Training Environmental Stewards from Mountains to Ocean

Module 2

Forests and Water Resources
Module 2: Forests and Water Resources

Learning Objectives:
1. Students will understand how forest cover impacts water quantity within a watershed.
2. Students will understand how upland forest cover maintains downstream water quality.
3. Students will understand how forestry practices can affect water quality.
4. Students will learn about forest management techniques that minimize water quality impacts.

Presentation Outline

Presentation Slides and Speaker Notes (45 min)

Classroom Activities
- Activity 1 (30-45 min): Financial Impact of Riparian Buffers

Homework Assignments
- Activity 1 (1-2 hrs independent study + 30 min class time):
  Understanding the Roadless Area Issue

Optional Activities:
- Activity 1: Visit the property of a landowner that has a written forest management plan that addresses water resources.
- Activity 2: Guest lecture on non-timber forest products.

Resource List

Additional Reading
- Riparian Areas: Fish and Wildlife Havens
- Wildland Waters Summer 2004 issue

Participant Evaluation (10 min)
2 Forests and Water Resources
2 Forests and Water Resources

Presentation Outline

1) Introduction: presentation components
   a) Hydrology overview
   b) How forests affect water quantity and quality
   c) Riparian zone function and management
   d) Management to protect water resources
   e) Enhancing riparian function in urban/suburban areas

2) Hydrology overview
   a) Definition of a watershed including discussion of various scales if time allows:
      basin, sub basin, stream reach, etc.
   b) Hydrologic cycle
      i) Precipitation
      ii) Interception/direct evaporation from canopy
      iii) Evapotranspiration
      iv) Percolation/Infiltration
   v) Groundwater input and outflow (upwelling)
   vi) Surface runoff/overland flow
   vii) Hydrology within a forest, and fate of precipitation: low amounts of overland
        flow, high amounts of infiltration/percolation and evapotranspiration

3) How forests influence water quantity within a watershed
   a) Water movement within a forest affects the amount of water entering surface
      water bodies over time
      i) Canopy intercepts precipitation, slowing it down
      ii) Water evaporates from canopy without reaching ground
      iii) Trees remove water from soil and transpire through leaves
         (1) Explain cohesion-tension (how water moves through a tree)
         (2) Hydraulic redistribution - water taken up by deep roots from deep soil
            during day, and at night released back into shallow soil by surface roots –
            drought adaptation mechanism
         (3) How drought can snap the water column and cause top dieback
      iv) Water percolates slowly through forest soils which act like a sponge
   b) After a heavy rain, water falling in forest reaches surface water bodies more
      slowly over time, important for flood control
      i) Compare fate of precipitation in forests, suburban areas and cities
      ii) Compare soil structure in forests, to developed areas
      iii) Discuss how costly it is to replace lost forest land with surface water retention
           systems
   c) Discuss hydrologic implications of the loss of forest land to development

4) How forests affect water quality within a watershed
   a) Filter for nutrients and sediment
   b) Shade
   c) Large woody debris
   d) Stream channel stabilization (reduces sedimentation)
   e) All of the above contribute to healthy fish habitat

5) Riparian zones
   a) Definition
2 Forests and Water Resources

b) Concept of the zone of influence

c) Functions
i) Shade
ii) Filtration
iii) Contribute nutrients to water
iv) Stream bank stabilization
v) LWD recruitment
vi) Excess sediment management
vii) Wildlife habitat: nesting/roosting structures, water source

6) Impacts of forest management activities on water resources

a) Roads
i) Biggest source of sediment in streams (90%)
ii) Surfaced roads are more expensive but produce less sediment
iii) Improperly sized culverts

b) Harvesting
i) Soil compaction from heavy equipment
ii) Removal of vegetation (trees)

7) Forestry Best Management Practices to maintain water quality

a) Riparian buffers
i) Required by law, standards set in Forest Practices Act
   (1) Core, inner and outer zones have differing permissible activities
   (2) Size of buffer depends on water typing: discuss water typing classifications

b) Retention of conifers near stream: persist longer as woody debris than hardwoods
i) Hardwoods provide important biological functions

c) Proper road design and maintenance
i) Plan new road locations carefully
ii) Minimize number of skid trails (trails used for taking logs out of the woods to a landing)
iii) Avoid wet areas and difficult stream crossings
iv) Avoid skidding directly up or down steep slopes
v) Appropriately sized culverts
vi) Re-vegetate unused roads and trails
vii) Use water bars and rolling dips
viii) Clear culverts

d) Low impact harvesting techniques
i) Horse logging
ii) Tracked skidder
iii) Wheeled arch
iv) Partial/selective harvest

e) Sources of assistance for small forest landowners

8) Restoring forested riparian function in urban environments

a) Reasons to restore: improve habitat and connectivity, flood control, shade streams, aesthetics, stabilize banks, education
b) Steps in making a restoration project work
c) Local organizations that are involved in riparian restoration
Forests and Water Resources

Developed by Amy Grotta, MS
WSU King County Extension
2 Forests and Water Resources

Forests and Water Resources

- Hydrology overview
- How forests affect water quantity and quality
- Riparian zone function and management
- Management to protect water resources
- Enhancing riparian function in urban/suburban areas

Speaker Notes:
Bulleted items are the topics to be covered in this presentation.
NOTE: Those who have presented Module 1: Watersheds, the Water Cycle and You module can skip this slide.

Speaker Notes:

A watershed is an area of land that drains all precipitation and runoff to a common body of water (i.e. lake, ocean, or river). The scale by which watersheds are defined can vary. For example:

• Basin scale: Skagit River Valley, Cedar River watershed, Columbia River basin
• Sub-basin: Issaquah Creek; North Fork Snoqualmie
• Stream reach: the area that feeds a small stream, which in turn feeds a larger water body, i.e. “third unnamed tributary to Tibbets Creek”

Ask the audience if they all know which watershed they live in. Have a map on hand that shows watershed boundaries, or a relief map so they can physically feel watershed boundaries.

References:

NOTE: Those who have presented the *Watersheds, the Water Cycle and You* module can skip this slide.

**Speaker Notes:**

Explain each of the labeled processes (See slides 9-13 of the Module I presentation for details)

Water enters streams thru overland flow (runoff) or groundwater discharge (upwelling). Runoff is more variable (in quantity and quality) through time, whereas groundwater upwelling is constant year round. It is also colder and cleaner –important for fish.

**References:**

2 Forests and Water Resources

Speaker Notes:
Note the insert of a soil “close-up”: the macro- and micro-invertebrates create the pores and passageways which allow water to infiltrate readily.

• Of the 15% runoff, about 14% enters the organic layer of the soil where it is filtered and nutrients are added; it then becomes interflow that enters surface water bodies. Only 1% actually flows on the surface.
Forests influence water QUANTITY through:

• **Interception**: trees capture falling water, which slows water’s path from air to soil

• **Evaporation**: of water that falls on the canopy

• **Evapotranspiration**: trees take up water through their roots and release it through stomata (pores) in leaves

• **Infiltration**: surface water is slowed by the forest floor layer of duff

**Speaker Notes:**

- **Overland flow** is generally minimal under a forest canopy. Water passes through the canopy and runs down the trunks picking up nutrients on the way. When the water reaches the forest floor it is altered in chemical composition.

- The canopy can cause condensation from clouds and result in **fog drip**.
Water droplets caught by conifer needles

Speaker Notes:
A lot of water can be held in the canopy of an evergreen tree. In winter, when it rains most in our region, evergreen forests are full of foliage that intercepts the rainfall and slows its path.
Water transport

- **Evapotranspiration**: driven by moisture gradient (soil → air)
- Trees can “lift” and redistribute soil water
- Drought can cause the water column to break

**Speaker Notes:**

- **Evapotranspiration**: Water is transported up the stem in the outer rings of xylem tissue (sapwood). Wood contains lots of vertically aligned tubes designed for water transport. Stomata, or tiny pores in leaves, let water vapor escape.

- How does water move upward against the force of gravity? Because water molecules chemically adhere to one another, water forms a continuous column from root to stem to leaf. Thus, when water moves out of the leaves and into the dry air, it is replaced by what’s in the sapwood, which then pulls water from the roots, and finally from soil.

- Some plants can redistribute water from deep soil layers to shallower soils where it is more accessible to the roots. Deep roots intake water during the day, and at night when air humidity increases, water is released by surface roots. This is an important drought adaptation.

