



# **Rural Technology Initiative**

## **Working Paper 1**

# **Economic Impacts of the Forests and Fish Rules on Small, NIPF Landowners**

## **Ten Western Washington Case Studies**

**Kevin Zobrist**

**Revised  
July 2003**

Rural Technology Initiative  
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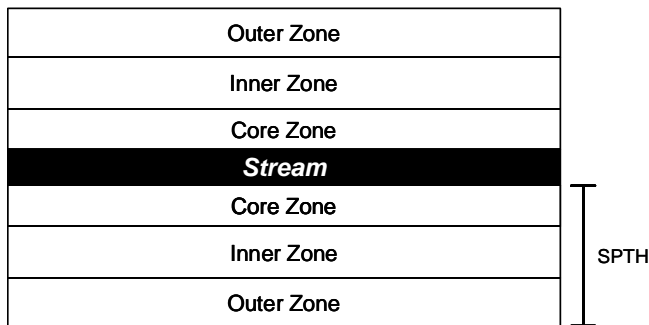
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## EXECUTIVE SUMMARY

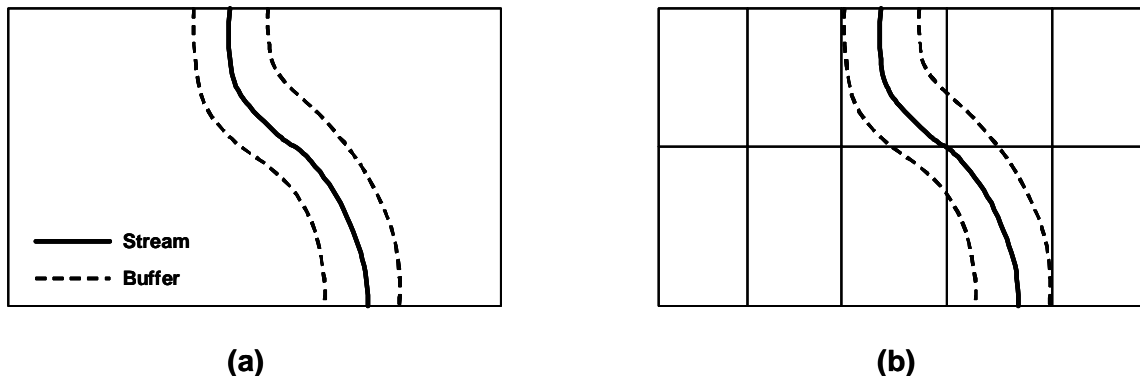
In July 2001, Washington State adopted the final version of a comprehensive update to its forest practices rules. The updated rules, known as the “Forests and Fish Rules” (FFR), are intended to protect and restore forested salmon habitat and other aquatic resources. The rules include significant restrictions on timber harvest in riparian areas. There is concern that the new rules will be particularly burdensome for small, non-industrial private forest (NIPF) landowners, diminishing their economic viability. This can cause unintended consequences counter to the intent of the rules, such as increased conversion of NIPF lands to non-forest uses. To better understand the economic impacts of the new rules on small landowners and the implications of these impacts, RTI has completed case studies on ten NIPF ownerships in Western Washington.

In Western Washington, the riparian harvest restrictions under the FFR include a three-zone buffer along both sides of fish-bearing streams, as shown in *Figure i*. No harvest is allowed in the zone adjacent to the stream, which is known as the core zone. Beyond the core zone is the inner zone, where partial harvest is allowed if the stand meets minimum density and basal area requirements. The outer zone is the least restrictive, allowing harvest subject only to minimum leave tree requirements. The total buffer width on each side of the stream extends to one site potential tree height (SPTH), which is 170 to 200 feet on productive sites.



**Figure i.** The FFR buffers for Western Washington.

The economic impacts of these buffers can be particularly burdensome for small forest landowners. Larger landowners can average their impacts over a large area (*Figure ii(a)*), but with small ownerships the impacts of buffers are concentrated on smaller areas (*Figure ii(b)*). This suggests that the impacts to small landowners are likely to be highly variable, as those with streams on their property may experience high impacts while those without streams may not be impacted at all.



**Figure ii.** With large ownerships, buffer impacts can be averaged over a large area. With small ownerships, buffer impacts are concentrated on smaller areas.

The purpose of doing case studies is to better understand these issues of variability and disparity and to see how individual landowners are impacted by the rules. Cases studies also offer opportunities to compare impacts between different management options. We looked at the extent to which the economic impacts would be reduced by doing

the maximum allowable partial harvest in the riparian zone compared to treating all three zones as a no harvest area, which is the strategy chosen by most small landowners who have harvested under the FFR.

We also looked at the extent to which economic impacts would be mitigated by participating in the Forestry Riparian Easement Program (FREP). The FREP was established along with the FFR to help offset the cost of the new riparian buffers to small landowners. Landowners who participate in the program are given cash compensation at the time of harvest for a portion of timber value that must be left in riparian buffers. If the value of the required riparian leave trees amounts to 19.1% or less of the total harvest value, then compensation is given at 50%. If the value of required leave trees exceeds a high impact threshold of 19.1% of the total harvest value, 50% compensation is given for the first 19.1%, while full compensation is given for the remaining value in excess of 19.1%. Participation in the FREP places a 50-year easement on the required leave trees.

## **METHODS**

To demonstrate the use of technology in addressing complex forestry issues, the latest computer software tools were employed to do the case studies. Spatial data for each case study was compiled using Geographic Information Systems (GIS). This data was then combined with forest inventory data in the Landscape Management System (LMS), a program developed at the University of Washington that integrates a suite of tools such as growth models and forest visualization programs. Using LMS, management simulations were done under the previous rules and then under the new rules. The harvest outputs from LMS were then put into spreadsheets for economic analysis.

Several criteria were used to evaluate the economic performance of the new rules relative to the previous rules for each case study. The first criterion was forest value, which represents the total value of a forest as an economic asset. This is the economic value of both the currently standing timber and the land on which it stands given a target rate of return, which was a real 5% for this study.

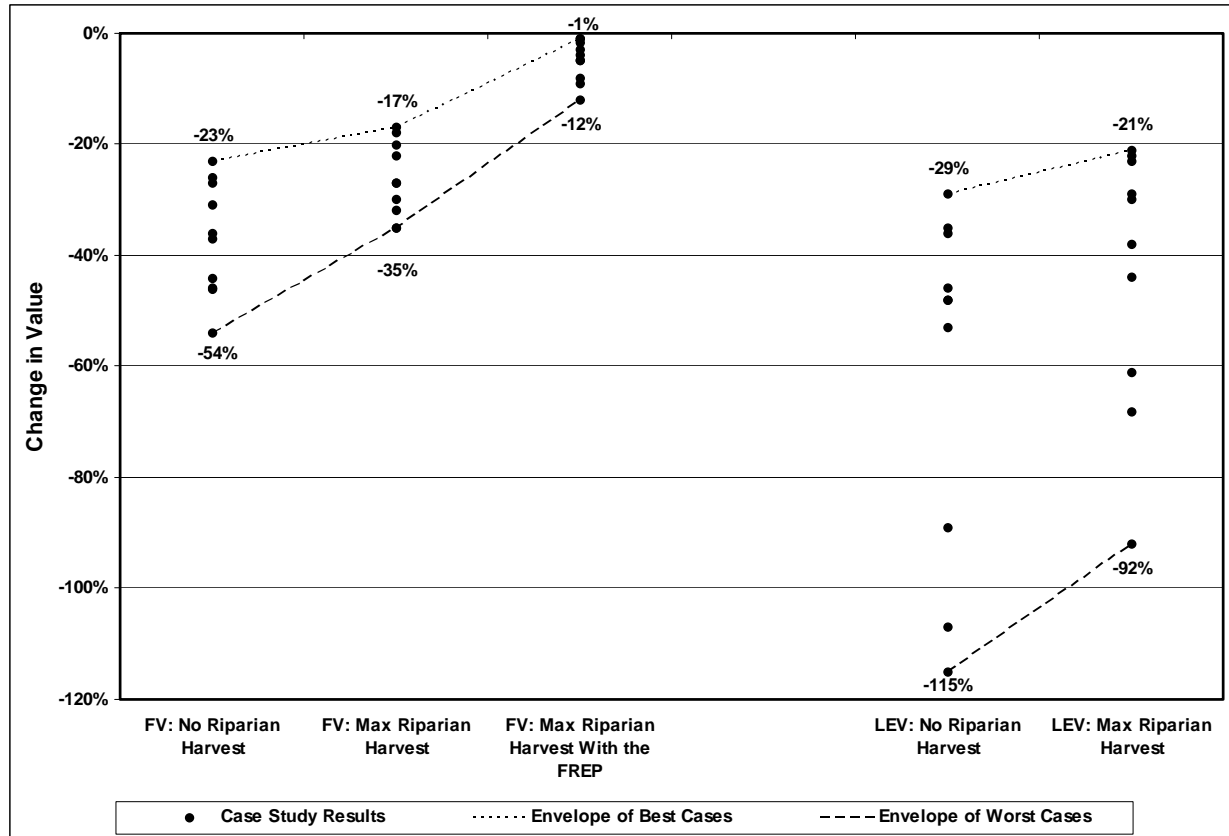
Land value (also called land expectation or soil expectation value) was then separated from forest value and used as an additional criterion. Land value is the residual value that remains after the existing timber is harvested, and it is based on the economic potential for producing timber rotations in perpetuity when starting from bare land. Land value is of particular interest because it demonstrates the economic performance of beginning a new rotation once the existing rotation is complete. Thus, it represents the economic potential for sustainable forest management.

## **RESULTS**

The results of the case studies are plotted in *Figure iii* as a percent change in value relative to the previous rules (the permanent rules that were in place before the FFR). The forest value losses are most severe if no riparian harvest is done, treating all three zones as no-cut areas. The impacts from that scenario range from a best case 23% loss to a worst case 54% loss. If the maximum allowable harvest is done in the inner and outer zones for each case study, impacts range from a 17% loss to a 35% loss in forest value. If the maximum allowable riparian harvest is done and each landowner participates in the FREP, impacts range from a 1% loss to a 12% loss.

The impacts on land value are more severe than impacts on total forest value. If no riparian harvest is done, impacts range from a best case 29% loss to a worst case 115% loss. If the maximum allowable riparian harvest is done, impacts range from a 21% loss to a 92% loss. Losses greater than 100% indicate that the target rate of return can no longer be achieved.





**Figure iii. Percent change in forest value and land value under the FFR relative to the previous rules for ten Western Washington case studies.**

## DISCUSSION

The results of these case studies support the idea that the economic impacts to small landowners from the FFR are highly variable and that the impacts will be severe for some landowners. The impacts are most severe if no harvest is done in the riparian zone. The results suggest that landowners can reduce their losses by doing the maximum allowable riparian harvest. However, even with maximum riparian harvest the losses are still substantial in some cases. Part of the reason that maximizing riparian harvest does not do more to minimize impacts is that calculating the allowable riparian harvest requires additional cruising and layout costs that offset any value recovery.

It appears that land value is particularly diminished by the new rules, with some case studies losing most or all of their land value. Land value is lost in no-cut areas such as the core zone and parts of the inner zone, as the permanent retention of these trees precludes the use of the land for growing future timber rotations. If a significant portion of a given property is taken out of production because of buffer restrictions, it makes the entire property unprofitable in some cases, as there is now a much smaller production base to cover fixed overhead costs. Fragmentation may also make management unfeasible for the entire property in some cases. Significant decreases in land value imply that continued forest management will no longer be economically viable for some small landowners under the FFR. This will likely result in unintended consequences such as increased land use conversion.

The results show that the FREP can be very effective at mitigating impacts. If each case study participated in the FREP, the magnitude and disparity of forest value losses would be significantly reduced. Part of the reason the FREP is so effective is that the 19.1% high impact threshold limits losses to a maximum of 9.55% of the total sale (50% of 19.1%). Since the timber qualifying for compensation under the FREP includes timber that had to be left

under the previous rules, landowners can actually have a gain in forest value relative to the previous rules in some cases. The FREP also compensates for the extra layout costs associated with harvesting in the riparian zone, making it more economical to do the maximum riparian harvest.

Unfortunately, current funding levels for the FREP fall well below the level required for large-scale participation, and future funding is uncertain. Consequently, the majority of small landowners will not be able to benefit from this program. Also, the FREP only compensates for standing timber; it does not compensate for the land on which that timber stands. Thus, it does not mitigate for losses in land value or address the associated long-term sustainability issues.

Additional work is being done to examine potential alternate plans that would provide equivalent protection of aquatic resources while minimizing economic impacts to landowners. Case studies for Eastern Washington have also been completed, raising different management questions. Those results are reported separately (Oneil 2003).

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## **1.0 INTRODUCTION**

Regulation of private forestland has been a contentious issue in the United States, and concern has increased over the economic impacts of these regulations on landowners and rural communities. This is particularly true in Washington State, which updated its forest practices rules in July 2001 to address the listing of salmon under the Endangered Species Act. Washington's new rules, known as the "Forests and Fish Rules" (FFR), include significant restrictions on timber harvest in riparian areas. There is concern that the new rules may result in a severe economic burden for non-industrial private forest (NIPF) landowners.

The purpose of this study is to examine the economic impacts of Washington's FFR on small, NIPF landowners through a series of case studies. The preliminary results of three Western Washington case studies have been presented in Zobrist and Lippke (2003). This paper presents the final results of these three case studies and seven additional Western Washington case studies. A companion study for Eastern Washington is also available (Oneil 2003).

Preceding this study, a Small Business Economic Impact Statement (SBEIS) was done to assess the average economic impacts of the rules on small landowners and to compare these impacts with those of large, industrial landowners (Perez-Garcia, Edelson, and Zobrist 2001). A county level analysis of impacts was also done (Lippke et al. 2000). These studies look at large-scale, aggregate impacts, however, and they do not consider the implications of site-specific differences. By taking a site-specific, case study approach, this analysis demonstrates the large variability that occurs on small land ownerships. Different riparian management options are compared to see how economic impacts are influenced by riparian management choices. The case studies also examine the effectiveness of the Forestry Riparian Easement Program (FREP) and the forest excise tax credit, which were established with the FFR to mitigate economic impacts.

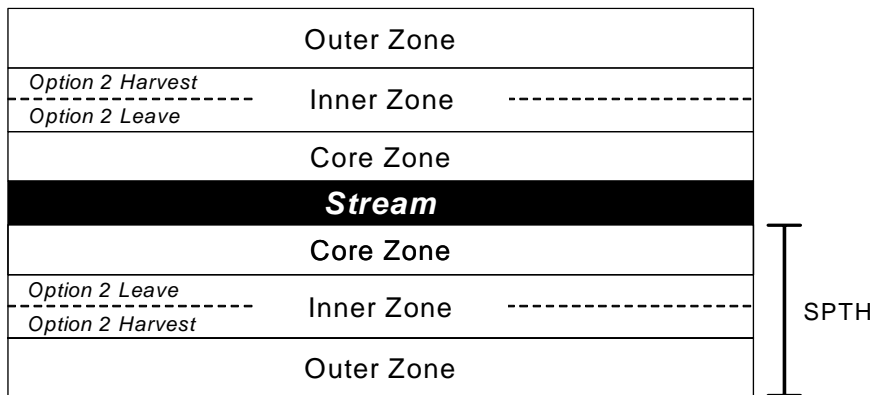


## 2.0 BACKGROUND

### 2.1 THE FORESTS AND FISH RULES (FFR)

The FFR were developed in response to the listing of salmon under the Endangered Species Act (ESA). These new regulations are a comprehensive update to the previous rules, and they include significant restrictions on timber harvest in riparian areas. The FFR are based on the recommendations of the Forests and Fish Report (1999), which is a set of recommendations by a caucus of federal and state agencies, the forest industry, NIPF landowners, and Native American tribes that were designed to meet the requirements of the ESA and the Clean Water Act.

For Western Washington, the FFR require a riparian buffer on either side of a fish-bearing stream. The required buffer extends to one site-potential tree height (SPTH) from bankfull width or the edge of the channel migration zone (CMZ). The SPTH varies from 90 to 200 feet depending on the site class (V-I). The riparian buffer is divided into three zones, as shown in *Figure 2.1*.



**Figure 2.1. The FFR riparian buffers for Western Washington.**

1. The core zone extends 50 feet from bankfull width or the edge of the CMZ. No harvesting is allowed in this zone.
2. The inner zone extends from the outer edge of the core zone to 67% of the SPTH for streams less than 10 feet wide or 75% of the SPTH for streams greater than 10 feet wide. Limited harvest is allowed in this zone only if the remaining number of trees, basal area, and proportion of conifer are sufficient to meet the Desired Future Conditions (DFC) when the stand is 140 years old. Whether a stand meets these requirements is determined by the DFC Worksheet program, which is based on the Stand Management Cooperative (SMC) variant of the ORGANON growth model. Harvesting that meets these requirements may be done using one of the following options:
  - Option 1: Thinning from below. The smallest trees are removed down to a minimum of the 57 largest trees per acre or however many trees are required to meet DFC, whichever is greater.
  - Option 2: Leave trees closest to the stream. The inner zone is split into two parts. No harvesting is allowed in the part closest to the stream (bordering the core zone), but harvest is allowed in the part furthest from the stream as long as 20 leave trees per acre are left, similar to the outer zone rules. The part of the inner zone that is not harvested must be no less than 30 feet wide.
3. The outer zone extends from the outer edge of the inner zone out to the SPTH. Harvest is allowed in this zone as long as 20 conifers per acre over 12 inches in diameter are retained as leave trees. If the inner zone is harvested under Option 2, a basal area credit may be available that decreases the outer zone leave tree requirements to as low as 10 trees per acre.

