



Technologies for Scanning Wilderness Permits

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Introduction

About 27 percent of wilderness managers use some form of visitor-use reporting system (fiscal year 2004 Infra-WILD reporting). In some instances, this information is collected through self-issued, mandatory wilderness permits; in others, it is collected through voluntary self-registration (figure 1). Both approaches require the manager to enter data into a database for storage and analysis. Other forests collect use information when they issue quota-based permits. These systems are not considered in this study because the data typically are entered directly into a database when the reservation or permit is created.

The Wilderness Act of 1964 (PL 88-577) directs the Forest Service to “preserve wilderness character,” which includes providing for “the use and enjoyment



Figure 1—A backpacker registers before entering the Alpine Lakes Wilderness administered by the Mt. Baker-Snoqualmie and Wenatchee National Forests in Washington.

Highlights...

- Wilderness managers may have thousands of handwritten visitor permits to enter in the Forest Service’s Infra-WILD database.
- Entering the permit data manually would take weeks.
- If permits are set up properly in advance, it may be possible to use optical scanning technology to prepare the data for input into the Infra-WILD database.

of the American people” while providing “outstanding opportunities for solitude.” To make informed decisions to protect ecological conditions or to maintain quality wilderness recreational experiences, wilderness managers must have accurate and timely information on the levels and patterns of recreation use.

Some national forests may lack the time or personnel to transfer data from the original hard-copy permit to a database or spreadsheet. Many forests have boxes of self-issued wilderness permits or trailhead registration cards awaiting database entry. In some instances, forests kept the data on the original hard-copy form because they did not have an appropriate database. This need was addressed in 2001 with the release of the Visitor Use Permit System



(VUPS), a module of the corporate INFRA database. This module contains the “Speedo form,” which is easy to customize and was developed to make it easier to enter batches of data. Even though this system is available, many national forests find it difficult to enter their hard-copy data. The ongoing workload is magnified by the data that had been collected but not entered during previous years.

The Missoula Technology and Development Center (MTDC) was asked to see whether scanning technology could automate the task of digitizing wilderness-use data. Although this project is intended primarily for wilderness (figure 2) permits, the technology could apply to cave, backcountry, rafting, and other permits.

Optical Scanning Technologies

Technologies are available to transform written information on paper to electronic information readable by computer. The complexity of the technology varies based on the type and the volume of information being collected. The equipment and software required varies, depending on the technologies selected. Contractors will scan written data and convert it to electronic format. Three types of scanning technologies are used to input written information into an electronic format:

- OMR—Optical mark recognition scanners read a particular kind of pencil or pen mark in a checkbox or a bubble that can be filled in. OMR is the most



Figure 2—Beautiful settings, such as this lake in the Desolation Wilderness of California, draw lots of visitors. Permits are one way of gathering information about wilderness visitors.

common scanning technology and has been available for many years. It is the fastest, most accurate, and cost-effective scanning method. This technology cannot read handwritten, printed, or machine-printed text.

- **OCR**—Optical character recognition scanners transform machine-printed text to an electronic format readable by computer. This technology requires specialized software to convert scanned text images into computer-readable data that can be edited, revised, or used as input for databases. It cannot read handwritten text.
- **ICR**—Intelligent character recognition is similar to OCR, but can read handwritten text and machine-printed information. The software to interpret the handwritten text is more complicated than OCR software, which can only read machine-printed text. Software transforms handwritten information into data readable by computer. ICR is the least reliable scanning technology. Scanning takes longer and requires more operator intervention than OMR or OCR.

Some software can combine more than one of the optical scanning technologies. Simple multiple-choice questions can be scanned using OMR, while handwritten information can be scanned using ICR.

Choosing Scanning Technologies and Services

Any one of the scanning technologies will work for scanning wilderness permits, but several issues should be considered when deciding which technology is best suited for a particular application. The type of information that needs to be collected can best determine appropriate scanning technologies. The complexity of the equipment, software, and forms and the amount of operator intervention required by a particular technology can vary considerably. The required equipment, software, and forms can be purchased to accommodate in-house scanning by a staff member or contractor. Availability of staff and the staff's level of computer skills, along with budgets, can determine the most appropriate technologies for each region or office.

Comparing Scanning Technologies

Because OCR is designed primarily to scan machine-printed text, the OMR and ICR technologies are best suited to scan handwritten wilderness permits or registration cards. Table 1 summarizes the main issues to consider when deciding whether to use OMR or ICR technologies. Some costs are sales representatives' estimates that vary depending on the selected technology, equipment, and vendor.

Choosing the technology that makes sense for a particular application can be difficult. If OMR technology fits a particular use, it will be less expensive, less complex, and more accurate than ICR technology. The basic issue is whether information can be captured using checkboxes or bubbles. The biggest issues with OMR technology relate to the data fields required and the number of choices that must be provided for each field. OMR forms are notoriously inefficient in their use of space. Of greatest concern are the numbers of entry and exit points to the wilderness, and the numbers of potential destinations. For a small wilderness with few access points and few common destinations, an OMR form might suffice.

