

The Value of Clean Water & Wild Forests

Economic and Community Benefits of Protecting New Mexico's Inventoried Roadless Areas

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Forest Guardians seeks to preserve
and restore native wildlands and wildlife
in the American Southwest
through fundamental reform
of public policies and practices.

Front Cover Photo: Jess Alford.



**The Value of Clean Water & Wild Forests:
Economic and Community Benefits of Protecting
New Mexico's Inventoried Roadless Areas***

By

**Dr. Robert Berrens¹
Dr. John Talberth²
Dr. Jennifer Thacher³
Michael Hand⁴**

**Center for Sustainable Economy
140 Chamiso Lane
Santa Fe, New Mexico 87505
(505) 986-1163**

Prepared for Forest Guardians

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¹ Professor of Economics, University of New Mexico

² Senior Economist, Center for Sustainable Economy

³ Assistant Professor of Economics, University of New Mexico

⁴ Ph.D. Candidate, Department of Economics, University of New Mexico

Synopsis

New Mexico's 1.6 million acres of inventoried roadless areas on national forests are a unique natural capital asset yielding significant economic benefits in the form of clean water, carbon sequestration, recreation, hunting and fishing opportunities, scenery, flood control, and habitat for threatened, endangered, and sensitive species. Nevertheless, their roadless status remains highly uncertain as federal regulations protecting these lands remain in political limbo. An important aspect of the policy debate involves economic values and consequences. While the economic costs of forgone timber production, mining, and oil and gas leasing are relatively well researched and understood there has yet to be any formal consideration of either market or non-market benefits conserved by maintaining roadless areas in an undeveloped state. This paper seeks to inform the debate over future management of inventoried roadless areas in New Mexico by estimating the current magnitude of such benefits.

To accomplish this, we disaggregate, update and recalibrate in part previous work completed at the national scale by Loomis and Richardson (2000) who considered recreation, passive use, scenic, waste treatment, and carbon sequestration values. We do so by incorporating site specific information on roadless area size, composition, and attributes, New Mexico-specific recreation data, and regionally-specific carbon sequestration data as a basis for more refined New Mexico values. In addition, we apply Sedell et al. (2000) to estimate the value of clean water flowing from roadless area watersheds and apply non-market values estimated by Loomis and Ekstrand (1997) for Mexican spotted owl critical habitat. We also estimate the community benefits associated with non-motorized recreation and quantify differences in the relative economic performance of counties with and without significant concentrations of roadless lands.

Our results provide evidence that New Mexico’s inventoried roadless areas generate tens of millions of dollars each year in both economic and community benefits.¹ Table 1, below, summarizes our results. Annual economic benefits range up to \$42 million for maintenance of water quality, \$24 million for carbon sequestration, \$26 million for outdoor recreation, \$14 million for passive uses, and \$1.4 million in enhanced property values. Annual community effects range up to 938 jobs and \$23 million in personal income. The magnitude of the values listed in Table 1 underscores the need for careful consideration of the full set of both market and non-market economic benefits of protecting inventoried roadless areas in the context of federal and state administrative processes affecting long term management of these unique natural areas.

Table 1: Annual Economic Benefits and Community Effects of Protecting New Mexico’s Inventoried Roadless Areas (IRAs)

Category	Protection of 1.6 million acres of inventoried roadless areas in NM	Full NM petition for protecting 1.7 million acres, including Valle Vidal
Annual water quality benefits	\$35.33 million	\$42.15 million
Annual carbon sequestration benefits	\$19.56 – \$21.72 million	\$21.69 – \$24.09 million
Annual on-site outdoor recreation benefits (non-motorized)	\$24.97 million	\$26.58 million
Annual passive use benefits	\$12.84 - \$13.05 million	\$13.67 – \$13.88 million
Off-site benefits:		
--Gain in local property values	6%	6%
--Annual market value	\$0.82 - \$1.31 million	\$0.88 - \$1.39 million
Annual community effects:		
-- Jobs	563 – 880	589 – 938
-- Personal income	\$13.69 – \$21.45 million	\$14.98 – \$22.85 million
-- Growth rate of key economic indicators	1.28% above counties w/o significant IRAs	1.28% above counties w/o significant IRAs

¹ For a complete conceptual review of economic benefits (e.g., consumer surplus) and community effects (e.g., regional economic impacts) measures, see McCollum and Bergstrom (1992, p. 137).

**Economic and Community Benefits of Protecting
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1.0 The Importance of Quantifying Roadless Area Values

Inventoried roadless areas (IRAs) on national forest lands in the United States are natural assets of great economic and ecological significance to nearby communities, the states in which they are found, and the nation as a whole. IRAs are those places in our national forests that have remained relatively free of roads, and therefore also relatively free of logging in the past 50 years or more and are at least 5,000 acres in size. Currently, IRAs represent 7.2% of the 747 million acres of forested land throughout the United States. Because they are so scarce, the ecological and economic services these IRAs provide are unique, and increasingly valuable. IRAs provide refuge for game and non-game species sensitive to human disturbance, reservoirs of genetic diversity, living laboratories for natural ecological processes, sites for high-value backcountry recreation, sources of pure water, sinks for absorbing carbon emissions, and many other kinds of tangible and intangible economic benefits. Taken together, Loomis and Richardson (2000) estimate that for the lower 48 states, unprotected IRAs generate \$600 million in recreation benefits, \$280 million in passive use values, between \$490 and \$1 billion in carbon sequestration services, \$490 million in waste treatment services, and 24,000 jobs each year.

Despite this economic significance, efforts to permanently protect IRAs have been mired in a political debate that has spanned nearly six consecutive years and two major regulatory processes. Economics has played a critical role in this debate, but almost exclusively in terms of potential economic harm. Comments on the Final Environmental Impact Statement (FEIS) supporting the roadless rule of 2000 cite impairment of timber production, increases in the cost of housing, reduction in Forest Service revenues, reductions in payments to States, loss of local employment and small business, and destabilization of local communities as major public concerns (USDA, 2000). And while a quantitative assessment of this potential harm has been

completed, there has been little or no quantification of economic benefits in the decision making process. For example, in summarizing the costs and benefits of roadless area conservation *nationally*, the Forest Service quantified the annual loss of timber harvest (74.3 million board feet), timber-related jobs (1,272), timber-related income (\$56.4 million), road construction jobs (192), mining-related jobs (3,095), leasable minerals related income (\$127.8 million), and minerals related payments to States (\$3.2 million) but not a single economic benefit.² The Office of Management and Budget (OMB) completed a similarly lopsided assessment. In a 2002 report to Congress (OMB, 2002), the OMB announced that the roadless rule would cost about \$184 million in costs from lost timber harvest and mining and produce just \$219,000 in benefits from a single benefit category – avoided costs of road building. As the legal scholars Heinzerling and Ackerman (2004) note in their recent law review discussion:

How did a rule protecting 60 million acres of publicly owned lands, containing fragile and precious sources of water, wildlife, and plant species, come to look so bad in economic terms? The answer is simple: just ignore most of the good things one wants to protect forests for—both the good things that could comfortably be stated in dollar terms (such as the economic value of a forest for tourism) and the good things that money cannot buy (such as the knowledge that pristine forests are being protected in perpetuity).

The most recent iteration of the roadless rule permits state Governors to petition the Secretary of Agriculture to promulgate regulations establishing management requirements for all or a portion of IRAs within that state (36 C.F.R. § 294.12). On May 31st, 2006, New Mexico Governor Bill Richardson filed a petition seeking “prohibitions on temporary and permanent road construction and most forms of commercial timber harvest” within all 1,597,000 acres of New Mexico’s IRAs (Richardson, 2006). Should the Secretary comply with Governor

² Federal Register, Volume 66, No. 9, Friday, January 12th, 2001, pages 3269-3270.

Richardson's request and promulgate such regulations, they will be accompanied by a "detailed quantitative analysis" of costs and benefits.³

This paper seeks to inform the decision making process involved with this petition, the upcoming regulatory cost-benefit analysis, and other federal and state-level decision making processes affecting New Mexico's IRAs by estimating the economic benefits of roadless area protection. By doing so, we hope to fill in the analytical holes left by the federal government's failure to quantify such benefits during development or analysis of IRA regulations. The remainder of this report is organized as follows. In Section 2, we produce a typology of roadless area economic values and display results from previous work. In Section 3, we describe three key regulatory processes affecting New Mexico's IRAs that require consideration of such values. In Section 4 through 8, we provide economic benefit estimates associated with water quality, carbon sequestration, onsite outdoor recreation, passive use, and offsite benefits to nearby properties. In Section 9, we describe the community benefits of roadless area conservation by examining the jobs and personal income generated in nearby communities as well as the relative economic performance of counties with and without significant concentrations of IRAs. In Section 10, we offer concluding thoughts.

2.0 A Typology of Roadless Area Values

As healthy natural ecosystems IRAs generate a diverse stream of economic benefits to nearby landowners, those who hunt, fish, or recreate on national forests, those who depend on these lands for reliable supplies of clean water, and to those who consider protection of these unique natural areas an important component of their overall quality of life. Morton (1999) provides a systematic classification of these benefits, which are divided into eight major categories including direct use benefits, community benefits, scientific benefits, educational

³ Federal Register, Volume 70, No. 92, Friday, May 13th, 2005, page 25659.

benefits, off-site benefits, biodiversity conservation, ecological services, and passive use benefits. This is the classification adapted by Loomis and Richardson (2000) for addressing the benefits of roadless areas. Other helpful classifications include Krieger (2001) and Talberth and Moskowitz (1999). Krieger (2001) uses three major classifications including watershed services, recreation, and cultural values. Talberth and Moskowitz (1999) group benefits into four major headings: products, services, functions, and values. Since the latter two studies address national forest ecosystems in general, and not roadless areas in particular, our benefit calculations follow the Loomis and Richardson (2000) typology. Table 2 is based on that typology and provides examples of specific benefit categories as well as results from previous work.

Direct use benefits include on-site recreation, on-site hunting or fishing, human development, cultural/ heritage benefits, and commercial benefits. On-site recreation benefits have been most frequently addressed in the peer-reviewed literature and can include a diverse set of non-consumptive activities, such as hiking, skiing, and canoeing. Based on 32 studies of all activities in wilderness areas, Rosenberger and Loomis (2001) find a mean recreational value per day (RVD) of \$45.⁴ Loomis (2005) finds a mean RVD of \$41 for hiking based on seven studies of the Intermountain West, which includes New Mexico. On-site hunting is another area in which there has been a good deal of research. For example, the average RVD for hunting in the Intermountain West, based on 109 studies, is \$52 (Loomis, 2005). Individuals may also hold cultural or heritage values for a site. For example, Native Americans may value holding a traditional ceremony in an area or hikers may value the opportunity to view historic settler cabins. Relatively little research has been done on cultural and heritage values in wilderness areas. One study in Manitoba, Canada found that canoeists on wilderness routes placed an additional value of \$81 on a trip if they were able to view a pristine pictograph (Boxall et al.,

⁴ Unless otherwise noted, estimates are presented in current dollar figures (\$2006).

2003). The two types of direct use values that are least quantified in the literature are human development benefits and commercial benefits. Human development benefits refer to the idea that roadless areas can provide an opportunity for spiritual and leadership growth and identity (Morton, 1999). This value has not been quantified. Commercial activities include outfitting services and non-timber forest products (NTFP). In the Southwestern Region of the Forest Service, the most commonly collected NTFPs are firewood, posts and poles, Christmas trees, transplants, boughs, edible plants, miscellaneous plants, mushrooms, and seeds (McLain and Jones, 2005). There has been little significant research on NTFPs outside of developing countries (SCBD, 2001). While the Forest Services recognizes that significant amounts of NTFPs are collected on national forest lands and that these commodities often command significant revenues (Cordell and Chamberlain, 2004; McLain and Jones, 2005), there is currently no data on the volume or the value of commodities collected in IRAs.

IRAs provide scientific benefits by providing a baseline of comparison for study. For example, scientists can compare areas with and without developed roads to determine the impact of roads on ecosystems and habitat. They allow understanding of how natural systems function. There has been no systematic work on valuing the scientific benefits of IRA or wilderness areas. Based on a literature search of five databases, Loomis and Richardson (2000) estimated that between 1960 and 1991 there were 422 articles dealing with wilderness areas. Using previous work from Black (1996) on the value of a scientific article, they suggest a scientific value of \$5.06 million for IRAs.

