Goods and Services Provided by Forest Lands that Would Be Protected Under the Cooper Spur Settlement Agreement: An Economic Assessment

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I. BACKGROUND AND SUMMARY

For over 30 years many citizens have been working to protect the lands on the north slope of Mt. Hood at Cooper Spur from further development. Toward this end, in 2005 the Cooper Spur Wild and Free Coalition (CSWF) and one of its member groups, the Hood River Valley Residents Committee (HRVRC) developed a proposed settlement agreement with Mt. Hood Meadows Oregon LP (Mt. Hood Meadows), the corporation that operates the ski area and the nearby Inn at Cooper Spur. The settlement agreement is between the HRVRC, Mt. Hood Meadows and Hood River County. The agreement has been incorporated into legislation written by U.S. Representatives Earl Blumenauer and Greg Walden in the House and by Senators Ron Wyden and Gordon Smith in the Senate. The settlement agreement has been included in legislation that has passed the House of Representatives and included in legislation introduced in the Senate.

The settlement agreement proposes the trade of land owned by Mt. Hood Meadows for land in Government Camp.[1] Specifically, Mt. Hood Meadows would transfer about 770 acres of private lands it owns (including the Inn at Cooper Spur) to public (Forest Service) ownership and relinquish a special-use permit that may allow ski-related development on an additional 1,350 acres of national forest land. As a result more than 2,000 acres of national forest land would be classified as wilderness and permanently protected from development. An additional area of more than 2,000 acres of national forest land would be protected as part of the Crystal Springs Management Unit and new resource-management direction would prevent commercial logging, residential development, and other activities that threaten to degrade the quality of the source water used by the Crystal Springs Water District.

Overall, the settlement agreement would restrict development activities (logging, road building, housing development, and ski-area development) on more than 4,000 acres that have the general characteristics of unroaded mature and old-growth forest. These forests are defined by dominant trees that have reached maturity; there is a high incidence of large trees, many with indications of decaying wood; there are numerous large snags and heavy accumulations of large downed logs and other wood on the ground. Under the settlement agreement, more than 2,000 acres of the forest land would be formally protected as wilderness under the 1964 Wilderness Act. These lands would be accessible for backcountry recreation, either on foot or by horseback. The settlement agreement includes provisions that promote the restoration of mature and old growth forests in the portions of those lands that have been adversely affected by past logging, roadbuilding and development.

The CSWF Coalition contracted with ECONorthwest to assess the economic benefits of protecting and restoring these lands as proposed by the settlement agreement. To understand these benefits, it is important to recognize that forests are economically important both when they produce commodities, such as logs and ski trips, and when they provide services, such as gathering and purifying water. Over the past several decades, economists and ecological scientists have examined the processes, called ecosystem

[1] Description of the settlement agreement provided by Ralph Bloemers, a representative of CSWF.

Table 1. Functions, Goods, and Services of Old-Growth Forest Ecosystems

Functions	Examples of Goods and Services Produced
Production and regulation of water	Forests capture precipitation; filter, retain, and store water; regulate levels and timing of runoff.
Formation & retention of soil	Forests accumulate organic matter, and prevent erosion to help maintain productivity of soils.
Regulation of atmosphere & climate	Forest biota produce oxygen, and help maintain good air quality and a favorable climate.
Regulation of disturbances	Forests reduce flood damage by storing and slowing water.
Regulation of nutrients and pollution	Forests improve water quality by trapping pollutants before they reach streams and aquifers.
Provision of habitat	Forests provide habitat for flora and fauna.
Food production	Forests convert solar energy into edible plants and animals.
Production of raw materials	Forests produce wood fiber and mushrooms.
Pollination	Insects facilitate pollination of wild plants and agricultural crops.
Biological control	Birds, bats, and microorganisms control pests and diseases.
Production of genetic & medicinal resources	Genetic material in forest plants and animals provide potential basis for drugs and pharmaceuticals.
Production of ornamental resources	Products from forest plants and animals provide materials for handicraft, jewelry, worship, decoration, and souvenirs.
Production of aesthetic resources	Trees, wetlands, riparian vegetation, and streams provide basis for enjoyment of scenery.
Production of recreational resources	Forests provide basis for outdoor sports, eco-tourism.
Production of spiritual, historic, and cultural resources	Forests serve as basis for group identity, spiritual renewal, folklore.
Production of scientific and educational resources	Forests provide inputs for research and focus for on-site education.