In many wildernesses, multiple trailheads and a number of popular destinations need to be tracked, making the OMR approach difficult to implement. One potential solution for such wildernesses may be to develop forms for individual trailheads or groups of trailheads. The number of choices on any single form would be within the limits that are practical for OMR. This solution introduces other complexities and is far from perfect.

Any unit's evaluation of scanning technology includes comparing scanning to manual data entry. This comparison can include several factors, such as hourly costs, data entry rates, and accuracy.

- **Hourly costs**—The skill level required for data entry is not high. Hourly costs can be kept low through the use of administrative staff, senior citizen employees (SCSEP), or volunteer staff. Entering certain permit information may require local wilderness knowledge that volunteers might lack.
- **Data entry rates**—Manual data entry rates are difficult to compare with scanning because the

Table 1—Comparison of optical mark recognition and intelligent character recognition scanning technologies.

	Optical Mark Recognition	Intelligent Character Recognition
Permit application	Checkbox or bubble. Good for yes-no and multiple choice questions. Poor for open-ended questions such as names, trailheads, or cities.	Can be designed to read checkmarks and handwritten letters or numbers.
Filling out forms	Easy to fill in bubbles with a pencil or pen, but can be slow and tedious compared to writing.	Forms can be filled in with letters and numbers, but poor handwriting or a poor writing surface will reduce the accuracy of the scanned information.
Equipment	\$6,000 per scanner, which includes software; simple to operate and dependable.	\$5,100 to \$20,000 per station; cost can vary depending on how many forms need to be processed and how quickly.
Software	Included with equipment.	Image scanning software, \$1,450. Windows verification software (to view and correct unreadable text), \$1,749.
Forms (two pages)	Purchase price \$3,500 for 50,000 forms (lower cost for larger purchases or for single-page forms).	Purchase price \$4,000 for 50,000 forms (lower cost for larger purchases or single-page forms).
Processing speed	2,000 to 10,000 forms per hour, depending on the scanner.	1,200 to 7,500 forms per hour depending on the number of characters per sheet, the software, the scanner, and the legibility of the handwriting.
Output accuracy	Almost 100 percent.	Lower accuracy (70 to 95 percent) when permits are scanned initially because of poor writing conditions and the permit's exposure to the elements at sign-in stations. Nearly 100 percent accuracy after operator intervention.
Staff interaction	Minimal, loading the autofeeding machine.	Manual correction is required for any rejected forms. ICR scanners typically hold fewer forms than OMR scanners.
Training	Minimal, 20 minutes, can be done from any office.	\$10,000 for training and services; makes sense to limit the number of people who will process permits.
Maintenance	None to minimal.	Included in personal service and training above.
Distribution	ASCII (computer text) data input into the Oracle Infra-WILD database	ASCII (computer text) data input into the Oracle Infra-WILD database
Outsourcing	17 cents per permit for scanning, \$50 for an output file (per run), 4 weeks to process and return data.	\$500 to set up a form scan (one-time fee), 19 cents per permit for scanning, \$50 for an output file (per run), 4 weeks to process and return data.

proficiency of the person entering the data can vary greatly and the number of fields that need to be entered also varies. As a general rule, a skilled worker can enter about 30 to 60 permits per hour.

- Accuracy—Accuracy rates are difficult to compare, depending on variables, such as the skill level of the person entering the data, the condition of the permit forms that need to be scanned, and the scanning technology used. Generally, if the forms are in good condition, OMR scanning or a well-calibrated ICR system will be about as accurate or perhaps slightly more accurate than a skilled worker entering data.

Form Design

Forms can be designed in-house or by contractors. Most form-design software is similar to database-design software. Unless the user is familiar with such software, the work will not be completed quickly. If many wilderness forms need to be designed, or the forms need many changes, it may make sense to do the design in-house. Typical design software costs around \$1,500 per license.

For most wilderness areas, it probably makes sense to contract form design. Such services cost roughly \$500 per form, depending on the complexity of the information and format. The contractor collects information about form requirements and submits a proof for approval. Changes to an existing form would cost less than creating a new form, with the savings depending on the amount of editing required. Several forests or regions could have forms printed with the same design to reduce design costs. Forms are typically cheaper when purchased in large volumes.

National forests that wish to implement a new permit form need prior approval from the Office of Management and Budget (OMB). Such approval is required whenever Federal employees ask more than nine members of the public the same set of questions. This requirement is waived if national forests use the data fields on the Visitor's Permit (FS-2300-30) or the Visitor Registration Card (FS-2300-32), or a subset of those fields. Requests for clearance are processed through the Washington Office and typically take several months for approval.