IRAs also provide living laboratories that benefit environmental education programs at both the K-12 and college levels. Participation in these programs has ancillary benefits in the form of improvements in physical fitness, coping and adaptation skills, problem-solving abilities,

intellectual capacity, and emotional development (Kellert, 1988). Participants also develop greater awareness and concern for the environment. There have been no attempts to value these educational activities.

IRAs can also have numerous off-site benefits. These are non-consumptive benefits derived from an IRA when an individual is not at the site. One example is hunting that takes place off-site. IRAs provide habitat for wildlife that travel in and out of that area. Therefore, private hunting ranches located near IRAs accrue benefits from the habitat provided by the IRAs. For example, Torell et al. (2004) find that between 1996 and 2002, high elevation, private-deed elk trophy ranches in New Mexico experienced a 7 to 12% appreciation in their sales value compared to the statewide ranch average of 1%. Property owners can also accrue benefits through pristine views and improved access to recreational areas. For example, Kim and Johnson (2002) find that being closer to a forest has a positive and significant effect on property values near Corvallis, Oregon. A Vermont study by Phillips (2004) found a 13% premium on properties in towns located near wilderness areas and that the premium declined by .8% per acre with each kilometer of distance away from the wilderness boundary. He also found that properties in towns currently not adjacent to a wilderness area experience an increase of \$4,715 per acre with the designation of a wilderness area; properties in the general area experience a \$295 per acre increase.

Although there have been no studies of the effect of wilderness designation on property values in the Southwest Region, Colby and Wishart (2002) find that for homes in Northeastern Tucson (Arizona), the average home price falls by \$5,666 for the first mile of distance from a protected riparian area. Increases in property values also result in increased tax revenue for local municipalities. A final type of off-site benefit is the value that individuals get from viewing the

site along scenic highways or even through photographs or other visual materials. These values have not been quantified.

Ecological services are benefits that the ecosystem provides to humans. These services can occur at a global level (e.g. climate regulation) or local level (e.g. water purification). Examples of ecological services provided by IRAs include carbon sequestration, watershed protection, pest control, and pollination. Carbon sequestration refers to the idea that trees capture carbon, thus preventing it from escaping into the atmosphere, and contributing to climate change. Carbon sequestration is one of the most significant values provided by forests (SCBD, 2001). Studies have estimated a range of values for this service. The USFS uses an estimate of \$65 per ton as the value of carbon sequestration in the Interior Columbia Basin (USDA/USDI, 1997).

Combining these results with estimates of the amount of carbon sequestered in IRAs, Loomis and Richardson (2000) estimated the carbon sequestration value of IRAs at \$1 billion annually. National forests provide high quality water by filtering the water, slowing storm runoff, reducing flooding, and protecting watersheds. National forest lands are the largest single source of water in the United States: nationally, approximately 14% of surface water comes from national forest lands. Within New Mexico, 29% of the surface water within the Rio Grande basin originates on national forest lands (Sedell, 2000). Watershed protection is another important service provided by IRAs. Most direct studies of the values of watershed protection have focused on developing countries (SCBD, 2001). However, we can get a sense of these values from looking at the values that individuals have for water as well as filtration costs that municipalities have to pay in the absence of natural filtration. Roads significantly increase erosion, which can cause increased sedimentation and turbidity in rivers (Amaranthus et al., 1985). Holmes (1988) estimated that the average cost to municipalities of turbidity treatment activities due to soil erosion is \$113 per

million gallons. Based on results from Brown (1999), Sedell (2000) estimates that for areas without ample water supply, the average marginal value of streamflow for off-stream use (public supply, domestic use, commercial use, irrigation, livestock, industrial use, mining, and hydroelectric power) is approximately \$40 per acre-foot and \$17 per acre-foot for instream flow in the West. Combining this with estimates of the acre-feet of instream and off-stream flow and use on national forests results in a value estimate of approximately \$205 million per year in the Southwest (Sedell et al., 2000). Two other categories of ecosystem services are pest control and pollination. Birds for example, provide pest control on lands bordering lands outside IRAs while bees provide pollination services.

Biodiversity refers to variability among living organisms and the communities to which they belong.⁵ IRAs provide at least three biodiversity services: direct use, genetic, and intrinsic. Direct use biodiversity values refer to the values that people have from directly using or viewing an ecological community. Examples in IRAs might include bird watching or wildflower viewing. For example, based on three studies presented in Rosenberger and Loomis (2001), the average value of a recreational visitor day (RVD) for wildlife viewing in the wilderness in the Intermountain West is \$8. The U.S. Fish and Wildlife Service (2003) reports that New Mexico residents value birdwatching at \$48 per day. Individuals also hold values for the genetic information contained within the DNA of plants and animals living in IRAs. One way that this information is valued in the marketplace is through pharmaceuticals. While the pharmaceutical values for such sites can be quite high in certain tropical areas, the marginal value of this information in IRAs is unclear but likely small (SCBD, 2001). There is no research on the value of genetic information in wilderness areas. Nunes and van den Bergh (2001) report an example

⁵ Christie et al (2004) note that most studies of biodiversity have focused on the value of a particular biological resource (particular species, habitat area, or ecological service) rather than on the value of the diversity itself.

of a pharmaceutical value from a U.S. protected area: Diversa's \$175,000 purchase of the right to conduct research on microorganisms found in Yellowstone hot springs. Finally, individuals can have an intrinsic value for the biodiversity of species or habitats. This is an area with little current research. In a study of U.K. citizens' willingness to pay (WTP) for biodiversity improvements in remote forests, Garrod and Willis (1997) find that respondents are WTP between \$0.74 and \$0.86 per year for each 1% increase in tree biodiversity. In a study of mixed management forests in Michigan, Racevskis (2005) finds that survey respondents are willing to pay \$1.83 per year for each 1% increase in the share of a forest with high migratory song bird diversity.

Community benefits take the form of jobs and income generated by non-motorized forms of recreation. Roadless areas also benefit nearby communities by attracting businesses, retirees, and workers who are often willing to accept lower wages in return for living near high quality natural environments. Studies that have considered community effects of wilderness or roadless areas include Walsh et al. (1981), Keith and Fawson (1995), and Loomis and Richardson (2000). Walsh et al. (1981) estimated daily expenditures per day in a wilderness area of Colorado at \$34. Keith and Fawson (1995) calculated daily expenditures near four wilderness areas in Utah at \$39. Loomis and Richardson (2000) estimated that recreation on roadless areas in the U.S. generates about \$433 million in local expenditures and supports \$576 million in personal income. While studies generally find positive impacts of recreational expenditures on local economies, these impacts are typically modest unless the recreation use is substantial and continuous throughout the year (Cordell and Chamberlain, 2004). A number of studies show that wilderness designation does not have a negative impact on employment, income, or population growth (e.g, Duffy-Deno, 1998). In fact, results discussed in Section 9 suggest that counties with

significant concentrations of wilderness areas and roadless lands outperform counties without these resources.

Passive use values include option, bequest, and existence values. These values are usually quantified through contingent valuation surveys, which ask respondents their annual willingness to pay to preserve some environmental amenity. An option value refers to the value that an individual places on a site because they wish to retain the option to visit that area sometime in the future. One could hold an option value for an IRA for a number of reasons: for future on-site recreation, off-site hunting, the ability to buy a house in the area with a view, or the option for future benefits from ecological services and habitat conservation. Research on option values has primarily dealt with on-site recreation. In a contingent valuation study of Colorado wilderness, Walsh et al. (1984) find that respondents are willing to pay \$13 per year for preservation of 2.6 million acres of Colorado wilderness. Gilbert et al. (1992) estimate that respondents are willing to pay almost \$2 annually for the protection and management of a wilderness site in Vermont. A bequest value is the value that an individual holds for a site because they wish to ensure its continued existence for future generations. Individuals may wish to pass on the ecological services, biodiversity, on-site recreation opportunities, or archaeological resources at a site. Studies on bequest value have typically not specified which of these functions that individuals are valuing but have instead used the general concept of valuing a site for the benefits provided to future generations. In the same studies of Colorado and Vermont wilderness, Walsh et al. (1984) and Gilbert et al. (1992) find that the bequest values for these areas are higher than the recreational option values: approximately \$17 and \$3 per year respectively. An existence value is the value that an individual holds for a site, even though they never plan to visit it; they just value knowing that the site exists. Individuals may hold an

existence value because they value habitat conservation, because they are concerned about endangered species, or just because they want to ensure the continued existence of that site. In the same studies, Gilbert et al. (1992) finds that individuals' existence value for the protection and management of Vermont wilderness is approximately \$2 per year while Walsh et al. (1984) finds that Coloradans have an existence value for habitat conservation of \$16 per year. In a study of the value of 62 threatened and endangered species and habitat in the four corners region, Loomis and Ekstrand (1997) estimate a total economic value of \$49 per household per year.

Analysis of types of values for wilderness areas from the National Survey on Recreation and the Environment finds that individuals consider ecological, environmental quality, and off-site values to be more important than use values (Cordell et al., 1998) and that the percent identifying non-use values (protecting water quality, providing habitat for wildlife, protecting air quality, and supporting endangered species) as important increased between 1994 and 2000. There are no practical differences between racial/ethnic groups and immigrants/non-immigrants with regards to passive use value, especially once acculturation is considered (Johnson et al., 2004). Finally, a number of studies have found passive use values to be the largest component of value for wilderness areas (McFadden 1994; Walsh et al., 1984; Gilbert et al., 1992)

To be complete, regulatory decisions over the fate of New Mexico's IRAs must consider all of these benefits and quantify them whenever possible. Otherwise, the economic benefits of protecting IRAs would be greatly understated as would the environmental, economic, and social costs of opening them up to logging, grazing, mining, oil and gas leasing, and road construction. In the next few years, there are at least three regulatory processes of particular importance. In Section 3, we review these processes and identify why valuation of the complete suite of IRA economic benefits is imperative for sound decision making.

3.0 The Role of Economics in Key Regulatory Processes Affecting New Mexico's IRAs.

In this section we highlight the importance of quantifying the economic benefits of New Mexico's IRAs in the context of three key decision making processes affecting their future management: (1) the U.S. Department of Agriculture's decision to accept or reject Governor Richardson's petition to initiate a rule making process for protecting all New Mexico IRAs; (2) the U.S. Forest Service's decisions over whether or not to designate IRAs as wilderness or otherwise permanently protect IRAs in the context of national forest land and resource management plans scheduled for revision over the next 7 years, and (3) the New Mexico Water Quality Control Commission's decisions over whether or not to list IRA surface waters as Outstanding National Resource Waters under the federal Clean Water Act and New Mexico's State Water Quality Act.

3.1 Governor Richardson's roadless area petition.

On May 13th, 2005, the U.S. Department of Agriculture (USDA) issued a final rule establishing a process that permits state Governors to petition the Secretary of Agriculture to promulgate regulations establishing management requirements for all or a portion of IRAs within that state (36 C.F.R. § 294.12). Once filed with the USDA, the petitions are reviewed by a national Roadless Area Conservation Advisory Committee (RACAC) who then makes recommendations to the USDA as to whether or not the petitions should be accepted. As of this writing, the Governors of South Carolina, North Carolina, Virginia, New Mexico and California have all submitted petitions. On May 26th, 2006 the RACAC recommended approval of the first three petitions, and on June 21st, USDA's Under Secretary Mark Rey accepted the petitions and initiated the rule making process in South Carolina, North Carolina, and Virginia. Importantly, it is the rule making process, not the petition process that ultimately determines the fate of IRAs.

In particular, “[t]he Secretary or the Secretary’s designee shall make the final decision for any State-specific inventoried roadless area management rule” (36 C.F.R. § 294.16).

Economics plays an important role in each stage of the petition and rulemaking process. First, the regulations setting forth the content of state level petitions specifically require petitioners to identify “the circumstances and needs intended to be addressed by the petition, including conserving roadless area values and characteristics..” (36 C.F.R. § 294.14). To fulfill this requirement each of the petitions filed thus far have identified important recreational or ecosystem service values of IRAs. For example, North Carolina Governor Michael F. Easley noted that “roadless areas are integral to our state’s natural heritage and tourism economy” (Easley, 2006). Virginia Governor Mark R. Warner stated that “these inventoried roadless areas provide important recreation and tourism opportunities, clean water, wildlife habitat, and scenic beauty in western Virginia” (Warner, 2006). In a similar vein, Governor Richardson (2006) has argued that:

[t]he vitality of New Mexico’s travel and tourism industry, as well as our State’s natural and cultural heritage, depends on the preservation of roadless areas.