In addition to the three-zone buffer for fish-bearing streams, 50-foot no-harvest buffers are required around certain portions of perennial, nonfish-bearing streams, including the first 300 to 500 feet above a confluence with a fish-bearing stream, depending on the total length of the nonfish-bearing stream. A 50-foot no-harvest buffer is also required around sensitive sites such as seeps or springs.

The FFR also contain new requirements for forest roads, stream crossings, equipment use, and other aspects of forest management, as well as harvesting restrictions on unstable slopes and wetlands. Additional economic impacts that may result from these management constraints are beyond the scope of this study.

## 2.2 MITIGATION OF ECONOMIC IMPACTS

Recognizing that the new riparian buffer requirements would have a significant economic impact on small landowners, the FFR include several mitigation options. One option is a forest excise tax credit that is available to any landowner who is impacted by the FFR. The credit refunds 16% of the forest excise tax, reducing the effective tax rate from 5% to 4.2%. Another option is the Forestry Riparian Easement Program (FREP), which is a program exclusively for small landowners. Eligible small landowners who choose to participate in the program are given cash compensation at the time of harvest for a portion of the fair market value of qualifying timber. Qualifying timber is that which must be left unharvested in riparian buffers. Only timber that is left pursuant to the FFR is considered qualifying timber; additional timber that is left voluntarily by the landowner does not qualify for compensation.

If the value of the qualifying timber amounts to 19.1% or less of the total value of the landowner's timber sale, then compensation is given at 50%. If the value of the qualifying timber exceeds a high impact override (HIO) threshold of 19.1% of the total sale value, 50% compensation is given for the first 19.1%, while full compensation is given for the remaining value in excess of 19.1% according to *Equation 2.2*. To illustrate this, some example calculations are given in *Table 2.2*.

### Equation 2.2. Forestry Riparian Easement compensation for qualifying timber.

$$FRE = (HIO * TV) + \left( \frac{t * TV}{2} \right)$$

Where:

$FRE$  = Forestry Riparian Easement compensation

$HIO$  = high impact override =  $(V_q/TV) - t$

$TV$  = total value of all timber covered under FPA =  $V_q + V_h$

$t$  = high impact of regulatory threshold (19.1% for Western Washington)

$V_q$  = value of qualifying timber

$V_h$  = value of harvested timber

**Table 2.2. Example FRE calculations.**

TV	Vh	Vq	Net Loss Without the FREP	HIO	FREP Compensation	Net Loss With the FREP
\$50,000	\$0	\$50,000	100%	80.9%	\$45,225	9.55%
\$50,000	\$35,000	\$15,000	30%	10.9%	\$10,225	9.55%
\$50,000	\$45,000	\$5,000	10%	0%	\$2,500	5.00%

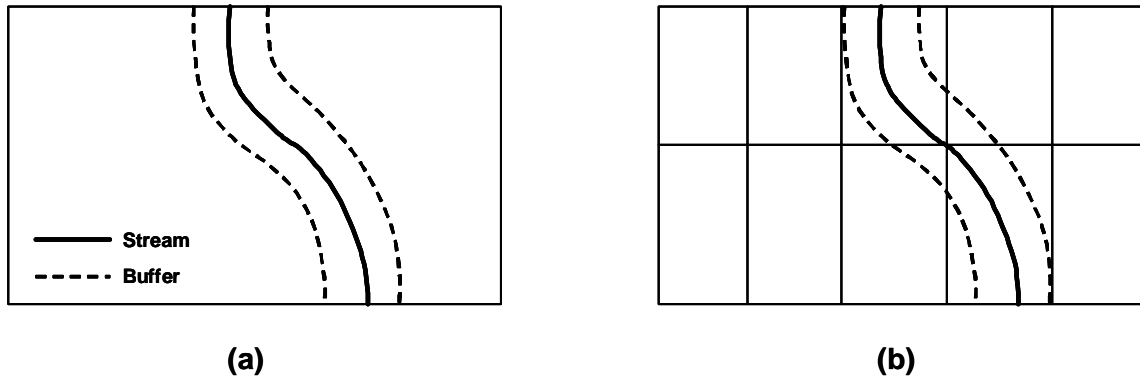
Participation in the FREP places a 50-year easement on the required leave trees. A new Small Forest Landowner Office (SFLO) was created within the Washington Department of Natural Resources (DNR) to administer the FREP and to assist small landowners with issues arising from the new regulations.

## 2.3 WHY THE CASE STUDY APPROACH

Case studies provide insights as to how actual landowners are impacted by the changing regulations. Case studies allow the comparison of different management options, and they reveal the variability of impacts, which may not be apparent from broader studies.

Variability is particularly important when looking at small ownerships. Consider the riparian buffers imposed over the area depicted in *Figure 2.3(a)*. In this case, the impacts of the riparian buffer can be averaged over a large area.

Now consider if the same area was composed of 10 small landowners as in *Figure 2.3(b)*. The average impacts over all parcels remain unchanged from the previous example. However, the impacts are concentrated on individual landowners, causing a large disparity of impacts between landowners.



**Figure 2.3. With large ownerships, buffer impacts can be averaged over a large area. With small ownerships, buffer impacts are concentrated on smaller areas.**

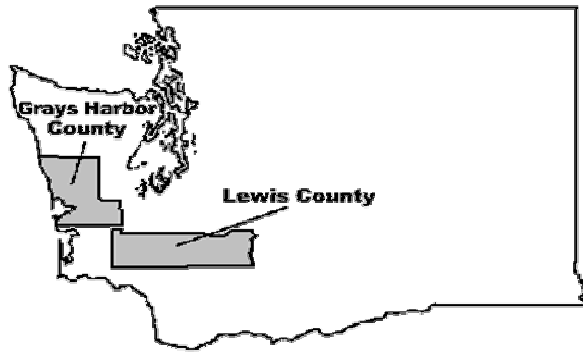
This simplified example illustrates why it is important to consider the variability and disparity within the range of impacts to individuals. Case studies provide point estimates of that variability which, when taken together with the results of broader studies like the SBEIS (Perez-Garcia, Edelson, and Zobrist 2001), provide a more complete understanding of the economic impacts of the new rules on NIPF landowners.



### 3.0 METHODS AND ASSUMPTIONS

#### 3.1 CASE STUDY PARTICIPANTS

Small, NIPF landowners with riparian holdings were approached and asked for voluntary participation in this study. Case studies 1 through 6 are from Lewis County in southwest Washington. Cases 7 through 10 are from Grays Harbor County, which is located along the Washington coast (*Figure 3.1*).

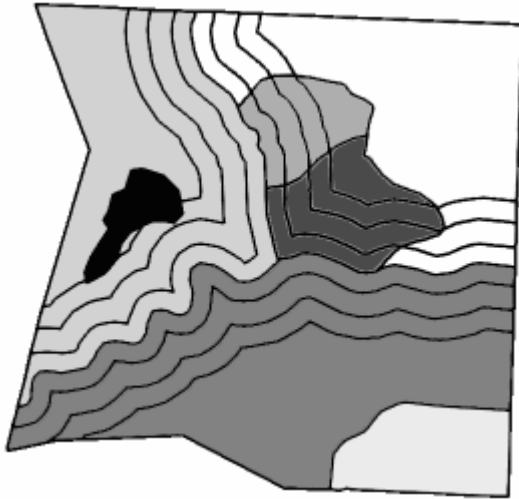


**Figure 3.1.** Case study locations.

#### 3.2 MODELING

For each case study property, the Landscape Management System (LMS) was used to simulate forest management over time under both the previous rules and the new FFR. LMS is a computer program developed at the University of Washington that integrates a suite of forestry software tools, including growth models and visualization programs. The growth model used within LMS for the case study management simulations was the SMC variant of ORGANON in order to be consistent with the modeling that is used as the basis for the FFR management options.

Modeling in LMS required several sets of data for each case study. The first data needed were GIS data, including property boundaries, a stand map, and the locations and types of all streams. These data were created or obtained for each property and loaded into ArcView GIS. For each stream, the appropriate riparian buffers were digitally overlaid onto the stand map in ArcView according to the specifications of the new rules. For streams classified as fish-bearing, the riparian buffers included the core, inner, and outer zones. The inner zone was further divided to represent management Option 2 under the FFR, in which the part of the zone furthest from the stream is harvested and the part closest to the stream is left untouched. These subdivisions create a set of discrete polygons that are defined by stand and buffer zone (*Figure 3.2*). These polygons represent unique management units for modeling in LMS.



**Figure 3.2. Creating unique polygons by stand and buffer zone.**

The next data needed were stand inventory data. Where recent timber inventory data were not available, sample plots were established in each stand. Data from these sample plots (or from existing inventory where available) were used to create a tree list for each stand. For stands in which riparian areas were not consistent with the upland areas, a separate inventory was created for each. The inventory data were then applied to the unique polygons created in ArcView to build an LMS file or “portfolio” for each landowner case study.

Site index data were also needed for each case study. Douglas-fir site index was used, as it is needed by the ORGANON growth model and it is also the basis for determining buffer width under the FFR. For some of the case studies in Grays Harbor County, Douglas-fir site index information was not available. In these cases it was computed from western hemlock site index using the following relationship: Douglas-fir site index =  $(1.11)(\text{western hemlock site index}) + 0.48$  (Nigh 1995).

### **3.3 MANAGEMENT SCENARIOS**

Five scenarios were modeled for each case study:

#### **1. Previous Rules**

The previous forest practices rules (the permanent rules in effect on January 1, 1999) specified a range of widths and leave tree requirements for riparian buffers on fish-bearing streams. For this analysis we approximated the average impact of these rules by using a 25-foot no-harvest zone to represent riparian buffer requirements for fish-bearing streams before the FFR. No buffers were required for nonfish-bearing streams under the previous rules.

The other four scenarios represent four possible riparian management options under the FFR.

#### **2. FFR with no riparian harvest**

For this scenario it was assumed that no harvesting was done in any of the FFR buffer zones. While the rules allow some harvesting in the outer and inner zones, some small landowners choose to treat the entire buffer as a no-cut area.



### **3. FFR with riparian harvest in the outer zone only**

This scenario assumed that harvesting was done in the outer zone, which is allowed as long as there are a minimum number of leave trees greater than 12" DBH. No trees were cut in the inner zone under this scenario.

### **4. FFR with inner/outer zone riparian harvest Option 1**

In this scenario, harvest was done in the outer zone and also in the inner zone if basal area was adequate to meet the Desired Future Conditions (DFC). Inner zone harvest was done according to Option 1, in which the smallest trees are harvested and the larger trees are left (thin from below). Determining which, if any, trees could be cut under Option 1 was done by feeding the predicted inventory at the time of harvest into the DFC Worksheet program (version 1.1.12). The DFC Worksheet is a program provided by the DNR that specifies how many trees from each diameter class may be harvested under Option 1 or what portion of the inner zone can be harvested under Option 2. The DFC Worksheet also computes any basal area credits in the outer zone under Option 2. Because DFC Worksheet specifies removal of the maximum number of trees while still achieving DFC at age 140, this study assumes that no further harvesting will be allowed in the inner zone.

### **5. FFR with inner/outer zone riparian harvest Option 2**

As with the previous scenario, harvesting in this scenario was done in the outer zone and also the inner zone if basal area was adequate to meet DFC according to the DFC Worksheet. This time harvesting in the inner zone was done according to Option 2, in which the inner zone is split into two parts. No harvest was done in the part closest to the stream (bordering the core zone). A clear-cut harvest was done in the part furthest from the stream, leaving the minimum leave trees required by the rules. In addition, a basal area credit sometimes allowed the reduction of the required leave trees in the outer zone under this option. The width of the harvested portion of the inner zone and the amount of basal area credit were determined by the DFC Worksheet. Note that Option 2 is not allowed with large streams on site class III or lower. If there was a mix of large and small streams on site class III or lower, this scenario used Option 2 where allowed along the small streams, but Option 1 was used along the large streams.

The basic management strategy underlying each of these five scenarios was based on information gathered about the typical management practices and goals of small landowners in the study area. This included information from the participating landowners. Two rotations were simulated for each case study: the current rotation and an additional full rotation.

The management simulations for the Lewis County case studies assumed a 50-year rotation of Douglas-fir with an early commercial thin and a clear-cut harvest. Most of the existing timber inventory was consistent with this management strategy. When the final harvest of the existing timber was complete, a subsequent rotation was starting by planting of 435 Douglas-fir per acre with an assumed survival rate of 90% to 95%. The simulation of the subsequent rotation included an early commercial thin from below to 180 stems per acre at age 20 and a final harvest at age 50.

The management simulations for the Grays Harbor County case studies assumed a 50-year rotation of Douglas-fir with a precommercial thin, one commercial thin, and a clear-cut harvest. Existing timber was consistent with this management strategy for the most part, though some of the existing stands were actually western hemlock stands that the landowner plans to convert to Douglas-fir in the subsequent rotation. When the final harvest of the existing timber was done, a subsequent rotation was starting by planting of 435 Douglas-fir per acre with an assumed survival rate of 90% to 95%. Additional natural ingrowth of approximately 600 western hemlock per acre was also assumed. The simulation of the subsequent rotation included a precommercial thin at age 15, leaving 200 Douglas-fir per acre and 70 western hemlock per acre. It also included a commercial thin from below at age 35 to remove half of the stems. Final harvest was done at age 50.

For the harvest simulations under the previous rules and for upland harvests under the FFR scenarios, two trees per acre were left as green recruitment trees in accordance with the forest practices rules.

### 3.4 ECONOMIC ASSUMPTIONS

Calculating the economic figures required assumptions about costs and prices. The average log prices for the year 2000 as reported in Log Lines (2001) were used. Region 1 (Puget Sound) prices were used for the Lewis County case studies and Region 2 (Washington coast) prices were used for the Grays Harbor case studies. Logging and haul costs were based on information from the Washington Landscape Management Project (Lippke, Sessions, and Carey 1996). The cost per thousand board feet (Mbf) was determined by the average diameter of the harvested trees. Higher costs were used for cable logging compared to ground logging and for commercial thinning compared to a clear-cut harvest. Cable logging prices were applied to stands with greater than 30% average slope; otherwise ground prices were used.

Other costs were based on input from local foresters and participating landowners. These costs are summarized in Table 3.4.

**Table 3.4. Forest management cost assumptions.**

	Lewis County	Grays Harbor County
Planting	\$239/acre (\$0.55/seedling)	\$239/acre (\$0.55/seedling)
Precommercial thin	N/A	\$100/acre
Early commercial thin	break-even (no net cost or revenue)	N/A
Annual overhead	\$40/acre/year	\$40/acre/year

Additional costs were added to the FFR management scenarios in which harvesting was done in the riparian zone. For nonfish-bearing streams requiring a 50-foot buffer and for fish-bearing streams in the outer zone harvest only scenario, an additional layout cost of \$0.50 per linear foot of stream was applied to reflect the additional expense of delineating the buffer zones. For fish-bearing streams in the Option 1 and Option 2 scenarios, an extra layout cost of \$2.50 per linear foot of stream was applied. This reflects the additional expense of delineating the buffer zones plus the other expenses associated with these options, such as a 100% cruise in the core and inner zones and running the DFC Worksheet program.

The only tax included in the analysis was the Washington forest excise tax, which was 5% under previous rules and 4.2% under the FFR. For this analysis it was assumed that there would be no real change in costs or log prices over time. All calculations assumed constant dollars and a real target rate of return of 5%.

### 3.5 ECONOMIC ANALYSIS

Economic analysis for each case study was done by comparing land expectation value and total forest value between the previous rules and the four FFR management scenarios. For the FFR scenarios a comparison was also done of forest value with and without the FREP. Calculations of land value and forest value were based on Faustmann's approach (Faustmann [1849] 1995).

#### 3.5.1 Land Value

This figure, also known as bare land value, land expectation value (LEV), or soil expectation value (SEV), estimates the economic value of the land alone based on its ability to generate income through the production of timber. It is calculated by taking the net present value of all the costs and revenues associated with growing timber in perpetuity when starting with bare land. In other words, land value is the sum of all the planting costs, thinning costs, net harvest revenues, and annual administrative costs from an infinite number of timber rotations discounted to the present from their respective years using a target rate of return. This value represents the amount someone would be willing to pay for bare land for the purpose of growing timber given a target rate of return and management assumptions.

The land value figures for these case studies may be positive or negative. A positive land value means that growing timber on the property under the given assumptions will earn higher than the target rate of return. Similarly, a negative land value means that growing timber on the property under our assumptions will earn lower than the target rate of return. Thus, land values are higher with lower interest rates and vice versa. A land value of zero would mean that growing timber on the land would earn exactly the target rate of return.

Land value is a very important figure because it represents the overall economic competitiveness of using the land to grow timber. As land values (and hence rates of return) fall, growing timber becomes less competitive relative to other potential land uses. Thus, a decrease in land value may lead to an increase in land-use conversion. *Equation 3.5.1* was used to calculate land value.

**Equation 3.5.1. Land value.**

$$LV = \frac{-P(1+i)^R - PCT_N(1+i)^{(R-N)} + CT_T(1+i)^{(R-T)} + H_R}{(1+i)^R - 1} - \frac{a}{i}$$

Where:  
 $P$  = planting cost  
 $PCT_N$  = cost of precommercial thin at year  $N$  (where applicable)  
 $CT_T$  = net commercial thin revenue at year  $T$   
 $H_R$  = net harvest revenue at year  $R$   
 $a$  = annual overhead cost  
 $i$  = target rate of return

**3.5.2 Forest Value**

Forest value is land value plus the added economic value of any standing timber (the total economic value of the forest). It is important to note that when calculating forest value, the economic value of currently standing timber is not the same as the net present market value. The economic value of the timber is the net present market value minus "land rent," which is the economic opportunity cost of using the land to hold the existing timber rather than starting a new rotation and earning land value. By combining the economic value of land and timber, forest value represents the total economic value of a forest asset.

