TRTR Funds – Successes in Watershed Restoration in the Eastern Region

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Eastern national forests are largely comprised of lands that were cut over, burned, farmed and mined. In over 100 years of National Forest System management we have made great progress in improving the condition of the "lands nobody wanted," but considerable work remains to address impacts to the aquatic component. Sediment continues to be the primary contaminant of concern in our aquatic systems. High historic sediment levels are sustained by persistent contemporary input, primarily from roads and trails. To improve the condition and health of our eastern watersheds, we need to address the delivery of sediment from our gravel and gravel-sand roads and trails. In addition to being a source of sediment, many of the road and trail crossings are impediments to passage by aquatic organisms. The Roads and Trails for States (TRTR) program, which returns to the Region ten percent of the prior year receipts collected from National Forests, has enabled the USDA Forest Service Eastern Region to make significant progress in addressing many of our road and trail stream crossing problems. Our TRTR program uses an integrated process to address sediment problems at many of our high priority road and trail stream crossings. TRTR projects range from improving high use hiking trails on the White Mountain National Forest (New Hampshire) to replacing open slotted bridges on the Chippewa National Forest, Minnesota. Our landownership pattern presents challenges but also offers numerous opportunities for partnering with others to achieve success. Many forests have leveraged their TRTR funds with partners to achieve transportation, recreation and riparian-habitat objectives.

Keywords: *watershed restoration, sediment, aquatic habitat impairment, stream crossings, transportation management*

Background

Eastern national forests differ markedly from the larger forests west of the 100th meridian. The Eastern Region of the USDA Forest Service (Region 9) is vast, extending from Minnesota to Maine, south to West Virginia, and west to Missouri. While the western forests are prominent on the landscape, eastern forests seem like mere flecks scattered across the eastern half of the nation (Shands 1979). Land ownership within national forest boundaries is fragmented and the percentage of federal ownership varies by forest.

While there is some public domain land in the East, eastern national forests were formed primarily of land purchased following passage of the Weeks Act in 1911. The Weeks Act authorized Congress to appropriate money to purchase forest reserves for the purpose of conserving forests and the water supply (Conrad 1997). No single law has been more important in the return of the forests in the eastern United States. The lands acquired to build the region were the "lands nobody wanted" (Shands 1977). Historical logging and burning, farming and burning, and mining and abandonment, left behind vast acreages of stump fields, severely eroded hillslopes with numerous gullies, thousands of acres of drained wetlands, and miles of sediment-clogged stream channels and lakeshores.

In 1920 there were 1,402,000 acres (567,800 ha) of national forests in what is now the Eastern Region (USDA 2004a). Today this figure is 12,061,766 acres (4,885,015 ha) or approximately 55 percent of the land within the administrative boundary (USDA 2004a). Ownership within watersheds varies from over 90% on the White Mountain National Forest in New Hampshire to less than 1% for some of the watersheds on the Wayne National Forest in Ohio. These intermingled lands that comprise a national forest are owned by states and counties, as well as private individuals and timber companies.

Today, because of high human population densities and relatively small public land acreages in the East, national forests here have been called "islands of green in a sea of people." Many Eastern Region national forests are within a day's drive of major metropolitan areas such as St. Louis, Minneapolis, Chicago, Cleveland, Detroit, Pittsburg, Philadelphia, Washington, DC, New York and

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Boston. People seeking recreational opportunities can readily travel to these national forests. Off-highway vehicle use, motorbike riding and horseback riding have increased significantly in recent years, and the demand for these uses is a major forest plan revision issue on most forests.

Recreational activities involving aquatic resources have also increased and present significant resource management challenges. The Eastern Region, with more than 962,000 acres (389,600 ha) of lakes and more than 15,300 miles (24,600 km) of streams, has more of these resources than any Forest Service region outside of Alaska (Schmal 2004). Lakes and wetlands dominate the forests in Minnesota, Wisconsin and Michigan, with streams dominant in Missouri and West Virginia. All Eastern Region forests contain both free flowing and flat water. It is public interest in accessing and using the eastern national forests that sets the stage for potential impacts to the riparian and aquatic resources, ultimately effecting watershed function and health.