Secondly, economic analysis will play a critical role in the analysis of proposed state level rules. Because the USDA has found the roadless rule to be a “significant regulatory action” it is required to conduct a quantitative assessment of benefits and costs pursuant to Executive Order 12866. In pertinent part, E.O. 12866 requires that for each matter identified as a significant regulatory action, the issuing agency shall provide “[a]n assessment of the potential costs and benefits of the regulatory action” (E.O. 12866 Section 6(a)(3)(B)ii). With respect to benefits, the direction is particularly noteworthy. Issuing agencies are required to complete:

An assessment, including the underlying analysis, of benefits anticipated from the regulatory action (such as, but not limited to, the promotion of the efficient functioning of the economy and private markets, the enhancement of health and safety, the protection of

the natural environment, and the elimination or reduction of discrimination or bias) together with, to the extent feasible, a quantification of those benefits (E.O. 12866 Section 6(a)(3)(C)i).

What is noteworthy is the explicit reference to market efficiency because a proposed regulation's effects on market efficiency cannot be demonstrated without quantification of all significant market and non-market benefits affected by that regulation. The U.S. Forest Service clearly acknowledges this fact. In its Economic and Social Analysis Handbook (FSH 1909.17) the agency defines economic efficiency as such:

Economic efficiency is a term used to describe how well inputs are used to achieve outputs when all inputs (activities) and all outputs (including market and non-market) are identified and valued. All costs and all benefits to society are included (FSH 1909.17, Chapter 10, Section 11.1).

In its May 13th, 2005 Federal Register notice, the USDA deferred a quantitative analysis of benefits and costs of IRA protection to the state-level rulemaking process. In particular, the USDA found that quantitative analysis of costs and benefits associated with the federal rule to be infeasible because many of the economic impacts would be based on State-specific rulemaking. Instead, the USDA offered the following:

For these reasons, the cost-benefit analysis prepared for this final rule focuses on the qualitative aspects of implementing a State petition process. Detailed quantitative analysis would be conducted in the future if and when any State-specific rulemaking proposals are made.⁶

Thus, by providing detailed quantitative information about the market and non-market benefits of roadless area conservation, this study will assist the USDA in conducting the required benefit-cost analysis of its proposed IRA rules in New Mexico should the agency accept Governor Richardson's petition.

⁶ Federal Register, Vol. 70, No. 92/ Friday, May 13th, 2005, page 25659.

3.2 Forest plan revisions.

Management of each national forest in New Mexico is governed by a land and resource management plan (LRMP) prepared pursuant to the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act, hereafter NFMA (16 U.S.C. § 1600 et seq.). Regulations implementing NFMA have been dramatically changed since their issuance in 1982. The most recent changes were adopted by the Forest Service on January 5th, 2005. Along with issuing those regulations, the Forest Service also issued a timetable for revising LRMPs in New Mexico. All five national forests are scheduled to initiate the plan revision process in 2007 and complete that process by 2009.

In the context of the forest plan revision process, New Mexico IRAs must be considered for wilderness designation. In pertinent part, the new planning regulations provide:

Unless otherwise provided by law, all National Forest lands possessing wilderness characteristics must be considered for recommendation as potential wilderness areas during plan development and revision (36 C.F.R. § 219.7a(5)ii).

By definition, IRAs have been deemed by the Forest Service to be lands possessing wilderness characteristics.⁷ As part of the wilderness evaluation process, the economic contribution of IRAs must be considered. Each IRA must be evaluated in terms of “pertinent quantitative and qualitative information including current use, outputs, trends, and potential future use and/or outputs for the applicable resources” FSH 1909.12 Chapter 74 (3). In addition, the Forest Service must “[d]iscuss the impact on the area if it were designated as wilderness and the impact on the area if it were managed as nonwilderness” by showing “the social and economic effects in each case” (FSH 1909.12 Chapter 74 (5)d).

To be complete, wilderness evaluations and all other economic evaluations required by the new planning regulations must take into account both market and non-market benefits. The

⁷ Federal Register, Vol. 70, No. 3, Wednesday, January 5th, 2005, page 1044.

Forest Service explicitly acknowledged this duty in an earlier issuance of the planning regulations. In the response to comments on the November, 2000 version of the new planning rules, the Forest Service clarified that the language “requires the inclusion of commodity and non-commodity resource benefits in economic analyses, with values assigned to these benefits.”⁸ Thus, by providing quantitative estimates of IRA economic benefits, this study will assist the Forest Service in its evaluation of the wilderness potential of New Mexico’s IRAs in the context of the land and resource management plan revisions scheduled to begin in 2007.

3.3 Outstanding national resource waters.

In order to provide protection for the nation’s highest quality waters, the federal Clean Water Act and New Mexico’s implementing regulations have established procedures for “any person” to nominate surface waters of the State for designation by the New Mexico Water Quality Control Commission (NMWQCC) as Outstanding National Resource Waters (NMAC 20.6.4.9). By law, Outstanding National Resource Waters (ONRW) are managed in accordance with the most stringent anti-degradation standards. Those standards provide that:

[w]here high quality waters constitute an outstanding natural resource, such as waters of National Parks, State parks, and wildlife refuges, and waters of exceptional recreational or ecological significance, that water shall be maintained and protected (40 C.F.R. § 131.12(a)3).

As interpreted in New Mexico, the ONRW nomination process may involve entire watersheds and not just isolated stream segments in order to protect all of the tributaries, intermittent streams, arroyos, and drainage channels influencing water quality in the particular stream or river segment of interest. For example, in December of 2005, the NMWCC designated all surface waters within the Valle Vidal as ONRWs. This action suggests that the ONRW process can be used to protect IRAs with significant clean water resources.

⁸ Federal Register, Vol. 65, No. 218, Thursday, November 9th, 2000, page 67551.

As with the IRA petition process and forest plan revisions, economics plays a vital role in the decision to protect ONRWs. In particular, any petition to classify a surface water of the State as an ORNW must include “a discussion of the economic impact of the designation on the local and regional economy within the State of New Mexico and the benefit to the State” (NMAC 20.6.4.9 A5). Thus, quantification of the economic benefits of New Mexico’s IRAs will provide valuable information to guide the ONRW nomination process. In Sections 4 -9, we provide initial estimates of IRA economic values of relevance to the ONRW, forest plan revision, and Governors’ petition processes.

4.0 Water Quality Benefits

New Mexico’s IRAs are sources of high quality waters that support a variety of beneficial uses of significant economic and cultural value to the State. Of particular importance are fishing, recreation, domestic water supply, industrial uses, and irrigation by traditional acequia farmers. A 2000 New Mexico Water Quality Control Commission report to Congress found that the majority of waters determined to fully support all these designated uses “are in wilderness areas or in watersheds protected from anthropogenic impacts” (WQCC, 2000). IRA waters are also critical for maintaining the integrity of endangered riparian ecosystems and species which inhabit them such as the southwestern willow flycatcher, Gila trout, Rio Grande cutthroat trout, and Mexican spotted owl – species that are a source of considerable existence value to New Mexico households. For example, Berrens et al. (1996) found that New Mexico households were willing to pay \$92 per year to protect minimum instream flows on all major New Mexico rivers as a way to conserve 11 threatened or endangered fish species found in those rivers.

Roads built for logging or to support other intensive land uses can increase erosion rates by a factor of 100 over undisturbed lands and contribute to more than half of the landslides on

such lands (Amaranthus et al., 1985). Roads also lead to other human disturbances that degrade water quality, such as the degradation associated with all terrain vehicles, heavily used campsites, and illegal trash dumps. Thus, protection of IRAs is essential for protecting the quality of New Mexico's surface waters.

As a way to gauge the potential magnitude of economic benefits associated with waters flowing from New Mexico's IRAs, we incorporate figures from Neilson (1995), Solley et al. (1998), Sedell et al. (2000) and recent runoff data from the U.S. Geological Survey. The first two studies provide estimates of surface water flows from different U.S. regions and the amount of water diverted to offstream uses. The data were adjusted by Sedell et al. (2000) to isolate flows originating from national forest lands. For national forests in the Southwestern region, they estimate annual surface water flows to be 7,428,051 acre-feet. According to the Forest Service, there are 22.8 million acres of national forest land in the Southwestern region, so this translates into 0.33 acre-feet per acre per year as a ballpark figure for surface water flows originating from national forest lands in New Mexico.

Given the fact that these flow figures were based in part on continental wide modeling, we felt it prudent to cross check with an independent estimate based on real time flow data maintained by the U.S. Geological Service (USGS). USGS maintains mean monthly surface flow estimates for hundreds of stream gages throughout the State.⁹ The mean flow estimates date back several decades, often as far back as the early 1930s. To sample these data, we generated a map of all New Mexico IRAs and stream gages, and selected a few gages at the base of drainages with significant concentrations of IRAs. The gages we selected included sites along

⁹ Real time USGS surface flow statistics are available online at: <http://waterdata.usgs.gov/nm/nwis/current/?type=flow>.

the Red, Gila, Pecos, Santa Fe, Jemez, Mimbres, San Francisco, and Mora Rivers. For each gage, we first calculated the mean annual flow from monthly data, then divided this flow by the drainage area. For the eight gages included in the sample, mean annual flow per acre ranged from .09 acre-feet per acre per year to .60. Predictably, the wetter sites were found in and around the northern mountains. Over our sample, the mean was .27 acre-feet per acre per year. Of course, this is quite close to the .33 estimate made by Sedell et al. (2000) based on an entirely different approach derived from modeling conducted over 11 years ago. Given the relative proximity of these values, use of the Sedell et al. (2000) flow figures seems valid. Multiplying the .33 annual acre-feet per acre flow estimate by 1.597 million acres yields 527,010 acre-feet as an estimate of annual surface water flow from New Mexico's IRAs.

To assign economic values to this flow, we adopt the Sedell et al. (2000) estimate of \$40 per acre-foot for consumptive water uses (withdrawals for irrigation, domestic use, etc.) and \$17 per acre-foot for instream flow (primarily recreation). Updating these figures to \$2006 yields \$47.04 for consumptive uses and \$19.99 for instream flow. Multiplying these figures by our estimate of water yield suggests that the value of water flowing from New Mexico's IRAs for both offstream and instream uses is at least \$35.33 million per year. If we add in the Valle Vidal, this figure rises to \$42.15 million.

It is likely that this value is significantly understated. First, it only considers use values, and leaves existence and other forms of passive use values alone, despite their significance to New Mexico households. Secondly, the Sedell et al. (2000) values did not control for quality. Clearly, higher quality waters can be expected to generate more value on a per acre-foot basis for recreational and domestic water users. Given that IRAs support the State's highest quality

waters and given the omission of passive use values, the \$35.33 million figure should be considered conservative.

5.0 Carbon Sequestration Benefits

Given the potential for catastrophic environmental, economic, and social costs of global warming there has been considerable research over the past decade in determining the value of carbon sequestration services provided by natural ecosystems. In their natural state, forested portions of New Mexico's IRAs capture carbon that would otherwise end up in the atmosphere and add to global climate change. Assigning a value to this function entails estimating the tons of carbon sequestered by IRAs on an annual basis and then multiplying this figure by a shadow price for each ton sequestered. While the former task is relatively straightforward, there are several approaches to the latter which yield a significant range of total values.

As a basis for estimating carbon sequestration rates, we rely on a geographic information system (GIS) analysis of the composition of New Mexico's IRAs to separate out relevant categories of vegetation, each with a separate rate of carbon sequestration or basis for valuation: (1) upper montane forest, which includes spruce fir, mixed conifer, and ponderosa pine forest types; (2) woodlands, which include pinon-juniper, mixed evergreen, and oak, and (3) non-forested tundra, shrubland, or chaparral. According to our GIS analysis, New Mexico's IRAs include 384,355 acres of upper mountain forest, 920,619 of woodland, and 243,648 non-forested acres.