If the current crop of timber is near the end of its rotation, it will have a high economic value (because revenues will be realized in the near future) and thus forest value will be much higher than land value. If the current crop of timber is very young, forest value will not be much higher than land value because it is only a few years past a bare land condition. In rare cases where the net present market value of the timber is lower than the opportunity cost of holding the land, forest value may actually be less than land value. This implies that it would be better economically to liquidate the current crop and start a new crop immediately rather than continuing to hold the current crop. *Equation 3.5.2* was used to calculate forest value.

### Equation 3.5.2. Forest value.

$$FV = LV - \frac{PCT_n}{(1+i)^n} + \frac{CT_t}{(1+i)^t} + \frac{H_r}{(1+i)^r} - \frac{(a+i(LV))((1+i)^r - 1)}{i(1+i)^r}$$

Where:

$PCT_n$  = cost of precommercially thinning existing timber at year  $n$  (where applicable)

$CT_t$  = net revenue from commercial thin of existing timber at year  $t$  (where applicable)

$H_r$  = net revenue from harvest of existing timber at year  $r$  (end of current rotation)

$LV$  = land value

$a$  = annual overhead cost

$i$  = target rate of return

### 3.5.3 Forest value with the FREP

This is forest value with cash compensation from the FREP factored in. This includes compensation for qualifying timber and reimbursement for additional layout costs associated with harvesting in the riparian zone. *Equation 3.5.3* was used to calculate forest value with the FREP.

### Equation 3.5.3. Forest value with the FREP.

$$FV_{FREP} = LV - \frac{PCT_n}{(1+i)^n} + \frac{CT_t}{(1+i)^t} + \frac{H_r + FREP_r}{(1+i)^r} - \frac{(a+i(LV))((1+i)^r - 1)}{i(1+i)^r}$$

Where:

$PCT_n$  = cost of precommercially thinning existing timber at year  $n$  (where applicable)

$CT_t$  = net revenue from commercial thin of existing timber at year  $t$  (where applicable)

$H_r$  = net revenue from harvest of existing timber at year  $r$  (end of current rotation)

$LV$  = land value

$FREP_r$  = total cash payment from the FREP at year  $r$

$a$  = annual overhead cost

$i$  = target rate of return

## 4.0 CASE STUDY RESULTS

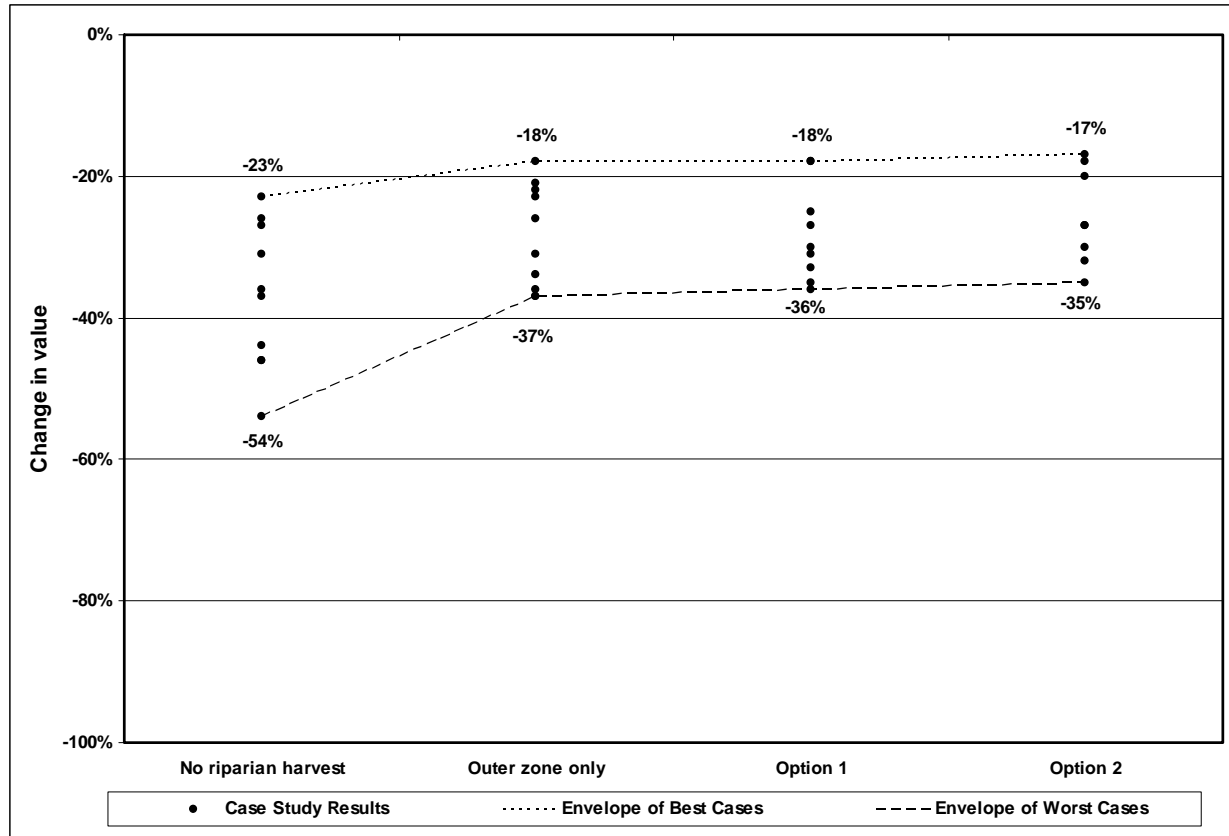
The collective results of the case studies are summarized below. More detailed results for individual case studies can be found in Appendix A.

### 4.1 IMPACTS ON FOREST VALUE

The impacts of the FFR on the forest value for each case study are summarized in *Table 4.1* as a percent change relative to the previous rules. In each case, there is a significant loss in forest value under any of the FFR management options. The losses are highest if no harvesting is done in the riparian zone, ranging from 23% (Case 4) loss to 54% (Case 1). Losses are lower if harvesting is done in the outer zone, ranging from 18% (Case 8) to 37% (Cases 1 and 3). Losses are lower still for some cases if harvesting is done in both the outer zone and the inner zone under option 1 or option 2. This is not true for all cases, though, as Case 8 remains unchanged and in Cases 7 and 9 the loss in forest value would actually be higher under option 1 or option 2 compared to harvesting only in the outer zone. Some of the FFR management options are not applicable for some case studies and are displayed as “NA” in *Table 4.1*. The range and distribution of forest value impacts are plotted in *Figure 4.1*.

**Table 4.1. Percent change in case study forest value under the FFR relative to the previous rules.**

Scenario	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
No riparian harvest	-54%	-31%	-46%	-23%	-37%	-46%	-36%	-26%	-27%	-44%
Outer zone harvest only	-37%	-22%	-37%	-21%	-26%	-34%	-31%	-18%	-23%	-36%
Option 1	-30%	NA	-36%	-18%	-25%	-31%	-33%	-18%	-27%	-35%
Option 2	-27%	NA	-35%	-17%	-20%	-30%	-32%	-18%	-27%	NA



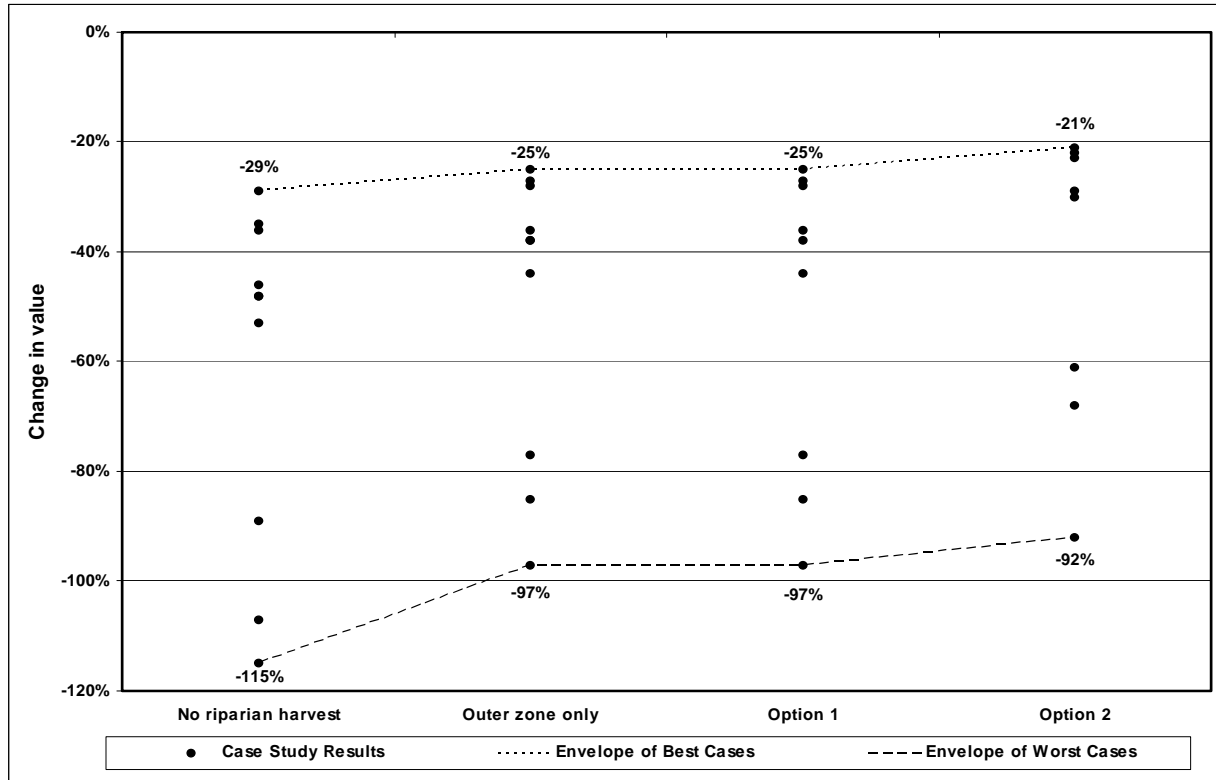
**Figure 4.1. Range and distribution of the impacts of the FFR on case study forest values.**

## 4.2 IMPACTS ON LAND VALUE

The impacts of the FFR on the land value for each case study are summarized in *Table 4.2* as a percent change relative to the previous rules. The impacts on land value are greater than the impacts on forest value, ranging from a 29% loss (Case 9) to a 115% loss (Case 1) if no riparian harvest is done. A loss in excess of 100% indicates that the target rate of return is not achieved for that scenario. The losses are lower if harvesting is done in the outer zone, ranging from 25% (Case 9) to 97% (Case 3). Losses in land value would not be reduced further by harvesting in the inner zone under option 1, but they would be reduced further if option 2 was chosen. Under option 2 the losses range from 21% (Case 8) to 92% (Case 3). The range and distribution of land value impacts are plotted in *Figure 4.2*.

**Table 4.2. Percent change in case study land value under the FFR relative to the previous rules.**

Scenario	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
No riparian harvest	-115%	-48%	-107%	-36%	-46%	-89%	-48%	-35%	-29%	-53%
Outer zone harvest only	-85%	-38%	-97%	-28%	-36%	-77%	-38%	-27%	-25%	-44%
Option 1	-85%	NA	-97%	-28%	-36%	-77%	-38%	-27%	-25%	-44%
Option 2	-61%	NA	-92%	-22%	-30%	-68%	-29%	-21%	-23%	NA



**Figure 4.2. Range and distribution of the impacts of the FFR on case study land values.**

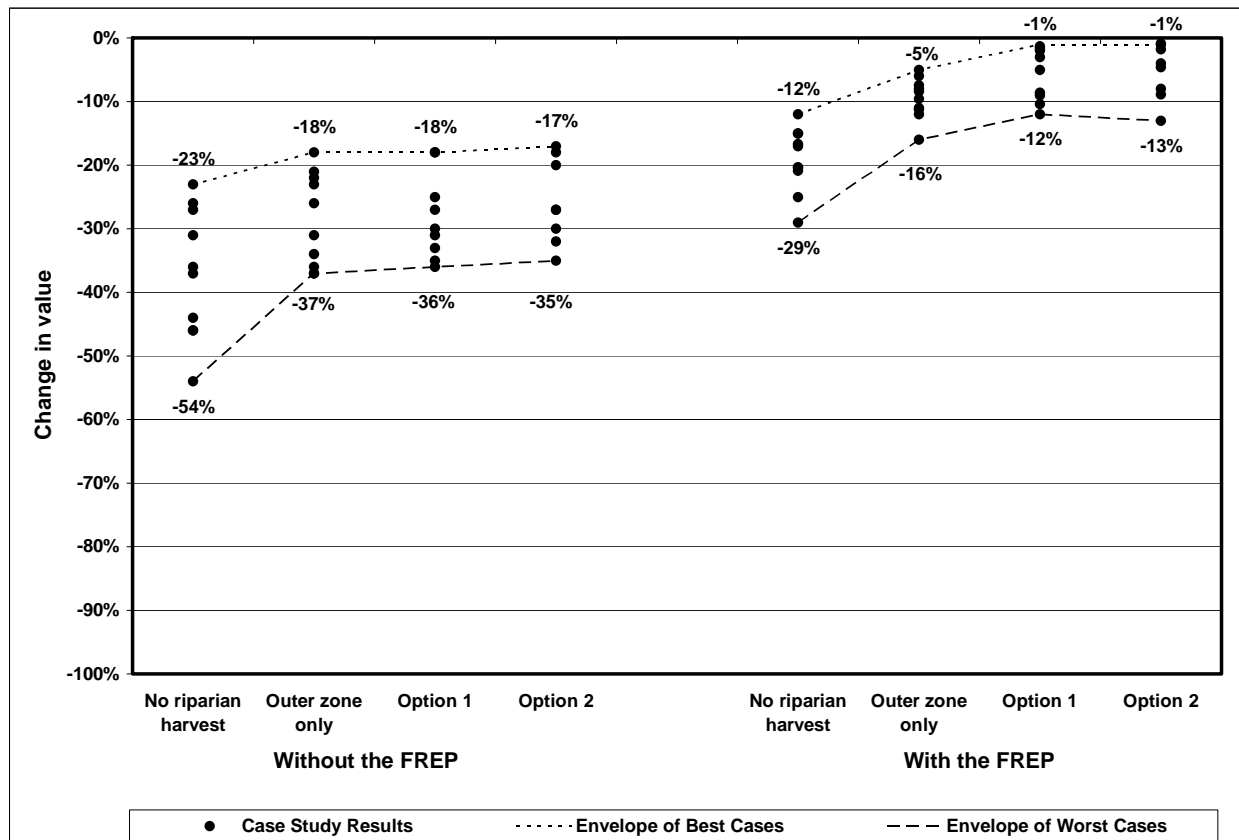
### 4.3 IMPACTS OF MITIGATION

The two mitigation options for small landowners are the forest excise tax credit and the FREP. The results above already assume that the landowner has received the forest excise tax credit under the FFR management scenarios. If cash payments from the FREP are also factored in, the net change in forest value for each case study with full mitigation is summarized in *Table 4.3*. The FREP significantly reduces both the magnitude and disparity of forest value losses across all FFR scenarios. With no riparian harvest, the impacts range from a 12% loss (Case 1) to a 29% loss (Case 9). This is roughly half of what the losses would be without the FREP. If riparian harvest is done under Option 2, the impacts range from a 1% loss (Case 1) to a 13% loss (Case 3). The loss for Case 3 drops to 12% if Option 1 is done instead of Option 2. Thus, if the economically optimal harvest strategy is used for each case, the impacts with the FREP range from a 1% loss to a 12% loss. The range and distribution of forest value impacts with and without the FREP is plotted in *Figure 4.3*.

The FREP only compensates for existing timber; it does not compensate for the lost value of land acreage that can no longer be used for commercial timber production. This leaves the impacts on land value unchanged.

**Table 4.3. Percent change in case study forest value under the FFR relative to the previous rules with cash compensation from the FREP included.**

Scenario	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
No riparian harvest	-29%	-15%	-25%	-15%	-20%	-20%	-17%	-21%	-12%	-17%
Outer zone only	-11%	-5%	-16%	-12%	-8%	-7%	-10%	-11%	-6%	-8%
Option 1	-2%	NA	-12%	-9%	-1%	-2%	-9%	-10%	-5%	-3%
Option 2	-1%	NA	-13%	-8%	-1%	-2%	-5%	-9%	-4%	NA



**Figure 4.3. Range and distribution of the impacts of the FFR on case study forest values, with and without the FREP.**



## **5.0 DISCUSSION**

### **5.1 ECONOMIC IMPACTS AND MANAGEMENT OPTIONS**

The results of these case studies indicate that some small landowners will potentially incur significant economic losses as a result of the FFR and that there is indeed a large variability and disparity of impacts across different landowners. Both the severity and the disparity of economic losses depend on the riparian management scenario, which implies that whether or not to harvest in the riparian zone is a very important question facing small landowners.