- In a prolonged drought, soil becomes quite dry, the moisture gradient that causes water to move up a tree is weakened, and the water column is broken. The tubes in sapwood become filled with air instead of water, which can cause all foliage above the breaking point to die because the water in their tissues is not replaced. This is more common on disturbed sites, i.e. along highways.

**References:**

An acre of Douglas-fir forest might take up 800 gallons of water on a sunny day during the growing season.

References:
Slide Information source: J-C Domec, Oregon State University, personal communication.
2 Forests and Water Resources

**Speaker Notes:**

This diagram shows the reason that forests are important for flood control. More *percolation* to groundwater means longer time delay before the water reaches the stream.
2 Forests and Water Resources

Speaker Notes:
This diagram shows the vast difference between the pathways water takes in forests and developed areas.
2 Forests and Water Resources

Speaker Notes:
Remind students of runoff differences between developed vs. vegetated areas. Highlight the following:

- **Runoff volume**
- **Peak flow**
  - Urban: peaks quickly with higher peak volume
  - Rural: less rapid peak, more even flow across time
- **Filtration**
  - Urban runoff is fast and dirty.
  - Rural/vegetated stormwater slowly percolates and is cleaned as it filters through soil.
Without forests, surface water accumulates in unwanted places

Speaker Notes:
Retaining tree cover is the most efficient way to manage surface water.
2 Forests and Water Resources

Hydrology in a suburban environment

Graphic reproduced from King County Department of Natural Resources and Parks

Speaker Notes:
Surface water retention systems capable of replacing converted forestland would cost $2.4 billion

• Note difference in “microscopic” view compared to intact forest environment (slide #4)

• Scientists and engineers are finding that even with the best technology available they are not able to reproduce a “normal” hydrology on developed sites.

• Based on loss of forest cover during a 24-year period (1972 - 1996) stormwater flow during a peak storm in the Puget Sound area has increased by an estimated 1.2 billion cubic feet (29%). Replacing this lost stormwater retention capacity with reservoirs and other engineered systems would cost $2.4 billion.

References:
Information source: American Forests Regional Ecosystem Analysis of the Puget Metropolitan Area, 1998. Available at:
2 Forests and Water Resources

Forest Conversion Over Time in Maple Valley, Washington

NOTE: This slide can be replaced with locally relevant examples.

Speaker Notes:
Each aerial photo covers about 1000 acres.
2 Forests and Water Resources

![Graph](image)

**NOTE:** This slide can be replaced with locally relevant examples.

**Speaker Notes:**
Changes in hydrology due to land clearing were observed at least 100 years ago. This graph shows the close correlation between lost forest cover and flood peak. Each point is a sub-basin in the Cedar River Watershed, King County.
Forests affect water QUALITY by:

• Filtering nutrients and sediment
• Providing shade, which keeps water temperatures cool
• Providing large woody debris (LWD) in streams, which reduces excess sediment flow downstream
• Stabilizing soils and stream channels, which reduces excess sediment flow downstream

Speaker Notes:
• Filtering sediments and nutrients: Possible due to slowed water movement.
• Temperature: Warm water may reduce the probability of fish and amphibian eggs hatching successfully.
• LWD: It was once believed that it was better to get LWD out of the water, because it would make it easier for the fish to swim upstream! Now we know that isn't true. LWD creates pools where water slows, which are important resting places for young fish and for older fish moving upstream to spawn.
• Stabilizing soils and stream channels: Trees along the stream banks stabilize soils through their root systems. This is particularly important in our region which is characterized by steep stream channels with high erosion potential.
Forests help provide habitat for fish

Speaker Notes:
What occurs upslope from a stream has a strong influence on in-stream conditions.

References:
Photo courtesy of Dave Powell, USDA Forest Service, www.forestryimages.org
Streams in forests support more coho than in rural, urban or farming areas

**Speaker Notes:**
A study by the National Marine Fisheries Service indicates that forestry as practiced today supports 1.5 to 3.5 times more coho than rural, residential or farming land.

**References:**
2 Forests and Water Resources

Speaker Notes:

Riparian zone: area along a stream or river that influences and/or is influenced by the water body

- The riparian zone of influence varies in size depending on the process affected (see bars in upper portion of diagram).

References:
Graphic reproduced from Colorado Riparian Association,
2 Forests and Water Resources

Riparian zone functions

• Contribute shade
• Filter out water soluble pollutants
• Contribute nutrients as food source for insects
• Stabilize stream banks
• Contribute large woody debris (LWD)
• Control excess sediment
• Support diverse wildlife

Speaker Notes:
• Movement of some sediment into streams is a natural process (there’s always some bank cutting/deposition naturally occurring), but a properly functioning riparian zone should prevent excess sediment deposition.
• Importance to wildlife includes: water source, nesting/roosting structure for birds
Forest Management Impacts

Road building:
• Poorly designed or maintained roads are the primary source of excess sediments produced from forest land.

Speaker Notes:
Although forests inherently protect water quality when compared to other land uses, forest management practices impact water quality when compared to undisturbed forest.
• (Left photo) Roads are the biggest source of sedimentation (90%).
  • Improperly sized culverts under roads can block flood flow and impede fish passage.
• (Right photo) Large harvests will release water to surface and subsurface flow and, in sensitive areas, could produce landslides because steep slopes become saturated due to reduction in transpiration, making them more prone to slumping.
Forest Management Impacts

Harvesting:

• Heavy equipment causes compaction and exposes mineral soil

• Removal of vegetation temporarily affects water cycle (less interception, evapotranspiration, infiltration)

Speaker Notes:

• Photo shows the organic soil layer (top several inches), which is often disturbed/removed during harvest, exposing mineral soil. The organic layer absorbs water and protects mineral soil from raindrop impact.

• Removal of vegetation temporarily reduces canopy interception and evapotranspiration, increases raindrop impact, decreases infiltration into bare soil, and increases potential for overland flow and soil erosion.
Good forestry practices can maintain water quality

• Retaining conifers near streams
• Riparian buffer strips
• Proper road design and maintenance
• Low impact harvesting equipment

Speaker Notes:
The next several slides address each of these points in more detail.
Retaining conifers ensures a long-term supply of Large Woody Debris

- Conifers provide physical habitat for fish

Speaker Notes:
Red alder, maple, and cottonwood decompose much faster than conifers so don’t persist as LWD.
- Example: a 1-foot diameter Douglas-fir lasts about 18 yrs as coarse woody debris. Red alder wood can decay significantly in as little as 3 years.

Additional Information:
For more detail on Red alder wood decay, see: Wipfli et al. (2002). Managing young upland forests in southeast Alaska for wood products, wildlife, aquatic resources, and fishes: problem analysis and study plan. USDA Forest Service PNW-GTR-558.

References:
Riparian hardwoods provide biological support to streams

• Red alder leaf litter is rich in nitrogen

• Stream macroinvertebrates increase in alder-rich watersheds

Photo courtesy of Andrew Bluhm, Oregon State University

Speaker Notes:
Nutrients from alder leaf litter can fall directly into the stream, or percolate through groundwater and then enter the stream. Increased sunlight penetration through a deciduous canopy increases stream algae, which in turn is a food source for macro-invertebrates, which then are a food source for fish.

References:
Information source: Mark Wipfli, University of Alaska, personal communication.
Buffers help maintain integrity of riparian zones and provide habitat connectivity

Speaker Notes:
By leaving a buffer area of undisturbed forest on either side of a stream during harvest activities, the riparian zone is protected. The buffer area shown inside the oval consists of mature trees while the surrounding forest is younger. Riparian buffers are required by state law.
Speaker Notes:

The Washington Dept. of Natural Resources administers Forest Practice Rules, which regulate what types of practices are allowed in riparian buffer areas.

- **BFW** = Bankfull width, refers to the width of the stream from the top of one bank to the top of the other; in other words the width of the stream during peak flow but without flooding.

- **CMZ** = channel migration zone, or the outside boundaries of all the potential channel meanders for a given stream reach. The core zone is measured from the outside edge of the BFW or CMZ.
  - **Core zone**: generally no harvest activity is permitted.
  - **Inner zone**: partial harvest may be permitted.
  - **Outer zone**: harvest allowed with riparian “leave” trees. (A “leave” tree is a tree not harvested for ecological reasons.)