Form Printing

Optical scanning requires specialized forms. The forms must be printed clearly and accurately or they will be rejected when scanned. Good quality forms require high-cost, accurate laser printers. Most wildernesses use a snap sheet, which includes a heavy front sheet and a thinner carbonless copy. The visitor puts the copy into a trailhead collection box, and keeps the front sheet as proof of permit compliance. Additional text, such as local regulations or Leave No Trace principles, may be printed on the back side of the visitor's copy of the form. When considering the overall cost of software, labor, equipment, snap sheets, ink, and paper supplies, it makes sense to have the forms printed by a commercial printer through the Government Printing Office rather than to do so in-house. Printing regulations may require you to do so, particularly if you will be printing more than a few copies of the forms.

Form Scanning

The decision to scan forms in-house or to contract this service depends on many variables. Scanning equipment and software can be relatively expensive, especially for ICR technology. Another key issue is the time operators will need to learn the scanning systems and perform the scanning operation. OMR is a fairly low-cost option that requires minimal operator training and time, but the type of information it can record is limited.

Having scanning done by a contractor can be as simple as stuffing the filled-out permits in an envelope and sending them to the contractor. The contractor scans the permits and returns the information in a delimited, ASCII (computer text) electronic format in about 4 weeks. This file would be input into the Infra-WILD Oracle database (<http://infra.wo.fs.fed.us/infra>) by Forest Service personnel using a data migration utility (expected to be available by the fall of 2005). Scanning costs typically include a fee to set up the scan, a fee for every sheet that is scanned, and a fee for generating the computer text output file with all of the data. Table 2 is a cost comparison put together by Christina Boston from the Boundary Waters Canoe Area Wilderness (BWCAW).

Table 2—Cost comparison for scannable self-issue permits for the Boundary Waters Canoe Area Wilderness. Cost estimates in table 2 are based on 12,000 permits being issued each year, the number of permits filled out each year by visitors to the Superior National Forest.

	Current Self-Issue Permit— Forest Service Data Entry	Scannable Self-Issue Permit— Contractor Scans Data	Scannable-Self Issue Permit— Staff in Pacific Southwest Region Scans Data	Scannable Self-Issue Permit— Buy Scanner To Scan Data Locally
Permit design	Design the permit ourselves	\$400 per form (unless we purchase \$1,750 software to design the form ourselves)	\$400 per form (unless we purchase \$1,750 software to design the form ourselves)	\$400 per form (unless we purchase \$1,750 software to design the form ourselves)
Permit printing	\$432 3.6 cents per form	\$3,240 27 cents per form if a contractor prints the form (price for GPO printing might be cheaper)	\$3,240 27 cents per form if a contractor prints the form (price for GPO printing might be cheaper)	\$3,240 27 cents per form if a contractor prints the form (price for GPO printing might be cheaper)
Permit data entry and distribution	\$5,500 Based on estimate of 2 minutes per permit (X 12,000 = 400 hours or 50 days) by GS-5 staff (\$110/day) into an MS Access database. The time and cost may go down when we switch to the Visitor Use Permit System and the Speedo data entry form.	\$3,450 29.5 cents per form	\$338 to \$450 3 to 4 days at GS-7 (\$112.71/day) Scanned at an estimated rate of 800 per hour (15 hours total) + time to deal with forms that go into the reject hopper	\$338 to \$450 3 to 4 days at GS-7 (\$112.71/day) Scanned at an estimated rate of 800 per hour (15 hours total) + time to deal with forms that go into the reject hopper
Maintenance agreement	None	None	Unknown May be asked to partially pay for the Southwestern Region's costs	\$800 (annual estimate)
Equipment purchase	None	None	Equipment already purchased	\$7,000 (one-time cost)
Error rate	Low	Unknown Estimated to be 25 percent or higher, based on knowledge about other scanned forms	Unknown Estimated to be 25 percent or higher, based on knowledge about other scanned forms	Unknown Estimated to be 25 percent or higher, based on knowledge about other scanned forms
TOTALS	\$5,932	\$7,090 if contractors design the form	\$4,090 if contractors design the form	\$4,809 if contractors design the form + one-time cost of \$7,000 for the equipment

Other Form and Scanning Considerations

Although many options exist for form designs, it is best to use one form design wherever possible. Forms typically are coded so that the scanner understands which scan key to use, allowing operators to mix forms of various designs in one processing cycle without having to process each type of form separately.

Many other issues need to be considered when selecting a scanning technology. National forests or regional offices

could band together to share scanning equipment and personnel when scanning forms. Buying one scanner per region or forest and training operators to be proficient with the scanning systems through regular use would be preferable to having a scanning system in each district office which may be used infrequently.