Source: Adapted by ECONorthwest from De Groot, R., M. Wilson, and R. Boumans. 2002. "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services." *Ecological Economics* 41: 393-408; Kusler, J. 2003. *Assessing Functions and Values*. Institute for Wetland Science and Public Policy and the Association of Wetland Managers, Inc.; and Postel, S. and S. Carpenter. 1997. "Freshwater Ecosystem Services." in *Nature's Services: Societal Dependence on Natural Ecosystems*. Edited by G.C. Daily. Washington, D.C.: Island Press, pgs. 195-214.

functions, by which forests and other ecosystems produce economically valuable goods and services, and in assessing these values they have segregated the functions, goods, and services into categories.[2] Table 1 illustrates these categories with examples representative of old-growth forests in this region. The old-growth forests at Cooper Spur that would be protected by the settlement agreement appear capable of producing goods and/or services in each category shown in Table 1.

[2] For more about ecosystem goods and services, we recommend: National Research Council of the National Academies. 2004. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. National Academies Press.

Generally speaking, it is far more difficult to determine the value of the services a forest provides when it is protected from logging and development, than the value of the goods it provides when logged or otherwise developed. The reason is because most forest-related services are less easily traded in markets and, hence, their values are not measured by market prices. This difference, however, does not mean that the services the intact and protected forest provides are necessarily less valuable. Instead, it means only that the society interacts with and derives value from these forests in a variety of ways. Therefore, economists must use a variety of techniques to determine the value of the full range of goods and services that the public obtains from its forests. Furthermore, the economic value of many forest services remains uncertain or unknown because economists have yet to develop appropriate techniques and data for measuring the value of some of the goods and services. In light of this limitation, this assessment examines only these services:

A. The forest's collection, purification, and regulation of water.

B. The forest's production of recreational opportunities, including opportunities with roadless/wilderness characteristics.

C. The forest's sequestration of carbon.

We find that these services have an economic value of about $11.4 – $16.8 million. Several factors indicate that the actual total value of the goods and services produced by the forests that would be protected under the proposed settlement agreement may be considerably greater. Among them is the fact that the area provides important wildlife habitat for economically valuable species, including deer, elk, and northern spotted owls, a species listed under the federal Endangered Species Act as threatened with extinction.

A. COLLECTION, PURIFICATION, AND REGULATION OF WATER

Scientific evidence indicates that the old-growth forests in the Cooper Spur area increase the amount of water in streams and aquifers, improve the quality of the water, and protect against extremes in the rate of runoff.

Forests on Mt. Hood increase the amount of water in aquifers and streams by inducing water vapor to condense and fall to the earth. Mature and old-growth forests are especially productive because, compared to younger forests, they have more leaf area on which fog can condense.[3] Research elsewhere on Mt. Hood—within the Bull Run watershed that supplies drinking water for the Portland metropolitan area—has found, for example, that the precipitation was 25 – 29 percent higher on lands with ancient forests than on adjacent lands that had been clearcut eleven years earlier, and the condensed fog constituted 30 percent of the total precipitation that reached the earth under old-growth trees.[4] These findings indicate there is a high likelihood that the mature and old-growth forests in the

[3] Franklin, J.F. and T.A. Spies. 1991. "Composition, Function, and Structure of Old-Growth Forests." In *Wildlife and Vegetation of Unmanaged Douglas-Fir Forests.* Edited by L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M.H. Huff. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

[4] Harr, R.D. 1982. "Fog Drip in the Bull Run Municipal Watershed, Oregon." *Water Resources Bulletin*. 18 (5): 785-789.