The width of the different zones varies with the size of the stream, the size of the parcel, and the region of the state (buffers are wider in W. Washington). The water typing system (next slide) is used to categorize streams according to these criteria.
Water Typing

- **S** = Shorelines
- **F** = Fish-Bearing
  - > 2 ft bankfull width and < 16% slope
- **Np** = Non-fish perennial
- **Ns** = Non-fish seasonal

**Speaker Notes:**

This is the Washington State water typing system, which is used to determine the width of the riparian buffer that is required along a particular stream. This new system took effect in 2005. Type S waters have the widest buffers, while Ns waters have minimal buffers.

- **S** = major rivers and lakes (examples: Lake Washington, Snoqualmie River, Skagit River)
- **F** = most streams fall into this category
  - Note that all streams meeting the physical criteria under “F” are assumed to be fish-bearing, even if fish presence has not been documented. Type F streams do not have to have water in them year-round.
- **Np** = stream runs year-round, but does not support fish
- **Ns** = stream runs only part of the year, and does not support fish
Plan roads and skid trails carefully

- Seek a consultant or engineer’s assistance
- Minimize number of skid trails
- Avoid wet areas
- Choose stream crossings with care
- Avoid skidding logs on steep slopes
- Use appropriately sized culverts

Photo courtesy of Roger Ramsdell, Washington DNR
2 Forests and Water Resources

Maintain existing roads

• Re-vegetate unused roads and trails

• Use water bars and rolling dips

• Clear culverts

Photos courtesy of Roger Ramsdell, Washington DNR

Speaker Notes:

Water bar: a small trench that crosses a road at an angle allowing water to enter the trench and run off the road rather than down it.

Rolling dip: similar to a water bar, only wider and shallower.
Choose your harvesting equipment carefully

...and harvest during dry periods

Speaker Notes:

- **Horse logging** (bottom left): very little soil disturbance, but time consuming. Best for single tree logging.

- **Tracked skidder** (top left): can cause less damage to wet soils than a rubber tired skidder (top right) because the ground pressure is distributed over a larger surface area.

- For transporting single logs, an **arch** (bottom right) keeps the log off the ground entirely.

- For large operations, a cable or high lead system keeps the logs off the ground. This is expensive and is restricted mainly to industrial forestry.

Additional Information:

For more information see WSU Extension publication, *A Primer for Timber Harvesting* (EB 1316)

References:

Photo courtesy of Doug Page, USDA Forest Service, www.forestryimages.org
2 Forests and Water Resources

Get help

• DNR Small Forest Landowner Office
  (www.dnr.wa.gov/sflo)

• Riparian Easement Program
  (>20 acres)

• Family Forest Fish Passage Program (culvert repair)

Speaker Notes:
The Small Forest Landowner Office of the Washington DNR administers both programs listed here.
Even though urban development has compromised much of the hydrologic function of our region’s forests, stewardship of creeks and streams in these areas can ensure that some of their function is restored. Greenbelts and forest buffers along waterways can, at the very least, keep some habitat functions in place. But, this will rest on the will of motivated community members that want to see healthy waterways in their backyards.

Whereas in forested areas we must focus on maintaining riparian function, in urban areas the focus is shifted to restoring it.
Restoring riparian function to developed areas can:

- Improve habitat and connectivity
- Provide flood control
- Create shade
- Improve aesthetics
- Stabilize streambanks
- Provide learning opportunities

Speaker Notes:
Restoring riparian zones in urban areas can enhance some of the same qualities that riparian areas in natural forests provide. Also, a key feature of restored riparian areas in urban landscapes is improved aesthetics.
2 Forests and Water Resources

What is restoration?

• Set goals
• Prioritize objectives
• Find partners
• Find money and people
• Make a plan
• Remove invasive weeds
• Plant native trees and shrubs
• Water
• Monitor and maintain

Speaker Notes:
Riparian restoration is a skill. It is much more involved than simply planting a few trees. However, a motivated group can achieve great success. The steps shown here are usually the path that needs to be taken.
Local organizations involved in restoration

• King Conservation District
• King County Dept. of Natural Resources and Parks
• Mid-Sound Fisheries Enhancement Group
• EarthCorps
• Mountains to Sound Greenway
• Lots of neighborhood organizations!

NOTE: Slide text can be replaced with appropriate local information.

Speaker Notes:
There are many public and private entities involved in restoration in the Puget Sound region. There are many opportunities for volunteers to get involved!
2 Woods and Water Resources

Questions?
2  Forests and Water Resources

Forests and Water Resources

Classroom Activities
Pages 39 – 46
2 Forests and Water Resources
Activity 1: Financial Impact of Riparian Buffers

Objective: Students will explore issues relating to environmental restrictions in riparian buffer areas.

Directions: Students examine accompanying maps showing riparian buffer areas along a stream in a hypothetical area of western Washington. Given data below, students calculate the percentage of forestland that is within riparian buffers, and therefore not harvestable, for both the large property (all 640 acres) and the small property (40 acres in southeast corner). Students then discuss some of the questions following the activity.

NOTE: If you are not in King County, you may choose to substitute local area maps and information to conduct this activity.

The map and photo you are looking at represent 640 acres of forestland in eastern King County, Washington. Lennox Creek, a type F stream, runs through the property along with several perennial and seasonal tributaries (type Np and Ns streams, respectively). Depicted on the map are riparian management zones as mandated by the Forest Practices Act of Washington. No harvest is allowed in the “core zone”. According to the Act, very limited harvest is allowed in the “inner zone”. For the purposes of this activity, no harvest is allowed here as well. Some harvesting is allowed in the “outer zone” as long as a minimum number of trees per acre are left standing. The core zone extends 50 feet from either side of the stream bank, the inner zone extends 78 feet on either side beyond the core zone, and the outer zone extends an additional 42 feet.

On the 640-acre property, 1,172,100 ft\(^2\), or approximately 27 acres, are within the bounds of the core and inner zones.

- What is the total percentage of land area on this property that is not harvestable based on Forest Practice Regulations? ______%.

Now, let’s look at a hypothetical 40-acre property that is located at the southeast corner of the section. It is called “Bob’s 40”. Note that Lennox Creek and one of its tributaries run through the property. On this 40 acres, 456,996 ft\(^2\), or about 10.5 acres, are within the boundaries of the core and inner zones.

- What is the total percentage of Bob’s 40 acres that is not harvestable according to Forest Practice Regulations? ______%.

Discussion questions:

- In the case of the larger landowner, revenue cannot be generated from timber on a relatively small portion of the property due to riparian areas. Do you think this constitutes a “taking” that should be reimbursed by the government? What about when more than 25% of the land is not harvestable? Why or why not?
2  Forests and Water Resources

- If Bob were concerned about generating revenue from his property, are there other avenues that you could think of besides cutting timber?

- Some policy makers argue that environmental restrictions on private property owners that reduce the profitability of forestry will lead to more development and loss of forestland. If so, how would regional water quality be impacted? What can be done about this?
Forests and Water Resources

Homework Assignments
Pages 47 – 54
2 Forest and Water Resources
Homework Assignment: Understanding the Roadless Area Issue

Objective: Students will explore and debate the issue of roadless area protections.

Directions: Students read two opposing viewpoints on proposed roadless area protection on National Forests (provided). Students identify the proposed roadless area closest to their region and spend some time outside of class researching it. Students then take part in a discussion.

Discussion Questions:
- What arguments are made for, and against, protecting roadless areas by various stakeholders? Are the arguments valid?
- What should be the fate of the “local” proposed roadless area and who should decide?
- How might regional water quality/quantity be impacted as a result of changes in roadless area policy?