For each case study, economic losses were higher under the no riparian harvest scenario compared to the scenarios in which partial harvesting was done in the riparian zone. Harvesting in the outer zone appreciably reduced economic losses compared to the no riparian harvest scenario. Given that harvesting in the outer zone does not require significant additional layout costs, this may be a desirable option for many landowners. According to the Small Forest Landowner Office this has indeed been the preferred option for most small landowners who have harvested under the new rules.

Harvesting in both the inner and outer zones using Option 1 or Option 2 further reduced economic losses in some of the case studies, but the incremental benefit of harvesting in the inner zone was relatively small. Part of the reason for this is that landowners should expect to incur significant additional layout and consulting costs by entering the inner zone. In some cases (Case 7 and Case 9), the costs of harvesting in the inner zone outweighed the benefits altogether. However, the FREP will reimburse participating landowners for these extra layout costs, as they are required for the preparation of the easement. Thus, whether or not a landowner is planning to apply for the FREP may determine whether it is economically advantageous to harvest in the inner zone.

Land values seem to be particularly sensitive to the new rules, with some case studies losing most or all of their land value. Land value for forest management is completely lost in no-cut areas such as the core zone and parts of the inner zone, as these acres can no longer be used for commercial management. If a significant portion of a given property is taken out of production because of buffer restrictions, it may make the entire property unprofitable, as there is now a much smaller production base to cover fixed overhead costs. Fragmentation may also make management unfeasible even in unrestricted areas.

Significant decreases in land value imply that it will not be economically viable for some landowners to continue to use their property for forest management beyond the current rotation given the new rules. Depending on what other values these landowners associate with their property besides economic returns, this could motivate land-use conversion, particularly to real estate uses (Lippke and Bare 1997). NIPF lands in Western Washington tend to interface with urbanizing areas, and real estate conversion of NIPF lands is a growing concern (Stinson 2000). NIPF lands in Washington have already been converted at a rate of almost 100 acres per day in recent years (WADNR 1998). The diminished economic returns for continued forest management under the FFR can be expected to exacerbate that trend.

### **5.2 EFFECTIVENESS OF MITIGATION**

The economic impacts of the FFR for these case studies were significant despite factoring in the forest excise tax credit that is available to landowners under the new rules. This suggests that the tax credit does not effectively mitigate the economic losses resulting from the new riparian buffer requirements. This is consistent with a study by the Washington Department of Revenue which found that the value of required riparian leave trees far exceeded the value of the forest excise tax credit (WADOR 2002).

In contrast, the case study results demonstrate that the FREP can be very effective at mitigating losses, especially when harvesting is done in the riparian zone. When cash payments from the FREP are considered, the forest value impacts of the FFR range from a 1% loss to a 12% loss under the least impact scenario. Thus, it appears that the FREP significantly reduces both the magnitude and disparity of economic losses for small landowners.

The extent to which compensation from the FREP mitigates economic losses is surprising. There are several reasons why it is so effective:

1. Compensation under the FREP is not given on a property-wide basis, but on an individual stand (harvest unit) basis. In many cases, riparian losses are concentrated in only a few stands on the property. Even though the loss for the property as a whole does not exceed the 19.1% high impact threshold, losses for those particular stands do. Thus, those stands are compensated sometimes well above 50%, which considerably reduces the loss to the property as a whole.
2. The FREP compensates not only for the new riparian leave tree requirements under the FFR but also for riparian leave trees that were required under the previous rules. This significantly reduces the incremental impact of the FFR relative to the previous rules.
3. The FREP reimburses landowners for the extra layout costs associated with harvesting in the inner zone. This makes it economically feasible to recover additional value from the riparian zone that would otherwise have been cost prohibitive for some landowners.
4. The value that landowners receive for their qualifying timber is not subject to the forest excise tax like it would be if the timber were actually harvested.

Despite its apparent effectiveness, the FREP does have several significant shortcomings. If participation is high, the cost will far exceed current funding plans. Estimated easements paid for these ten case studies alone exceed \$2.4 million over the next 45 years at year 2000 log values. The present value of this cost at a 5% discount rate is approximately \$777,000, which is equivalent to a cost of about \$44,000 per year for 45 years.

The total riparian acreage for the ten properties in this study is 400. This yields a nominal cost per riparian acre of approximately \$6,000 over the next 45 years, with a present value cost per riparian acre of \$1,942. Based on the SBEIS analysis (Perez-Garcia et al. 2000), there are approximately 1,372,175 acres of NIPF parcels greater than 20 acres in Western Washington that are eligible for the FREP. According to a 1997 GIS analysis sponsored by the Washington Forest Protection Association, 17.41% of these acres are riparian acres.<sup>1</sup> Using this figure, there are approximately 238,896 riparian acres on NIPF land in Western Washington that are subject to the FFR. Assuming the cost per riparian acre is consistent throughout Western Washington, the total Westside cost for full participation in the FREP would be over \$1.4 billion over 45 years at year 2000 prices. The present value of this cost would be over \$463 million, which is equivalent to a cost of about \$26 million per year for the Westside alone. Statewide funding for the FREP was \$5 million for the first biennium, which was reduced to \$2 million for the following biennium. Future funding for this program is uncertain, but it is unlikely that it will ever be funded at adequate levels for large-scale participation. Thus, the majority of small landowners will not enjoy the benefits of this program.

Another shortcoming of the FREP is that the easement only compensates for currently standing timber. It does not compensate for the loss in land value of riparian acreage that can no longer be used for sustainable forest management. By not mitigating the substantial reductions in land values under the new rules, the FREP does not address the potential unintended consequence of increased forestland conversion.

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<sup>1</sup> From a report prepared for the Washington Hardwoods Commission by Marshall and Associates, Inc.

### **5.3 BROADER IMPLICATIONS**

The results of these case studies show the economic impacts of Washington's new forest practices regulations to be not only more severe than the previous regulations, but also more severe than regulations in other regions. Lickwar, et al. (1992), for instance, found that implementing best management practices in the Southeast to protect water quality only reduced gross harvest revenue by 2.9%. Another study in Wisconsin found that new requirements did not significantly decrease and may even increase (depending on the baseline used) net present values for landowners (Stier and Martin 1997). Similarly, Kittredge, et al. (1999) found little impact from forest practices regulations when they compared regulations in two states in the Northeast.

Of these three studies from other regions, only Lickwar, et al. (1992) involved riparian buffers, and the restrictions were much less stringent than with the FFR. Thus, the restrictive buffer requirements of the FFR may set Washington apart from other states and regions in terms of the economic impacts of forest practices regulations. This is consistent with a study done on national forests in the Midwest, which found leaving buffer strips to be the most expensive practice to protect water quality, resulting in a net revenue reduction of over 26% (Ellefson and Miles 1985).

While these rules and their impacts are unique to the state of Washington, other states are facing similar issues. Forest practices regulations have become increasingly strict in the West over the past few decades (Cubbage 1995). The East has also seen trends towards increasing state and local regulation of private forestry, and those trends are predicted to continue (Cubbage and Siegel 1988). If regulations do indeed continue to increase, especially if they involve riparian buffers, landowners in other states can expect to face larger economic impacts. Washington's rules represent an important starting point for understanding the implication of those impacts and the ability of public cost sharing programs like the FREP to mitigate those impacts.

### **5.4 FUTURE RESEARCH**

In addition to the FREP, the FFR include an additional provision to address economic impacts. This provision gives landowners the flexibility to pursue alternate management plans that “meet riparian functions while requiring less costly regulatory prescriptions” (RCW 76.113.110). The FFR further provide for the creation of templates to facilitate the implementation of alternate plans. Given the funding and other shortfalls of the FREP, alternate plan templates will be an important mechanism for mitigating economic impacts. Future research will focus on the development of templates that effectively meet riparian functions while maintaining the economic viability of landowners.



## REFERENCES

- Cubbage, F.W. 1995. Regulation of private forest practices: What rights, which policies? *Journal of Forestry* 93(6):14-20.
- Cubbage, F.W. and W.C. Siegel. 1988. State and local regulation of private forestry in the East. *Northern Journal of Applied Forestry* 5(2):103-108.
- Ellefson, P.V. and P.D. Miles. 1985. Protecting water quality in the Midwest: impact on timber harvesting costs. *Northern Journal of Applied Forestry* 2(2):57-61.
- Faustmann, M. 1995. Calculation of the value which forest land and immature stands possess for forestry. *Journal of Forest Economics* 1(1):7-44. Reprint of translation in *Institute Paper 42*, Commonwealth Forestry Institute, University of Oxford, 1968. First published in *Allgemeine Forst- und Jagd-Zeitung* 15, 1849.
- Forests and Fish Report*. 1999. Available online at <http://www.dnr.wa.gov/forestpractices/rules/forestsandfish.pdf>; last accessed June 2003.
- Kittredge, D.B., M.G. Rickenbach, and S.H. Broderick. 1999. Regulation and stumpage prices: A tale of two states. *Journal of Forestry* 97(10):12-16.
- Lickwar, P., C. Hickman, and F.W. Cubbage. 1992. Costs of protecting water quality during harvesting on private forestlands in the Southeast. *Southern Journal of Applied Forestry* 16(1):13-20.
- Lippke, B. and B.B. Bare. 1997. Viability of non-industrial private forest sector in Washington State. Unpublished.
- Lippke, B., S. Marshall, M. Ludwig, J. Moffett, D. Fitzpatrick, and B.B. Bare. 2000. Lewis County economic assessment. *CINTRAFOR Special Paper 35*. Seattle, WA: Center For International Trade In Forest Products, College of Forest Resources, University of Washington.
- Lippke, B.R., J. Sessions, and A.B. Carey. 1996. Economic analysis of forest landscape management alternatives. *CINTRAFOR Special Paper 21*. Seattle, WA: Center For International Trade In Forest Products, College of Forest Resources, University of Washington.
- Log Lines. 2001. *2001 Statistical Yearbook*. Mount Vernon, WA: Arbor-Pacific Forestry Services, Inc. and Resource Information Systems, Inc.
- Nigh, G. 1995. The geometric mean regression line: A method for developing site index conversion equations for species in mixed stands. *Forest Science* 41(1):84-98.
- Oneil, E. 2003. Impacts of the forest and fish rules on small forest landowners in Eastern Washington: some key consequences from riparian zone case study analysis. Master's thesis, College of Forest Resources, University of Washington, Seattle, WA.
- Perez-Garcia, J.M., J. Edelson, and K. Zobrist. 2001. *New proposed forest practices rules small business economic impact statement*. Olympia, WA: Washington State Department of Natural Resources.
- Stier, J.C. and A.J. Martin. 1997. Economic impacts of timber harvest regulations in the Lower Wisconsin State Riverway. *Northern Journal of Applied Forestry* 14(3):126-134.
- Stinson, S.D. 2000. Family forest conservation project: Lewis County Washington pilot project for non-industrial private forests. In *Proceedings of Summit 2000: Washington Private Forests Forum*, March 2000, edited by J.K. Agee. Seattle, WA: Institute of Forest Resources, College of Forest Resources, University of Washington.

- Washington Department of Natural Resources (WADNR). 1998. *Our changing nature: Natural resource trends in Washington State*. Olympia, WA.
- Washington Department of Revenue (WADOR). 2002. Comparing the value of “Forests and Fish” leave-trees with the forest excise tax credit. Report to the Legislature. Olympia, WA.
- Zobrist, K. and B.R. Lippke. 2003. Case studies examining the economic impacts of new forest practices regulations on NIPF landowners. In *Forest policy for private forestry: Global and regional challenges*, edited by L. Teeter, B. Cashore, and D. Zhang. Wallingford, UK: CABI Publishing.

## RELATED WEB SITES

(URLs are current as of July 2003)

- **DFC Worksheet Program:**

<http://www.dnr.wa.gov/forestpractices/dfc/>

- **Forest Practices Act (Chapter 76.09 RCW):**

<http://www.leg.wa.gov/RCW/index.cfm?fuseaction=chapterdigest&chapter=76.09>

- **Forest Practices Board:**

<http://www.dnr.wa.gov/forestpractices/board/>

- **Forest Practices Rules (Title 222 WAC):**

<http://www.leg.wa.gov/wac/index.cfm?fuseaction=title&title=222>

- **Landscape Management System (LMS):**

<http://lms.cfr.washington.edu/lms.shtml>

- **ORGANON:**

<http://www.cof.orst.edu/cof/fr/research/organon/>

- **Rural Technology Initiative:**

<http://www.ruraltech.org>

- **Small Forest Landowner Office:**

<http://www.dnr.wa.gov/sflo/>

- **University of Washington College of Forest Resources:**

<http://www.cfr.washington.edu/>

- **Washington Department of Natural Resources:**

<http://www.dnr.wa.gov/>

- **Washington State University Natural Resources Extension:**

<http://ext.nrs.wsu.edu/>





## APPENDIX A: INDIVIDUAL CASE STUDY RESULTS

### A.1 CASE STUDY 1

Case Study 1 (*Figure A.1.1*) is a parcel with approximately 32.5 acres of commercial forestland located in Lewis County, WA. Most of the timber is a 20-year-old Douglas-fir plantation, with a few pockets of 40-year-old Douglas-fir as well as some areas of lodgepole pine. Site quality is class II, for which the FFR requires a total riparian buffer width of 170 feet on each side of a fish-bearing stream. A small fish-bearing stream runs east to west across the property, with another small fish-bearing stream joining up with it from the north. This leaves a total of 49% of the commercial forest acreage impacted by riparian buffers under the FFR, with 35% in the core and inner zones (*Table A.1.1*). Economic impacts for Case Study 1 are summarized in *Table A.1.2*, *Figure A.1.2*, and *Figure A.1.3*.

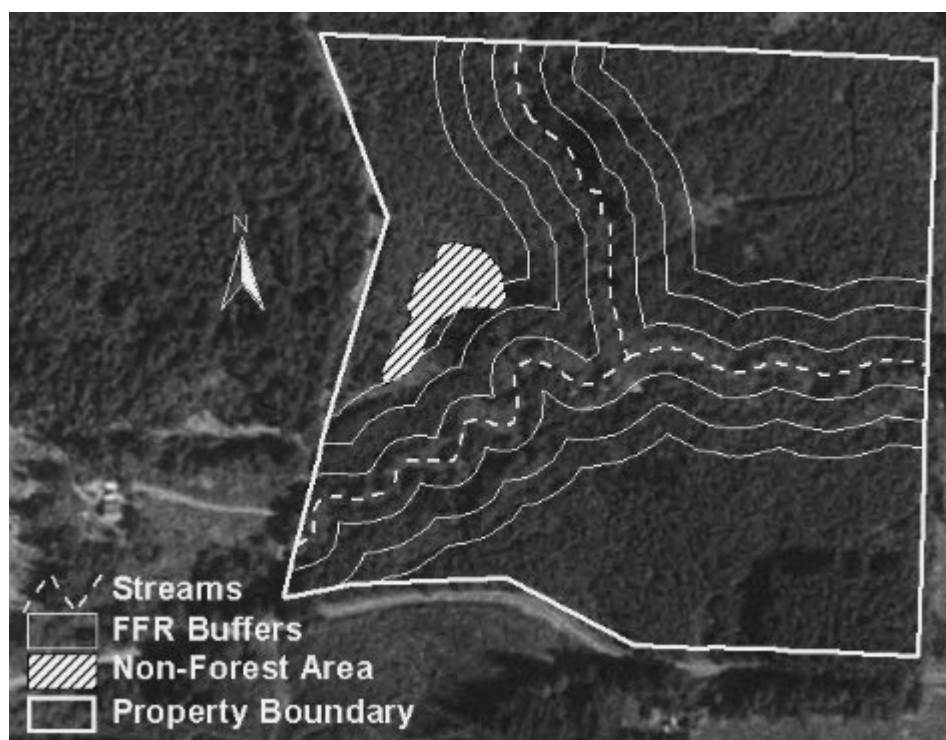


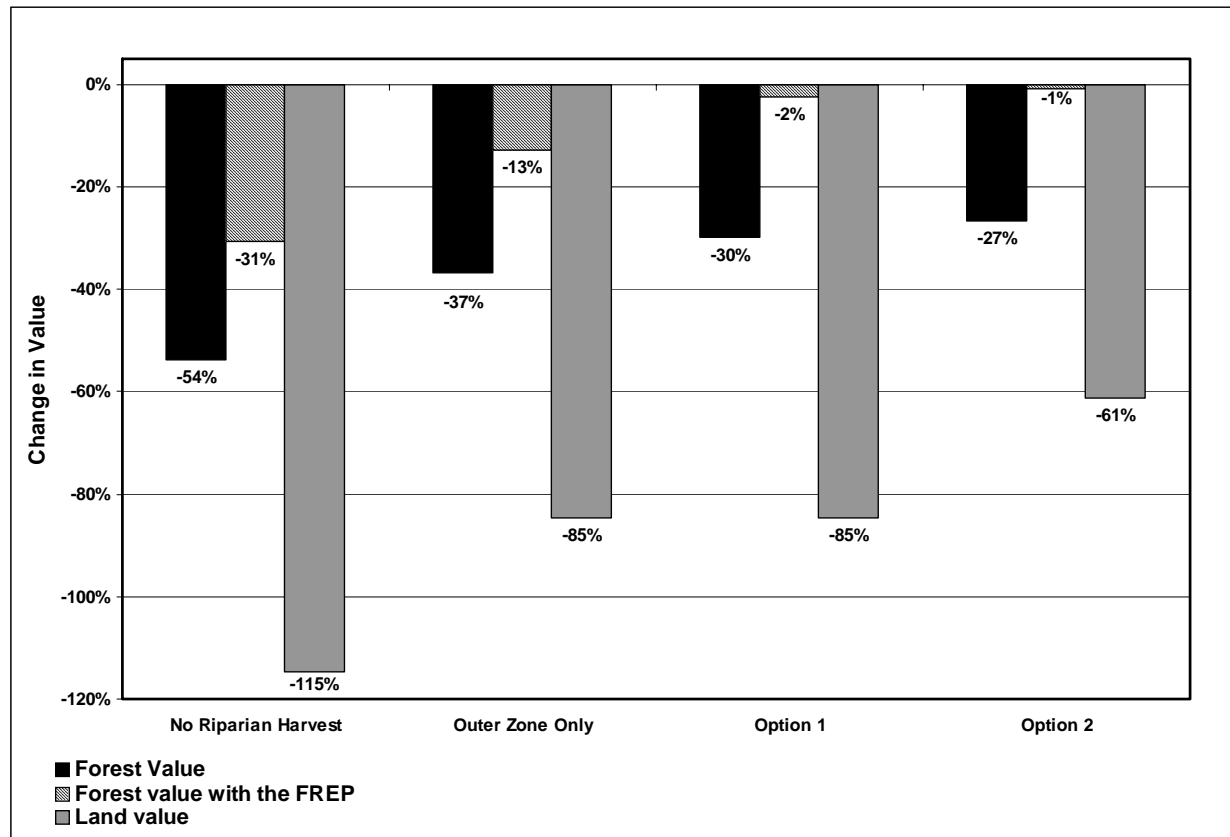
Figure A.1.1. Case Study 1.

