHWA has recently reported that 100 jobs are created for every $40 million of highway projects. This can add a significant boost to the economies of small communities that are struggling to survive recent cutbacks in the timber program.

Whether or not the Forest Service is successful in getting the PFSR category through reauthorization of the next Highway Bill, the Forest Service can and will continue to designate National Forest System roads as public. As forest managers weigh the benefits against the shortfalls and risks associated with this designation, many will find that it is worth the risk.

The PFSR program is one avenue for providing a safe, seamless, and enjoyable traveling experience for visitors accessing the National Forests while simultaneously ensuring permanent access for future generations.
It is worth the risk!

Supporting the Burned Area Emergency Response (BAER) Program with Remotely Sensed Imagery

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Introduction

In the immediate aftermath of a wildfire, a Forest Service Burned Area Emergency Response (BAER) team is dispatched to the site to do an initial assessment of burn severity and to estimate the likely future downstream impacts due to flooding, landslides, and soil erosion. One of the first tasks for this team is the creation of a burn severity map that highlights the areas of high, moderate, and low burn severity. This map then serves as a key component in the subsequent flood modeling and Geographic Information System (GIS) analysis.

Traditionally, the BAER burn severity map was created by sketch mapping on a topographic map—or even a forest visitor map—from a helicopter or road-accessible overlook. With this method, location accuracy and wall-to-wall coverage were often difficult to come by. As a result, BAER burn severity mappers began researching ways to obtain a single image of the burned area at or near the time of the fire's containment.

In 1996, the Remote Sensing Applications Center (RSAC), in conjunction with several experienced Forest Service hydrologists and soil scientists, tested an airborne color infrared digital camera for its ability to quickly record postfire condition (Lachowski et al 1996). The resulting image mosaic proved useful and led to further refinement of the technique—eventually culminating in the commercialization of the product. Today, BAER team leaders can hire approved contractors to quickly fly and build a digital image of a burned area.

However, inherent limitations to these airborne digital image mosaics caused BAER mappers to seek further improvements. In 2001, RSAC agreed to evaluate a variety of other platforms and sensors for use in BAER burn severity mapping. The project team collected data from moderate- and high-resolution satellites, as well as from fixed-wing hyperspectral and multispectral sensors. Eventually, the difficulties with scheduling rapid acquisition and delivery of fixed-wing data prompted further research into the capabilities of satellite data as a more likely alternative.

Discussions began on the possibility of rapid acquisition and delivery of satellite data with various vendors and satellite operators. (Prior to the start of this project, data delivery times varied from 2 weeks to 2 months.) After explaining the limitations of airborne digital image mosaics to the data providers, we discovered that same-day or next-day delivery of satellite data was possible. We tested that possibility over the course of the 2001 fire season by ordering rapid acquisition and delivery of satellite images for about 15 National Forest burned areas. We obtained imagery from six different moderate- to high-resolution sensors during that fire season including Landsat 7, Landsat 5, SPOT 1, SPOT 2, SPOT 4, and IKONOS.

While the results were mixed and delivery was not always as smooth as planned, we succeeded in providing very timely and useful data to a number of BAER teams during 2001. As a result, we received funding from the National Fire Plan to reprise our service for the 2002 fire season. That funding allowed us to upgrade our hardware and software capabilities to better meet the demand for operational support. For 2002 we provided daily satellite tracking, ordering, and processing services to dozens of Forest Service BAER teams as well as onsite support in a number of cases. The almost universally positive response from the field has encouraged us to continue to offer these services during 2003 and beyond.

What We Provide

Despite the frequent media portrayals of complete devastation, the typical wildland fire burns at varying levels of intensity depending on weather and fuel conditions. As a result, the postfire burned area will be a mosaic of unburned islands, light understory burns, and high- and moderate- severity patches. It is the job of the BAER burn severity mapping team to locate these areas and produce a full coverage four-class burn severity map. The classes are high severity, moderate severity, low severity, and unburned. RSAC assists in this process by delivering a number of satellite-derived products to BAER teams in the field.

Preliminary Burn Severity

Our preliminary burn-severity product is developed using any of a number of band ratios depending on the type of imagery we've acquired for a particular fire. The most common and well known of these are the NDVI and the NDBR. These ratios have been proven effective for highlighting burned area conditions. We classify the resulting ratios using an ISODATA clustering routine and visual interpretation. The final product is a georeferenced four-class burn severity map in raster and vector formats that is delivered via File Transfer Protocol (FTP), Compact Disk, or hard copy poster. The product is "preliminary" and requires field verification by experienced soil scientists and/or hydrologists.