Resources for researching Roadless Areas:

US Forest Service Roadless Area Information Home Page:
http://roadless.fs.fed.us/

TerraServer USA Photos and Maps:
http://terraserver-usa.com/geographic.aspx

Here you can access aerial photos and topographic maps, but you need to know latitude and longitude of the place you are searching. This information is available from GPS and many software programs or websites. A helpful one from USGS is:
http://geonames.usgs.gov/pls/gnis/web_query.gnis_web_query_form
American Forest and Paper Association Policy Statement on Roadless Areas

1. Inventoried Roadless Areas
AF&PA filed suit to stop the implementation of the Forest Service's January 2001 roadless rule. The rule, along with a suite of other regulations, represented an attempt to abandon active management of the National Forest System and leave the health of public forests to chance. HR 4865 proposes to enact this seriously flawed rule. AF&PA strongly opposes this legislation and any effort to attach it to appropriations bills or other "must pass" legislation.
AF&PA opposed the rule on the following grounds, and continues to oppose efforts to enact the rule through legislation:

2. The roadless rule contains conflicting and flawed designation of "roadless areas."
Not all designated roadless areas are truly roadless or pristine. A survey of just 17 affected national forests found roads, power lines, Federal Aviation Administration radar and tower sites, water and gas pipelines, campgrounds, mines, reservoirs, and a radio tower within "roadless" areas. In addition, nearly 25 million acres of truly roadless area are already protected under existing forest plans and other laws.

3. The bill would exempt roadless areas from site-specific environmental review.
The bill would override individual forest plans. Forest plans provide a forum for collaborative, multi-stakeholder efforts to address management decisions based on a national forest's unique location, terrain, wildlife, habitat, existing structures, and other characteristics of the area in question. The plans are accompanied by extensive, site-specific analysis under the National Environmental Policy Act (NEPA) and the National Forest Management Act (NFMA). Analysis of the environmental impacts of setting aside roadless areas has never been prepared using accurate, site-specific data. This bill would only serve to ratify this deficiency. Further, enacting this into law would serve to supercede the ongoing judicial proceedings on the legality of the roadless rule.

4. The roadless rule will inhibit the Forest Service’s ability to control the fire risk in National Forests.
According the Forest Service, "There will be a greater chance of severe fire...creating negative effects within the ecosystem and...threatening increasing numbers of people and communities." The Forest Service says 22 million acres (almost 40%) of inventoried roadless areas are at moderate to high risk from uncharacteristic wildfire and that millions of acres of roadless areas need active management to reduce the risk of catastrophic fire. The roadless rule calls for fire suppression only. Codifying the rule will serve to prevent the Forest Service from actively managing threatened forests. By preventing the Forest Service from controlling the fires risk on federal lands, the bill increases the probability of fire spreading to private and state lands as well.

5. Vast tracts of private, state, and other federal lands exist within designated roadless areas.
There are at least 422,000 acres of private lands, 43,000 acres of state lands, and 29 million acres of federal land managed by agencies other than the Forest Service within the 45 million acres of inventoried roadless areas in the contiguous U.S. A misguided "roadless" designation will have a dramatic impact the way these state, private, and other lands are managed, including blocking private landowners from access to their own land.
6. Given the complexity of land management decisions, the administration of roadless areas should be based on sound science not on a popularity vote. In its report about forest stewardship, the Clinton Administration's own Committee of Scientists says "public land management has always rested on scientific and technical knowledge, not simply the desires of the public or the preferences of managers…" And while the supporters of the legislation cite the 2001 public comment period as proof of widespread public support for the rule, a federal court in Idaho determined, "the comment period was grossly inadequate…depriving the public of meaningful dialogue or input into the process;" and the end result was "predetermined."

7. This one-size-fits-all, Washington, DC-based approach ignores local experience and input, tying the hands of Federal land managers as they try to manage very diverse forests with varying needs. The Washington, DC approach essentially says, "what is good for Florida is good for Idaho, and what works in northern California will work in New York." Common sense tells anyone, this is simply not the case.

Additional Information:
For more information on AF&PA's position on how the Federal public lands should be managed, please see our New Federal Forestry website:
http://www.newfederalforestry.org/

References:
Information source accessed September 10, 2004: www.afandpa.org
2 Forests and Water Resources

Natural Resources Defense Council Statement on Roadless Area Policy

1. What are roadless areas?
"Roadless areas" may not be a very suggestive term, but in fact these are some of the most beautiful and ecologically significant lands in our national forests. Roadless areas are exactly that -- places where no roads have been built and where, as a result, no logging or other development has occurred. Unspoiled by large-scale human activity, roadless areas are among the last strongholds of the primeval American landscape.

2. Why are these areas important?
Roadless areas are havens for fish and wildlife, whose habitat in many other forest areas has been fragmented or entirely destroyed. They provide habitat for more than 1,600 threatened, endangered or sensitive plant and animal species, and include watersheds that supply clean drinking water, unpolluted by development, for millions of Americans.
These quiet, pristine places offer refuge to people as well; a world apart from the bustling, settled landscapes of our daily lives, they harbor some of the best trout fishing, hunting, hiking and camping in the nation.
Where roads go, non-native plants and animals inevitably follow, colonizing landscapes and upsetting the delicate balance of native ecosystems. Roadless areas are a buffer -- they protect pockets of these native landscapes from such erosion.

3. What is the Roadless Area Conservation Rule?
The Roadless Area Conservation Rule is an administrative rule that was issued by the U.S. Forest Service in January 2001 to protect the last remaining wildlands in our national forest system. It places about one-third of the national forest system's total acreage off-limits to virtually all road building and logging. (More than half of our national forest land is already open to such activity.) This protection is the only way to spare roadless areas from the severe damage that roads and intense development like clearcut logging have caused in other parts of our national forests.
The plan protects 58.5 million acres of unspoiled national-forest land in 39 states. But in protecting these areas, the plan does not isolate them from the public. Instead, it preserves all current opportunities for public access and recreation, including hiking, fishing, hunting, camping and mountain biking, as well as the revenue and jobs that these activities generate in local areas.

4. What kinds of places are protected under the rule?
The rule protects hundreds of thousands of trails across the country -- including significant stretches of the Appalachian National Scenic Trail, Continental Divide National Scenic Trail and Pacific Crest National Scenic Trail. The roadless rule also protects many backcountry areas in the Rockies and the Sierra Nevada.

5. Who supports the roadless rule?
An overwhelming, and bipartisan, majority of Americans. The plan was adopted after a 2-year process that included more than 600 public meetings. The Forest Service has received more than 4 million comments on the roadless rule, the vast majority of them in favor of strong protection for roadless areas in our national forests. Support for the forest-protection plan has also poured in from scientists, religious leaders and newspapers across the country, and polling has shown strong support among outdoor-recreation enthusiasts. According to one survey, 86 percent of anglers and 83 percent of hunters back the plan. And it's not only concerned individuals who voiced their
support for the roadless rule. Even KB Home, one of the nation’s largest homebuilding companies, sent a letter to the Forest Service in support of forest protection, saying that the homebuilding industry does not need lumber from roadless areas of our national forests. You can access the KB Home letter at: http://www.nrdc.org/land/forests/roadless_KB_letter.pdf

6. Who opposes the roadless rule?
Despite the support for forest protection among forward-thinking businesses like KB Home, the timber industry, with help from its allies in government, is still intent on sacrificing America’s last remaining wild forests for its own short-term gain. Many former industry lobbyists and executives now hold key positions in the Bush administration.

7. What is the Bush administration’s position on the roadless rule?
Using a range of tactics, the Bush administration has attempted to dismantle the roadless rule since taking office. For example, the administration has repeatedly refused to defend the rule in court, and in December 2003, Bush officials “temporarily” exempted Alaska’s Tongass rainforest -- our largest national forest -- from roadless protections. They are now moving forward with approximately 50 timber sales in Tongass that would violate the rule.

In its most aggressive assault yet on America’s last wild forestlands, the administration announced in July 2004 its plan to eliminate the roadless rule completely. If successful, this move would allow unbridled development on millions of acres in pristine forests across the country, including the Tongass National Forest. In the past, heavy support for the roadless rule among Americans has helped derail the administration’s damaging plans; continued public support of the rule will be critical to the effort to defend it.

8. Without the roadless rule, who would decide the fate of our national forests?
To draw attention away from its controversial plan to abandon the roadless rule, the Bush administration has said it will create a process whereby governors can petition the Forest Service to protect roadless areas in their states. This proposal, however, does nothing to bolster local input: governors, like any other individuals, already have the right to petition the Forest Service to make changes in the management plans of their local forests -- both for and against protections. The new petitioning process would impose deadlines on governors and would require them to conduct cumbersome analyses and reviews. Also, the federal government would still have the authority to accept or reject a governor’s request.

9. Why do we need national guidelines for managing roadless areas?
Local decision-making can actually pose a grave threat to our remaining wildlands because decisions made out in the field by agency officials do not always take into account cumulative impacts across the national landscape -- or the real value of disappearing wildlands to the nation as a whole. In the past, leaving the fate of our wildest forest areas in the hands of local officials has resulted in a large-scale loss of wildlands.