Table A.1.1. Case Study 1 acreage.

Location:		Lewis County	
Total acres of commercial forestland:		32.5	
Acres previously in buffers (estimated):		2.9	9%
Acres in buffers under new rules:			
	Core	5.5	17%
	Inner	6.0	18%
	Outer	4.7	14%
	Total	16.2	49%

**Table A.1.2. Economic comparison of the previous rules and the FFR management options for Case Study 1.**

Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$90,786	\$2,793					\$16,477	\$507	
FFR: no riparian harvest	\$41,893	\$1,289	-54%	\$64,535	\$1,986	-29%	(\$2,430)	(\$75)	-115%
FFR: outer zone only	\$57,414	\$1,767	-37%	\$80,644	\$2,481	-11%	\$2,524	\$78	-85%
FFR: Option 1	\$63,635	\$1,958	-30%	\$88,630	\$2,727	-2%	\$2,524	\$78	-85%
FFR: Option 2	\$66,626	\$2,050	-27%	\$90,046	\$2,771	-1%	\$6,372	\$196	-61%

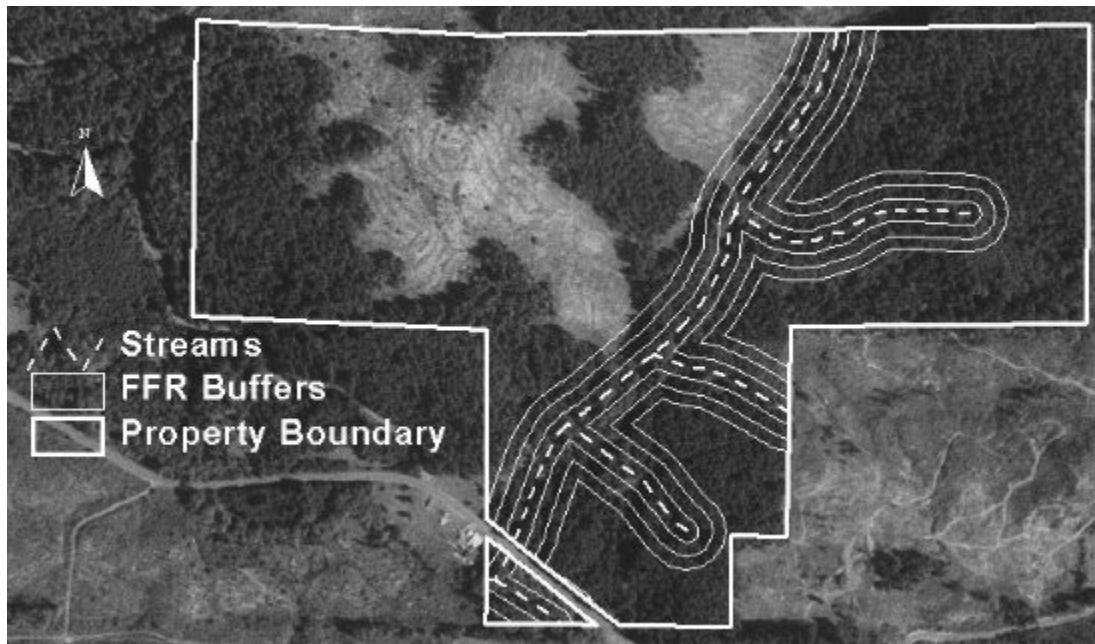


**Figure A.1.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 1.**

## A.2 CASE STUDY 2

Case Study 2 (*Figure A.2.1*) is a parcel with approximately 156 acres of commercial forestland located in Lewis County, WA. Most of the timber is Douglas-fir that is 40 to 45 years old. There are also several stands of 10-year-old timber and a small stand of 100-year-old alder in the southwest corner that is separated by a county road from the rest of the property. The property is site class II, for which the FFR requires a total riparian buffer width of 170 feet on each side of a fish-bearing stream. There is a small fish-bearing stream that runs north to south, with several small streams flowing into it from the east that are also considered fish-bearing. The main stream passes under the road and empties into another stream in the alder stand in the southwest corner of the property. A total of 26% of the property is impacted by riparian buffers under the FFR, with 18% in the core and inner zones (*Table A.2.1*). Economic impacts for Case Study 2 are summarized in *Table A.2.2*, *Figure A.2.2*, and *Figure A.2.3*.

Unlike the upland areas, the riparian zones are dominated by hardwoods. A separate inventory was compiled for these areas. According to the DFC Worksheet, the riparian zones have inadequate conifer basal area to permit any inner zone harvesting. Thus, options 1 and 2 are not applicable for this case study.



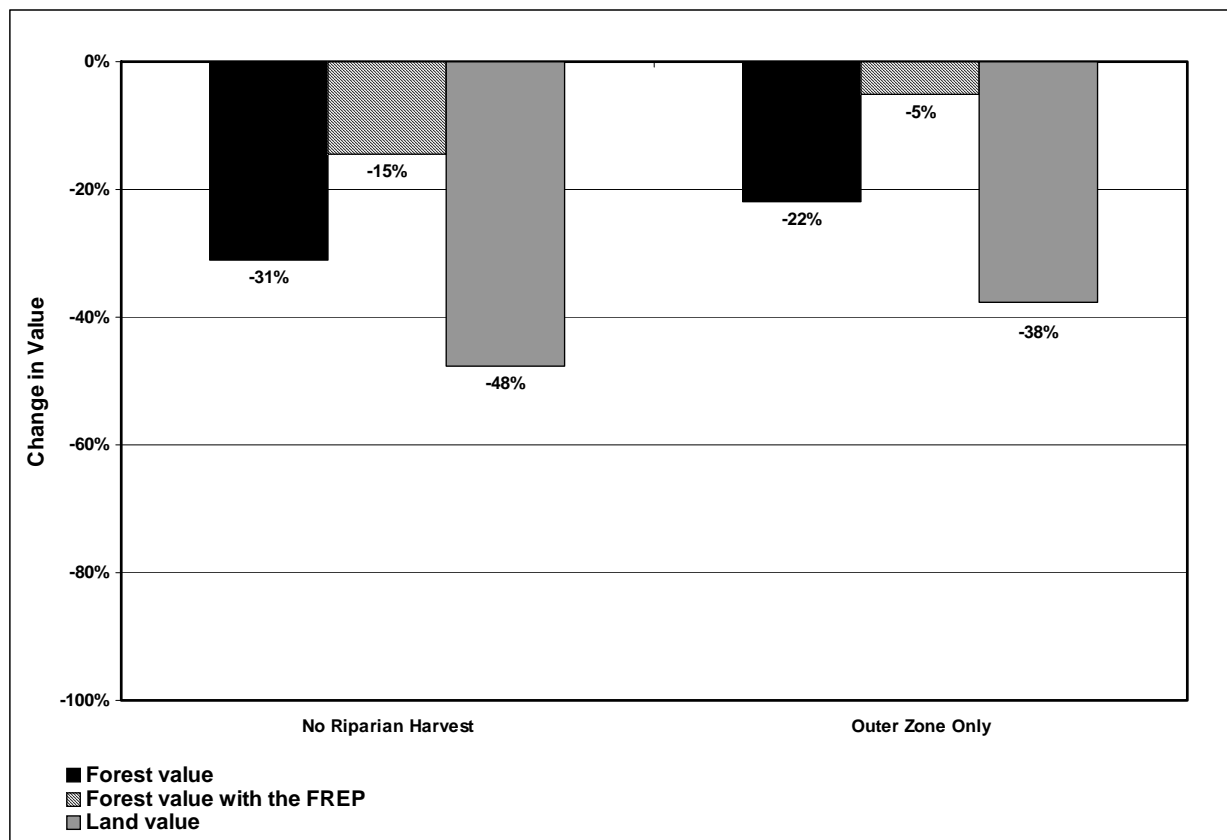
**Figure A.2.1.** Case Study 2.

**Table A.2.1.** Case Study 2 acreage.

Location:		Lewis County	
Total acres of commercial forestland:		156	
Acres previously in buffers (estimated):		3.9	3%
Acres in buffers under new rules:			
	Core	13.2	8%
	Inner	15.3	10%
	Outer	12.6	8%
	Total	41.1	26%

**Table A.2.2. Economic comparison of the previous rules and the FFR management options for Case Study 2.**

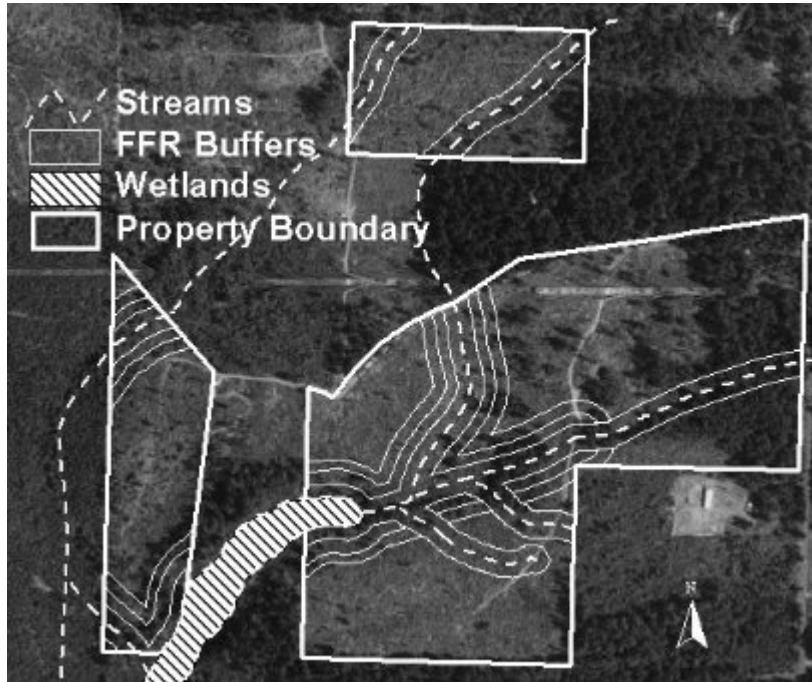
Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$1,535,156	\$9,841					\$134,036	\$859	
FFR: no riparian harvest	\$1,059,762	\$6,793	-31%	\$1,311,790	\$8,409	-15%	\$70,016	\$449	-48%
FFR: outer zone only	\$1,200,272	\$7,694	-22%	\$1,456,889	\$9,339	-5%	\$83,693	\$536	-38%



**Figure A.2.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 2.**

### A.3 CASE STUDY 3

Case Study 3 (*Figure A.3.1*) is comprised of three noncontiguous parcels with approximately 67.8 acres of commercial forestland located in Lewis County, WA. Most of the timber is a 5-year-old plantation with a mix of Douglas-fir, grand fir, and western redcedar. The property is site class III, for which the FFR requires a total riparian buffer width of 140 feet on each side of a fish-bearing stream. Two of the parcels include a wetland that has fish-bearing streams flowing through it. Above certain points these streams are considered nonfish-bearing, for which only a 50-foot buffer is required. A total of 31% of the commercial forest acreage is impacted by riparian buffers under the FFR, with 25% in the core and inner zones (*Table A.3.1*). Economic impacts for Case Study 3 are summarized in *Table A.3.2*, *Figure A.3.2*, and *Figure A.3.3*.



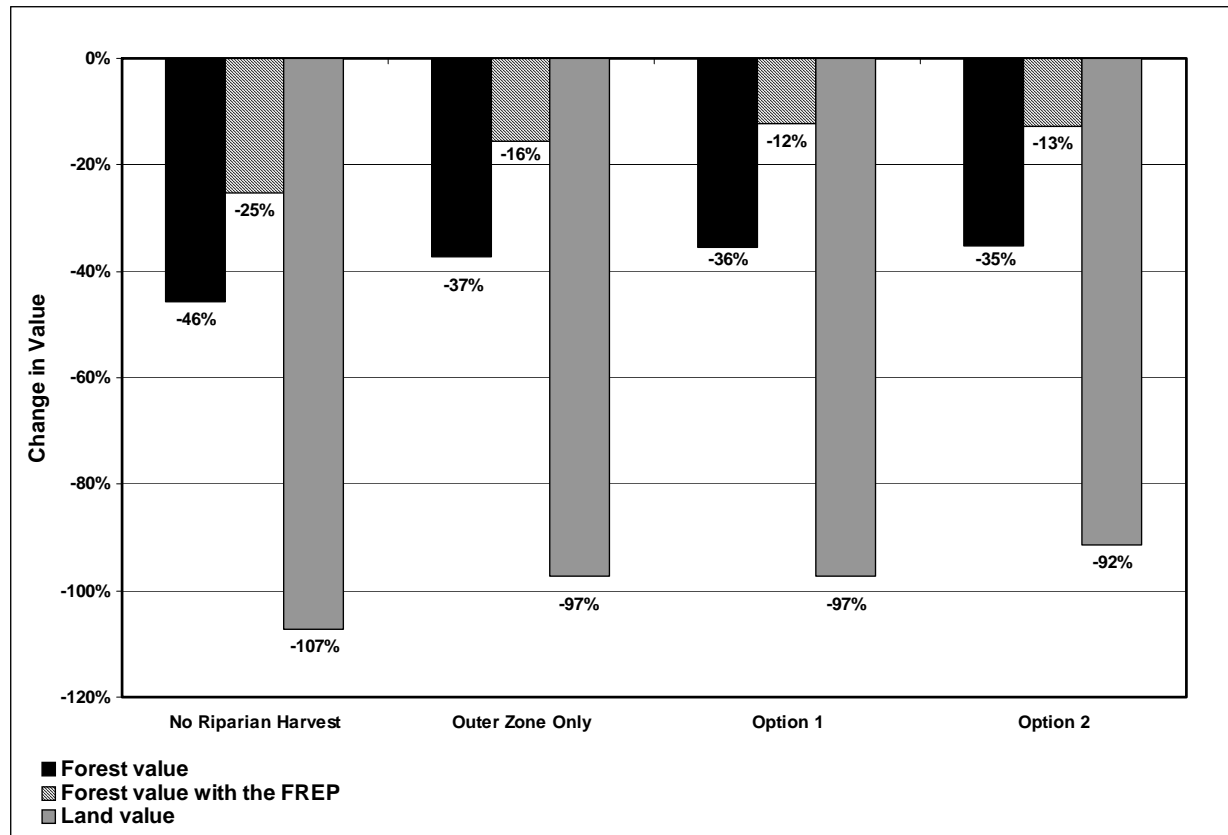
**Figure A.3.1.** Case Study 3.

**Table A.3.1.** Case Study 3 acreage.

Location:		Lewis County	
Total acres of commercial forestland:		67.8	
Acres previously in buffers (estimated):		1.5	2%
Acres in buffers under new rules:			
	Core	11.9	18%
	Inner	4.6	7%
	Outer	4.4	6%
	Total	20.9	31%

**Table A.3.2. Economic comparison of the previous rules and the FFR management options for Case Study 3.**

Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$77,046	\$1,136					\$19,409	\$286	
FFR: no riparian harvest	\$41,783	\$616	-46%	\$57,627	\$850	-25%	(\$1,404)	(\$21)	-107%
FFR: outer zone only	\$48,324	\$713	-37%	\$65,038	\$959	-16%	\$534	\$8	-97%
FFR: Option 1	\$49,678	\$733	-36%	\$67,700	\$999	-12%	\$534	\$8	-97%
FFR: Option 2	\$49,923	\$736	-35%	\$67,292	\$993	-13%	\$1,645	\$24	-92%



**Figure A.3.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 3.**

#### A.4 CASE STUDY 4

Case Study 4 (*Figure A.4.1*) is the largest case study, with approximately 318.6 acres of commercial forestland located in Lewis County, WA. Most of the stands are 5 to 15 years old, and they are predominantly Douglas-fir except for one riparian stand of 40-year-old alder. Site quality is class II, for which the FFR requires a total riparian buffer width of 170 feet on each side of a fish-bearing stream. A small stream that is considered fish-bearing under the FFR runs from north to south and meets up with another fish-bearing stream flowing east to west in the southern portion of the property. There are also several nonfish-bearing streams on the property requiring 50-foot buffers. Under the previous rules none of the streams were considered fish-bearing and no riparian buffers were required. Under the FFR a total of 21% of the property is impacted by riparian buffers, with 15% in the core and inner zones (*Table A.4.1*). Economic impacts for Case Study 4 are summarized in *Table A.4.2*, *Figure A.4.2*, and *Figure A.4.3*.