To determine annual carbon sequestration rates for upper montane forests, we relied on calculations by Richards et al. (1993) and assumptions about age class distribution contained in USFS (1996). Richards et al. (1993) show that carbon sequestration rates peak at 3 tons carbon (tC) per acre per year at age 65, diminishing to roughly .60 tC when a stand matures to over 155

years. We used these data in combination with age class profiles contained in USFS (1996) to produce a weighted average of 1.7688 tC per acre per year for upper montane forest types. This translates into a total carbon sequestration rate of 679,827 tC per year. To determine annual carbon sequestration rates for woodlands, we relied on the Heath (1997) regional average of .6768 tC per acre per year across all national forest lands in the Rocky Mountain region (which includes the Southwest in her classification). IRA woodlands, then are presumed to sequester another 623,110 tC per year. Taken together, upper montane forests and woodlands sequester roughly 1.3 million tC per year. Non-forested acres are excluded as carbon sequestration rates for these lands are not readily available. By not including the value of non-forested acres, our estimates of carbon sequestration are conservative. While quantification of the value of carbon sequestration in non-forested areas is not yet available, research findings are demonstrating significant benefits from grasslands and other non-woodland areas as carbon sinks (e.g. Conant et al., 2001). Increased carbon sequestration in these areas may be obtained through rehabilitation of overgrazed rangelands through decreased livestock pressure (Conant and Paustian, 2002). U.S. Department of Agriculture research is underway on grasslands and shrublands in New Mexico to determine under what conditions carbon sequestration in these habitat types can be maximized.¹⁰

In terms of assigning a value to these carbon sequestration rates, there are a number of approaches we can use. The first, partially following Loomis and Richardson (2000), is to apply the results from contingent valuation surveys conducted in support of the Interior Columbia Basin Ecosystem Management Plan (USDA/ USDI 1997) that suggest that U.S. households are willing to pay \$65 per ton carbon (\$86.37 in \$2006) to protect the carbon sequestration services of federal forest lands in the region. This yields an annual estimate of over \$112.53 million.

¹⁰ See <http://www.ars.usda.gov/Main/docs.htm?docid=5549>.

This value can be thought of as “avoided damages from climate change or the cost savings from sequestering carbon rather than reducing fossil fuel use” (Loomis and Richardson, 2000, pg. 24). This figure, however, is somewhat suspect because it is based on the values reported in a single study completed over ten years ago and because the resulting benefit figure is disproportional to the other benefit figures reported here.

Another approach is to use the Costanza et al. (1997) figure of \$35 per acre (\$46.31 in \$2006) of temperate forest as a shadow price for climate regulation services. This would yield an annual benefit figure of \$60.69 million for the carbon sequestration services of forested land within New Mexico’s IRAs. Again, however, this figure may lack credibility due to the level of aggregation (i.e. all temperate forests worldwide) and reliance on a single value.

A third approach is to incorporate data from a recent meta-analysis by Tol (2004), who considered 103 separate estimates of the marginal damage costs associated with a ton of carbon emissions. Tol (2005) found a median of \$14 tC, a mean of \$93 tC, and concluded that “the marginal damage costs of carbon dioxide emissions are unlikely to exceed \$50 tC, and probably much smaller.” Updating his median value to \$2006 (\$15.01) and applying this to the total annual sequestration rate provided by forested IRA acres in New Mexico yields an annual benefit estimate of \$19.56 million. Again, this represents the avoided damage from climate change associated with carbon that would otherwise enter the atmosphere.

A fourth and final approach would be to rely on actual market transaction data. In anticipation of formal carbon offset markets associated with the Clean Development Mechanism of the Kyoto Protocol and to meet growing commitments to greenhouse gas reductions by environmentally sensitive companies, there are a number of active markets already in existence. The logic behind these markets is well expressed by the Chicago Climate Exchange:

Emissions trading introduces scarcity by establishing limits on overall emissions, specifying firm-level limits, and allowing those who can cut emissions at low cost to make extra cuts. Companies facing high costs to cut emissions can comply by purchasing tradable emission rights from those who make extra cuts. The market in a property-like instrument — emission allowances — helps assure efficient use of the limited resource (the environment) and yields a price that signals the value society places on use of the environment. That price represents the financial reward paid to those who reduce emissions, and also indicates the value of creating innovative pollution reduction techniques.¹¹

Thus, we can rely on actual prices from carbon offset markets as a rough approximation of the producer (and arguably societal as well) benefits associated with reduction of carbon emissions. The most recent Chicago Climate Exchange trading price is \$4.50 per ton of CO², which translates into a price of \$16.67 per ton of carbon (since the carbon component of CO² is .27 per ton). Applying this price yields a benefit estimate of \$21.72 million for the annual carbon sequestration services of New Mexico's IRAs.

Since the latter two estimates are based on more recent data and are tiered to the site specific carbon sequestration data from the Southwest region (as opposed to generic per acre figures) we adopt them as our range and estimate that New Mexico's IRAs provide between \$19.56 and \$21.72 million per year in carbon sequestration services. If we add the 101,174 acre Valle Vidal to this and calibrate for its vegetative profile (80,359 acres mixed conifer, 21,435 non-forest) the range increases to \$21.69 - \$24.09 million.

6.0 Outdoor Recreation Benefits

Recent estimates for 2000-2003 report approximately 20.5 million national forest (NF) visits (and 23.6 million total NF *site* visits) occur annually in the national forests and grasslands of the Southwest Region¹² (and see Unsworth et al. 2005, p. 6-3). These estimates are from

¹¹ See <http://www.chicagoclimatex.com/environment/>.

¹² A NF visit can contain multiple *site* visits. The Southwest Region (Region 3) contains 11 national forest and 3 national grasslands totaling 22.3 million acres, which are located primarily in Arizona and New Mexico, and small parts of Oklahoma and Texas.

Round 1 of the National Forest Visitor Use Monitoring Program (NVUM), and are also broken down by NM national forests, and into wilderness area visits (see Table 3). Using these results, it can be estimated that there are currently more than 8 million NM national forest visits and 9.5 million site visits annually, including approximately 1.1 million visits and 714,500 recreation visitor days (RVDs) to NM national forest wilderness areas.¹³ This is only for the current Congressionally-designated wilderness areas of approximately 1,388,000 acres in NM. It is reasonable to assume that New Mexico IRAs support a similar intensity of visitation since they are often adjacent to protected wilderness and support many of the same outstanding recreational values. In this section, we quantify the economic benefits associated with outdoor recreation in New Mexico's IRAs.

Over the last four decades, economists have developed a battery of techniques for estimating the economic values of non-market goods and services. These techniques include a variety of both revealed preference (e.g., travel cost and hedonic pricing methods) and stated preference approaches. These techniques are applied to estimate both use values (e.g., for outdoor recreation that is not priced and traded in a market), and more controversially to nonuse values (e.g., associated with protecting a natural area or ecosystem services without any direct *in situ* use of those services). Literally thousands of published applications of non-market valuation now exist, including numerous studies investigating use values for outdoor recreation (e.g., hiking, fishing, hunting, etc, see Champ et al. 2003 for an introduction to this literature).

Consumer surplus is a standard economic welfare measure, and represents the net benefits to a participant in an activity; it is the differences between their willingness to pay, as measured off an individual demand curve, and the amount actually paid for the activity.

¹³ A recreation visitor day (RVD) is defined as a 12 hour unit, which can be accrued by one or more persons (Loomis and Richardson, 2000, p. 9).

Consumer surplus values for outdoor recreation have been commonly calculated and used for many decades in a wide variety of federal, state and local planning processes (Loomis, 2001). In this context, they are typically converted into values per recreation visitor day (RVD) to facilitate aggregation and comparisons. The U.S. Forest Service commonly uses these values in a variety of planning assessments (e.g., see summary in Loomis, 1999, p. 615).

Associated with any recreationist's consumer surplus is some level of expenditure (e.g., gas, food, lodging, etc.). For example, nationally across all national forests the average spending (within 50 miles) per person per trip (primary destination) spending was \$43.79 (\$2006), with a typical trip duration of 19 hours (USDA, 2004). While conceptually distinct from consumer surplus or economic benefit measures (McCollum and Bergstrom, 1992), these expenditures are the source of community effects or regional economic impacts (direct, indirect and induced).

Table 4 provides mean consumer surplus values, in current dollars, per recreation visitor day for a variety of outdoor recreation activities that would typically be expected to be associated with protected areas. The values are specific to the Intermountain West region, which includes New Mexico, and the activities include hiking, cross-country skiing, floating and rafting, fishing, hunting and wildlife viewing. The surplus estimates are taken from a recent updated review of over a 100 studies from 1967-2003, for use in national forest planning assessments (Loomis, 2005), by census region, and updated into current dollars (\$2006) using a CPI inflator.

Loomis and Richardson (2000, p.10) estimated the annual recreation use from preserving 42 million acres of NF roadless areas at 9,465,035 recreation visitor days (non-motorized recreation) for the Intermountain West region. Given 32,957,000 acres of roadless areas in the Intermountain West, New Mexico's 1,597,000 roadless areas represent 4.59 percent of the regional total. By simply proportioning RVDs, then New Mexico would have 434,445 RVD's

from protecting roadless areas in NM national forests. At an RVD value of \$44.68 (Loomis, 2005), this rough proportioning amounts to \$19,411,007 of annual value from protecting NM national forest roadless areas. More rigorously, Loomis (1999) uses an econometric regression model to statistically calculate a visitor use elasticity measure defined as:

$$\varepsilon = \% \Delta \text{NFWU} / \% \Delta \text{NFWA},$$

where NFWU is national forest wilderness use (in RVDs), and NFWA is national forest wilderness acres. Estimated elasticities are: $\varepsilon_{\text{NAT}} = 0.89$ nationally, and $\varepsilon_{\text{EAST}} = 1.1$ for the Eastern U.S., and $\varepsilon_{\text{WEST}} = 0.35$ for the Western U.S. Using the $\varepsilon_{\text{WEST}}$ measure, we can calculate the predicted increase in RVDs for New Mexico's approximately 1.6 million acres of national forest roadless areas (1,597,000 roadless acres * 0.35 = 558,950 RVDs).¹⁴

The estimated RVDs of 558,950 can then be multiplied by a per RVD value to calculate the annual consumer surplus (net benefits) to non-motorized outdoor recreationists from protecting national forest roadless areas in New Mexico (558,950 RVD * \$44.68 per RVD = \$24,973,886). The RVD value of \$44.68 is a benefit transfer estimate taken from the recent Loomis (2005) review of more than 30 wilderness area studies for the intermountain census region of the U.S., and updated into current dollars (see Table 4). Thus, the predicted annual consumer surplus value is approximately \$24.97 million.

¹⁴ We can put this estimate of 585,950 on-site RVDs from protecting 1,597,000 acres of national forest inventoried roadless areas in perspective by comparing to the estimated RVDs for current national forest wilderness area in New Mexico. Currently, there are approximately 1,388,000 acres of national forest Wilderness area in New Mexico. Using results from a variety of USDA Forest Service publications from the National Visitor Use Monitoring Program (see Table 3) an estimate of current wilderness area RVDs for NM national forests is approximately 714,500 annually. This amounts to a ratio of 0.52 RVDs/NM national forest Wilderness acres. For this analysis using the Loomis and Rosenberger (2000) visitor elasticity measure for the western U.S., we have an estimated ratio of 0.37 (585,950 RVDs/1,597,000 NM national forest roadless acres), which is thus relatively conservative. Secondly, the estimate of RVDs for current NM national forest wilderness areas is based on a significant downward revision in Region 3 wilderness area visits since 2001 (see Table 3 and USDA 2001a).

Following Governor Richardson's petition, which would add approximately 101,000 acres of the Valle Vidal to protected status, the total amount would be approximately \$26.6 million in consumer surplus benefits annually (1.7 million acres * 0.35 * \$44.68 = \$26,584,600).

7.0 Passive Use Benefits

Loomis and Richardson (2000) calculated an annual per acre passive use of \$6.72 for the western U.S., exclusive of Alaska. Updating this figure into current dollars (\$2006) provides a value of \$8.17 per acre. Applying this value across the board to the 1.597 million acres of national forest IRAs in New Mexico provides an annual total passive use value of \$13,047,490. Adding the 101,794 acre Valle Vidal under Governor Richardson's petition provides a total annual passive use values estimate of \$13,879,147.¹⁵

This figure assumes that the \$8.17 figure calculated for all western IRAs is a good estimate for per acre values in New Mexico. As a way to incorporate more site-specific valuation data, we recalculated these passive use value figures with one additional study that estimated U.S. households' willingness to pay for protection of 4.6 million acres of Mexican spotted owl critical habitat in Utah, Colorado, Arizona, and New Mexico designated by the U.S. Fish and Wildlife Service in accordance with provisions of the Endangered Species Act and its implementing regulations (Loomis and Ekstrand, 1997). According to geographic information system (GIS) data relied upon in this analysis, New Mexico IRAs support roughly 324,117 acres of critical habitat. In their study, Loomis and Ekstrand (1997) found an annual willingness to pay value of \$40.49 per household, or \$51.09 in \$2006.