The Problem

The intermingled land ownership patterns of eastern national forests bring challenges and opportunities. Transportation management is one of the challenges. There are approximately 30,000 miles (48,300 km) of inventoried Forest Service roads and more than 12,000 miles (19,300 km) of inventoried Forest Service trails in the region (USDA 2003). In addition to what has been inventoried, there are many unauthorized and unmanaged user-developed roads and trails. The existing network provides access to recreational areas and serves as a conduit for the harvest of wood products. But the existing roads and trails were not initially designed to address aquatic and riparian resource needs.

Many existing roads follow old railroad beds and have surfaces of native gravels and sands, often with stream crossings at the lowest elevation in the watershed. Drainage structures comprised of corrugated metal pipes are common and many bridges are open-slotted (the bridge travel surface is not solid). In parts of the region, crossing structures are non-existent, and low water crossings or fords are used instead. These existing crossings are major contributors of sediment to the aquatic resources.

Excessive sediment has both physical and biological effects. The addition of sediment can alter stream channel morphology (e.g., increase width-depth ratios) and reduce the carrying capacity of the channel. During high runoff periods, the crossing may be overtopped, causing subsequent removal of road surfacing material and erosion of stream banks. High sediment levels rarely kill adult fish, but can harm eggs and juvenile fish. Many streams with important fish habitat in the forests of the Great Lakes region are Rosgen "C" types. These are perennial streams with sinuous, low-gradient, low-relief channels, and well-developed floodplains (Rosgen 1996). Much of the deposited sediment stays in the channel where it can bury important food, spawning, and cover habitat.

Consider the "Brill Cream" slogan that was popular twenty years ago, "A little dab'll do ya." If you are a fish or other aquatic organism living in a low gradient stream or a stream with numerous undersized culverts or open-slotted bridges, "A little dab of sediment will do you in". Fish habitat studies in Michigan and other parts of the country have shown that the addition of inorganic sediments can seriously alter habitat conditions, thereby affecting food sources which can then limit reproductive potential of certain fish species (Hansen et al. 1982). Fish and other aquatic organisms need pools for cover and the addition of inorganic sediment fills the pools, further altering the stream channel and habitat.

Older culvert crossings frequently impede aquatic organism passage. While most culverts were designed to meet the hydraulic design criteria, they are undersized when consideration is given to debris, sediment and aquatic organism passage. These culverts may effectively pass water during moderate and high flow conditions but still serve to block or inhibit upstream aquatic organism passage due to increased velocity during high flows and insufficient water depth during low flows. Changes in stream configuration over time, including scour and ponding around the upstream end of culverts, have also resulted in raised inlets in many cases. The issue of raised inlets was noted as the second most significant issue identified from the integrated stream crossing inventories on the Huron-Manistee National Forests, Michigan (CRA and USFS 2004). Raised inlets are a significant concern because they block downstream passage of aquatic organisms during low flows and pond water upstream of the crossing. This can accelerate bank erosion and sedimentation.

Trail stream crossing problems are also prevalent throughout the region. Many of the existing trails were initially developed by users. Limited effort was expended on location, design or installation, and best management practices were not applied. While some trails have culverts, many more do not. The existing culverts were installed to provide drainage to protect the trail, but may not meet variable flow conditions or aquatic organism passage needs.

Across the Eastern Region, erosion of sediment from our existing road and trail network further alters streams working to recover from prior land use practices. This is especially true when viewed from a cumulative perspective across a watershed.

Roads and Trails for States Program (TRTR) – "The Hero"

Interest in improving road and trail stream crossings in the Eastern Region began in the late 1980s and parallels the "Rise to the Future" initiative. This initiative was created in 1986 by Chief Max Peterson and implemented the following year by Chief Dale Robertson. In 1988, the Eastern Region started hiring fish biologists. Assessments of aquatic habitat conditions were initiated, followed by habitat improvement projects. An evolutionary process occurred in the Eastern Region. Fish biologists knew sediment was harmful to fish and their habitat. Early aquatic habitat restoration work focused on repairing individual sites, such as an eroding stream bank. These eroding stream banks were thought to be "the problem". This evolved to treating all actively eroding sites on a river. But still stream sedimentation and aquatic habitat impairment continued. Concurrent with concerns about sediment in the East, Dr. Jerry Franklin and other scientists were examining the relationship between the health of aquatic systems and what was occurring in the watershed (Franklin 1989; Verry 1992). From knowledge gained through discussions both within and external to the region, larger landscape inventories, and in many cases, watershed inventories were initiated. These larger-scale inventories identified road and trail stream crossings as major sources of sediment on most Eastern Region national forests.