Cooper Spur area have a similar effect, increasing the annual inflow of water to the area's aquifers and streams and the supply of water available for use by the Crystal Springs Water District and the people in Hood River County who get their drinking water from this source.

Undeveloped mature and old-growth forests also tend to produce high-quality water. Research in old-growth forests similar to those on Mt. Hood has found that headwater streams in old-growth forests have 7 – 14 percent of the algal biomass in headwater streams in logged areas.[5] Other research has found that streams in old-growth forests typically have lower water temperatures, and the beneficial effects for fish, aquatic life and other resources from these conditions can extend far downstream.[6, 7] Old-growth, unroaded forests typically deliver less sediment to streams than forests that have been logged. In some settings, building roads and logging old-growth trees can dramatically increase the amount of soil lost through erosion and sedimentation of streams. A summary of research concluded: "Sediment yields from logging and roads are widely documented … and studies generally show a 2- to 50-fold increase over background levels, with most of the increase associated with roads."[8] The research shows that increased sedimentation remains higher than background rates more than 5 years after logging.

Old-growth forests also tend to exhibit smaller variation in stream flows relative to those in forests that have been logged or otherwise developed. In old-growth forests, most rainfall is absorbed into the ground where it moves slowly and is released into streams only after some period of time. This process diminishes the peak flows that accompany winter storms and spring runoff and increases stream flows during dry summer months. Studies conducted near Puget Sound show that more than 99 percent of rainfall in these forests is absorbed into the ground, while 84 percent of the rainfall in urbanized areas immediately becomes surface runoff, and rain storms quickly raise the levels of water in streams.[9] Some research indicates that old-growth forests diminish the peak flows of streams following storms by 33 – 50 percent, relative to logged forests.[10] Other research, conducted on Mt.

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[5] Kiffney, P.M, and J.P. Bull. 2000. "Factors Controlling Periphyton Accrual during Summer in Headwater streams of Southwestern British Columbia, Canada." *Journal of Freshwater Ecology* 15 (3): 339-351. http://www.dnr.wa.gov/hcp/type5/authors/beechie_2000.html (accessed August 29, 2006).

[6] Beechie, T.J., B.D. Collins, M.M. Pollock, and G.R. Pess. 2000. "Watershed-Scale Patterns of Stream Temperature Change in a Puget Sound River Basin." Northwest Fisheries Science Center, National Marine Fisheries Service. http://www.dnr.wa.gov/hcp/type5/authors/beechie_2000.html (accessed August 29, 2006).

[7] Brosofske, K.D., J. Chen, R.J. Naiman, and J.F. Franklin. 1997. "Harvesting Effects on Microclimatic Gradients from Small Streams to Uplands in Western Washington." *Ecological Applications* 7 (4): 1188-1200. http://www.dnr.wa.gov/hcp/type5/authors/beechie_2000.html (accessed August 29, 2006).

[8] Reid, L.M. 1993. *Research and Cumulative Watershed Effects*. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. General Technical Report. PSW-GTR-141, p. 69.

[9] Beyerlein, D. and J. Brascher. 1998. "Traditional Alternatives: Will More Detention Work?" Presented at *Salmon in the City (Can Habitat in the Path of Development be Saved)* in Mount Vernon, WA.

[10] Jones, J.A. and G.E. Grant. 2001. "Comment on 'Peak Flow Responses to Clear-Cutting and Roads in Small and Large Basins, Western Cascades, Oregon: A Second Opinion' by R.B. Thomas and W.F. Megahan." *Water Resources Research* 37 (1): 175-178.