The federal government created national forests to stop forest destruction at the hands of local interests. Now, more than half of the national forest system has been roaded and developed. The roadless rule was designed to make sure that short-term motivations and local issues do not determine the future of our last remaining unprotected forestlands. There is no doubt that many local officials would have a difficult time
2 Forests and Water Resources

withstanding political pressure to allow road building and logging -- and to destroy, one by one, the remaining critical areas of our national forests.

10. Isn't road-building and logging in these backcountry areas essential to efforts to reduce wildfire risk?
No. In fact, roadless areas serve as buffer zones that help prevent wildfires. Forest Service studies have found that large fires occur much more frequently in areas that are already roaded than in roadless areas covered by the rule. Human-caused wildland fire is nearly five times more likely to occur on essentially roaded lands than on essentially unroaded lands. According to a 15-year study by independent scientists, large wildfires are more likely to occur and to burn to greater extents in roadless areas. Logging and roadbuilding in roadless areas can increase fire risk in several ways. First, cutting down trees and building roads opens up the forest and lets in sunlight and wind, both of which dry out the forest interior and increase flammability. Second, when removing trees, loggers often leave behind collections of highly flammable materials -- brush, limbs, twigs, needles, and saplings -- which are difficult to remove. Third, opening up forests promotes the rise of brushy, flammable undergrowth in a short time period. Fourth, logging equipment compacts soil so that water runs off instead of soaking in evenly to keep soils moist and trees healthy. Fifth, logging and roads introduce diseases and pests, which damage trees left behind and can make them more flammable. And last, roads allow more people into the forest, which leads to more human-caused forest fires.

Last revised 12.15.04

References:
2 Forests and Water Resources

Resource List: Forests and Water Resources

Hydrology

Hillslope and Watershed Hydrology Lab at Oregon State University: Website containing current resources, research and information on hydrology and runoff issues. 
Available at: http://www.cof.orst.edu/cof/fe/watershd/index.htm

Forests and Water Quality, Water Quantity

Available at: http://eesc.orst.edu/agcomwebfile/edmat/ec1143.pdf

Available at: http://www.woodlandfishandwildlife.org/pubs/riparian.pdf

Available through WSU Extension Publication Sales: http://pubs.wsu.edu

Forest Soils and Water Quality Research Group at Oregon State University: Website containing current publications, research projects and contacts in forest management and water quality. 
Available at: http://www.cof.orst.edu/cof/fe/research/fswq/index.htm

Enhancing Function

Available through Thurston Conservation District: (360) 754-3588

Available through Washington Department of Fish and Wildlife Salmon Recovery: http://wdfw.wa.gov/recovery.htm
2 Forests and Water Resources

Family Forest and Fish Passage Program, Washington State Department of Natural Resources: Website containing information on this cost-share program that helps small forest land owners to restore fish passage barriers. 
Available at: http://www.dnr.wa.gov/sflo/fffpp/

Forestry Riparian Easement Program, Washington State Department of Natural Resources: Website containing information on this program that "compensates eligible small forest landowners in exchange for a 50-year easement on 'qualifying timber'."
Available at: http://www.dnr.wa.gov/sflo/frep/
Forests and Water Resources

Additional Reading
Pages 57 – 90
2 Forests and Water Resources
If your property includes a body of water such as a pond or stream, part of your land is riparian. “Riparian” is simply a name for the border of moist soils and plants next to a body of water. This area may be only a foot or so wide, like the steep bank of a small creek, or hundreds of feet wide along lowland streams, rivers, lakes and ponds.

Riparian areas are only a small part of the natural landscape, but they are of great value to fish and wildlife. They are also productive areas for timber and forage, and are important for recreation. Landowners can maintain these unique areas by giving them special attention.

This publication tells how riparian area provide essential fish
and wildlife habitat, how land use can affect this habitat, and briefly describes management practices that protect or enhance habitat. (Other publications in this series provide more detailed advice for managing specific kinds of fish and wildlife.) Many of these practices are required by law. Managing riparian areas can increase your use and enjoyment of your land and may even increase the value.

Riparian Habitat

To live and thrive, our native fish and wildlife have a number of requirements:

**Fish**
- food and year-round water
- clean, cool water
- cover from predators
- spawning and rearing areas
- stable conditions during spawning and rearing

**Wildlife**
- food and water
- cover from heat and cold
- cover from predators
- breeding and rearing areas

Riparian areas help provide most of the needed elements of good habitat to a wide variety of fish and wildlife. Riparian areas help provide most or all of these elements for a wide variety of fish and wildlife species. Trees and other plants that shade streams help keep water cool while stabilizing banks and providing food (leaves, twigs, etc.) for insects that fish eat. Trees also provide food and cover for wildlife. When trees die and fall into streams, the logs create small dams and pools that offer fish rearing habitat and cover from predators. Logs that remain on land provide cover for wildlife.

Wildlife heavily use riparian areas because the moist, fertile soils support a rich food supply and offer good shelter from predators and the elements. Despite their relatively small size, riparian and wetland areas are used at some time by nearly all of the animal species in Oregon and Washington.

Riparian habitats can look very different depending on their location, the water body they border, and the season of the year. For example, east of the Cascades, riparian areas may have pine, cottonwood or aspen trees with willow shrubs or grass and edge undergrowth. West of the Cascades, ash, red alder, cedar, and spruce are more common, as are salmonberry and devil’s club.

Differences in riparian habitats are often related to differences in terrain and stream size. Riparian areas along small upland streams may be very narrow and noticeably different from each other only in undergrowth. Where broadleaf plants are common, the natural pattern of spring leaf-out and autumn leaf fall lead to some unique riparian conditions.

Effects of Land Use on Riparian Habitat

As in the case with most everything in nature, riparian areas are constantly changing. A great many of the changes occur naturally, while others come about as a result of human activities. Floods and landslides are the most common natural disturbances in riparian areas.
human activities in riparian areas include forest management, road construction, mining, grazing, agriculture, recreation and development. However, with some thought and planning, impacts that might be detrimental to fish and wildlife can be minimized without seriously interfering with other land uses. In many instances, fish and wildlife habitat may be improved in conjunction with other activities.

Protecting and Enhancing Riparian Areas

Loss of vegetation is one of the most serious changes affecting the riparian area. The impact can be great because, until enough regrowth occurs, the land can be more vulnerable to erosion and food and cover for fish and wildlife are altered. The adjacent water may be subject to siltation and increased temperatures.

In the case of streams, fallen trees present a particularly challenging situation. Removal can contribute to the loss of stream bed and bank stability because of increased streamflow velocities. Leaving the trees may also contribute to soil erosion by directing the flows into banks. If carried to extremes, either case can be detrimental to fish and wildlife populations.

Forest Harvesting Operations: If timber harvest is planned in or near riparian areas along major streams, state regulations usually require retaining some "leave" trees to provide shade and organic debris to the aquatic and riparian area. A mix of broadleaf and coniferous trees can help provide year round cover and supplies of debris. The conifers are important because the debris from them is slow in decaying and the cover provided is long-lasting. Both dead snags and live trees of varying sizes are left to provide essential and diverse habitat for many kinds of birds and mammals, as well as travel corridors for big game.

Depending on the stream size and location, harvest of some riparian trees may be allowed. Such trees should be felled so they do not damage the remaining "leave" trees and logging slash and debris should be kept out of the water. Designated skid trails are preferred and heavy
equipment should be kept out of the riparian area. Although some small organic material and larger debris is important to the aquatic habitat, too much material entering the water in an uncontrolled manner can deplete oxygen and block fish passage.

Conversely, if the pond or stream is quite barren, a nearby logging operation can be an opportunity to make some improvements. Large logs can be carefully placed in the water to create fish habitat, with a portion left on land to prevent them from drifting away. This type of activity should only be carried out in streams by getting expert advice and the necessary permits before the work begins.

**Roads:** Forest roads may be a major source of sediment to streams and alteration of riparian areas. In the past, roads and skid trails were often located in or near riparian areas because they provided easy access routes. The results sometimes included water quality degradation, vegetation changes, and reduced riparian habitat.