Imagery

In addition to our preliminary burn-severity product, we also supply BAER teams with a georeferenced copy of the satellite image itself in both digital and poster formats. This allows the BAER team to do its own digital image processing if there are team members with the necessary skills. It also serves to provide a synoptic view of the entire burned area for team and public meetings. Finally, it can be used as a basemap for traditional sketch mapping if the BAER team mappers are uncertain of the accuracy of our initial burn severity product.

Three-Dimensional Visualization

For very large fires or special requests, we have the tools to build three-dimensional (3d) visualization products for the BAER teams. These include 3d .jpegs and posters as well as short “fly by” movies. While not necessarily useful for GIS analysis, these products are effective public relations tools.

Technical Support

Once our products are available to field users, we work to help them understand the products and how they can best be utilized. This is frequently done over the phone or via e-mail, but we also provide onsite support by request. During 2002, we worked on location with BAER teams at the East Fork and McNally Fires, among others. These collaborations provide an opportunity for us to learn about the BAER process and to develop more useful products.

Image Archive

Finally, as a byproduct of our image-acquisition program we have developed an extensive image archive that is available for future projects such as burned area monitoring. Depending on data licensing restrictions, these data may be shared with other agencies and organizations. All of the images that we collected during 2002 can be viewed on our Web site at http://firemapper.fs.fed.us/baerfire/baer.html.

2002 Case Studies

The RSAC BAER support team provided Landsat 7, SPOT 4, IKONOS, and Quickbird data to over 70 incidents during the 2002 fire season. Since many fires required several images for full coverage, we processed and posted more than 120 separate image files to our Web page and ftp site. These files included data for burned areas as small as 500 acres. Our most successful images, however, were obtained for several of the very large wildland fires that burned during 2002. A couple of those are described below.

Missionary Ridge, CO

On June 9, 2002, the Missionary Ridge Fire ignited on the San Juan National Forest about 10 miles north of Durango, CO. By the time it was contained on July 17, it had grown to more than 70,000 acres—much of it in steep terrain. The BAER team had assembled by the end of June. To assist the team, RSAC obtained several images, two of which were used extensively for burn severity mapping and for public information.

On June 23, Space Imaging collected an image of the fire with its IKONOS satellite. We purchased both the 4-meter multispectral and the 1-meter panchromatic data from them. After merging these two data sets, we delivered a 1-meter multispectral image to the BAER team. These were huge digital files with very fine detail. This sort of imagery is not very useful for automating ratios and classifications, but it was used effectively to demonstrate to the public the values at risk from postfire landslides and flooding—both of which occurred after the first big rain event. (On 1-meter data homes and individual tree crowns are clearly visible.)

On June 30, a Landsat 7 image was acquired by the EROS data center. We purchased it on July 1 and produced a preliminary burn severity map for delivery on July 2. This was a 30-meter data product on which individual homes were not visible, but broad areas of high, moderate, and low severity were delineated. On July 3, two RSAC BAER support staff members went to Durango to work directly with the BAER team. While there, we worked to modify the burn severity map, collected ground verification data points, and developed 3d visualizations using the IKONOS data.

The results of our work on Missionary Ridge were very positive. From the ground control data points we collected, we estimated that our preliminary severity map was about 70 percent accurate. Some BAER team members have estimated that this level of accuracy can save them up to 10 days work on a large fire because they can focus their efforts on the areas of confusion between, for example, high and moderate severity. In addition, the onsite work gave us the opportunity to collaborate with the BAER team on changes to the burn severity map and to learn more about their needs.

Biscuit, OR

In the middle of July 2002, several small fires ignited on the Siskiyou National Forest in southwestern Oregon. Originally called the Biscuit Complex, these small fires eventually merged and became the huge—half million acre—Biscuit Fire that was finally contained on September 5. The BAER team began assembling in late August, but it wasn't until the first week of September that their work began in earnest. By that time, RSAC had collected three Landsat images of the fire, two of which were eventually used by the team.