¹⁵ Relative to our annual outdoor recreation use value estimate of \$26,584,600, the annual passive use value estimate of \$13,879,147 represents 34% of the combined total. By way of comparison, from the studies reviewed in Loomis and Rosenberger (2000), the evidence indicates that passive use values typically represent about half of the combined total (passive use plus recreation use values). Thus, our passive use value per acre represents a relatively conservative estimate by this measure (and see Walsh et al., 1984).

According to the latest census data there are 677,847 households in New Mexico, so multiplying this out suggests that New Mexico households are willing to pay \$34,631,203 each year to protect 4.6 million acres of MSO critical habitat, or \$7.53 per acre per year. Of course, this independent estimate is only slightly less than the \$8.17 estimate from Loomis and Richardson (2000), so we incorporate it as a lower bound, but only as it applies to critical habitat acreage within IRAs. By multiplying the \$7.53 figure by the 324,117 acres of critical habitat in New Mexico and the remaining IRA acres by the \$8.17 figure from Loomis and Richardson we arrive at a lower bound estimate of \$12,839,576 without the Valle Vidal, and \$13,671,233 with the Valle Vidal included (but no assumed critical habitat). Thus, we can say that the roadless lands identified in Governor Richardson's petition generate between \$13,671,233 and \$13,879,147 in passive use values each year.

8.0 Off-Site Benefits

In addition to on-site benefits, the approximately 1.6 million acres (1.7 million acres under the NM petition, including the Valle Vidal) of NF roadless areas in NM provide considerable off-site economic benefits as well. These off-site benefits may include visual or scenic amenities, and habitat for fugitive resources such as big game species where a significant proportion of the stock get hunted and harvested off-site.

Using hedonic pricing techniques (Taylor, 2003), economists have repeatedly demonstrated over the last four decades that environmental amenities or quality characteristics can significantly increase the market value of adjacent lands (Loomis and Richardson, 2000; Rosenberger and Loomis, 2001). The essential idea is that visual or proximal access to some set environmental amenity and disamenity characteristics (hereafter the "amenity bundle") gets capitalized into the sales price of the property. Thus, with commonly available property

transaction data, econometric models can be used to statistically decompose observed price variation, and isolate the effect of individual property attributes as they vary across the data. Characteristics that would typically affect property price would include physical attributes and structural characteristics of the property itself, neighborhood characteristics, and the environmental amenity bundle in the proximal area. Advances in geographic information systems (GIS) have made spatially explicit information widely available, and have enhanced hedonic pricing models.

As stated by Loomis and Richardson (2000, p. v): “[p]rotecting natural environments such as roadless areas can increase the property values of adjacent private lands.” As a relatively direct example, they review a Vermont case study (Phillips, 1999) for the Green Mountain National Forest, where hedonic pricing analysis was applied to over 6,000 land sales to isolate the value of parcels near designated wilderness areas. Results indicate that proximal parcels sold at prices 13% higher than otherwise, with a price decrease of 0.8% per acre for each kilometer of distance from the wilderness area (Phillips, 1999; Loomis and Richardson, 2000). More recently, Phillips (2004) has updated this study to cover all property sales in the area from 1987-2002, covering more than 12,000 transactions and 82 towns across southern and central Vermont within 14 kilometers of the NF boundary. Some of the key findings include: (1) towns with adjacency -- designated wilderness acreage within their borders – had a 19% higher per acre price than those that did not; (2) the per-acre price of land falls by 0.33% for each kilometer of distance from a wilderness boundary; and (3) a 1% increase in proportion of a town with designated wilderness is associated with a 0.8 percent increase in land prices. Given proposed changes in wilderness boundaries, Phillips (2004) predicts that towns currently without adjacent

wilderness areas would see a land price increase of \$4000 per acre. Towns within the general area would expect to see a price increase of \$250 per acre.

While not as direct as the Phillips (1999; 2004) case of wilderness effects in Vermont, there are some Southwestern U.S. examples of protected areas providing off-site benefits. Colby and Wishart (2002a and 2002b) use hedonic pricing, with over 25,000 property transactions, to investigate the effects of protecting riparian areas and buffer zones along a 15 mile stretch in northeastern Tucson area. Controlling for all other effects, they find that the value of being near protected riparian areas accounts for up to six percent of the typical home sale price, with almost all of this off-site benefit captured by homes within the first several miles away from a protected site.

As noted by Loomis and Richardson (2000) the expectation is that protected roadless areas generate similar off-site amenity benefits as found in Phillips (1999). Roadless areas often are located on the fringe or buffer zone of designated wilderness areas. The question is whether there is a reasonable expectation that similar off-site benefits hold for New Mexico protected areas, including NF wilderness areas and roadless areas given that New Mexico has different population densities and characteristics and a much greater proportion of the landscape in natural condition (i.e. relative scarcity is much less than elsewhere, such as Vermont). The issue is further complicated in the New Mexico case because property prices are not subject to full public disclosure (one of only several states).¹⁶ Thus, while hedonic pricing studies are common elsewhere, they remain quite rare in NM. But the absence of publicly-available property sales prices data does not imply that off-site amenity, scenic and proximal values aren't being capitalized into market values. Since *off-site benefits* can sometimes seem abstract, we provide a concrete NM example within the context of fishing and hunting, which are commonly discussed

¹⁶ For detailed discussion of this issue, see Berrens and McKee (2004).

as motivations for protecting NM roadless areas (Baker, 2006). More specifically, to further evaluate this argument, we investigate the case of elk hunting.

As recently reviewed by the New Mexico Department of Game and Fish (NMDGF, 2006), inventoried roadless areas provide critical wildlife habitat for hundreds of species, including a number of threatened and endangered species. Further, this habitat provides some significant proportion of the forage and life support of prominent game species (e.g., elk) that move across the mosaic of federal, state municipal and private lands. Given that approximately 44% of New Mexico is public land, these lands (and especially roadless and protected lands) are often critical to providing habitat to game species (NMDGF, 2006). As many of these habitat benefits are captured on private lands, then high quality habitat (like roadless areas) provides “spillover” or diffusion effects on adjacent private lands.

Hunting and fishing and other outdoor recreation activities are important contributors to the New Mexico economy. For the case of hunting, in New Mexico the aggregate output from all hunting related expenditures (in 2001) was estimated at \$349 million; these expenditures generated an estimated 4,057 jobs and resulted in \$1,366,184 in state sales tax, and \$8,449,134 in federal income tax revenues in 2001 (IAFWA, 2002). These impacts are from hunting on both private and public lands combined. Unlike many areas in the U.S., there is evidence that hunting is actually increasing in New Mexico. Total hunting-related expenditures in 2001 were 58% higher than in 1996, and average expenditure per hunter was 46% higher over the same period (NSFHWAR, New Mexico 1996, 2001). There is evidence that hunting on private land has been expanding. In 2001, 39% of all hunting days in New Mexico took place on private lands, compare to 31% in 1996. Between 1996 and 2001, total expenditures on hunting-privilege and

other fees increased by 116%, and per hunter expenditures on hunting-privilege and other fees rose by 76% (see Mozumder et al., 2006).

New Mexico has an active market for big-game hunting, and most prominently elk hunting.¹⁷ Elk hunting permits are allocated and regulated by the state, which runs a large annual public lottery as well as select over-the-counter sales and high bid auctions. The annual market also includes numerous private and tribal entities, and even a high profile federal participant (the Valles Caldera National Preserve). As a tool for rural economic development, New Mexico has focused recent efforts on cooperative game management arrangements through public-private ventures. The general program, formerly known as the Landowner Sign-up System (LOSS), is described in detail in Leal & Grewell (1999), and now is composed of the on-going elk (E-PLUS) hunting permit authorization program on private ranches.¹⁸ These authorizations act like quasi-permits, and are location specific but fully transferable. An active private market exists, as elk hunting in New Mexico has been characterized as a monopolistically competitive market (Little et al., 2005), where entrants try to quality differentiate their product to capture price-making power. The value of mature bull permits often run in the \$5,000-\$10,000 range, but can

¹⁷ According to the 2001 National Survey of Fishing, Hunting, and Wildlife Associated Recreation, 112,000 individuals spent a total of 711,000 big game hunt days in New Mexico in 2001, with associated expenditures of \$101 million (NSFHWR, 2001). Although the majority of big game hunting days are still spent on public land, between 1991 and 2001 there was a noticeable increase in the number of days spent big-game hunting on private land (see further discussion in Mozumder et al., 2006).

¹⁸ In New Mexico there are currently approximately 2,800 ranches participating in the E-PLUS elk hunting authorization program, with a total of approximately 5.5 million elk-occupied acres. (See the New Mexico Department of Game and Fish website: <http://www.wildlife.state.nm.us/recreation/hunting/index.htm>). As Little (2005) states, this authorization program: “has aided greatly in increasing the availability of private land hunting in the state of New Mexico. In 2003 a total of 18,646 authorizations for elk permits were issued, 10,304 of which were converted to non-transferable permits). Non-residents converted 52 percent of ... authorized permits; New Mexico residents converted the remaining 48 percent. Between 20-25 percent of authorized permits were for mature bull elk.” Further, the program allows participants to avoid the uncertainty associated with the state lottery system. As these authorizations are not allocated through public draw, they are exempt from the state’s 80% resident quota (i.e., a larger fraction of out-of-state dollars enter local economies). The program fosters rural economic development by diversifying income and creating linkages between authorized ranchers, outfitters, and guides (Little, 2005; Mozumder et al., 2006).

increase greatly depending upon characteristics and bundled services (Little, 2005).

Economically, it would be expected that this value would get capitalized into the value of private ranches with permit authorizations.

Thus, consistent with the recent expansion of big game hunting on NM private land has been the significant appreciation of property values for private ranches that offer high quality trophy hunting. In a rare example of a hedonic pricing model applied to NM sales data (provided by the Farm Services Credit Bureau, with restrictions on release), Torell, et al. (2004) found that high elevation, private-deed trophy ranches were the highest-priced ranches in New Mexico; these ranches experienced the largest appreciation in sales value for 1996-2002 (e.g., 7-12% annually compared to 1% annual property value appreciation of low-priced ranches with public land grazing permits).

While there are a variety of prominent elk hunting areas in New Mexico that are affected by the roadless petition, such as the Valle Vidal (Carson NF), consider the case of the Gila NF in southwest New Mexico. The Gila NF contains approximately 735,000 acres of inventoried roadless areas, or approximately 21% of the total national forest lands. Another 24% is in designated wilderness areas (more than 800,000 acres). The Gila NF is contained within, NMDGF game management units (GMUs) 15a, 15b, 16a 16b, 16c, 16d, 16e, 21, 22, 23, and 24. As shown in Table 5, these game management units are further lumped into four elk management regions, composed of a total of over 8 million acres. Almost 40% of this total is U.S Forest Service (Gila NF) land (approximately 3.3 million acres), 28% is private land and 15% is state land, with the remainder a mix of BLM and other lands. Notably, 20% of the greater Gila area is in protected roadless lands, with 8.8% in IRA lands. Approximately three-fourths (> 6 million acres) of the total is designated as COER (core occupied elk range) habitat,

with essentially all of the USFS land in the COER habitat (i.e., greater than 50% of key elk habitat is USFS land). In reviewing the habitat contribution of roadless areas for elk, the NMDFG (2006, p. 2) has recently stated that roadless areas “provide unique high quality hunting and fishing opportunities. They serve as core habitat areas for game animals and cold water fish species.” This statement is an articulation of an off-site benefit.

In the greater Gila area, there are some 272 ranches with a total of more than 1400 permits (roughly 25% mature bull), with almost 600,000 acres of elk acreage on these ranches. One hundred of these private ranches are designated unit-wide (i.e., likely to be part of the COER elk habitat). In total, it can be roughly estimated that for a typical year (since this is a composite of data from multiple years) there are more than an estimated 9,600 permits, private and public, allocated annually in the area. Success rates (across all weapon types) are often 33% or more on public permits, and often much higher on select ranches or protected areas. As recently reviewed by the New Mexico Department of Game and Fish (NMDGF, 2006), there is a significant body of published scientific literature that shows that roadless areas have higher elk habitat quality.