Some wildernesses may require more extensive information or longer written responses from visitors than is needed for the Infra-WILD database. One option for such information is to make an electronic clip image (similar





Figure 4—A typical trailhead registration station in the Lye Brook Wilderness area of the Green Mountain National Forest.

Observations and Recommendations

Determining which scanning technology best fits the needs of a particular wilderness is not easy. Each region and national forest office has different needs and budgets. The biggest decisions that need to be made upfront are:

- Which scanning technology should be used (OMR or ICR)
- Which steps, if any, will be done in-house?

Because of the cost of acquiring the scanning software and hardware, as well as the time and skill needed to learn how to use the specialized software and hardware, many units will outsource all, or at least part of the process to contractors. Most contractors or vendors will work with the customer to help them select the best options. Some contractors offer full service form development and scanning. Others are more specialized and may concentrate

on software, equipment, or scanning services. A contractor may say they are full service, but subcontract part of their services. That's not necessarily a bad thing, but be aware of the possibility.

Some vendors offer online demonstrations of their software. This allows the purchaser a chance to view the program layout, ease of use, and its applicability to scanning permits. When a suitable scanning technology is selected, the next step is to develop a pilot test.

Pilot testing involves running a small-scale version of a scanning technology to see if it fits the application. At this point, most vendors will require a fee for services. A pilot test may allow the software, hardware, or scanning service to be tested, without committing to the cost of a full-scale project. The pilot test presents an opportunity to see how complicated the software might be, review scanning accuracy, determine how much time is needed to perform scanning operations, and to come up with a better cost estimate for the scanning operation. Some vendors may provide scanning equipment and software for a one-time pilot test but some cost will probably be involved. Contracting out scanning services for the pilot test might be the cheapest way of seeing whether scanning makes sense for a given application.

Technology in the scanning industry is always improving. OMR has not changed much in the last 30 years. ICR is becoming more accurate, less expensive, and easier to use. Many vendors are combining OMR and ICR technologies to improve accuracy, while maintaining simplicity in the scanning equipment and procedures. The downside of rapidly improving technology is that software and equipment quickly becomes outdated.

As with most electronic equipment and software, the cost of scanning equipment and software has dropped over the years. As the technology becomes less complicated, more vendors enter the market, typically reducing overall costs to the consumer. Industry mergers and buyouts change company names. Several sales representatives changed and a merger occurred during this short study. Such changes can be very confusing when you are trying to select the right scanning technology and vendor.

Conclusions

As with most large purchases, searching for the right scanning technology and vendor requires legwork. Vendors may try to sell you equipment or software that doesn't fit your application. Don't scan more fields of data than you need. Try to keep as many data fields in the OMR format as practical to lower costs and improve accuracy. Deal with vendors who are willing to help you scan your information at the lowest cost and with the highest accuracy. Contracting out scanning services initially will make it easier to define long-term costs, accuracy, the time needed to implement the technology, and whether to continue to contract out scanning or to purchase the required software and equipment to perform the service in-house.

Vendor/Resource List

The list below includes several scanning companies that MTDC considered while researching this project. MTDC does not endorse the listed companies.

Apperson, Data Collection Service Group

Web site: <http://www.appersondcsg.com>

Phone: 800-877-2341

CSS Consultants, Inc.

Web site: <http://www.cssconsult.com>

Phone: 585-377-4235

Mercator (Snap Survey Software)

Web site: <http://www.mercatorcorp.com>

Phone: 603-610-8700

NCS Pearson

Web site: <http://www.pearsonnncs.com>

Phone: 800-447-3269

Scantron Corp.

Web site: <http://www.scantron.com>

Phone: 800-445-3141

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Christina Boston is a natural resource recreation manager wilderness specialist for the Boundary Waters Canoe Area Wilderness, Superior National Forest.

Kevin Cannon is a recreation forester for the Canyon Lakes Ranger District, Arapaho-Roosevelt National Forest.

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Library Card

Kees, Gary; Butcher, Steve. 2005. Technologies for scanning wilderness permits. Tech Tip 0523-2324-MTDC. Missoula, MT: U.S. Department of Agriculture Forest Service, Missoula Technology and Development Center. 10 p.

Discusses the use of optical scanning technologies to convert information on printed wilderness permits into an electronic form that can be incorporated into the USDA Forest Service Infra-WILD database. The tech tip compares optical mark recognition scanning systems (that read checkboxes and shaded bubbles) to intelligent character recognition systems that can read handwriting. Combinations of both systems may be needed to gather information on wilderness permits that are filled out by the visitors. Without optical scanning systems, wilderness managers face the daunting task of having someone manually enter all of the information from thousands of permits into a database for analysis.

Keywords: data entry, databases, ICR, Infra-WILD, intelligent character recognition, OCR, OMR, optical character recognition, optical mark recognition, wild and scenic rivers, wilderness areas

Single copies of this document may be ordered from:

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