It is preferable to locate roads along ridges or stable benches and avoid the riparian areas. If a road must enter a riparian area near a stream, it should be constructed at right angles to the area to reduce the impact. Excavated soil is not pushed over the side of the road but hauled away to an area where it won’t pollute the water. Road width should be minimized to retain as much vegetation as possible, and exposed soils can be seeded with native vegetation to prevent erosion.

**Chemicals:** Use of herbicides and other toxic chemicals should be avoided in the riparian area. However, they may be needed to control noxious weeds and other plants that compete with desirable native species. Application methods used in adjacent areas should include prevention of allowing chemicals into the riparian area or the water.

In both Oregon and Washington there are many specific logging, road construction, and other regulations that apply to riparian areas. Seek advice from forestry or other natural resource agencies before operating in these areas!

**Grazing and Agriculture:** Occasionally, grazing by deer and elk may alter riparian vegetation or a busy pair of beavers can make dramatic changes, but generally the activities of wildlife do not harm an area. However, heavy use by domestic animals can damage stream-banks, promote erosion, and impact water quality with animal waste. Fencing animals out of sensitive areas or providing alternate sources of water and feed can help limit these impacts. Controlling the timing and numbers of animals allowed on the areas can also be useful management tools.

Agricultural activities can greatly affect the riparian area when conducted near the water’s edge. Runoff from such lands can carry chemicals and soil into the water, causing problems for fish and other aquatic life. Protection of the riparian area as a filter can help control these problems. If the damage has already been done, plantings with native vegetation can help the area recover. Incentives and technical assistance for restoring
Riparian areas retired from crop production may be available to qualified landowners. Contact your local USDA Service Center or Conservation District office for more information.

**Recreation and Development:**
Recreational activities in the riparian area may include fishing, hunting, hiking and camping. In some instances sites may be developed in conjunction with these pursuits. Such facilities can eliminate habitat as well as disrupt the activities of wildlife. Locating recreation sites outside of the riparian area is desirable to avoid such changes. Surveys made prior to development can make sure important nesting sites for eagles, herons, and other sensitive species are not disturbed. Developments such as summer homes not only directly eliminate habitat, but may also disrupt wildlife travel routes. Structures may create the need for bank protection with riprap, causing further habitat changes. Septic systems are a potential source of water pollution.

Values tied to the riparian area make the site desirable to begin with—development that harms these values is counterproductive. Shifting development to nearby upland areas can help avoid such unintended consequences.

**Habitat Management**

General information on habitat improvement may be obtained from a variety of sources. On a more personal and local level, you can consult with professional resource foresters and biologists working for public and private organizations. Both technical and financial assistance programs exist for landowners. Help is usually as near as your telephone or computer, but you must ask or look for it.

Perhaps the first, most important step in habitat management is to maintain what is already there if it provides for the needs of desirable fish and wildlife. Protection of riparian areas from undesirable change is much more effective than trying to restore areas that have been damaged. Change in riparian areas is not necessarily detrimental, but it should be carefully planned if fish and wildlife are to benefit.

Management to improve fish habitat usually involves restoration of vegetation, bank stabilization, and possible placement of large debris or boulders in streams. The in-stream activities are mostly aimed at increasing cover and rearing habitat for fish. Because of concerns for water supplies and the hydraulic forces involved, expert advice is important and state fish and wildlife agencies must approve such projects. This is especially true with streams. Early consultation will make the job easier and less frustrating.

As has been mentioned, riparian areas usually contain food, water and cover needed by wildlife. Fruits that tend to dry on the stems and are slow to fall to the ground supply important winter food. Mountain ash, hawthorn, Russian olive, crabapple and rose can be planted to increase winter food for many birds and mammals. Information on the best food plants for your area can be obtained from your fish and wildlife agencies in either Washington or Oregon. Publications listing preferred food for various species are available.

Adjacent to cultivated lands, wildlife cover may be seriously lacking. Some of the material planted to supply food may also
provide good cover for wildlife. Again, suggestions for plants that will do best in your area may be obtained from your fish and wildlife, as well as forestry, agencies.

More specific information on riparian areas is available in publications and from the agencies listed in the reference section that follows. Direct contact with individuals working in your area can help produce ideas specifically tailored to your situation.

Generally, the best management of riparian areas for fish and wildlife is protection of the plant life. If the area is in a somewhat natural condition, it is probably supporting a great number of plants valuable to fish and wildlife. However, by looking at the area for needed improvements, new plants may be added for the benefit of both fish and wildlife and for you as landowner.

For example, willow can be planted to stabilize banks while providing shade and organic matter. Rose bushes might be added in certain areas to provide winter food and cover while creating a fence effect. Again, consultation with technical experts can be time well spent.

You have taken a big step by recognizing the value of riparian areas. By properly managing and protecting such areas, and staying informed about new developments and techniques, you can help assure the continued existence and enhancement of these valuable areas.

<table>
<thead>
<tr>
<th>Oregon Dept. of Forestry</th>
<th>College of Forest Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>2600 State Street</td>
<td>University of Washington</td>
</tr>
<tr>
<td>Salem, OR 97310</td>
<td>Seattle, WA 98195</td>
</tr>
<tr>
<td>Phone: 503-945-7200</td>
<td>Web site: <a href="http://www.odf.state.or.us/">http://www.odf.state.or.us/</a></td>
</tr>
<tr>
<td>Web site: <a href="http://www.odf.state.or.us/">http://www.odf.state.or.us/</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oregon Dept. of Fish &amp; Wildlife</th>
<th>Washington Dept. of Natural Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>3406 Cherry Ave. NE</td>
<td>PO Box 47001</td>
</tr>
<tr>
<td>Salem, OR 97303</td>
<td>Olympia, WA 98504-7001</td>
</tr>
<tr>
<td>Phone: 800-720-6339</td>
<td>Phone: 360-902-1000</td>
</tr>
<tr>
<td>Email: <a href="mailto:ODFW.info@state.or.us">ODFW.info@state.or.us</a></td>
<td>Email: <a href="mailto:information@wadnr.gov">information@wadnr.gov</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extension &amp; Experiment Station Communications</th>
<th>Wildlife Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon State University</td>
<td>Washington State University</td>
</tr>
<tr>
<td>422 Kerr Administration Bldg.</td>
<td>PO Box 646410</td>
</tr>
<tr>
<td>Corvallis, OR 97331</td>
<td>Pullman, WA 99103-6410</td>
</tr>
<tr>
<td>Web site: <a href="http://eesc.oregonstate.edu/">http://eesc.oregonstate.edu/</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forestry Communications Group</th>
<th>U.S. Environmental Protection Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Forestry</td>
<td>Ariel Rios Bldg.</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>1200 Pennsylvania Ave. N.W.</td>
</tr>
<tr>
<td>256 Peavy Hall</td>
<td>Washington, D.C. 20460</td>
</tr>
<tr>
<td>Corvallis, OR 97331</td>
<td>Phone: 202-272-0167</td>
</tr>
</tbody>
</table>
Titles available in the Woodland Fish & Wildlife series:

Is There a Place for Fish and Wildlife in Your Woodland? ............................................ MISC0132
Riparian Areas: Fish and Wildlife Havens ................................................................. MISC0133
Managing Small Woodlands for Grouse ........................................................................ MISC0141
Wood Ducks on Small Woodlands ........................................................................ MISC0142
Managing Ponderosa Pine Woodlands for Fish and Wildlife ........................................ MISC0158
Managing Small Woodlands for Cavity-Nesting Birds ................................................... MISC0160
Trout in Small Woodlands .................................................................................. MISC0161
Managing Small Woodlands for Elk ........................................................................ MISC0164
Coastal Douglas-fir Forests and Wildlife ................................................................. MISC0168
Hawk, Eagle and Osprey Management on Small Woodlands ........................................ MISC0169
Wetlands as Varied as our Region ........................................................................ MISC0179
Wildlife on White Oak Woodlands ........................................................................ MISC0180
Quail on Small Woodlands ................................................................................ MISC0187
Managing Deer on Small Woodlands ........................................................................ MISC0189
Beaver, Muskrat, and Nutria on Small Woodlands ................................................ MISC0196
Managing Forest Habitats for Neotropical Migrant Songbirds ................................ MISC0198
Habitat Management for Bats on Small Woodlands ................................................ MISC0226
Managing Western Juniper for Wildlife ..................................................................... MISC0286
Wildlife in Broadleaf Forests of Oregon and Washington ........................................ MISC0534

These publications may be ordered from Washington State University Extension Bulletin Office, (800) 723-1763 or online http://pubs.wsu.edu/. You may also download copies at: http://www.WoodlandfishandWildlife.org.
A Woodland Fish and Wildlife Project Publication

By

Millard S. Deusen, Fisheries Biologist, Washington State Department of Fish and Wildlife, and
Paul W. Adams, Forest Watershed Extension Specialist, College of Forestry, Oregon State University.