While the Huron-Manistee National Forests led the region in this effort, other eastern forests also initiated road-stream crossing inventories. These road-stream crossing inventories identified over 14,000 culverts in the region, with large numbers of problem crossings-raised inlets, perched outlets, high flow velocity issues, low flow passage organism passage problems, to name a few (Schmal 2004). While the focus was on national forest lands, it was apparent that problem crossings were not exclusive to the national forests. The challenge was how to meet the need to address these problems and stay within existing program constraints.

Within the Forest Service, Soil and Water Resource Improvement funds can cover the installation of land treatment and structural measures for erosion control, rehabilitation of abandoned roads and trails, and stream bank and gully stabilization (USDA 2004b). But these funds are not appropriate to fund erosion control work or perform other maintenance, including replacing stream crossing structures on existing roads or trails. Maintenance work should be implemented using road and trail maintenance funds, but the need far exceeds our region's annual appropriations. This issue was not unique to the Eastern Region. Alternative funding sources were needed. In 1913, a statute was written that addressed this need. The original statute in 16 USC Sec. 501, Title 16, Chapter 2, stated that:

"On or after March 4, 1913, ten per centum of all moneys received from the national forests during each fiscal year shall be available at the end thereof, to be expended by the Secretary of Agriculture for the construction and maintenance of roads and trails within the national forests in the States from which such proceeds are derived".

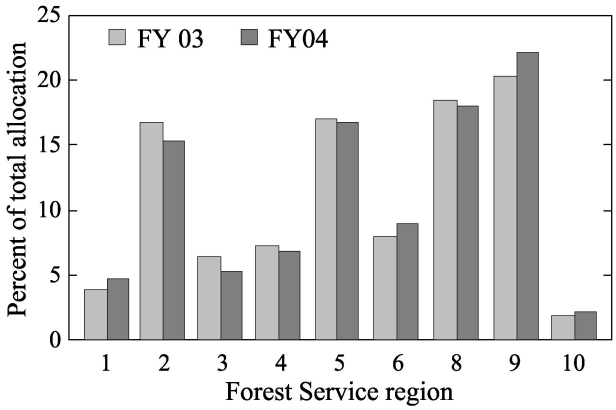
But it was not until 1996 that Congress authorized use of ten percent of the prior year's receipts from national forests, "…to repair or reconstruct roads, bridges and trails on national forest system lands…..for the purpose of reducing risks to human health and safety and public property, and to enhance ecological functions, long-term productivity, and biological integrity (USDA 1998). The program was called "Roads and Trails for States" and the agency assigned the program the "TRTR" fund code.

All regions started receiving TRTR funds in 1998. The TRTR funds were viewed as "the hero" in the Eastern Region because program direction enabled forests to use the funds to address environmental problems caused by existing roads and trails. Initially, the funds went back to the forest based on the forest's collection of receipts, but in subsequent years, regions were directed to select and fund the highest priority projects based on factors including watershed condition, watershed integrity, and partnerships, and other relevant considerations, regardless of which forest initially generated the funds (USDA 1999).

TRTR Program in Region 9

The Eastern Region has been successful with the TRTR Program for several reasons. A number of forests had inventories of road and trail stream crossings that included assessment of problem crossings. Crossing needs were known, and project designs to address both the transportation and aquatic resource needs existed or were nearing completion. Secondly, the national program direction emphasized program integration. Implementation of the TRTR program offered support to those forests where engineering, fisheries, watershed and recreation were working together. The added value from this internal integration has been tremendous and will continue to have significant program benefits. Lastly, the region's percentage share of TRTR funds has been significant (Figure 1). Our annual allocation of approximately 3 million dollars along with program direction that gives priority to projects with partnership potential, has opened the door to working across boundaries with a variety of partners. For partnerships to work, all partners need to bring

Figure 1. Percentage share of TRTR funds for fiscal year 2003 and 2004 by Forest Service Region. Regions: 1. Northern, 2. Rocky Mountain, 3. Southwestern, 4. Intermountain, 5. California, 6. Pacific Northwest, 8. Southern, 9. Eastern, 10. Alaska



something to the table. Without a stable source of funding, maintaining and expanding partnerships is difficult at best. Across the Eastern Region, most forests are working with external partners to address road and trail stream crossing needs. By leveraging TRTR funds with partner funds they are able to correct road-trail stream crossing problems and accelerate watershed restoration on "the lands nobody wanted".