On August 14, the EROS data center obtained a smoky image of the Biscuit Fire that we purchased on August 15. The fire was estimated at about 400,000 acres. While there was still a lot of active burning and a fair amount of haze due to smoke, we produced our first preliminary severity map for use by the initial BAER team members late on August 15. This first image and severity product gained importance the following week when southwestern Oregon was visited by several high level delegations from Washington, DC. While we were uncertain of the validity of our map because of the poor conditions under which it was created, it was the best available map at the time. Fortunately, a couple days of reconnaissance by a few staff members around this time confirmed that our initial product was reasonably accurate and useful.

Then, on August 30, EROS data center obtained another Landsat image. This one was almost 100 percent smoke free, and the fire was estimated at about 499,000 acres—very close to its final size. We repeated our severity mapping processing and issued a new "preliminary" severity map by August 31st. Fortunately, this map was similar to our original product. After several helicopter reconnaissance flights by the primary BAER team mapper and a few days of editing, the burn severity map was finalized.

Once again, the feedback was positive. For a fire of this size, the traditional methods of mapping via helicopter or road overlook were unlikely to be practical. Other options, including high-resolution fixed wing mosaics or IKONOS images were likely to be very expensive, large, and time consuming. A 30-meter, landsat-derived, burn-severity map was probably the best possible solution in this case and, with it, the BAER team was able to complete its work in record time.

How to Obtain Assistance

It is important for BAER teams to contact us early in the process so that we can negotiate acquisition and delivery with our data providers prior to the team's deadline. We are always tracking fires and satellites, but imagery will not be purchased until it has been requested by the BAER team. On the other hand, it is reasonable to wait until the fire's progress has slowed and there is some expectation of containment. During 2002, we purchased several images that were probably too early and too smoky to be useful. Also, some requests—no matter how well timed—will go unfilled due to clouds obscuring the view. If it is cloudy over our area of interest on the day of acquisition, we will be unable to help the BAER team.

The BAER team leader can help us provide appropriate satellite image support by providing the following information:

- Designate a contact person equipped with good computer and GIS skills, if possible, to help us coordinate effective digital delivery and troubleshooting.
- Advise us of any special products the team may need. For example, we can provide just the classification or we can provide a number of other products including hard copy plots and 3d visualizations.
- Alert us to special circumstances such as remote locations inaccessible to FedEx or GIS teams working outside the Forest Service firewall.

With these things in mind, it is easy to start the ball rolling: Simply give us a call or send us an e-mail.

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Mark Saurer	msaurer@fs.fed.us	801-975-3822
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More Information on BAER

Additional information on the BAER program can be found at: fsweb.gsc.wo.fs.fed.us/baer/.

Bibliography of Publications from Washington Office Engineering and Detached Units

This bibliography contains information on publications produced by the Washington Office Engineering staff and its detached units. Arranged by series, the list includes the title, author or source, document number, and date of publication.

This issue lists material published since our last bibliography (*Engineering Field Notes,* Volume 33, July–December 2001). Copies of *Engineering Field Notes,* and most Engineering Management Series documents can be obtained from the Washington Office Engineering staff or from the Forest Service Intranet at http://fsweb.wo.fs.fed.us/eng/pubs/efn/efn.cont.htm. Copies of reports, *Tech Tips,* and videotapes can be obtained from the center listed as the source. A number of special reports, sponsored by the Geospatial Executive Board and authored by Geospatial Advisory Committee (GAC) teams, are available through the Geospatial Service and Technology Center (GSTC) and the Remote Sensing Applications Center (RSAC).

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Publications

Engineering Management Series and other Publications

The Engineering Management (EM) Series contains publications serving a purpose or reader and publications involving several disciplines that are applied to a specific problem.

Engineering Field Nots (EFN)

This publication, which is published every 6 months, provides a forum for the exchange of information among U.S. Department of Agriculture (USDA) Forest Service personnel. It contains the latest technical and administrative engineering information and ideas related to forestry.

EFN by Title (Volume 34)

2001 *Engineering Field Notes* Article Award Nominations	Editor (January-June 2002): 36-38
2001 *Engineering Field Notes* Article Award Winners	Editor (July-December 2002): 5
2001 Forest Service Engineers of the Year Awards	Editor (January-June 2002): 16–35
Alexander G. (Sam) Morigeau Deputy Director of Engineering	Morigeau, Alexander G. (Sam) (January-June 2002): 3
Bibliography of Publications from Washington Office Engineering and Detached Units	Editor (July-December 2002): 33-42
EFN Goes Electronic	Editor (July-December 2002): 1
Engineering Field Notes Guidelines for Authors	Editor (January-June 2002): 39
INFRA To Celebrate 10th Anniversary and Launch Infra 5.0	Bodin, Claudine (January-June 2002): 4-8
Juggling Resources To Maintain and Improve Engineering Excellence	Stokes, Vaughn (July-December 2002): 3–4
McClain Creek Landslide: Installation of Drainage Systems, August to October 2001	Anderson, Terri and Prellwitz, Rodney (July-December 2002): 11–21
Public Forest Service Roads—A “Service First” Approach To Managing Our National Forests	Moore, Thomas L. (July-December 2002): 23–26