Elk herds move across this habitat, where roadless and other protected areas appear to compose a very significant fraction of the high quality habitat. There are economic benefits being generated by this prominent game species. There are numerous economic agents capturing consumer and producer surplus, including hunters, landowners, guides and outfitters. Further, as reviewed above, the hunting expenditures generate important economic impacts for the region. The USFS (and the BLM) appear to collect only minimal revenue on this regional enterprise,¹⁹ but protected roadless lands and national forest inventoried roadless area lands are a critical input to this regional economic activity. While we are not aware that it has quantified the contribution

¹⁹ NM hunters who use any federal lands in the state must pay a \$5 wildlife habitat stamp, with their license fees.

of protected Forest Service lands to elk habitat, and state and private enterprises, this diffusion effect is clearly recognized by the state (NMDGF, 2006, p.17):

Roadless areas in New Mexico, including Wilderness areas, provide some of the highest quality elk hunting opportunities and provide habitat that sustain elk populations for surrounding areas.

Thus, the position of the New Mexico Department of Game and Fish (NMDGF, 2006) is consistent with the argument that in addition to any on-site hunting benefits (i.e., consumer surplus to hunters), national forest inventoried roadless areas provide significant off-site economic benefits to state and private lands. Using the greater Gila area in southwestern New Mexico as an example, the pattern of evidence and land ownership configuration discussed for elk hunting -- where both a large state lottery and active private market exists -- support this economic argument.

There are spatial considerations and limits to this argument. Those properties closest to roadless and other protected areas would be expected to have the largest diffusion or spillover effects, which would then decay with distance (e.g., Wishart and Colby, 2002a and b; Phillips, 1999). Further, ranches near protected areas known for extremely high quality (probability of trophy hunts and proportion of mature bulls), such as say the Valle Vidal, would be expected to realize the biggest off-site benefit effect. Finally, we note that similarly to the positive spillovers on elk hunting, roadless areas can provide a variety of off-site benefits (e.g., fishing impacts, scenic amenities, etc.) that are capitalized into property and other heterogeneous market goods (guide and outfitter services etc.).

The national roadless study conducted by Loomis and Richardson (2000) estimated a 13% gain in local property values, based largely on the results of Phillips (1999). More recent work by Phillips (2004) points to an even higher value of 19%. However, these hedonic pricing

analyses were conducted in Vermont. Absent an original hedonic pricing study that is targeted to this issue in New Mexico (and see Berrens and McKee, 2004), this report has reviewed the New Mexico case, and argued that there is substantial support for significant off-site effects from protected roadless areas. However, given relative scarcity of protected areas, other benefit categories often show that percentage and per acre unit values in the eastern U.S. are higher than in the western U.S. For example, Loomis and Richardson (2000) estimate that various recreation use values per acre in the west range are typically only 27% of eastern values, and passive use values per acre in the west are only 69% of eastern values. Thus, it is reasonable to assume that mean off-site benefits in the west might be less in percentage terms than observed by Phillips (1999 and 2004).

This argument is countered by the particular NM case (e.g., see Table 4) of a prominent big-game hunting allocation (including public lottery, auctions and private sales), where roadless and other protected areas “sustain elk populations for surrounding areas” (NMDFG, 2006). We conservatively estimate a 6% gain in local property values from being proximal or adjacent to a NF roadless area. We would expect this impact to exhibit distance decay, and thus to be largely captured with the first several miles of distance.²⁰ We expect this impact to be realized both by residences (e.g., due to scenic and access effects) and to ranches (e.g. due to proximal habitat effects, as well as scenic and access effects). IRA lands in NM are generally remote and not located near any large towns or cities, so for practical purposes, adjacent private lands are largely large tract or ranch lands.

²⁰ As the basis for our estimate, and to accommodate the relative reduction of approximately one-third of value in the west versus the eastern U.S. for outdoor recreation use values, this 6% estimate represents 31% of the Phillips (2004) figure of 19%. It might also be noted that this estimated magnitude and distance effect is similar to results found in Wishart and Colby (2002b) for riparian protected areas.

The conceptual issue is how to convert this percentage effect in the capitalized present value of the property into an annualized value for some amount of private and adjacent to the IRA lands. As typically done, one approach would be to estimate market value per acre for some fixed boundary around the IRA lands, annualize this value (e.g., Torell et al., 2004, p. 58) and apply the 6% off-site benefit (multiply by 0.06).

Using a GIS analysis conducted for this study it was determined that there are 775,037 acres of private land within 2 miles of FS IRA lands in NM. Torell et al. (2004, p. 72) found that high elevation trophy ranches in NM sold for over \$563 per acre (converted into \$2006), with an implied capitalization rate of 5% to 7%. For their entire NM sample of 492 ranch sales, the average per acre sales value was \$146 (converted into \$2006). For the “trophy ranch,” converting this into an equivalent annual income stream (in perpetuity) would yield a value of \$28.15 per acre, assuming a 0.05 interest or yield rate. For the average-price NM ranch, converting this into an equivalent annual income stream (in perpetuity) would yield a value of \$7.30 per acre, assuming a 0.05 interest or yield rate.

Of our 775,037 acres within 2 miles of FS IRA lands in NM, we expect that a relatively high fraction (>50%) would be high-valued (e.g., greater Gila area). Thus, to start we apply the annual equivalent income value per acre to half of our total adjacent acres, and then multiply by 0.06 (6% off-site benefit assumption) to get \$654,519. Using the lower annual equivalent income value per acre to half of our total adjacent acres, and then multiply by 0.06 (6% off-site benefit assumption) to get \$169,733. Summing these two values together, we get: \$824,252. Thus, although there is spatial variation, on average each acre of IRA in NM, (approximately 1.597 million acres total) generates roughly 52 cents of off-site benefits annually. Extending this proportionally to the full Governor’s petition (including the Valle Vidal), we get a total annual

value of \$877, 413. Alternatively, given recent ecological and habitat assessments (NMDFG, 2006), we can apply the high equivalent annual income figure to all 775,037 acres of adjacent land, while still using our other assumptions. This yields an annual market value of \$1,309,038 for the off-site benefits of NM IRA lands, and extending proportionally to the full Governor's petition (including the Valle Vidal), we get a total annual value of \$1,393,465 million. These estimates represent an initial attempt to generate an annual market value for off-site benefits to private lands from adjacent IRA lands in NM.²¹

9.0 Community Benefits

9.1 Discussion.

In the Intermountain West, where public lands are a prominent feature of the landscape, policy decisions over the status of these lands trigger intense debates over their role in local and regional economies. As traditional resource extraction has become less important, the amenity value of forests and public lands has received more attention (see, for example, Power (1996, 33-43)). People spend money on recreation, seek desirable residential locations, and make employment decisions based on the amenities that preserved forest resources offer. These behaviors have the potential for large local and regional economic impacts.

Studies of the amenity value of roadless areas stem from observations of the economic effects of broadly-delineated regional amenities (like climate). The main idea is that people are willing to pay and will adjust their economic behavior to access nice places. For example, an amenable climate may account for lower wages and higher housing prices across regions (Roback 1982, 1988; Hoehn et al. 1987; Blomquist et al. 1988), higher population growth (Clark and Murphy 1996; McGranahan 1999), and higher employment and economic growth (Power

²¹ Conservatively, we only estimate an off-site effect for private lands where there is more readily available market price information.

1996, ch. 2). Further, increasing incomes and scarcity appear to be increasing the amount people are willing to pay for amenable climates (Costa and Kahn, 2003).

Only a few studies have investigated the amenity value of roadless areas in particular, but several other studies look at similar policy designations, such as Congressionally-designated wilderness areas, state and national parks, and multiple-use forest lands. Duffy-Deno (1997) notes that amenable land characteristics, state parks in this case, can have two effects on local economies: recreation opportunities are “exported” to visitors, creating jobs and income, and the amenity value of the parks draws people to live and work in areas with amenity access. The author used a multi-equation simultaneous model of the Intermountain West to show that the density of state parks increases population growth at the county level. In a similar application in the northern forest (i.e. Minnesota, Wisconsin, and Michigan), Lewis et al. (2002 and 2003) found that population growth is positively related to the density of multiple-use public lands, like national forests.

The desirability of publicly-provided forest resources may also have observable effects in housing and labor markets. Kim and Johnson (2002) estimated hedonic premiums for forest amenities in a local housing market; they found that proximity to publicly-managed forest land increases property values. Forest management practices also appear to affect property values; houses with views of clear-cut forest areas had significantly lower property values. Kim and Wells (2005) used hedonic estimates to show that hazardous fuel treatments in forests that reduce wildfire risk and increase scenic beauty are related to higher housing prices. Finally, Schmidt and Courant (2006) estimate hedonic wage premiums for proximity to forests and outdoor recreation opportunities. Metropolitan-area wages are lower in closer proximity to these

amenities; the authors hypothesize, following the work of Rosen (1974) and Roback (1982), that people are willing to accept lower wages in exchange for easier access to nice places.

The economic effects of inventoried roadless areas are generally studied by focusing on the impacts of recreation-based economic activity. Loomis and Richardson (2000) estimated that recreation on roadless areas in the U.S. generates about \$433 million in local expenditures and supports \$576 million in personal income. Southwick Associates (2000) argues that amenity-based recreation accounts for higher-than-average economic growth in Oregon counties with wilderness and roadless areas. The positive economic performance in these counties has occurred in spite (or because) of drastic declines in the importance of natural resource extractive industries. The Sonoran Institute (2006) finds similar results for one county, Doña Ana in New Mexico. Lorah and Southwick (2003) also find that county-level employment, population, and income growth are all positively related to the existence of protected lands (both wilderness and roadless).

A common criticism of roadless areas protection is that such preservation keeps natural resources “locked up” from high-value extractive uses (Power 2000, 4). But there is little empirical evidence that protecting roadless areas from development will have, on net, any negative impacts in local or regional economies. Duffy-Deno (1998) showed that designated wilderness areas have no negative impact on employment, income, or population growth. Other localized studies have shown that drastic reductions in timber harvests are correlated with overall employment gains (Power, 2000; Niemi et al., 1999).

9.2 Community benefits calculations for New Mexico IRAs.

As a first step towards evaluating the community economic effects of roadless areas in New Mexico, six economic indicators in counties with significant roadless areas are compared to

the performance of the remainder of the state.²² The indicators – total employment, wage and salary employment, income, population growth, real earnings, and earnings per worker – are evaluated over the decade that encompasses the debate and implementation of the roadless rule, 1995 to 2004 (which is the most recent year with complete data).

Counties with roadless areas appear to have performed as well or better than the rest of the state on most economic indicators; panel (a) of Table 6 summarizes these comparisons. Total and wage and salary employment growth rates for these counties are slightly higher than the state average. Both total real income and population are growing faster in roadless counties than in other counties. To get a better idea of how workers are doing in roadless counties, wage and salary earnings growth rates are compared. Roadless counties' total earnings grew slightly faster than the state average, as did earnings per wage and salary worker. Averaged across all six indicators, Table 6 suggests that counties with significant tracts of roadless areas performed 1.28% better than those without.

It is also desirable to look at a more disaggregated picture of employment in roadless and non-roadless counties. This task is inhibited to some degree by the lack of available data, but the data do allow for some conclusions about the relative importance of various industries within New Mexico's economy. Panel (b) of Table 6 presents two primary comparisons. First, forestry and mining employment is a small share of total non-farm employment. Roadless counties have a higher share of employment in forestry and mining industries, but this share is still below 5%. Second, both roadless and non-roadless counties have about 33% of non-farm employment in service industries, excluding government; the engine of economic activity in New Mexico is

²² Significant roadless areas are defined here as comprising at least 1% of the county's land area in FS inventoried roadless area. These counties include Catron, Eddy, Grant, Hidalgo, Lincoln, Otero, Rio Arriba, San Juan, San Miguel, Santa Fe, Sierra, Socorro, and Taos. Although Los Alamos County has more than 1% of its land in roadless areas, it was not included in this group due to the unique dependence of that county's economy on Los Alamos National Laboratories.

services, not natural resources industries. Finally, services have become much more important in recent history, and more so in roadless counties. Services employment has grown by 44% in roadless counties and 42% in non-roadless counties from 1990 to 2000.²³

While this brief look at economic performance cannot fully determine the extent of economic impact of roadless areas to local and regional economies, it does highlight two points. First, counties with roadless areas have not recently suffered any abnormal economic harm compared to non-roadless counties; if anything, these counties have done better along some broad measures of economic performance. Second, natural resource extraction industries are a small part of the overall economic picture. Industries that do not depend on extraction and export of natural resources, such as services, are a large and growing part of the economy.

A more detailed assessment of the economic impact of roadless areas begins with the fact that recreationists make expenditures in local and regional economies. To the extent that these expenditures represent dollars that would not otherwise be spent locally, production and consumption relationships circulate these dollars through the local and regional economies. For example, a dollar spent by a recreationist will be spent by an outfitter on labor and supplies, which will then be spent by hired labor and suppliers on other goods and services. Expenditures support a community's income and jobs directly in the recreation industries (as businesses meet recreation demands) and indirectly through linkages to other industries in the economy.