Hood, shows that flows in a stream near old-growth forest decline less during late summer than those near logged areas.[11]

In sum, this scientific evidence indicates that the old-growth forest that would be protected under the Cooper Spur settlement agreement provides significant water-related services. Protecting these old growth forests in the future would increase the quantity of surface and groundwater, improve the quality of the water, diminish the risk of flooding, and increase the likelihood that streams will flow year-round. We are not aware of any research that has quantified the value of these specific services. Data from elsewhere in the region, however, provide insight into the economic value of these services.

For example, a recent summary of economic studies concluded that an increase in streamflow on national forest lands in the Pacific Northwest has a value of about $24 per acre-foot.[12] Research conducted near Salem, Oregon, found that, when a forest produces water sufficiently pure that it requires minimal treatment before being used for municipal-industrial purposes, the savings equal roughly $20 – $40 per person receiving the water.[13] The forests that generate the source water for the Crystal Springs Water District deliver water with this purity to about 5,000 persons, indicating that the annual savings are about $100,000 – $200,000.[14] The U.S. Department of Agriculture conducted research which found that, for the Pacific states, sediment in streams causes damages that exceed $6 per ton when it clogs ditches, fills-in stream channels, and has other detrimental effects.[15] Old-growth forests prevent this damage when they prevent sedimentation of streams.

B. RECREATIONAL OPPORTUNITIES

Table 2 shows the estimated economic value of some of the recreational services (excluding those directly associated with the ski area) provided by the forest in the Cooper Spur area. The first data column shows the estimated number of participants for each type of activity. The estimates generally come from records of actual use, such as a registry listing visitors to backcountry cabins. These estimates understate the actual levels of recreational activity

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[11] Harr, R.D. 1982. "Fog Drip in the Bull Run Municipal Watershed, Oregon." *Water Resources Bulletin* 18 (5): 785-789.

[12] Brown, T.C. 2004. *The Marginal Economic Value of Streamflow from National Forests*. U.S. Forest Service, Rocky Mountain Research Station. Discussion Paper. DP-04-1, RMRS-4851. December 28. An acre-foot of water is the amount that would cover one acre of land one foot deep, or about 326,000 gallons.

[13] Hulse, D., G. Grant, E. Niemi, A. Branscomb, D. Diethelm, R. Ulrich, and E. Whitelaw. 2002. *Muddy Waters: How Floods Clarify Evolving Relationships among Landscape Processes and Resource Management Decision-Making in Municipal Watersheds*. National Council on Environmental Research and Quality Assurance, U.S. EPA GAD # R825822.

[14] For more information regarding the Crystal Springs water system, *see* Yinger, M. and E. Salminen. 2003. *Crystal Springs: Zone of Contribution*. Crystal Springs Water District. January; and Oregon Department of Human Services, Health Services and Oregon Department of Environmental Quality Water. 2003. *Source Water Assessment Report*. June.

[15] Ribaudo, M.C. 1989. *Water Quality Benefits from the Conservation Reserve Program*. U.S. Department of Agriculture, Economic Research Service. Agricultural Economic Report. 606. February.

Table 2. Estimated Value of Recreation Services

Name of Activity	Number of Participants in the Activity/Year[a]	Value of Activity[b]	Total Value/Year[c]
Backpacking	360	$53.60	$19,300
Birdwatching	68	$30.45[d]	$200
Camping	480	$107.35	$51,500
Cross-country skiing	270	$49.77	$13,400
General recreation	N/A	$33.28	N/A
Hiking	541	$23.91	$12,900
Hunting	700	$46.80	$32,800
Horseback-riding	144	$18.64[d]	$2,700
Mountain biking	N/A	$51.11	N/A
Picnicking	240	$66.07	$15,900
Sightseeing	203	$20.85	$4,200
Snowshoeing	203	N/A	N/A
Wildlife viewing	68	$74.57	$5,100
All activities in wilderness	3,074[e]	$26.97	$82,900
Total			$240,900

Source: ECONorthwest. Values are in 2005 dollars. N/A = data not available.