There are many TRTR success stories in the Eastern Region that exemplify "working together" with both internal and external partners. Five projects described below provide representative examples of the region's use of TRTR funds to address environmental problems associated with our existing roads and trails.

Chippewa – Woodtick Road Relocation (Figure 2)

The Chippewa National Forest in north-central Minnesota has been an active participant in the TRTR program. The forest has a long-standing commitment to restoring the health of watersheds from the impacts of past land use practices. While addressing road stream crossings has been a major focus of the TRTR program on the Chippewa, the success story involves the relocation of a road and the restoration of a large connected complex of wetlands.

Forest Road (FR) 2107 was a gravel-surfaced, system road open seasonally to public highway traffic (Figure 2a, c). The road bed was frequently flooded in the spring or during heavy rainstorms and required frequent maintenance. The road had been in place for many years and was partially located in a wetland. The purpose and need for the relocation project was to reduce long-term maintenance costs, improve safety, and restore water flow within the wetland through which the road passed. The project had been previously identified and listed on the Chippewa's road maintenance inventory. In 2002 the project was selected as the Forest's number one priority for TRTR funds because of the opportunity to address both transportation issues and watershed restoration concerns.

The proposed action involved relocating 3,500 feet (1067 m) of FR 2107 by constructing a permanent bypass for the portion of the existing roadway that ran through a wetland (USDA 2002c). The relocated roadway would provide a 22-foot-wide (6.7-m) driving surface with 3:1 side slopes. The bypass would traverse uplands that include open fields and forest. It would diverge north and west from the existing roadway to form a new junction with Minnesota Trunk Highway 371, approximately 1,000 feet (305 m) north of the current junction. The bypassed portion of the roadway would be removed and restored to approximate the topography and native vegetation that were present before the road was constructed.

Construction of the new road segment cost $159,000 and was funded using TRTR. Removal of the old roadbed and restoration of the adjacent topography and vegetation was accomplished through a partnership between the Chippewa National Forest and Cass County (Figure 2b, d, e). The county paid for the removal of the grade in exchange for use of the fill on a nearby project and to obtain credit for wetland restoration that offset wetland losses on the Forest due to other county highway projects. The value of the County contribution was $25,000. The National Forest contributed $15,000 of TRTR funds to cover surface re-contouring, topsoil costs, and the creation of a few small sandy areas suitable for turtle nesting.

The strength of this project was the partnership that formed and helped to elevate the importance for the project. The result was an improved and safer access to national forest resources, the restoration of flow through 19 acres (7.7 ha) of wetland, and the direct restoration of almost two acres (0.81 ha) of wetlands.

Hiawatha – Sturgeon River Bridge Replacement (figure 3)

The Hiawatha National Forest is located in Michigan's Upper Peninsula, between Lake Superior and Lake Michigan. As with other Lake States' forests, it has numerous lakes, wetlands and rivers. Many of the rivers are classified as wild and scenic rivers, including the Sturgeon River, the site of this success story.

The Sturgeon River Bridge crossing has long served as a chronic source of sediment to the Sturgeon Wild