An assessment of the size of these community effects typically begins with an estimate of recreation expenditures in a community and an input/output model. Loomis and Richardson (2000) used estimates of average expenditures per wilderness day and increased recreation

²³ Disaggregate industry data is often unreported in specific counties due to confidentiality requirements; this problem is exacerbated when using the NAICS data available from 2001 to 2004. Data reported on a SIC basis (prior to 2001) can be aggregated into larger super-sectors, such as all services. Using the date range of 1990 to 2000, under the SIC system, allows for employment changes to be calculated for most counties.

visitor days (RVDs) with an IMPLAN input/output model to calculate personal income and total value added to the economy as well as jobs created for protecting 42 million acres of national forest roadless areas nationally. Their estimated results (direct, indirect and induced) included \$576 million in personal income and 23,700 jobs in the national economy.

A useful property of input/output models (such as IMPLAN) is that they generate economic multipliers. For example, a personal income multiplier measures the increase in economy-wide personal income that would be supported by an additional dollar of directly accumulated personal income. Loomis and Richardson (2000) find a personal income multiplier equal to 2.07 for wilderness recreation in the United States. The authors also find that a dollar of recreation expenditure supports \$0.65 of direct personal income, minus leakages and exports. Using their income multiplier (2.07 multiplied by \$0.65), a dollar of expenditures generated from recreation on protected roadless lands supports \$1.34 of personal income in the U.S. economy.

Multipliers vary in magnitude across regions and industries. Rudzitis and Johnson (2000) estimated output multipliers across several industries in two Oregon counties that ranged between 1.33 and 1.93. Kriesel et al. (1996) found income multipliers for recreation expenditures at three BLM sites between 1.79 and 2.37.

Community effects of roadless areas recreation in New Mexico are estimated by applying multipliers and per acre effects estimated from other sources, primarily Loomis and Richardson (2000). Table 7 shows the estimated economic impacts per acre of roadless area. These estimates imply that New Mexico's approximately 1.6 million Forest Service inventoried roadless acres support 880 jobs and \$21.4 million of personal income.²⁴ If we apply the per acre

²⁴ Since the focus of this community effects analysis is the benefits that accrue to citizens of the state of New Mexico, total value added to the economy from roadless recreation expenditures is not reported here.

impacts in Table 7 to the 101,174 acre Valle Vidal and add the impacts, the total is 938 jobs and \$22.85 million in personal income.

Table 8 summarizes the jobs and personal income supported by roadless acres in each of New Mexico's 33 counties. While roadless-supported total income and jobs is only a small fraction of total state income and employment, counties with large tracts of roadless land are likely much more dependent on recreation expenditures. For example, Catron County, which has the largest Forest Service roadless areas in New Mexico (both in terms of acreage and percent of county land area), has an estimated 240 jobs supported through roadless areas recreation. This amounts to almost 16 percent of the county's total employment. Given the prominence of roadless areas and other protected areas in the county (over 20 percent of the county's land area is federally protected as roadless or wilderness), it is reasonable to expect a large employment effect of recreation spending in the county.

The estimates from Loomis and Richardson (2000) were generated for an empirical application very similar in concept to the one addressed in this report. However, their focus was on national effects of roadless areas as opposed to the state-level analysis considered here. Thus, the multipliers may not correspond perfectly to an application in New Mexico. Also, a multiplier around 2.0 is in the upper range of multipliers mentioned above. The results obtained using the 2.07 income multiplier are considered to be upper-bound estimates. A lower-bound estimate is obtained by incorporating the lowest multiplier estimate cited above, 1.33.

A complication in using other multipliers is that it is desirable to scale the community effects with per acre estimates calculated by Loomis and Richardson (2000). But these estimates result from the input/output modeling that generated the income multiplier of 2.07; imposing a different multiplier imposes a different structure in the model, which would generate different

per acre community effects. This difficulty is overcome by assuming that the ratio of jobs to personal income supported by recreation expenditures is approximately constant. This ratio (calculated from Loomis and Richardson (2000, 13) table 5) is 0.0000412. It is also assumed that the direct contribution to personal income of a dollar of recreation expenditure is \$0.65. Using the smaller multiplier, the estimated personal income supported by a dollar of recreation expenditure (through direct, indirect, and induced economic linkages) is \$0.86. Multiplying this number by total recreation expenditures gives a total \$374 million of income supported by roadless recreation nationwide, or \$8.84 per acre of roadless land. Using the jobs-to-personal-income ratio calculated above, this corresponds to approximately 15,390 jobs nationwide or 0.000364 jobs per acre of roadless land with the smaller multiplier.

Table 9 summarizes the jobs and personal income supported by roadless areas in New Mexico under the assumption of a smaller income multiplier; the original estimates are reproduced for comparison. The lower-bound estimates are that roadless recreation in New Mexico supports 563 jobs and \$13.7 million of personal income. If we add the Valle Vidal, the figures rise to 589 jobs and \$14.98 million.

10.0 Concluding Thoughts and Recommendations for Future Refinements.

New Mexico's 1.6 million acres of inventoried roadless areas on national forests yield significant economic benefits in the form of clean water, carbon sequestration, recreation, hunting and fishing opportunities, passive uses, and offsite benefits to nearby properties. Valuation of the complete suite of these economic benefits is imperative for sound decision making in the context of the roadless area petition process and forest planning process at the federal level as well as the outstanding national resource waters designation process at the State level.

By recalibrating previous work of Loomis and Richardson (2000) at the national level and by incorporating site specific New Mexico data we demonstrated that these individual benefits categories range from just under \$1 million to over \$45 million each year. Maintenance of water quality (up to \$42.15 million), outdoor recreation (up to \$26.58 million) and carbon sequestration (up to \$24.09 million) appear to be the most significant annual benefits. In addition, our analysis suggests that recreation, hunting, and fishing in New Mexico's inventoried roadless areas support up to 938 jobs and generate up to \$22.85 million in personal income for New Mexico communities. Finally, we demonstrated that over the 1995-2004 decade counties with significant tracts of inventoried roadless areas appear to have outperformed counties without such areas by an average of 1.28% across five separate measures of economic growth including total employment, wage and salary employment, population, total real income, real earnings, and real earnings per worker. This being said, there are several caveats to consider.

First, there are many reasons to believe that the estimates presented here are conservative. For example, the full suite of ecosystem benefits generated by IRAs includes a wide range of products, uses, services, and values not addressed by this report. Subsistence foods and medicines, pest control and pollination services, flood control services, waste assimilation services, existence values for many other threatened and endangered species such as the Mexican gray wolf, and cultural and historic values were not considered. There is a significant body of literature documenting the economic significance of these benefits (Talberth and Moskowitz, 1999; Kreiger, 2001; Costanza et al., 1997).

Secondly, we make no pretense of having conducted a full benefit-cost analysis of any action to protect roadless areas in New Mexico. Nor are we aware of any such analysis that exists. As noted previously, such analysis may be required of any future regulatory action or

rulemaking, but our investigation (independent but concurrent with the state petitioning phase) simply provides *prima facie* evidence on the economic benefits associated with protecting IRA lands. Similar to the recent Loomis and Richardson (2000) study done nationally, our focus is on providing reasonable estimates of the magnitude of economic and community benefits associated with the current level of protection for roadless areas; i.e., we examine the question of what annual economic benefits and community effects are generated by these natural capital assets in their present state. This evidence counters arguments that in their protected state IRA lands are economically insignificant or have zero value (e.g., OMB, 2002, and see discussion in Heinzerling and Ackerman, 2004).

Third, this report makes no pretense of analyzing any range of alternatives (e.g., mixed levels of protection, varying spatial configurations, etc.). For example, any reduction in the estimated benefits from protection shown herein would depend upon the specific program for opening up some or all of the IRA lands to logging and development. Analyzing any changes in benefit (or cost) streams over time would require with and without analysis for specific programs, which to date have not been fully articulated. The current state petition is for full protection of all IRA lands plus the Valle Vidal in New Mexico, and thus the restriction in our focus to current benefits and community effects associated with this full level of protection.

Fourth, it should be clear that our analysis is dependent upon available research (e.g., relevant published studies, agency reports, etc.) and secondary data (e.g., Census, GIS). While a variety of calculations and assumptions have been made to tailor estimates and available evidence (e.g., Loomis and Richardson, 2000) to the New Mexico context, no original econometric valuation or regional modeling was conducted for this study, given time and budget restrictions.

As a note of caution, concerns with any attempt to make benefit transfer estimates from prior research include applying consistent assumptions and the potential non-additivity of overlapping benefit categories. Working from a previously-used value typology (Loomis and Richardson, 2000; Morton, 1999), we have endeavored to isolate estimates of conceptually distinct benefit categories. Further, economic benefits or values (i.e., consumer surplus) and community effects (direct, indirect and induced impacts from out of pocket expenditures) are separate economic measures and should not be simply added (for further discussion, see McCollum and Bergstrom, 1992).

Finally, this report should not be interpreted as arguing that there isn't ample room for additional *de novo* research (e.g., holistic valuation approaches and computable general equilibrium models of the regional economy) into investigating the economic and social importance of protecting IRAs and other natural assets. Quite the opposite, we argue that such investigations should be an important part of any programmatic research agenda for understanding sustainable development and the New Mexico economy in its current context. The New Mexico roadless debate serves to underscore this point.

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Table 2
Typology of Roadless Area Values and Applicable Examples from Previous Work

Benefit Category	Benefit	Example (s)	Good (s)	Value
I: Direct Use				
	On-site recreation	Baker (1996)	Wilderness/ primitive/roadless RVD value (CA)	\$31.68 per day (\$2006)
		Loomis (2005)	Mean CS for hiking RVD from 7 studies of Intermountain West	\$41.30 per day (\$2006)
	Cultural/ heritage	Boxall et al. (2003)	Additional value for canoe trip from seeing pristine pictograph	\$81.47 per trip (\$2006)
	On-site hunting	Loomis (2005)	Hunting in Intermountain West RVD value (Avg of 109 studies)	\$52.05 per day (\$2006)
II: Scientific				
	Research	Loomis and Richardson (2000)	422 scientific journal articles studying wilderness areas	\$6.17 million (\$2006)
IV: Offsite				
	Off-site hunting	Torell et al. (2004)	High elevation, private-deed elk trophy ranches in New Mexico (1996-2002)	7-12% appreciation in sales value compared to average of 1%
	Scenic viewsheds	Kim and Johnson (2002)	Square root of distance to research forest in OR	Property value falls \$359 (\$2006)
	Property values	Phillips (2004)	Effect of proposed changes in Wilderness boundaries on towns currently without adjacent wilderness area in VT	Price increase of \$4,715.45 per acre in adjacent towns and \$294.72/acre in general area (\$2006)
		Colby and Wishart (2002)	Value of proximity to protected riparian areas in AZ	Average home price falls by \$5666 (\$2006) in one mile of distance from site
	Photographs, visual materials			
V: Ecosystem Services				
	Carbon sequestration	USDA/USDI (1997)	WTP for carbon sequestration	\$65 per ton
	Watershed protection	Costanza (1997)	Annual climate regulation benefits	\$35 per acre (\$1997)
		Sedell (2000)	Consumptive water use	\$40 per acre foot (\$2000)
			Non-consumptive water use	\$17 per acre foot (\$2000)

Table 2, Continued

Benefit Category	Benefit	Example (s)	Good (s)	Value
VI: Biodiversity Conservation				
	Direct use	Rosenberger and Loomis (2001)	Wildlife viewing in wilderness areas in Intermountain West	\$8.13 per day (\$2006)
		US Fish and Wildlife Service (2003)	Birdwatching value of NM residents	\$48.05 (\$2006) per day
	Genetic	Nunes and van den Bergh (2001)	Right to conduct research on microorganisms in Yellowstone hot springs	\$175,000
	Intrinsic	Racevskis (2005)	% of forest with high migratory song bird diversity (forests in MI)	\$1.83 per 1 unit increase
		Garrod & Willis (1997)	WTP per person for 1% biodiversity improvements in remote forests (UK)	\$0.74-\$0.86 per year (\$2006)
VII: Community				
	Recreation expenditures	Walsh et al. (1981)	Daily expenditures in CO wilderness area	\$34.49 (\$2006)
		Keith & Fawson (1995)	Daily expenditures in Utah wilderness	38.77 (\$2006)
VIII: Passive Use				
A. Option Value				
	Future on-site recreation	Walsh et al. (1984)	WTP for preservation of 2.6 million acres of CO wilderness	\$13.40 (\$2006) per year
		Gilbert et al. (1992)	Annual WTP for protection and management of VT wilderness	\$1.76 (\$2006)
B. Bequest Value				
	Future generations	Walsh et al. (1984)	WTP for preservation of of 2.6 million acres of CO wilderness	\$16.63 (\$2006) per year
		Gilbert et al. (1992)	Annual WTP for protection and management of VT wilderness	\$3.08 (\$2006)
C. Existence Value				
	Continued existence	Gilbert et al. (1992)	Annual WTP for protection and management of VT wilderness	\$2.10 (\$2006)
		Rollins and Lyke (1998)	Creation of 10 parks in remote areas of Canada	\$215.01 (\$2006)
	Habitat conservation	Walsh et al. (1984)	WTP for preservation of 2.6 million acres of CO wilderness	\$16.16 (\$2006)/ yr.
	Endangered species	Loomis and Ekstrand (1997)	WTP for protection of 4.6 million acres of Mexican spotted owl critical habitat.	\$51.09 (\$2006)/ yr.