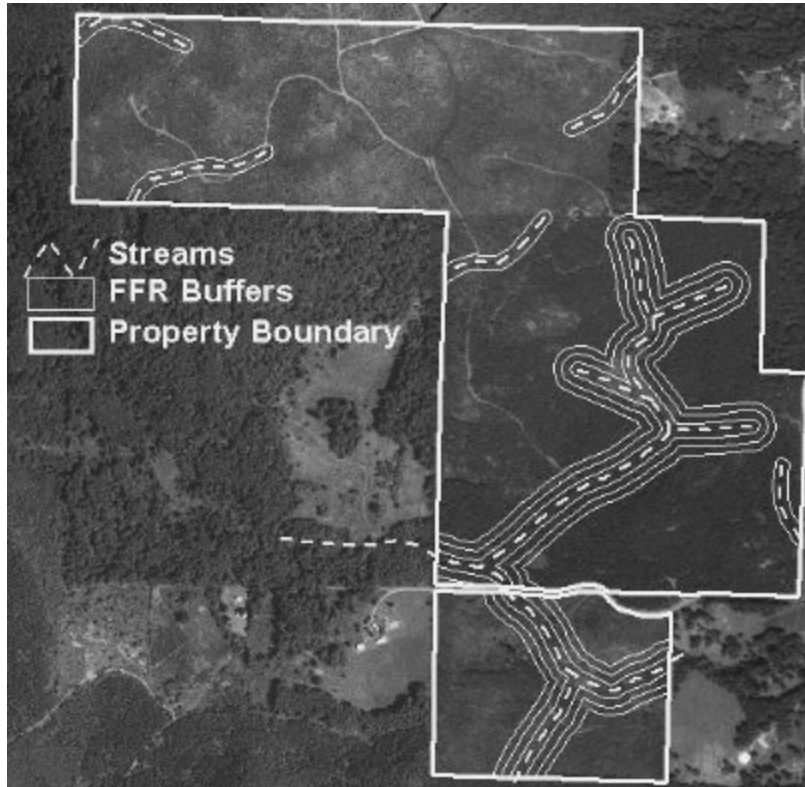


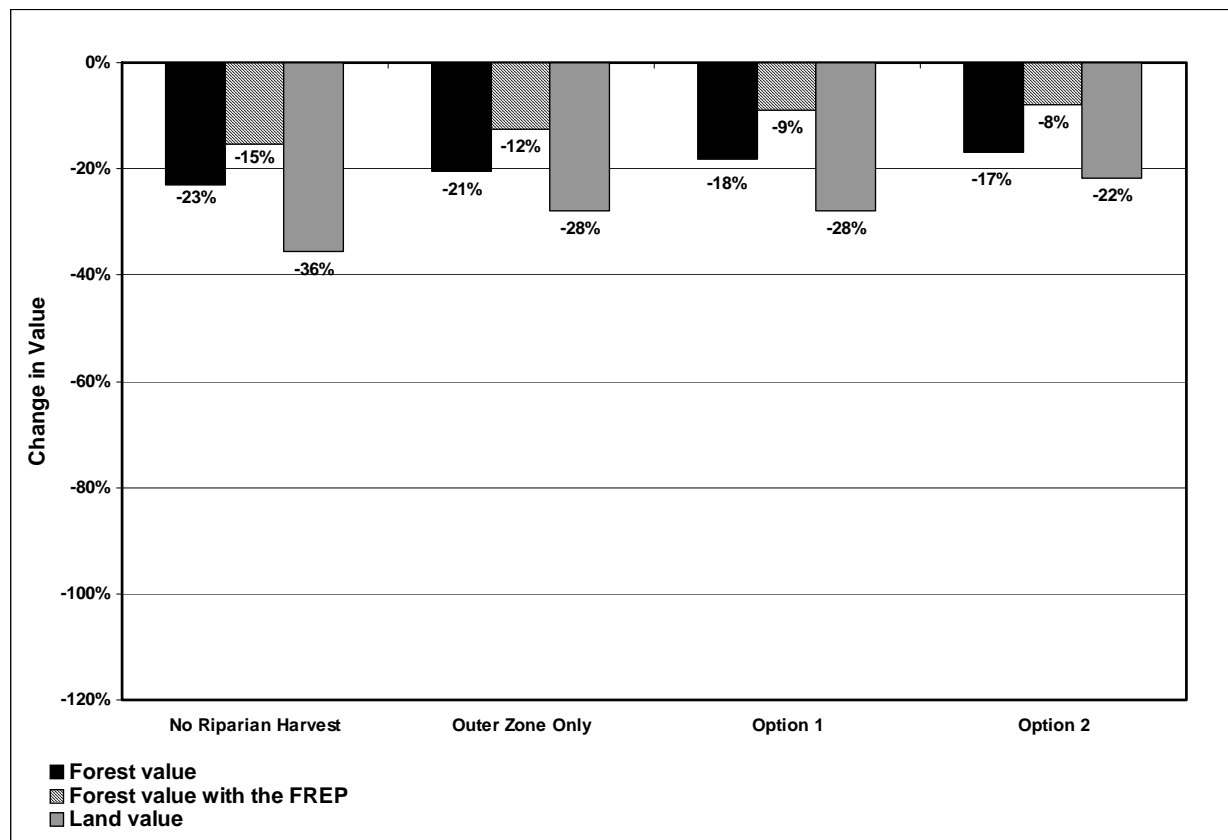
Figure A.4.1. Case Study 4.

Table A.4.1. Case Study 4 acreage.

Location:		Lewis County	
Total acres of commercial forestland:		318.6	
Acres previously in buffers (estimated):		0	0%
Acres in buffers under new rules:			
	Core	26.9	8%
	Inner	21.4	7%
	Outer	18.4	6%
	Total	66.7	21%

**Table A.4.2. Economic comparison of the previous rules and the FFR management options for Case Study 4.**

Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$651,943	\$2,046					\$313,718	\$985	
FFR: no riparian harvest	\$501,865	\$1,575	-23%	\$552,501	\$1,734	-15%	\$202,017	\$634	-36%
FFR: outer zone only	\$517,678	\$1,625	-21%	\$570,750	\$1,791	-12%	\$226,380	\$711	-28%
FFR: Option 1	\$532,805	\$1,672	-18%	\$594,015	\$1,864	-9%	\$226,380	\$711	-28%
FFR: Option 2	\$541,126	\$1,698	-17%	\$599,971	\$1,883	-8%	\$245,379	\$770	-22%



**Figure A.4.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 4.**



## A.5 CASE STUDY 5

Case Study 5 (*Figure A.5.1*) is a parcel with approximately 130.2 acres of commercial forestland located in Lewis County, WA. Most of the stands are mixed conifer with an age range of 5 to 50 years. The oldest timber is in the riparian zones. Site quality is class II, for which the FFR requires a total riparian buffer width of 170 feet on each side of a fish-bearing stream. A fish-bearing stream traverses the property from south to north with two other streams feeding into it. A total of 27% of the property is impacted by riparian buffers under the FFR, with 18% in the core and inner zones (*Table A.5.1*). Economic impacts for Case Study 5 are summarized in *Table A.5.2*, *Figure A.5.2*, and *Figure A.5.3*.

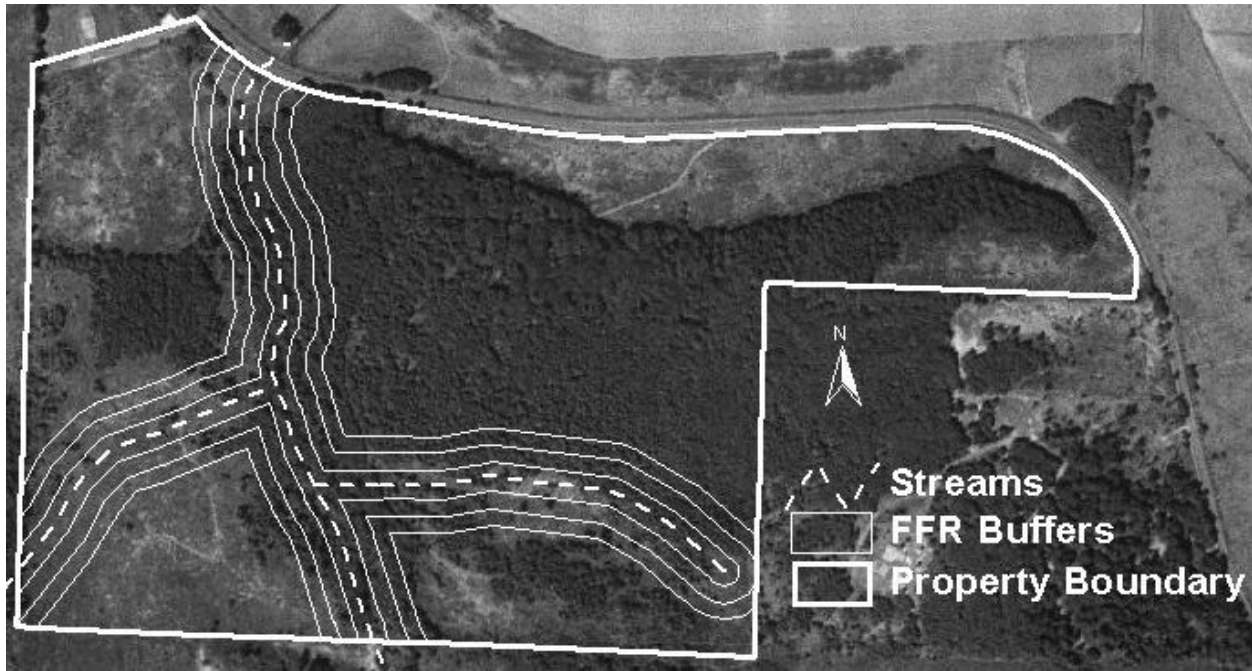


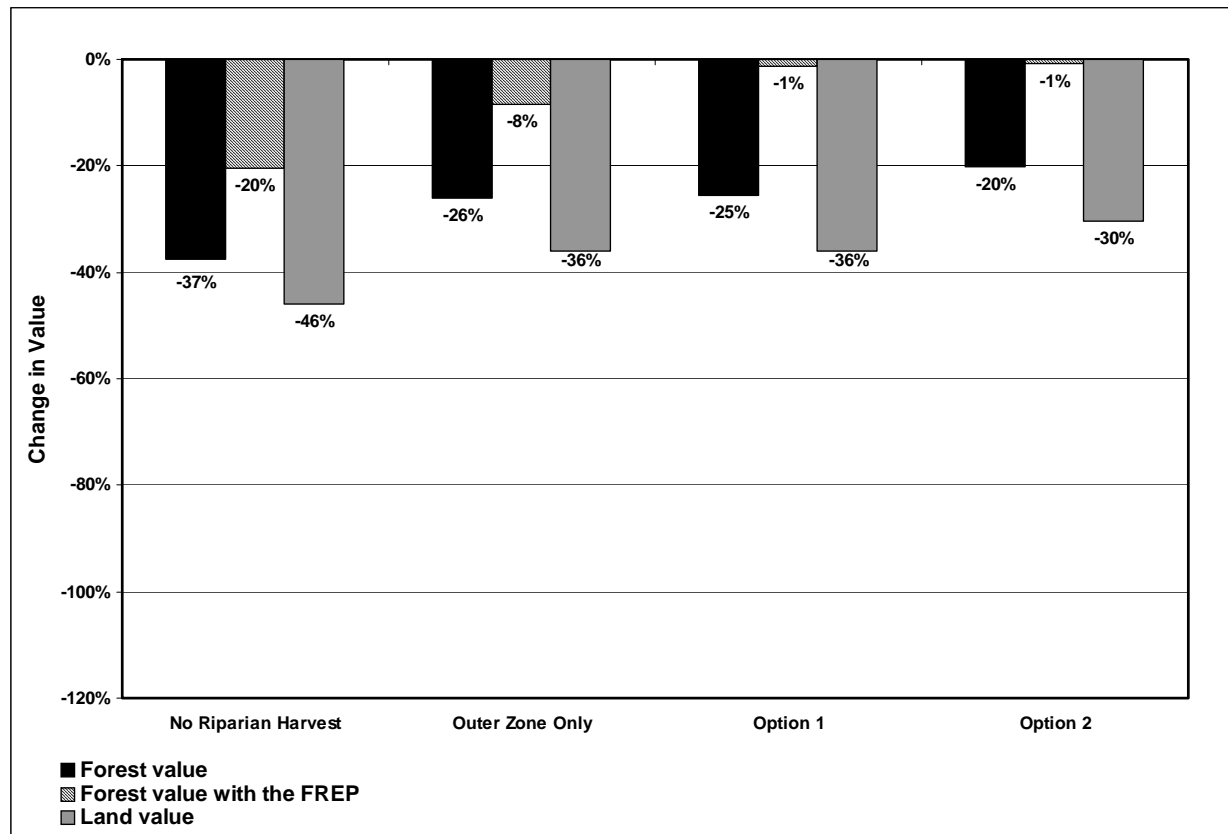
Figure A.5.1. Case Study 5.

Table A.5.1. Case Study 5 acreage.

Location:	Lewis County	
Total acres of commercial forestland:	130.2	
Acres previously in buffers (estimated):	5.4	4%
Acres in buffers under new rules:		
Core	10.9	8%
Inner	13.3	10%
Outer	11.4	9%
Total	35.6	27%

**Table A.5.2. Economic comparison of the previous rules and the FFR management options for Case Study 5.**

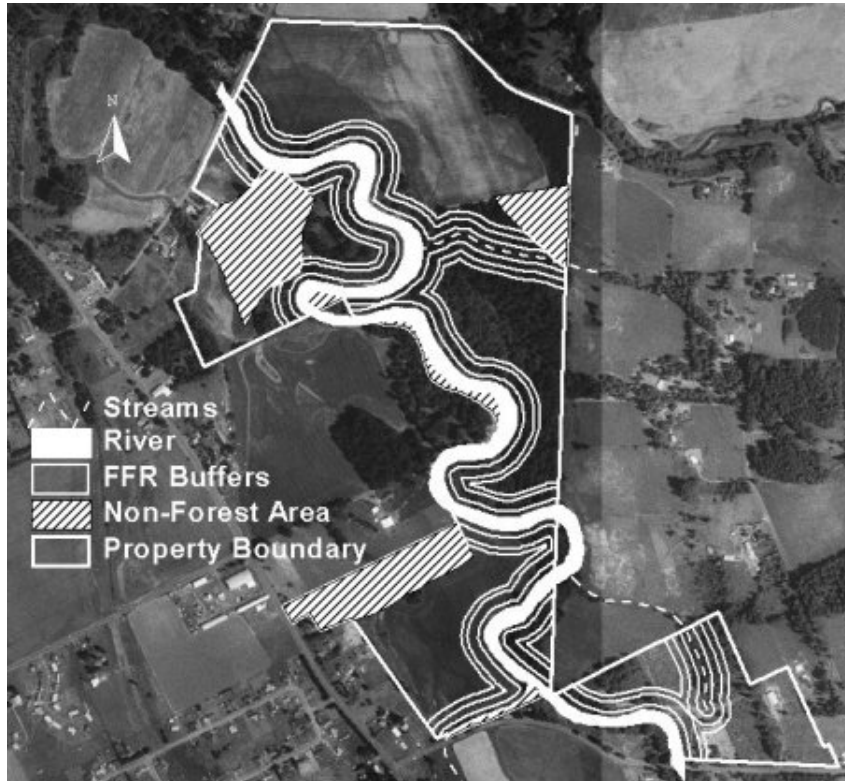
Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$558,851	\$4,292					\$109,374	\$840	
FFR: no riparian harvest	\$349,340	\$2,683	-37%	\$444,622	\$3,415	-20%	\$59,223	\$455	-46%
FFR: outer zone only	\$413,324	\$3,175	-26%	\$511,887	\$3,932	-8%	\$69,946	\$537	-36%
FFR: Option 1	\$416,404	\$3,198	-25%	\$551,346	\$4,235	-1%	\$69,946	\$537	-36%
FFR: Option 2	\$445,569	\$3,422	-20%	\$553,977	\$4,255	-1%	\$76,125	\$585	-30%



**Figure A.5.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 5.**

## A.6 CASE STUDY 6

Case Study 6 (*Figure A.6.1*) is a parcel with approximately 171.4 acres of commercial forestland located in Lewis County, WA. There are a number of different stands on the property, which range in age from 3 to 47 years old. The predominant species is Douglas-fir, with western redcedar and a mix of hardwoods present as well. Site quality is class II, for which the FFR requires a total riparian buffer width of 170 feet on each side of a fish-bearing stream. A large fish-bearing stream with several tributaries winds through the property, which creates a complex patchwork of riparian areas. A total of 37% of the commercial forest acreage is impacted by riparian buffer zones under the FFR, with 28% in core and inner zones (*Table A.6.1*). Economic impacts for Case Study 6 are summarized in *Table A.6.2*, *Figure A.6.2*, and *Figure A.6.3*.