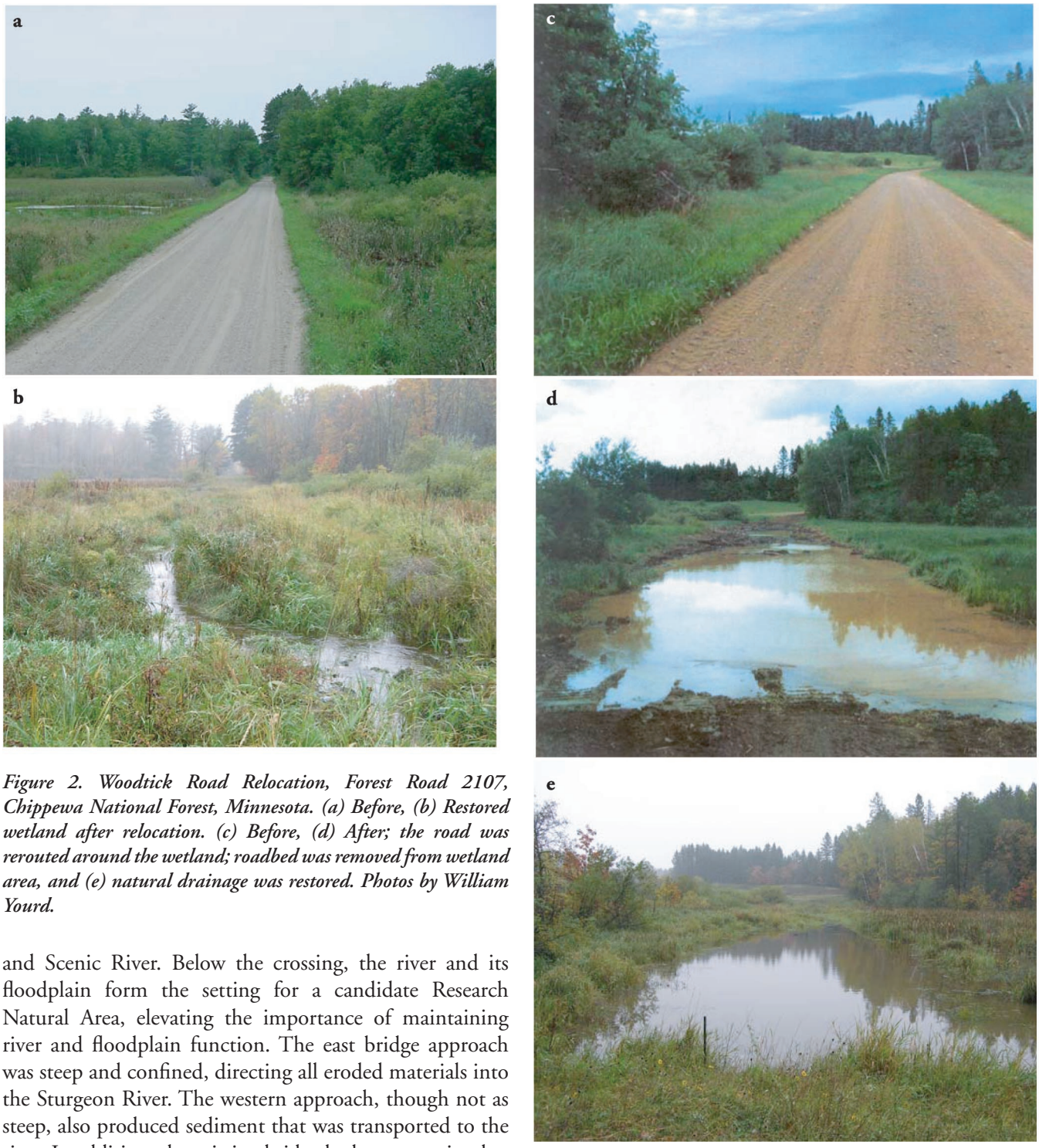


Figure 2. Woodtick Road Relocation, Forest Road 2107, Chippewa National Forest, Minnesota. (a) Before, (b) Restored wetland after relocation. (c) Before, (d) After; the road was rerouted around the wetland; roadbed was removed from wetland area, and (e) natural drainage was restored. Photos by William Yourd.

and Scenic River. Below the crossing, the river and its floodplain form the setting for a candidate Research Natural Area, elevating the importance of maintaining river and floodplain function. The east bridge approach was steep and confined, directing all eroded materials into the Sturgeon River. The western approach, though not as steep, also produced sediment that was transported to the river. In addition, the existing bridge had a center pier that continuously caught large woody debris being transported downstream by the river. The bridge abutments intruded into the bankfull area of the river, constricting the channel, with resultant upstream sediment deposition and increased width-depth ratio (Figure 3a).

Support for this project came from within the forest as well as from private contacts, including county and township road commissions. The Forest Hydrologist, Fish Biologist, Wild and Scenic River Planner and Recreation staff all worked together with the Forest Engineer to assess the site and to develop a conceptual design for the structure that met all the resource needs. Actual bridge design and National Environmental Policy Act (NEPA) documentation was contracted with a private engineering firm. Funding for the bridge came from the Capital Resource Improvement Program in addition to TRTR funds. The the entire project cost $521,000 and took four years to accomplish.