The Woodland Fish and Wildlife Project was initiated to provide information on fish and wildlife management to private woodland owners and managers. It is the intent of the organizations involved in this project to produce publications that will serve as practical guides to woodland owners.

Each publication is intended to be complete in itself. Users may find it convenient to collect all publications in this series in a three ring binder to form a permanent reference file. Woodland Fish and Wildlife Project publications range from an overview of fish and wildlife opportunities on woodland properties to specific publications concerning techniques for managing individual species.

Reprinting of this publication, in whole or in part, is allowed with written permission of Woodland Fish and Wildlife.
IN THIS ISSUE

- On the Front Line:
- Private Forests & Water Resources
- Key Issues
- Land Management Implications
- For Further Reading
Private Forests

Comprising roughly half the forested land in the United States, non-industrial private forests include vital yet vulnerable water resources. This issue explores the land-use activities and pressures that confront these forests, and provides examples of programs and policy options to support working private forests for the future.

Susan Stein, who coordinates studies on private forestlands for the Cooperative Forestry Staff of the Forest Service State and Private Forestry Deputy Area, coordinated the development of this issue. Brett Butler, a research forester with the Forest Service Northeastern Research Station, provided critical guidance and statistics on private forest owners based on the National Woodland Ownership Survey, which he manages. Mary Carr, a technical publications editor for the Forest Service, deftly wrote the entire issue, based on source materials provided by Susan and others.
George Fenn treats his forest like a tree farm. Pat McFadden sees his forest as a refuge for native plants and wildlife. Jean Shaffer’s forest provides a source of artistic materials for a value-added furniture-making business. All three private landowners manage their forests in ways that protect water, soils, and vegetation. Their different perspectives reflect the diversity of goals and styles used to manage millions of non-industrial private forests throughout the United States.

Comprising roughly half the forested land in the country, nonindustrial private forests—what we’ll call “private forests”—are on the frontline of providing and protecting the Nation’s water. These are parcels of land that have or could have forest cover and are neither public (managed by governments) nor industrial (owned and managed by a timber company). The extent of private forests and their proximity to population centers make them among our most vital yet most vulnerable water sources.

From trees to taps: the role of forests in providing and protecting water

It’s no surprise that forests have long been recognized as premier sources of clean water for multiple uses including recreation, fish habitat, and drinking water supplies. In a forested environment, most precipitation does not strike soil directly but is intercepted by the tree canopy, shrubs and herbaceous vegetation, and decaying organic matter on the forest floor. Some precipitation filters down to the soil layer, slowing the flow over land and allowing water to seep into the subsurface and replenish the groundwater. Other water evaporates and transpires back to the atmosphere, to fall again as rain, snow, fog, or mist.
Forests are responsible for priceless, water-related ecological services that are vital for our well-being. Take, for example:

- **Fresh water resources.** About two-thirds of the Nation’s fresh water originates on forested lands; about 51 percent of the lower 48’s water supply comes from forests.

- **Drinking water.** Forested watersheds provide a source of drinking water for 180 million people.

- **Protection from erosion.** Forest cover protects soils by intercepting rainfall and slowing its impact as it hits the ground. This significantly reduces erosion, especially during floods. In riparian (streamside) forests, tree roots help stabilize soils, thus stabilizing streambanks and hillsides.

- **Filtering out contaminants.** Riparian forest buffers can reduce fertilizer, pesticide, and sediment runoff into streams by as much as 90 percent.

- **Support of wildlife.** Riparian and upland forests provide food and shelter for aquatic species as well as for terrestrial wildlife.

### Private forests take the lead

Of all the Nation’s forests, private forests play the lead role in providing and protecting water. “Forests in the lower 48 States contribute about 51 percent of the water in streams and rivers,” observes U.S. Department of Agriculture (USDA) Forest Service researcher Tom Brown, whose Rocky Mountain Research Station team is developing models to measure the water derived from U.S. forests. “Approximately half of that amount comes from private forests.” In other words, nearly 25 percent of all the water flow in the country can be said to come from private forests. “That’s a lot of water,” notes Brown, “about 123 trillion gallons per year, equal to the amount of water in Lake Erie.”

Private forests take the lead in water supply and conservation in part because of their sheer magnitude. Nearly 350 million forest acres are managed by some 10 million individuals, families, organizations, Indian tribes, or other nonindustrial

---

**Counting the drops**

Scientists at the Forest Service Rocky Mountain Research Station and Colorado State University are in the process of quantifying available water volume from U.S. forests. Annual contributions to water supply will be estimated by State and water resource region, and by land cover class and land management class. Such research will lay the groundwork for further studies that may be able to more accurately estimate the actual contributions of private forest lands to our water resource supply. See [http://www.fs.fed.us/rm/value/research_cpl.html](http://www.fs.fed.us/rm/value/research_cpl.html)
private entities across the country. With parcels ranging from 1 to 5,000 acres or more in size (94 percent of which are smaller than 100 acres), private forest landowners altogether hold nearly five times more acreage than industrial forests, and slightly more forest acres than all Federal, State, and county agencies combined.

The importance of private forests to water is also a function of where they are located. Acreage of private forest in the heavily populated East is four times that of public forest, but in the less crowded West there are three times more acres of public (mostly Federal) forest than private. This means that private forests are more likely than forests in other ownerships to be located closer to human population centers, making them not only more important for providing water-related services but also more threatened by development.

Sound management for sustainable water resources

People own private forests for a host of reasons, including family legacy, aesthetics, nature protection, hunting and fishing, investment, privacy, rural lifestyles, and sale of forest products. For some, the forest is simply part of their home or farm. Consequently, private forests are managed for a mix of uses, such as recreation, timber harvesting, and conservation of wildlife, water, and other natural resources. Stewardship of private forests is often intensely personal: landowners may also be the managers and sometimes even the workforce of “working forests,” which provide the social and economic underpinning for thousands of families and small businesses.

Forest management for such a range of purposes can involve actions as diverse as thinning, timber harvesting, tree planting, road or trail construction and maintenance, and application of chemicals. Unless managed properly, some of these activities—particularly timber harvesting and construction of roads and stream crossings—have the potential
to disturb soils, increase sedimentation to streams, alter stream temperatures, affect the amount and timing of water flow, introduce contaminants to water supplies, and influence how and where nutrients move through the system.

“How forests are managed has a profound effect on the water quality of lakes, streams, wetlands, and groundwater and on the ability of watersheds to perform their most basic functions,” states Lori Wilson, hydrologist on the Mark Twain National Forest in Missouri. “Sound watershed management, protection, and restoration are key to maintaining and achieving healthy aquatic, riparian, and wetland ecosystem function and condition.”

To foster sound forest management, all States and a number of tribes have developed “best management practices” (BMPs). These are practices designed to help landowners, foresters, and loggers protect water quality during all stages of forestry. BMPs often include guidelines for preharvest planning, streamside and wetland area management, road construction and maintenance, timber harvesting, revegetation, and chemical management.

Such guidance is a powerful tool for protecting a State’s waters from silt and other pollution. In Vermont, for example, where BMPs are known as AMPs or “acceptable management practices,” the Department of Natural Resources reports that “at a very low cost AMPs have been highly effective in reducing the numbers and severity of water quality violations on logging operations.” While BMPs are voluntary in most areas, compliance with forest management practices is mandatory in some States, such as Oregon, Washington, and California.

Whether the rules are voluntary or mandatory, private forest landowners play a critical role in their implementation on the ground. A key to effective water quality protection is to help ensure that landowners, along with their loggers and the forestry consultants who advise them, are not only trained but inspired to participate successfully in sustainable forest management practices.