Rising From the Ashes	Devlin, Sherry (July-December 2002): 7–10
Satellite Remote Sensing for the 2002 Winter Olympic Games	Greenfield, Paul H. (January-June 2002): 9-15
Supporting the Burned Area Emergency Response (BAER) Program with Remotely Sensed Imagery	Orlemann, Andrew (July-December 2002): 27–31
Working Together	Stokes, Vaughn (January-June 2002): 1-2

EFN by Author (Volume 34)

Anderson, Terri and Prellwitz, Rodney	McClain Creek Landslide: Installation of Drainage Systems, August to October 2001 (July-December 2002): 11–21
Bodin, Claudine	INFRA To Celebrate 10th Anniversary and Launch Infra 5.0 (January-June 2002): 4-8
Devlin, Sherry	Rising From the Ashes (July-December 2002): 7–10
Editor	2001 *Engineering Field Notes* Article Award Nominations (January-June 2002): 36–38
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Morigeau, Alexander G. (Sam)	Alexander G. (Sam) Morigeau Deputy Director of Engineering (January-June 2002): 3
Orlemann, Andrew	Supporting the Burned Area Emergency Response (BAER) Program with Remotely Sensed Imagery (July-December 2002): 27–31
Stokes, Vaughn	Juggling Resources To Maintain and Improve Engineering Excellence (July-December 2002): 3–4
Stokes, Vaughn	Working Together (January-June 2002): 1–3

Other EM Publications

Title	Number	Source	Date
Facilities Planning (electronic only) (http://fsweb.wo.fs.fed.us/eng/eng_man_pubs/EM73104_FacilitiesPlanning.pdf)	EM-7310-4	WO	05/02
Timber Sale Contract Administration for Construction Inspectors and Engineering Representatives Self-Study Guide (electronic only) (http://fsweb.wo.fs.fed.us/eng/pubs/ccp/ssg.htm)	EM-7115–502-100	WO	03/02

Reports

Project Reports

Title	Number	Source	Date
New Technique for Segmenting Images (by Bonnie Ruefenacht, Dave Vanderzanden, Michael Golden, and Mike Morrison)		RSAC	02/02
Geographic Resampling, Nearest Neighbor, Bilinear Interpolation, Cubic Convolution (by Donald T. Evans and Brad Quayle)		RSAC	04/02

Overview of Most Similar Neighbor (MSN) Analysis (by Nicholas Crookston, Melinda Mouer, David Renner, and Karen Owens)		RSAC	04/02
Helicopter Cargo Hook Safety Link (by Carl Bambarger)	0257–1201	SDTDC	06/02
Riparian Protection and Restoration: Road Design Techniques (by Jim Bassel)	0223–1202	SDTDC	09/02
Anadromous Fish Strainers For Use in Wildland Drafting Operations by Lois Sicking)	0251–1203	SDTDC	09/02
EPA and CARB Emission Standards To Control Nonroad Exhaust Emissions in Pumps and Chain Saws (by Lois Sicking)	0251–1204	SDTDC	09/02
BAER Necessities for Hydrologists and Engineers: A Guide to Basic Burned Area Emergency Rehabilitation Treatments (by Jeff Moll)	0277–1205	SDTDC	09/02
Large Scale Photography—An Initial Look Into the Application and Results of Large Scale Photography (by Kevin Megown, Julie Caylor, Mark Finco, Gretchen Moisen, Bob Simonson, and Barry Bollenbacher)		RSAC	09/02
Using IKONOS Satellite Imagery for Spruce Beetle Mapping (by Jan Johnson, Paul Greenfield, and Jim Ellenwood)		RSAC	09/02
Visual Learning System's Feature Analyst: A Forest Service Beta Test (by Dave Vanderzanden and Mike Morrison)		RSAC	09/02
MrSID and ECW Image Compression Comparisons (by Dave Vanderzanden and Mike Morrison)		RSAC	10/02
Remote Sensing Applied to Ecosystem Management (in Guidebook for Integrated Ecological Assessments) (by Henry Lachowski and Vicky Johnson)		RSAC	2002