Figure 3. Sturgeon River Bridge, Hiawatha National Forest, Upper Peninsula of Michigan. (a) Before, (b) After. Former road was narrow, with native road surfacing material; stream crossing was at the lowest elevation on the road and this allowed runoff to flow down the road and deposit sediment into the Sturgeon River, a cold-water, low gradient stream. The new crossing was slightly elevated, provided more sunlight to the roadbed; the bridge was replaced; the approaches and crossing were hardened and runoff drains were constructed. Photos by Richard Kell.

The project included removal of the old structure, followed by installation of a single span bridge that spanned the entire bankfull width, establishment of functioning ditches and drainage relief structures, and hardening the road approaches to the river (USDA 2002b). Because of the magnitude of the project, the construction activities occurred over three years.

As a result of the work accomplished, the following benefits were achieved:

- a reduction in sediment delivered to downstream aquatic habitat,
- the restoration of the free flowing characteristics of the Wild and Scenic River, and
- a safer, wider bridge with regulation guardrails

The new Sturgeon River Bridge is now complete and an outstanding example of one of the larger, more complex stream crossing projects accomplished with TRTR funds (Figure 3b).

Green Mountain – Catamount Trail Bridge Replacement (figure 4)

The Green Mountain is a small but very special national forest in southern and central Vermont. As with many eastern national forests, there are non-Forest Service recreation sites within and adjacent to the national forest. The Catamount Trail, a cross-country ski trail running the entire length of Vermont, is an example of a trail that has access points on the forest. One segment of the trail crosses Burnt Meadow Brook. This section of the Catamount Trail has been in existence for a number of years, and passes through the grounds of the Macartney House, a pristine country inn, which is operated under a special-use permit from the forest. The existing bridge was in need of replacement from a structural standpoint, and the approaches and decaying native log abutments were causing sedimentation (Figure 4a).

Figure 4. Burnt Meadow Brook Bridge replacement, Catamount Trail, Green Mountain National Forest, Vermont. (a) Before, (b) After. Photos by Richard Gaiotti.

As a result of discussions between the forest TRTR coordinator and members of the Catamount Trail Association, Macartney House and the State of Vermont, a partnership developed and plans were made to replace the Burnt Meadow Brook Bridge (USDA 2002a, 2002d, 2002e). The Burnt Meadow Brook Bridge was the largest of nine bridges replaced on the Catamount Trail on the Manchester Ranger District, during the summer of 2003. The Forest Service, using TRTR funds, agreed to share the cost of its construction with the Catamount Trail Association, which had received grants from the State of Vermont. The new Burnt Meadow Brook Bridge has a standard Forest Service trail bridge design with steel stringers and treated timber mudsills, railing, and decking. Heavy equipment was used to transport the stringers to the site and set them in place. All other work was performed by a ten-person Vermont Youth Conservation Corps (VYCC) crew, with Forest Service and Catamount Trail Association personnel. The Catamount Association, Forest Service, and Macartney House shared in providing logistical and technical support.

The new bridge (Figure 4b) met the resource needs and assured safe access across Burnt Meadow Brook while providing a worthwhile and rewarding project for the VYCC crew.

Hoosier – Charles Deam Wilderness Trail Restoration (Figure 5)

The Hoosier National Forest comprises 200,000 acres (81,000 ha) on two units in southern Indiana. The northern unit of the forest includes the Charles C. Deam Wilderness, the only congressionally designated wilderness in the state of Indiana. This wilderness is a popular weekend destination for local residents from nearby Bloomington, Indiana, a city of 120,000 people. In the last decade, both horseback riding and hiking have steadily increased. Much of the wilderness is covered with lush second growth hardwood forests. The existing network of trails, many of which follow the old road system built in the late 1800s, has been maintained but was not designed to accommodate the increased horse traffic (Figure 5a). Many trails were originally built without adequate cross-drainage. There were numerous damaged areas with increasing concern for erosion, runoff, and subsequent sedimentation to Monroe Reservoir, the municipal water supply for Bloomington, Indiana.