**Table 3:
New Mexico National Forest Visitation Estimates**

Location	Year	Total Annual NF Visits (ave. hrs)	Total Site Visits [rate per NF site visit] (ave. hrs)	Wilderness area visits [rate per NF or site visit] (ave hrs)	Estimated Wilderness area RVD's	Source
Carson NF (NM)	2003	1,010,218 (14.1 hrs)	1,110,662 (11.3 hrs)	41,203 site visits [0.037] (13.1 hrs)	44,980 ((41,203*13.1)/12hrs)	USDA (2004b)
Carson NF (NM)	revision NVUM round 1	1,010,000	1,111,000	41.2 site visits [0.037]	--	USDA (2006)
Cibola NF (NM)	2000	2,880,000 (3.1 hrs)	3,110,000 (2.4 hrs)	707,858 site visits [0.2276] (2.2 hrs)		USDA (2001b)
Cibola NF (NM)	revision NVUM round 1	2,386,000	2,557,000	649,000 site visits [0.2538]	118,983 ((649,000*2.2)/12hrs)	USDA (2006)
Gila NF (NM)	2001	1,337,250 (39.4 hrs)	1,830,684 (34.6)	115,331 site visits [0.0629] (29.2 hrs)		USDA (2002)
Gila NF (NM)	revision NVUM round 1	1,361,000	1,870,000	133,600 site visits [0.0714]	325,093 ((133,600*29.2)/12hrs)	USDA (2006)
Lincoln NF (NM)	2003	735,237 (29.6 hrs)	851,013 (14.2)	25,253 site visits [0.0297] (10.1)		USDA (2004c)
Lincoln NF (NM)	revision NVUM round 1	735,000	851,000	25.4 site visits [0.298]	21,378 ((25,400*10.1)/12hrs)	USDA (2006)
Santa Fe NF (NM)	2003	1,356,000 (11.9 hrs)	1,522,000 (8.5 hrs)	64,956 site visits [0.0427] (14.3 hrs)		USDA (2004d)
Santa Fe NF (NM)	Revision of NVUM round 1	1,356,000	1,522,000	65,000 site visits [0.0427]	77,458 ((65,000*14.3)/12hrs)	USDA (2006)
Region 3	2000	17,300,000	20,900,000	3,400,000 NF visits [0.1965]		USDA (2001a)
Region 3	2001	18,600,000 (19 hrs national)	22,600,000	2,800,000 site visits [0.1239]		USDA (2002)
Region 3	2004	20,500,000 (19 hrs national)	23,800,000	1,900,000 site visits [0.0927]		USDA (2004a, p. 3))
Region 3	revision NVUM round 1 (2000-2003)	20,458,000	22,688,000	1,866,000 site visits [0.0822]		USDA (2006)
All NM NFs	revision NVUM round 1 (2000-2003)	6,848,000	7,911,000	914,200 site visits [0.1156]		USDA (2006)
All NM NFs	2006-2007 Estimates	8,323,786	9,615,870	1,111,215 site visits	714,586 RVDs	Assuming 0.05 annual growth rate (Loomis et al. 1999), from 2002.

Table 4
Estimated Net Benefits Per Recreation Visitor Day (RVD)

Outdoor Recreation Activity Type	Number of Studies for Intermountain West, 1967-2003	Mean Consumer Surplus Value per RVD, in \$2006	95% Confidence Interval
Hiking	7	\$41.30	\$24.84 - \$57.76
Cross-county skiing	7	\$32.03	\$22.40 - \$41.64
Floating/rafting/ canoeing	22	\$72.57	\$42.46 - \$102.68
Fishing	48	\$53.14	\$38.52 - \$67.76
Hunting	109	\$52.05	\$45.05 - \$59.05
Wildlife viewing	31	\$39.92	\$32.98 - \$46.86
All activities in the wilderness	32	\$44.68	NA

Note: RVD: a recreation visitor day is defined by the Forest Service as 12 hours of recreation use (Loomis and Rosenberger, 2000, p. 9)

Source: Loomis (2005), updated into 2006 dollars, using the Federal Reserve Bank of Minneapolis's CPI calculator (URL: www.minneapolisfed.org/research/data/us/calc/ Site accessed 6/7/06).

Table 5: Elk Hunting in the Greater Gila NF Area¹

Elk Management Area: Game Management Units	Total Private ranches/ #UW/tot elk acreage	Total Private Permit Authorizations/ #mature bull permit authorizations	Ave. annual state allocated Permits (yrs)	Estimated total permits: state + utilized private ²	Public Rermit Success Rate (yrs)	Elk Population goal/ Estimated population (2002 pre-hunt)	Total Acreage [approx. % in Core-occupied elk range COER]	Private Land [% of area total]	State land [% of area total]	NF Land [% of area total]	Protected Roadless acres [% of area total]	NF Inventoried Roadless Area (IRA) acres [% of area total]
Central Gila: 16B, 16C and 21A	10/5 /41,814	110/3	1,680 (97-01)	1,740	35% (98-00)	4,300 /4050	1,269,243 [≈100%]	76,154 [6%]	31,563 [1.4%]	1,166,434 [91.9%]	834,546 [66%]	213,411 [17%]
Northeast Gila: 16E and 21B	43/16 /384,959	646/121	770 (97-01)	1,125	45% (98-00)	1800 /1400	2,254,523 [≈40%]	847,701 [37.6%]	592,940 [26.3%]	4,509 [0.2%]	73,843 [0.03%]	131 [0.0%]
Northwest: Gila: 15, 16A, 16D, 23	206/78 /216,537	645/219	5,800 (97-01)	6,155	35% (98-00)	10,150 /9,050	3,642,978 [≈90%]	979,961 [26.9%]	480,873 [13.2%]	1,686,698 [46.3%]	429,040 [12%]	363,032 [10%]
Southern Gila: 22A, 22B, 24	13/1/ 39,493	42/16	580 (97-01)	603	31% (98-00)	1,550 /1,650	1,158,348 [≈50%]	425,114 [36.7%]	179,544 [15.5%]	414,689 [35.8%]	332,154 [28.6%]	158,275 [13.7%]
	272 tot ranches/ 100 “unit wide” ranches/ 582,803acres	1443 private permits/ 359 mature bull (25%)	8,830 tot public permits	9.623	.365 Weighted. Average rate	17,800 pop goal /16,150 est pop	8,325,092 [≈75%]	2,328,930 [27.97%]	1,284,920 [15.43%]	3,272,330 [39.31%]	1,669,583 [20.05%]	734,849 [8.83%]

Notes:

1. Information on IRA lands, and land percentages conducted from original GIS analysis. Other source information taken or calculated from New Mexico Department of Game and fish website: <http://www.wildlife.state.nm.us/recreation/hunting/index.htm> Numbers may not be exact due to rounding and mapping approximations.
2. Assumes a 55% conversion rate for authorized, fully transferable private permits (the proportion used) (see Little, 2005).

Table 6
Selected Economic Indicators for Roadless Counties and Non-Roadless Counties

Indicators	NM counties with significant roadless areas ¹	NM counties, no significant roadless areas	U.S. Total
<i>(a) Growth rates, 1995-2004 (%)</i>			
Total employment	15.2	14.5	14.2
Wage and salary employment	13.4	12.9	11.5
Total real income	29.5	25.8	27.4
Population	12.0	10.0	10.3
Real earnings	29.2	28.5	31.0
Real earnings per workers	14.0	13.9	17.5
<i>(b) Composition of employment (%)</i>			
Share of non-farm employment in forestry and mining, 2004 ²	4.8	1.0	1.1
Share of non-farm employment in services, 2004 ³	32.6	32.9	32.4
Growth rate in services employment, 1990-2000 ⁴	44.1	41.5	37.0

Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Dept. of Commerce

Notes:

¹ Counties with significant roadless areas include Catron, Eddy, Grant, Hidalgo, Lincoln, Otero, Rio Arriba, San Juan, San Miguel, Santa Fe, Sierra, Socorro, Taos.

² Calculated from NAICS-based data; includes two-digit supersectors 11 (Ag., Forestry, Fishing, and Hunting) and 21 (Mining); not all counties in group may be included due to withheld data.

³ Calculated from NAICS-based data; includes two-digit supersectors 51 (Information), 52 (Finance and Insurance), 54 (Professional and Technical), 61 (Educational), 62 (Healthcare and Social), 71 (Arts and Entertainment), and 72 (Food and Accommodation); not all counties in group may be included due to withheld data.

⁴ Calculated from SIC-based data (which was discontinued in 2001); services include SIC 7 and 8 sub-sectors; non-roadless counties calculation does not include Colfax and Harding counties due to withheld data.

Table 7
Estimated Jobs and Personal Income Supported by Roadless Recreation*

	Jobs	Personal Income
Economic impact of roadless recreation per acre	0.000568	\$13.84

*Recreated from Loomis and Richardson (2000) table 6.

Table 8
Estimated Jobs and Personal Income from IRA Recreation by County

County	Total acreage	Forest service roadless acreage	Roadless acreage as percent of county (%)	Est. jobs supported	Est. personal income supported
Bernalillo	747,758	0	0	0	0
Catron	4,442,100	422,957	9.52	240	\$5,853,726
Chaves	3,885,323	0	0	0	0
Cibola	2,909,910	6,358	0.22	4	\$87,998
Colfax	2,409,792	0	0	0	0
Curry	900,704	0	0	0	0
De Baca	1,492,594	0	0	0	0
Dona Ana	2,441,270	0	0	0	0
Eddy	2,684,698	32,262	1.20	18	\$446,501
Grant	2,543,502	218,545	8.59	124	\$3,024,660
Guadalupe	1,938,742	0	0	0	0
Harding	1,359,930	4,167	0.31	2	\$57,672
Hidalgo	2,210,377	43,456	1.97	25	\$601,429
Lea	2,811,527	0	0	0	0
Lincoln	3,089,782	48,219	1.56	27	\$667,352
Los Alamos	69,950	8,775	12.54	5	121,449
Luna	1,899,445	0	0	0	0
McKinley	3,496,288	13,307	0.38	8	\$184,174
Mora	1,236,482	10,927	0.88	6	\$151,225
Otero	4,238,759	97,925	2.31	56	\$1,355,286
Quay	1,843,710	0	0	0	0
Rio Arriba	3,772,841	136,241	3.61	77	\$1,885,569
Roosevelt	1,570,649	0	0	0	0
Sandoval	3,549,631	0	0	0	0
San Juan	3,028,619	30,651	1.01	17	\$424,213
San Miguel	2,376,993	52,622	2.21	30	\$728,287
Santa Fe	1,222,159	58,038	4.75	33	\$803,248
Sierra	2,711,942	129,108	4.76	73	\$1,786,849
Socorro	4,255,390	170,326	4.00	97	\$2,357,309
Taos	1,409,957	65,689	4.66	37	\$909,141
Torrance	2,139,960	0	0	0	0
Union	2,450,975	0	0	0	0
Valencia	683,579	0	0	0	0
New Mexico, Total	77,825,337	1,549,573	1.99	880	\$21,446,086

Table 9
Community Effects for Alternative Multiplier Assumptions (IRAs)

Multiplier	1.33 (Rudzitis and Johnson, 2000)	2.07 (Loomis and Richardson, 2000)
Jobs	563	880
Personal Income	\$13,694,714	\$21,446,086



312 Montezuma, Santa Fe, NM 87501 www.fguardians.org