[a] Russ Pascoe, Cooper Spur Wild and Free Coalition. 2006. Personal Communication. Data from several sources, including the register of visitors to backcountry cabins. Numbers shown probably understate the actual number of participants in each activity.

[b] Values represent consumer surplus per person per day by activity for the Pacific Coast Region. Loomis, J. 2005. *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands*. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Gen. Tech. Rep. PNW-GTR-658, p. 6. http://www.fs.fed.us/pnw/pubs/ pnw_gtr658.pdf (accessed December 10, 2005).

[c] The product of the number of participants in the activity times the value of the activity. Numbers rounded to nearest hundred.

[d] Value represents the national average consumer surplus for the activity.

[e] Sum of all participants, excluding snow-shoeing participants, assuming each activity involves some lands with wilderness characteristics.

that occur in the area, insofar as some participants do not leave a record of their activities, and others register once and then spend more than one day engaged in a given activity.

The second data column shows the average economic value, per person per day, for each activity. The value represents what economists call the net economic benefits, or consumer's surplus of each activity, i.e., the difference between the total amount each participant, on average, is willing to pay for a day of the activity and the amount he or she actually pays to do so. Therefore, these numbers represent the increase in well-being that occurs when people use the forest for recreation. The next-to-last row shows that recreation on lands having wilderness characteristics have extra value—$29.97 per person per day—relative to similar activities on lands lacking these characteristics. We assume that all recreation represented in Table 2 involves activities on lands with wilderness characteristics.

The data indicate that the current levels of recreational activity produce a net economic benefit, or consumer's surplus, of at least $240,900 per year.

C. CARBON STORAGE

Old-growth forests of the Pacific Northwest store about 600mt/C (metric tons of carbon) per hectare, which is equivalent to about 268 U.S. tons of carbon per acre.[16] As a consequence, the amount of carbon in the atmosphere is lower than it otherwise would be, and future world populations may avoid some of the damages associated with the effects of carbon dioxide on global warming and the resulting climate change. In other words, protecting mature and old-growth forests from logging and other development provides a valuable service by storing carbon.

While there is uncertainty over the value of carbon sequestered in forests, many economists have attempted to estimate generally the social cost of carbon in the atmosphere, which is a monetary indicator of the global damage resulting from the emission of one extra ton of carbon today. By extrapolation, the social cost of carbon emitted into the atmosphere also indicates the social benefit that results when carbon is stored in a forest. A recent review of 103 estimates from 28 published studies found the median estimate of the social cost of carbon is $14/tC (dollars per metric ton of carbon) and the mean is $93/tC.[17] The median probably provides a better estimate of the true value of the social cost of carbon than the mean provides, because the studies producing the highest estimates have obvious flaws.

Other work, however, indicates that even those studies that are otherwise methodologically sound underestimate the social cost of carbon because they incorrectly compare damages that occur at different points in time. Several studies have addressed this issue and conclude that correctly accounting for the effects of time increases the social value of carbon.[18] Applying these findings to the median value reported by Tol (2005) indicates the social value of sequestered carbon is about $14 – $25/tC.

Putting all these numbers together indicates that the carbon stored in the old-growth forests in the Cooper Spur area may have a value of about $3,400 – $6,000 per acre. Overall, the carbon stored in 2,000 acres of old-growth has a value of $6.8 million – $12.0 million.

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[16] Harmon, M.E., W.K. Ferrell, and J.F. Franklin. 1990. "Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests." *Science,* New Series Feb. 9: 699-702.

[17] Tol, R.S.J. 2005. "The Marginal Damage Costs of Carbon Dioxide Emissions: An Assessment of the Uncertainties." *Energy Policy* 33: 2064-2074.