Remote Sensing Tips

Title	***Number***	***Source***	***Date***
New Approaches for Monitoring Stream Temperature: Airborne Thermal Infrared Remote Sensing (by Paul Maus, Henry Lachowski, and Russell Faux)	RSAC-23	RSAC	2002

Assessing Watershed Conditions Using Remote Sensing and Geographic InformationSystem(by Michael Williamson, Haans Fisk, Henry Lachowski, Edward Reilly, and John Proctor)	RSAC-24	RSAC	01/02
Detecting Historic Changes in Sage Grouse Habitat Using Remote Sensing and GIS(by John Gillham, Bonnie Ruefenacht, Haans Fisk, and Henry Lachowski)	RSAC-34-1	RSAC	01/02
Converting a Historical Aerial Photograph To Use With a Digital Image Processing System: A Comparison of Two Methods (by John Gillham, Bonnie Ruefenacht, Haans Fisk, and Henry Lachowski)	RSAC-34-2	RSAC	01/02
Remote Sensing Tools for Burned Area Emergency Rehabilitation (BAER) (by Tom Bobbe, Mark Finco, Paul Maus, and Andrew Orlemann)	RSAC-43	RSAC	2002
Application of Scanned High Resolution, GPS Controlled Large Scale Aerial Photography to a Forest Inventory (by Julie Caylor, Kevin Megown, Mark Finco, Bob Simonson, Barry Bollenbacher, Doug Bergland, Ken Brewer, Gretchen Moisen, and Larry DeBlander)	RSAC-4001	RSAC	05/02

Tech Tips

Title	**Number**	**Source**	**Date**
Striping Parking Areas on Unpaved Surfaces (by Marty Willbee)	0223–1314	SDTDC	06/02
Backpack Archeology Screen (by Ellen Eubanks)	0223–1316	SDTDC	07/02
Two-Cubic-Yard Bearproof Dumpster (by Lester Sinclair)	0223–1319	SDTDC	09/02
SST Installation Guide (by Brenda Land)	0223–1320	SDTDC	11/02
Crosscut Saw Tooth-Setting Tool (by Bob Beckley)	0223-2324	MTDC	07/02
Monitoring the Temperature of Tree Seedlings with the Thermochron iButton Data Logger (by David S. Gasvoda, Richard W. Tinus, Karen E. Burr, and Andy Trent) http://fsweb.mtdc.wo.fs.fed.us/pubs/htmlpubs/htm02242311/	0224-2311	MTDC	03/02

Air-Kwik Air Powered Firefighting System (by Dale Dague)	0251–1301	SDTDC	09/02
Pulaski and Combination Tool Skilled Grubbing Technique Training Program (by Lois Sicking)	0251–1302	SDTDC	09/02
Pulaski Tool Sheath—A Method To Loosen Up Hoe and Ax Sheath Ends (by Lois Sicking)	0251–1303	SDTDC	06/02
Lightweight Pressure Regulator With Gauge to Reduce Pressure in a Downhill Hose Lay (by Lois Sicking)	0251–1304	SDTDC	06/02
New and Improved Flap Cup Grinder Disc for Sharpening Fire Handtools (by Lois Sicking)	0251–1305	SDTDC	06/02
Water-Gate Instant Water Barrier (by Ralph Gonzales)	0251–1306	SDTDC	06/02
Hardline Hose Comparison Study (by Lois Sicking)	0251–1307	SDTDC	09/02
Remotely Activated Structure Pump (by Fred Cammack)	0251–1315	SDTDC	06/02
The Use of Air Curtain Destructors For Fuel Reduction (by Al Schapiro)	0251–1317	SDTDC	09/02
How To Calculate Nozzle Reaction and Secure Hose When Service Testing Fire Pump Systems on Fire Apparatus at High Flow Rates (by Lois Sicking)	0251–1318	SDTDC	09/02
Feeding the Wildland Firefighter (by Brian Sharkey, Brent Ruby, and Carla Cox)	0251–2323	MTDC	07/02
Personal Safety in Remote Work Locations: Supervisor Responsibilities (by Jon Driessen and Lisa Outka-Perkins)	0267-2316	MTDC	06/02
Making Your Web Site and Other Electronic Documents More Accessible (by Michelle Beneitone, Jacob Cowgill, and Bob Beckley) (electronic only)	0271–2304	MTDC	03/02