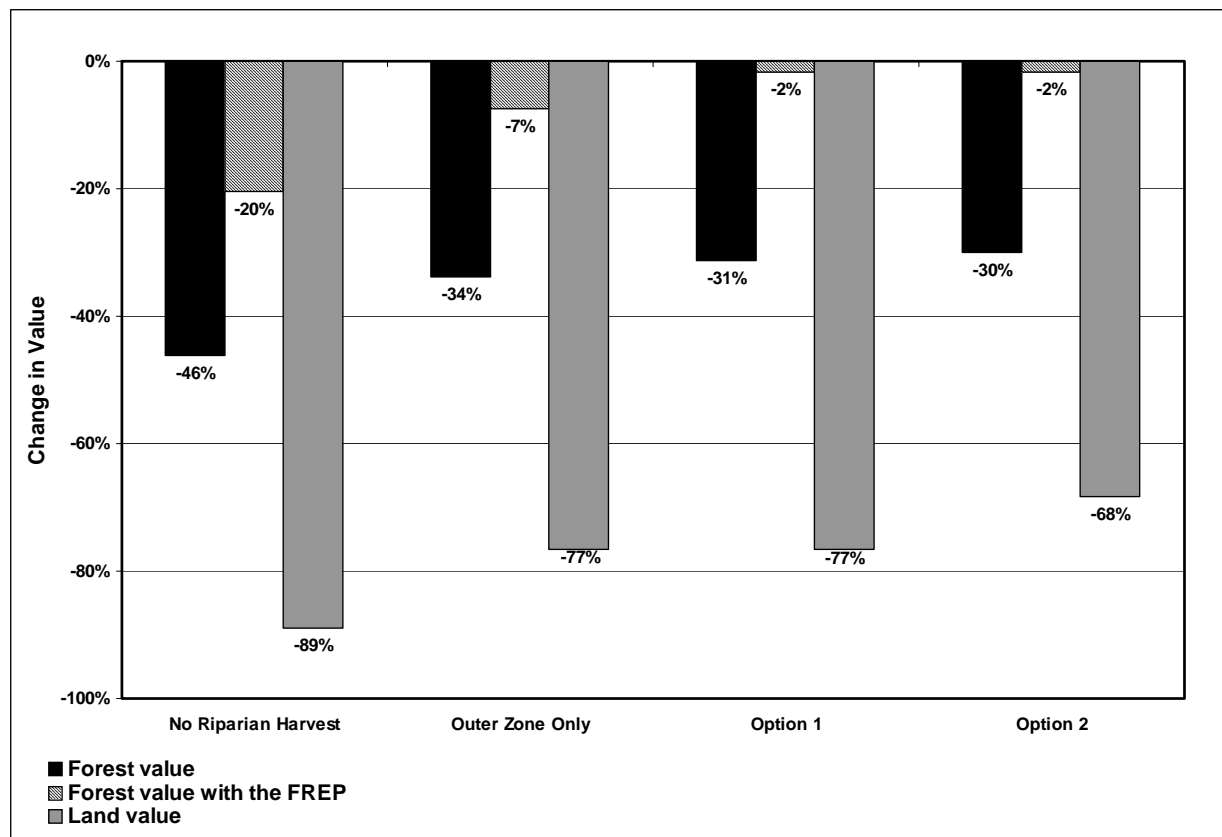
**Figure A.6.1.** Case Study 6.

**Table A.6.1.** Case Study 6 acreage.

Location:		Lewis County	
Total acres of commercial forestland:		171.4	
Acres previously in buffers (estimated):		10.0	6%
Acres in buffers under new rules:			
	Core	20.2	12%
	Inner	28.2	16%
	Outer	15.9	9%
	Total	64.3	37%

**Table A.6.2. Economic comparison of the previous rules and the FFR management options for Case Study 6.**

Scenario	Forest value			Forest value with the FFRP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$934,224	\$5,451					\$97,862	\$571	
FFR: no riparian harvest	\$502,813	\$2,934	-46%	\$744,037	\$4,341	-20%	\$10,756	\$63	-89%
FFR: outer zone only	\$618,087	\$3,606	-34%	\$864,873	\$5,046	-7%	\$22,917	\$134	-77%
FFR: Option 1	\$642,626	\$3,749	-31%	\$918,829	\$5,361	-2%	\$22,917	\$134	-77%
FFR: Option 2	\$654,041	\$3,816	-30%	\$917,510	\$5,353	-2%	\$31,011	\$181	-68%

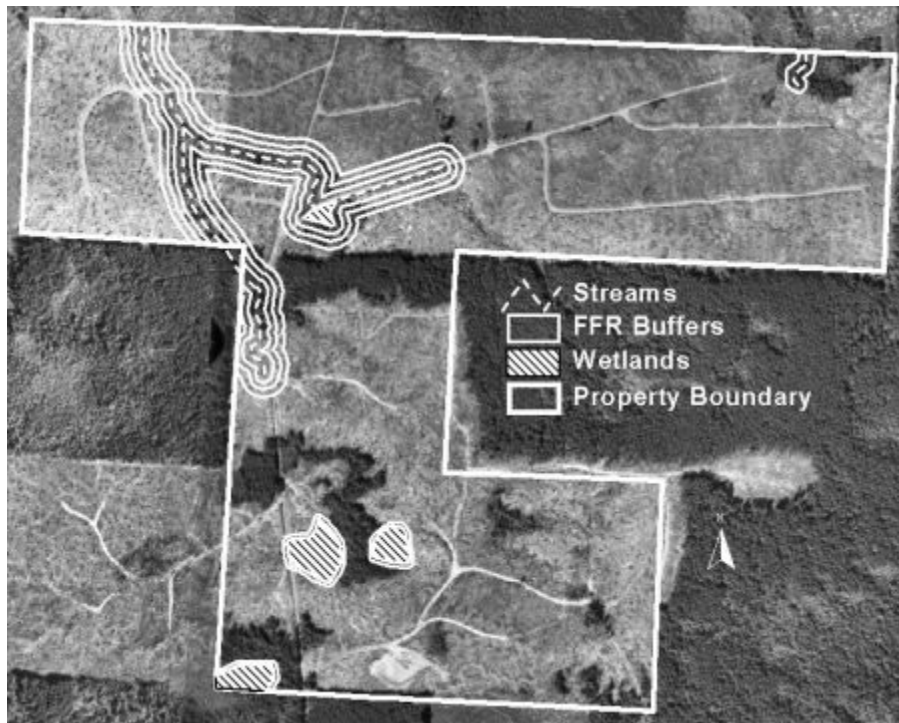


**Figure A.6.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 6.**

## A.7 CASE STUDY 7

Case Study 7 (*Figure A.7.1*) is a parcel with approximately 276.4 acres of commercial forestland located in Grays Harbor County, WA. The majority of the timber is 5-year-old regeneration, with some pockets of 40 to 60-year-old timber. The predominant species are western hemlock and western redcedar. DNR forest practices site class maps classify the property as site class III, for which the FFR requires a total riparian buffer width of 140 feet on each side of a fish-bearing stream. However, landowner observations suggest that some stands are actually closer to site IV. Growth model runs for these stands were based on the landowner observations.

Two fish-bearing streams originate on the property, join together, and flow out to the north. There is a nonfish-bearing stream in the northeast corner that requires a 50-foot buffer and several wetlands that require wetland management zones (WMZ). A total of 11% of the commercial forest acreage is impacted by riparian buffer zones under the FFR (including WMZ areas), with 7% in the core and inner zones (*Table A.7.1*). Economic impacts for Case Study 7 are summarized in *Table A.7.2*, *Figure A.7.2*, and *Figure A.7.3*.



**Figure A.7.1.** Case Study 7.

**Table A.7.1. Case Study 7 acreage.**

<b>Location:</b>		<b>Grays Harbor County</b>	
<b>Total acres of commercial forestland:</b>		276.4	
<b>Acres previously in buffers (estimated):</b>		5.0	2%
<b>Acres in buffers under new rules:</b>			
	<b>Core</b>	10.5	4%
	<b>Inner</b>	8.4	3%
	<b>Outer</b>	8.7	3%
	<b>WMZ (approx.)</b>	1.5	1%
	<b>Total</b>	29.1	11%

**Table A.7.2. Economic comparison of the previous rules and the FFR management options for Case Study 7.**

<b>Scenario</b>	<b>Forest value</b>			<b>Forest value with the FREP</b>			<b>Land value</b>		
	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>
Previous rules	\$100,174	\$362					\$34,792	\$126	
FFR: no riparian harvest	\$64,236	\$232	-36%	\$83,438	\$302	-17%	\$18,221	\$66	-48%
FFR: outer zone only	\$69,243	\$250	-31%	\$90,552	\$328	-10%	\$21,431	\$78	-38%
FFR: Option 1	\$66,655	\$241	-33%	\$91,538	\$331	-9%	\$21,431	\$78	-38%
FFR: Option 2	\$68,411	\$248	-32%	\$95,564	\$346	-5%	\$24,617	\$89	-29%

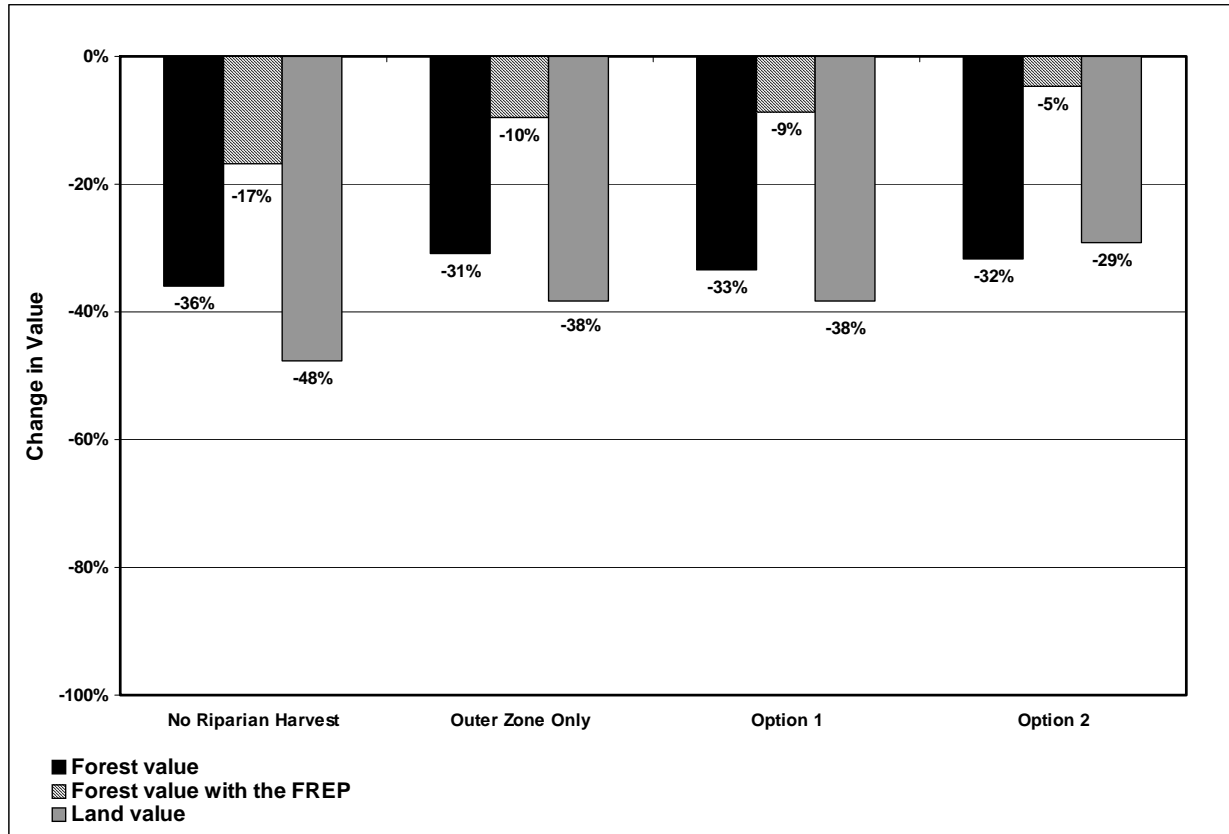


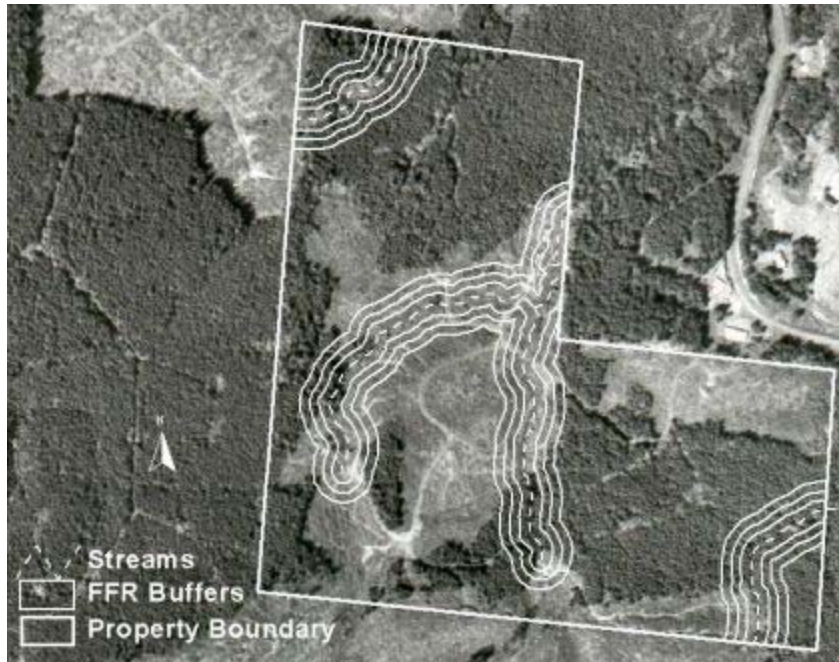
Figure A.7.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 7.





## A.8 CASE STUDY 8

Case Study 8 (*Figure A.8.1*) is a parcel with approximately 122.4 acres of commercial forestland located in Grays Harbor County, WA. About half of the stands are 40 to 45 years old, with the other half being 10-year-old regeneration. The predominant species in the mature stands is western hemlock, with a mix of western hemlock and Douglas-fir in the regeneration stands. DNR forest practices site class maps classify the property as site class III, for which the FFR requires a total riparian buffer width of 140 feet on each side of a fish-bearing stream. However, landowner observations suggest that the property is actually site I. Growth model runs were based on the landowner observations. Several fish-bearing streams run through the property. A total of 25% of the commercial forest acreage is impacted by riparian buffer zones under the FFR, with 17% in core and inner zones (*Table A.8.1*). Economic impacts for Case Study 8 are summarized in *Table A.8.2*, *Figure A.8.2*, and *Figure A.8.3*.



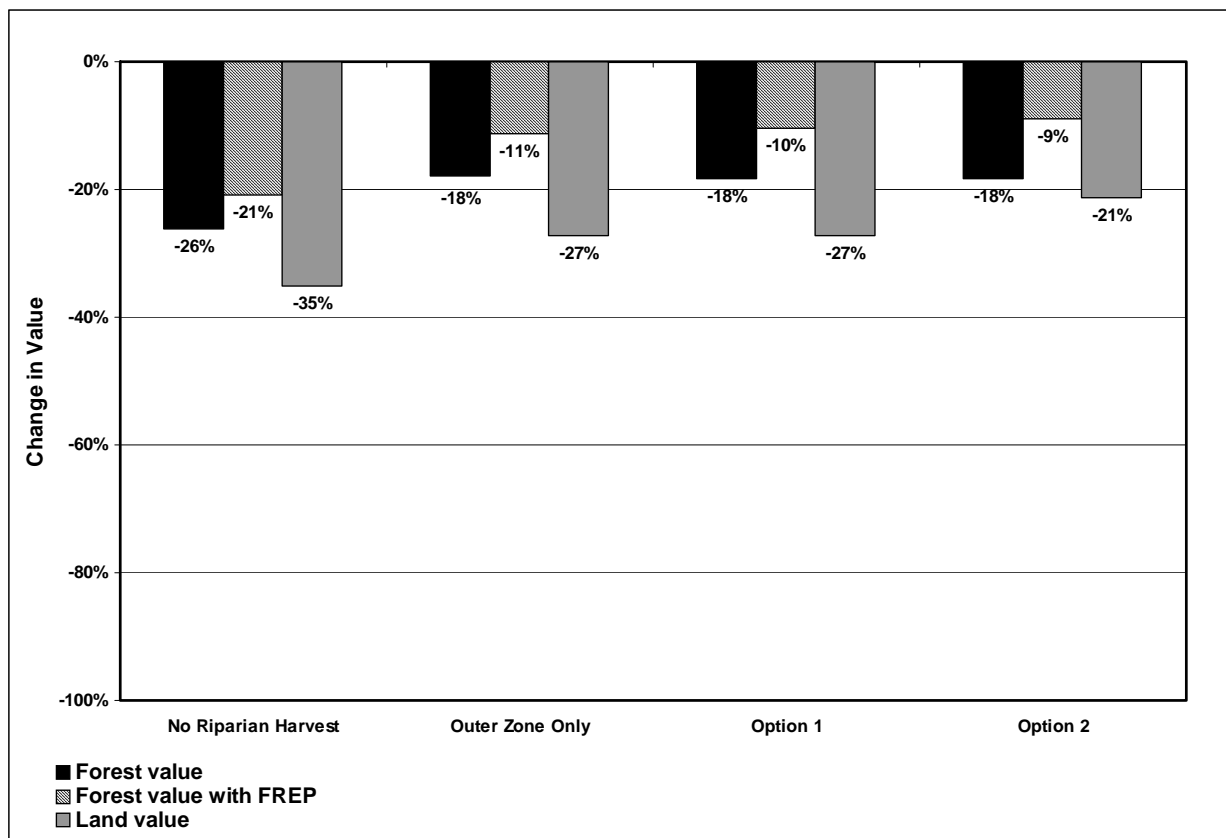
**Figure A.8.1.** Case Study 8.