[18] *See*, e.g., Newell, R.G. and W.A. Pizer. 2003. "Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?" *J. of Environmental and Economic Management* 46: 52-71; Pearce, D.W. 2003. "The Social Cost of Carbon and Its Policy Implications." *Oxford Review of Economic Policy* 19 (3): 362-384; and Guo, J., C.J. Hepburn, R.S.J. Tol, and D. Anthoff. 2006. "Discounting and the Social Cost of Carbon: A Closer Look at Uncertainty." *Environmental Science & Policy* 9: 205-216.

The forests that would be protected under the Cooper Spur settlement agreement provide many economically valuable goods and services. This report focuses on the current research that provides an estimation of economic values for only a few of these goods and services. Table 3 summarizes estimates for three services: the ecosystem's purification of water, which allows the Crystal Springs Water District to avoid treatment costs; the provision of wilderness recreational opportunities; and the storage of carbon.

The middle column of Table 3 shows the annual value of the water- and recreation-related services; the annual value of carbon-sequestration services is not known. The last column shows the estimated present value for each of the three services. Present value is a single amount, measured today, that is equivalent to a stream of future values. To compute the present value of the water- and recreation-related services, we use a process called discounting. For the water-related services, we look forward 20 years and use a commonly-used discount rate, 3 percent per year. For the recreation-related services we also look forward 20 years, but assume that increases in the annual value of recreational opportunities, stemming from growth in the value of the different recreational activities and growth in the number of people participating in these activities, will offset the discount rate.

The actual value of all the goods and services provided by the forests that would be protected under the proposed Cooper Spur settlement probably is greater than the total shown in Table 3, insofar as many of the goods and services provided by this protected ecosystem are not included in the table. In addition, the estimate of the value of recreational opportunities probably understates the actual value because existing data fail to account for all persons using the area.

Table 3. Summary of Economic Estimates

	Estimated Value	
Ecosystem Service	**Annual**	**Present Value[a]**
Water-Purification	$100,000 – $200,000	$1.5 million – $3 million[b]
Recreational Opportunities	$240,900	$4.8 million[c]
Carbon Sequestration	N/A	$5.1 million – $9.0 million
Total	N/A	$11.4 – $16.8 million

Source: ECONorthwest. N/A = not available.

[a] Present value is the amount today that is equivalent to a stream of future values.

[b] Assuming the annual value remains constant for the next 20 years, discounted using a 3 percent discount rate.

[c] Assuming the annual value grows over the next 20 years at a rate that offsets the discount rate.

Several factors indicate that the actual total value of the goods and services produced by the forests that would be protected under the proposed settlement agreement may be considerably larger than the estimates in Table 3. Among them is the fact that the area provides important wildlife habitat for economically valuable species. For example, it

supports significant populations of deer and elk,[19] which have value beyond what appears in the estimates for recreational hunting. Perhaps more important, the area provides habitat for northern spotted owls, a species listed under the federal Endangered Species Act as threatened with extinction. Several studies have found that the American public places a value on protecting this species and its habitat. In one study, researchers told participants in a nationwide survey that, on average, 21,000 acres of old-growth forest and spotted owl habitat burns each year, and asked them to describe the value they place a value on reducing the acres burned by 3,000 acres per year. Their responses indicate the value of protecting each acre of old-growth and spotted owl habitat is $632,000 – $1,359,000 per acre.[20] Further research is needed before these findings could be applied to develop a reliable estimate of the value of protecting spotted owl habitat in the Cooper Spur area. The findings do indicate, however, that spotted owl habitat in the area may have a value of several million dollars.

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[19] Vesely, D. and L. Whitney. 2003. *An Assessment of Especially Sensitive Big Game Habitat on the Cooper Spur of Mt. Hood, Hood River County*. Pacific Wildlife Research. January.

[20] Loomis, J.B. and A. Gonzalez-Caban.1998. "A Willingness-to-Pay Function for Protecting Acres of Spotted Owl Habitat from Fire." *Ecological Economics* 25: 315-322.