An Environmental Assessment released in 2001 analyzed several trails in the Charles C. Deam Wilderness (USDA 2001). The Environmental Assessment focused on improving trails where improper drainage and flooding was causing sedimentation into the Monroe Reservoir. Knowing that any trail restoration work must comply with wilderness requirements, the forest began contacting western forests with mule strings that might be available to assist with the work. The Bridger-Teton National Forest in Idaho reported they had two mule packers and eight

Figure 5. Charles Deam Wilderness Trail, Hoosier National Forest, Indiana. (a) Before, (b) After. Several sections of this popular, heavily used hiking/horseback riding trail were located lower on the slope, with little consideration for cross drainage. This project involved closing and rehabilitating some of the wetter sections, moving the trail father upslope, adding cross drains, and also surfacing. Photos by Eric Solerno.

mules that handled their trail restoration work during the summer season. But during the winter and late spring, these resources were available and willing to work. A partnership formed between the forests, and since 2000, two packers and eight mules have spent the month of May on the Hoosier National Forest performing trail restoration work both inside and outside wilderness. In that period, 11.5 miles (18.5 km) of trail have been constructed or reconstructed to move them up out of the low areas and more than 500 tons (453 metric tons) of gravel have been hauled by mules and placed to harden the trail surface (Figure 5b).

This partnership is both innovative and definitely a "win-win" situation for both national forests and the resources.

Huron-Manistee – Landscape Approach Through Partnerships (figure 6)

The Huron-Manistee National Forests' motto is "United by Rivers". The forests' location in central Lower Michigan makes them accessible to over 60 million people who are within a day's drive (Leefers et al. 2003). A prized feature is the deep groundwater-fed rivers that support world-class fishing, as well as providing habitat for a variety of endangered, threatened, and sensitive species. Viewing the mixed land ownership patterns within the watersheds as an opportunity, the forests took a collaborative approach using partnerships to tackle problems on a landscape scale.

In the mid 1990s, the forest partnered with local Resource Conservation and Development Councils, and initiated watershed-wide inventories focused on stream crossings (NMRC&D and USFS 1992; NMRC&D and USFS 1994; HPRC&D and USFS 1996; CRA and USFS 2004). The partners developed a rating system to assess potential for sediment delivery and fish passage impairment. Over 1170 crossings were identified at the watershed level (within 5th-level Hydrologic Units). A majority of crossings were off the national forest; only 220 were on National Forest System lands. Sediment was the most frequent problem, with county roads accounting for a majority of the problems. Of the county crossings, 70% were rated "severe" or "moderate". In addition to sedimentation problems, 160 crossings had fish or aquatic organism passage problems.

Using the inventory results, the forest has successfully integrated the TRTR Program into their watershed restoration efforts. During the period 1998-2002, 46 projects have been completed with nine different county road commissions, upgrading road-stream crossings, addressing aquatic organism passage, and improving roads in riparian areas (Figure 6). Almost $2.7 million has been expended, of which 40% or $1.1 million has been contributed by the partners. Benefits include over 92 miles (148 km) of stream habitat improvement downstream from the projects. The partners' funding has come from multiple sources including Clean Water Act, Section 319 grants, Department of Transportation Intermodal Surface Transportation Efficiency Act [ISTEA, 1991] and Transportation Equity Act for the 21st Century [TEA-21, 1998] funds, and Clean Michigan Initiative funds.

Figure 6. Road improvements on the Huron-Manistee National Forest, Lower Michigan. (a) Before, photo by William Fowler, (b) After, photo by Robert Stuber. Former road was narrow, with native material for road surfacing; drainage structures were undersized with many acting as barriers to aquatic organism passage. Road surfacing was hardened; alignment improved, some of the crossings were elevated; drainage structures were replaced with at least one bridge added; side slopes were stabilized and outlet drains provided to catch and direct runoff. This was a 2-mile long project that occurred over three years.

Working together, the forest and its partners have been able to leverage funds to accomplish work that no one partner could do alone, providing multiple benefits to the

public, the resources and to the watersheds. There is still more work to do and it continues annually, with the goal of improving aquatic habitat and watershed function.

Closing

Eastern national forests are largely comprised of lands that were cut over, burned, farmed and mined. In over 100 years of managing these national forests we have made great progress in improving the condition of the "lands nobody wanted", but considerable work is still needed to address impacts to the aquatic resource. The Roads and Trails for States program has enabled the Eastern Region to address many of the existing road and trail stream crossings that are contributing sediment and restricting aquatic organism passage. Continued implementation of this program using integrated teams and partners ensures that the transportation system can co-exist with maintenance of valuable riparian and aquatic habitats.

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