**Table A.8.1.** Case Study 8 acreage.

Location:		Grays Harbor County	
Total acres of commercial forestland:		122.4	
Acres previously in buffers (estimated):		6.0	5%
Acres in buffers under new rules:			
	Core	11.6	9%
	Inner	9.6	8%
	Outer	10.2	8%
	Total	31.4	25%

**Table A.8.2. Economic comparison of the previous rules and the FFR management options for Case Study 8.**

Scenario	Forest value			Forest value with the FREP			Land value		
	Total	Per Ac	% Change	Total	Per Ac	% Change	Total	Per Ac	% Change
Previous rules	\$315,426	\$2,577					\$147,443	\$1,205	
FFR: no riparian harvest	\$232,548	\$1,900	-26%	\$249,618	\$2,039	-21%	\$95,832	\$783	-35%
FFR: outer zone only	\$259,289	\$2,118	-18%	\$279,990	\$2,288	-11%	\$107,193	\$876	-27%
FFR: Option 1	\$257,502	\$2,104	-18%	\$282,610	\$2,309	-10%	\$107,193	\$876	-27%
FFR: Option 2	\$257,545	\$2,104	-18%	\$287,326	\$2,347	-9%	\$116,007	\$948	-21%

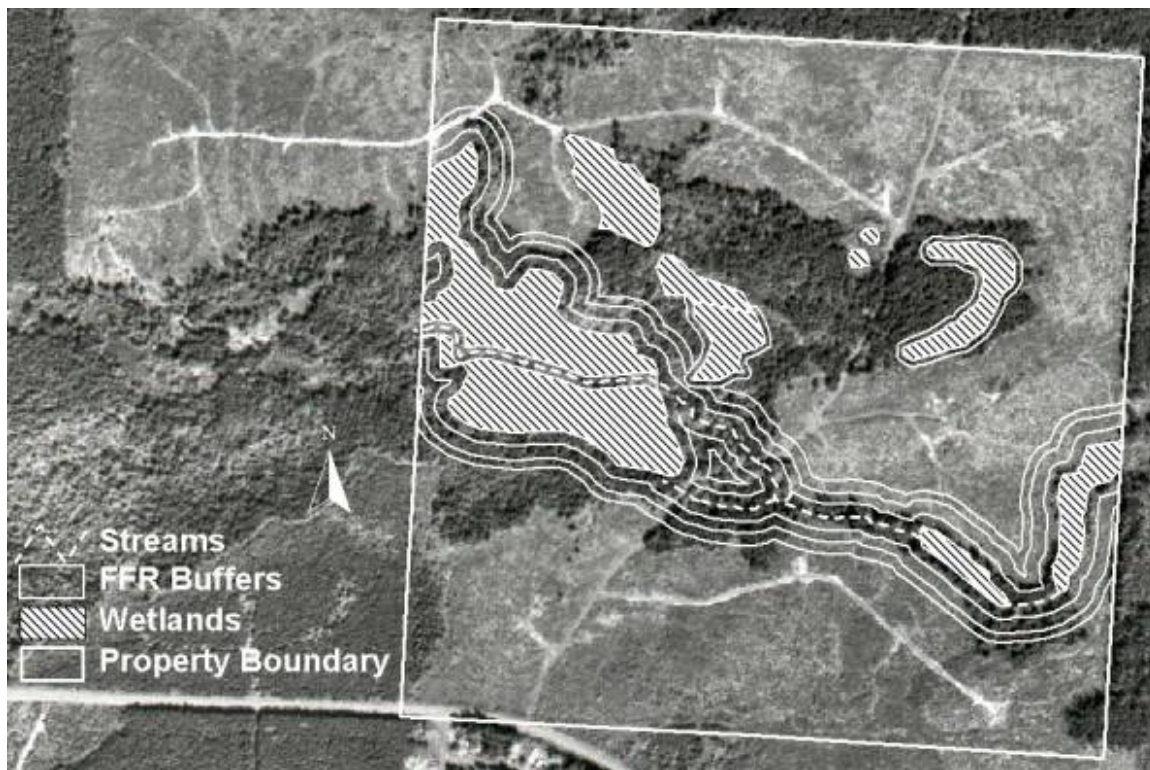


**Figure A.8.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 8.**

## A.9 CASE STUDY 9

Case Study 9 (*Figure A.9.1*) is a parcel with approximately 147.6 acres of commercial forestland located in Grays Harbor County, WA. The majority of the timber is 10-year-old regeneration, with some areas of 45 to 50-year-old timber. The predominant species are western hemlock, Douglas-fir, western redcedar, and Sitka spruce. DNR forest practices site class maps classify the property as site class III, for which the FFR requires a total riparian buffer width of 140 feet on each side of a fish-bearing stream. However, landowner observations suggest that some stands are actually site II. Growth model runs for these stands were based on the landowner observations.

There are several wetlands on the property that are connected by a fish-bearing stream. Under the FFR, this entire system is considered fish habitat and requires full buffers. The wetland portions are considered large streams, while the rest is treated as a small stream. There are also several wetlands that are not part of the system that only require a wetland management zone (WMZ) and two forested wetlands that do not require any buffering. A total of 21% of the commercial forest acreage is impacted by riparian buffer zones under the FFR (including WMZ areas), with 16% in the core and inner zones (*Table A.9.1*). Economic impacts for Case Study 9 are summarized in *Table A.9.2*, *Figure A.9.2*, and *Figure A.9.3*.



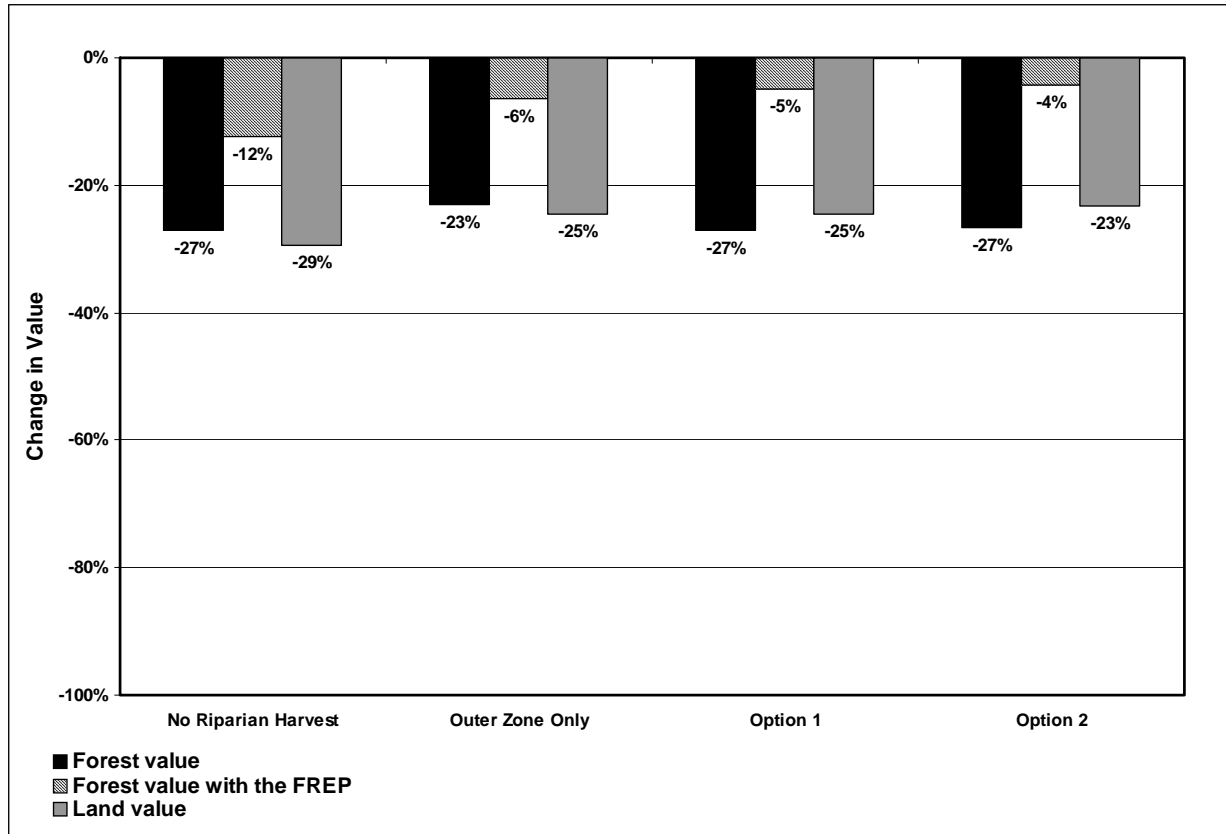
**Figure A.9.1.** Case Study 9.

**Table A.9.1. Case Study 9 acreage.**

<b>Location:</b>	<b>Grays Harbor County</b>	
<b>Total acres of commercial forestland:</b>	147.6	
<b>Acres previously in buffers (estimated):</b>	5.1	3%
<b>Acres in buffers under new rules:</b>		
<b>Core</b>	12.6	9%
<b>Inner</b>	10.1	7%
<b>Outer</b>	6.6	4%
<b>WMZ (approx.)</b>	1.6	1%
<b>Total</b>	30.9	21%

**Table A.9.2. Economic comparison of the previous rules and the FFR management options for Case Study 9.**

<b>Scenario</b>	<b>Forest value</b>			<b>Forest value with the FREP</b>			<b>Land value</b>		
	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>
Previous rules	\$220,796	\$1,496					\$72,254	\$490	
FFR: no riparian harvest	\$161,017	\$1,091	-27%	\$193,371	\$1,310	-12%	\$51,038	\$346	-29%
FFR: outer zone only	\$169,844	\$2,118	-23%	\$206,488	\$1,399	-6%	\$54,510	\$369	-25%
FFR: Option 1	\$161,089	\$1,151	-27%	\$209,852	\$1,422	-5%	\$54,510	\$369	-25%
FFR: Option 2	\$161,775	\$1,096	-27%	\$211,287	\$1,431	-4%	\$55,452	\$376	-23%



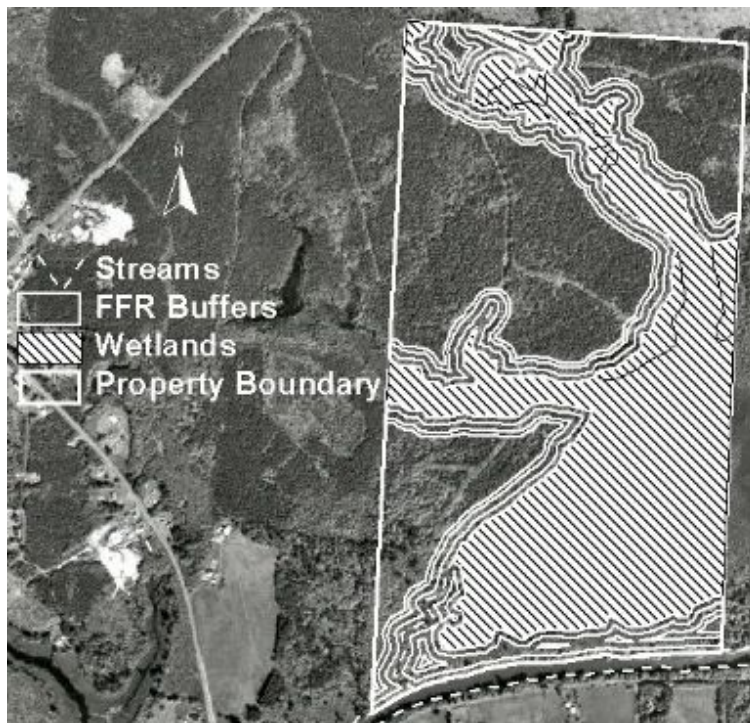
**Figure A.9.2.** Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 9.



## A.10 CASE STUDY 10

Case Study 10 (*Figure A.10.1*) is located along the Humptulips River in Grays Harbor County, WA. A large portion of the site is a wetland, which is surrounded by approximately 163.4 acres of commercial forestland. The predominant species are western hemlock, red alder, and Douglas-fir. Stands range from 25 to 40 years old, except for one 85-year-old alder stand. DNR forest practices site class maps classify the property as site class III, for which the FFR requires a total riparian buffer width of 140 feet on each side of a fish-bearing stream. However, landowner observations suggest that some stands are actually site I. Growth model runs for these stands were based on the landowner observations. A total of 39% of the commercial forest acreage is impacted by riparian buffer zones under the FFR, with 32% in the core and inner zones (*Table A.10.1*). Economic impacts for Case Study 10 are summarized in *Table A.10.2*, *Figure A.10.2*, and *Figure A.10.3*.

Note that because the property is site class III and both the wetland and the Humptulips River qualify as large streams, Option 2 is not applicable.



**Figure A.10.1.** Case Study 10.

**Table A.10.1. Case Study 10 acreage.**

<b>Location:</b>		<b>Grays Harbor County</b>	
<b>Total acres of commercial forestland:</b>		163.4	
<b>Acres previously in buffers (estimated):</b>		14.3	9%
<b>Acres in buffers under new rules:</b>			
	<b>Core</b>	26.7	16%
	<b>Inner</b>	25.4	16%
	<b>Outer</b>	12.1	7%
	<b>Total</b>	64.2	39%

**Table A.10.2. Economic comparison of the previous rules and the FFR management options for Case Study 10.**

<b>Scenario</b>	<b>Forest value</b>			<b>Forest value with the FREP</b>			<b>Land value</b>		
	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>	<b>Total</b>	<b>Per Ac</b>	<b>% Change</b>
Previous rules	\$556,503	\$3,379					\$145,600	\$884	
FFR: no riparian harvest	\$312,505	\$1,897	-44%	\$462,479	\$2,808	-17%	\$68,736	\$417	-53%
FFR: outer zone only	\$356,195	\$2,163	-36%	\$513,596	\$3,118	-8%	\$80,876	\$491	-44%
FFR: Option 1	\$359,324	\$2,182	-35%	\$539,005	\$3,273	-3%	\$80,876	\$491	-44%



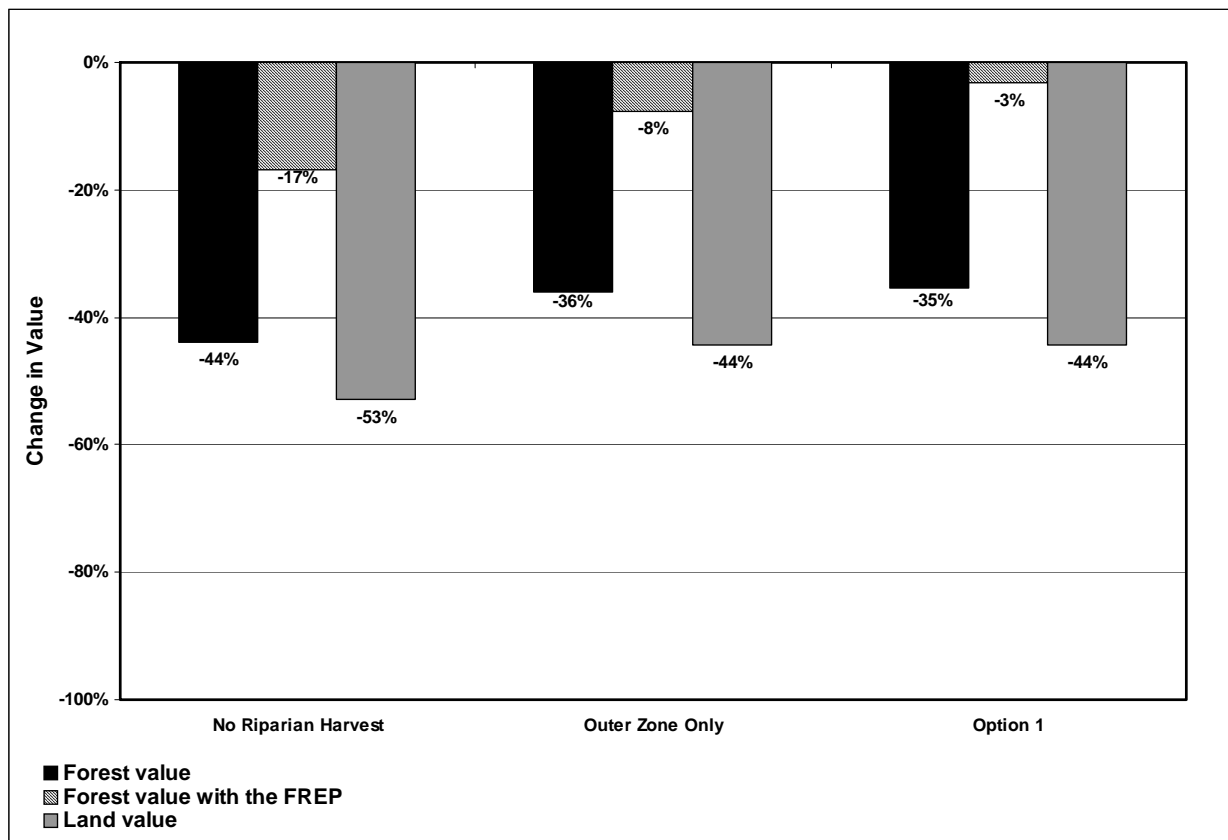


Figure A.10.2. Percent change (relative to the previous rules) in forest value and land value under the FFR options for Case Study 10.