Special Reports

Title	Number	Source	Date
Geospatial Technology Core Competencies (by Geospatial Advisory Committee (GAC) Focus Area Three Team)	Unnumbered	GSTC	02/01
Floating Trail Bridges and Docks (by Jason Neese, Merv Eriksson, and Brian Vachowski)	0223–2812	MTDC	07/02
Smallwood II (by Andy Horcher)	0224–1802	SDTDC	09/02
Reforestation and Nurseries Level 1 (by Andy Trent)	0224–2805	MTDC	04/02
DataRAM 2000 Particulate Monitor: Forest Service User's Guide (by Mary Ann Davies)	0225–2803	MTDC	04/02
MTDC Air Program News #2 (by Andy Trent) (electronic only) (http://fsweb.mtdc.wo.fs.fed.us/programs/wsa/air_news/issue2.htm)	0225–2807	MTDC	01/02
DataRAM4 Particulate Monitor: Forest Service User's Guide (by Mary Ann Davies)	0225–2810	MTDC	07/02
Access Guide for Incident Facilities (by Dale Dague)	0251–1801	SDTDC	06/02
Crew Cohesion, Wildland Fire Transition, and Fatalities (by Jon Driessen) http://fsweb.mtdc.wo.fs.fed.us/pubs/pdfpubs/pdf02512809 pdf02512809.pdf	0251–2809	MTDC	02/02
Wildland Firefighter Health & Safety Report No. 5 (by Brian Sharkey) http://fsweb.mtdc.wo.fs.fed.us/pubs/htmlpubs/htm02512815/index.htm	0251–2815	MTDC	07/02
Lessons Learned from the Thirtymile Fire: Training Program (by Tim Lynch) (electronic only) (http://fsweb.mtdc.wo.fs.fed.us/lessons)	0251–2819	MTDC	09/02
Lessons Learned from the Thirtymile Fire: Instructor Guide (by Tim Lynch) (electronic only) http://fsweb.mtdc.wo.fs.fed.us/lessons/slides/insGuide.htm	0251–2820	MTDC	09/02
FS-14 Parachute Packing Instructions (by Pat Wilson)	0257–2814	MTDC	05/02

Treatment of Petroleum-Contaminated Soil in Remote, Cold, Wet Regions (by David L. Barnes, Shawna R. Laderach, and Charlie Showers) (electronic only) (http://fsweb.mtdc.wo.fs.fed.us/pubs/lc/lc02712801.htm)	0271–2801	MTDC	09/02
QuartersTools (by Kathie Snodgrass) (electronic only) (http://fsweb.mtdc.wo.fs.fed.us/toolbox/qtr/index.htm)	0271–2802	MTDC	02/02
T&D News: Winter 2002 (by Bill Kilroy) http://fsweb.mtdc.wo.fs.fed.us/pubs/htmlpubs/htm02712806/index.htm	0271–2806	MTDC	03/02
2001 MTDC Documents Brochure (by Jerry Taylor Wolf)	0271–2817	MTDC	05/02
MTDC: Shaping Solutions for the Forest Service (by Bert Lindler) http://fsweb.mtdc.wo.fs.fed.us/pubs/htmlpubs/htm02712818/	0271–2818	MTDC	06/02
Historic Facilities Tools (by Kathie Snodgrass) (electronic only) (http://fsweb.mtdc.wo.fs.fed.us/toolbox/his/index.htm)	0271–2822	MTDC	02/02
T&D News: Summer 2002 (by Bill Kilroy and Jerry Taylor Wolf) http://fsweb.mtdc.wo.fs.fed.us/pubs/htmlpubs/htm02712828/index.htm	0271–2828	MTDC	08/02
Forest Service Geospatial Strategy (by GAC Focus Area Two Team and Forest Service GeoTeam)	Unnumbered	GSTC	08/02
Tactical Plan for the Forest Service Natural Resource Applications Geospatial Interface (by GAC Focus Area Two Team and Forest Service GeoTeam)	Unnumbered	GSTC	08/02
GIS Core Data Pilot Final Report (by GAC Focus Area One Team)	Unnumbered	GSTC	09/02
Value of Civil Imagery and Remote Sensing (sponsored by the Federal Geographic Data Committee)	Unnumbered	RSAC	10/02

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