Anne Hairston-Strang, a forest hydrologist from Maryland, and Paul Adams, a professor and forest watershed extension specialist in Oregon, surveyed private forest landowners in Oregon, to assess their level of support for mandatory regula-
tions under Oregon’s Forest Practices Act (Hairston-Strang and Adams 1997). Among their findings: the costs and complexity of rules and the desire to feel in control of management decisions are major factors influencing the support of private landowners and managers for water protection measures. “The challenge of improving fish habitat,” they conclude, “likely depends on social science—that is, motivating landowners to pursue these goals in their riparian land management.”

Paving paradise: development and other pressure points

The high profile of private forests in providing water-related goods and services is matched by a high level of vulnerability to their being damaged or lost. Millions of woodland acres are prime candidates for development or conversion to other uses, which represents the single largest threat to private forests across the country. In addition, some 7 percent of private forests nationwide are considered at risk for mortality from insects and disease, and many face a recurring potential risk of catastrophic fire.

The social, economic, and ecological pressures facing private forest landowners underscore the complexity of the challenge to maintain these working forests for the future. It’s no wonder that keeping their land intact for future generations is the number one concern of private forest landowners.

Cutting up the pie

In recent decades the United States has seen increasing conversions of forest land dominated by vegetation to developed land dominated by pavement and buildings. This accelerating trend has been driven in some areas by population growth, in other areas by shifts in population to new locations, and everywhere by lifestyle demands that are causing development to increase at rates even faster than population growth itself.
Development’s conjoined twin is fragmentation—remaining forests are being chopped into smaller and smaller parcels and otherwise split apart by disjointed ownership, patchy vegetation, and incompatible land uses. Development and fragmentation reduce the ecological, economic, and social benefits that intact private forests provide.

A variety of interrelated factors contribute to a disproportionate susceptibility of private forests to being subdivided, sold, and converted to residential, commercial, recreation, agricultural, and other uses. Consider:

- **Location, location, location.** Some of the fastest-growing populations affecting private forests are in the East, where most forest lands are private and many overlap with prime land for residential and second home development.

- **Demographics.** Two-thirds of woodland owners are over the age of 55; 40 percent are over the age of 60; nearly 17 percent are already older than 75. An aging population portends probable turnover in the near future.

- **Economic and tax pressures.** When forest product markets are weak and property values are through the roof, land-use choices get tough. The impact of taxes is among the top four concerns of forest landowners.

- **Regulatory pressures.** If forest practice and watershed protection rules are complex, inflexible, or too costly, they can increase uncertainty, generate confusion, and make management cumbersome.

---

**Hard surfaces are hard on streams**

Effects of hard surfaces on streams and aquatic life

<table>
<thead>
<tr>
<th>Stream attribute</th>
<th>Percent of impervious surface</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-10</td>
</tr>
<tr>
<td>Stream stability</td>
<td>Stable</td>
</tr>
<tr>
<td>Water quality</td>
<td>Good</td>
</tr>
<tr>
<td>Stream biodiversity</td>
<td>Good to excellent</td>
</tr>
</tbody>
</table>


---

**Urbanization**

Of particular concern is urbanization—converting forests and other open spaces into suburbs and shopping centers. Urbanization replaces natural vegetation cover with impermeable surfaces such as roads, parking lots, driveways, and rooftops. Rainfall isn’t captured and retained by vegetation but runs off quickly into streams, carrying pesticides, chemicals, fertilizers, oils, and metals. Aquifers don’t get recharged. Stream stability, surface and groundwater quality, and aquatic biodiversity all suffer when the amount of impervious surface is increased by as little as 10 percent (see sidebar).
Forest lands and farm lands can—and do—convert back and forth to some extent in some parts of the country. According to the National Resource Inventory, between 1982 and 1997 more than 20 million acres of forest land were gained from lands that were previously in crop, pasture, or rangelands. However, conversion of forest lands to urban areas, either directly or by way of agriculture, is essentially irreversible (see figure), so the net result is a continuing loss of forest lands.

Urbanization can also have social implications with respect to water protection and conservation. People moving into newly urbanized areas often bring different attitudes and a lack of experience with natural resources and rural social values. As areas around private forests become more populated, newcomers may be unwilling to support forest management practices on remaining forest lands. One study in Virginia, for example, estimates a near-zero probability of sustainable forest management when population density exceeds 235 people per 1,000 acres (Virginia Department of Forestry 1997, cited in Sampson and Decoster 2000); another predicts that the probability of commercial timber harvest approaches zero at around 150 people per square mile (Wear et al. 1999).

Ecological pressures

A recent Forest Service survey revealed that the second highest concern of private forest landowners is insect damage. Forest Service inventory data show that approximately 20–25 percent of private forests in some Eastern States—Delaware, Maine, New Hampshire, West Virginia, and Virginia, for example—are at risk of damage from insects and disease; many others are in the 10–20 percent at-risk range.

The direct link between insect damage and water quality is not well understood, but researchers are investigating how insects and disease may affect hydrologic function, water temperature, and streamflow. For sure, insect and disease impacts can increase the vulnerability of forests to fire, which runs a close third in the list of forest landowner concerns. Catastrophic fire in forest lands has the potential for severe ecological damage through soil erosion; increased sediment, turbidity, or
excessive nutrients in surface waters; flooding and mudslides; and other threats to aquatic and human life and water supplies. Insects, disease, and fire have their natural and necessary place in forested ecosystems. However, private forests already fragile from fragmentation and development may be less able to rebound if the extent or severity of such pressures becomes extreme.

Untapped treasures: programs and policies for private forests

Sustainable forest management that protects water resources can be a daunting challenge for private forest landowners, especially for those whose training and backgrounds are far from professional forestry. Assistance and education programs and supportive public policies can make a critical difference in the retention of sustainable working private forests and the conservation of the water resources they provide.

An abundance of assistance

Paradoxically, while many private forest landowners say that one of their primary management objectives is to improve water and wildlife, only a handful of these landowners—a mere 7 percent of those owning parcels between 10 and 5,000 acres in the lower 48—currently have a written management plan. Fewer than half of private forest landowners seek professional assistance, even though innumerable Federal, State, and private resources are available (see Assistance Program Sampler sidebar).
A number of factors may be at play. In many areas, State forestry agencies are the primary source of technical assistance. They, like other government agencies, may be understaffed, underfunded, and unable to respond effectively when asked; many are never even asked because landowners may be unaware of State-level options. Some loggers soliciting timber from private forests may be unfamiliar with or resistant to appropriate BMPs. Some people may shy away from seeking help because of the complexity of the issues or the red tape in which assistance is often entangled. Some are unaware of or perhaps overwhelmed by the sheer abundance of programs available, or they don’t know where to turn to get started.

It’s certainly not for want of need or interest. A 2002 survey conducted by the Ozark Woodland Owners Association (OWOA) in north-central Arkansas, where 90 percent of the 2.4 million acres of forest lands are private forests, revealed that “while private landowners are highly motivated to manage their forest lands themselves, two-thirds of the landowners surveyed say they don’t have the skills and resources to do so,” according to OWOA President Thomas E. Brent. “Furthermore,” Brent notes, “the majority have limited personal time and financial resources to devote to management activities.”

Such factors point to a need for education and assistance programs to be more visible and accessible—not only to increase the likelihood that private forests will remain productive and healthy but also to help keep them afloat. Focused public education efforts could help raise awareness of the value of forests and forest management among people in both urban and rural areas. There may also be a need to improve training and education for the trainers themselves, to help them keep up to date with rapidly changing technologies, techniques, and ideas.
Assistance Program Sampler

**USDA Forest Service, Cooperative Forestry (202-205-1389)**

- **Forest Stewardship Program (FSP)**—offers technical assistance and planning guidance for writing management plans. [http://www.fs.fed.us/spf/coop/programs/loa/fsp/](http://www.fs.fed.us/spf/coop/programs/loa/fsp/)

- **Forest Land Enhancement Program (FLEP)**—offers financial and technical help for implementing forest stewardship plans, with a specific objective to improve water quality. [http://www.fs.fed.us/spf/coop/programs/loa/flep/](http://www.fs.fed.us/spf/coop/programs/loa/flep/)

- **Forest Legacy Program (FLP)**—helps States to develop and carry out their forest conservation plans through encouragement and support of conservation easements. [http://www.fs.fed.us/spf/coop/programs/loa/flp/](http://www.fs.fed.us/spf/coop/programs/loa/flp/)


**USDA Farm Service Agency (FSA)**

- **Conservation Reserve Program (CRP)**—provides financial incentives to convert highly erodible or other environmentally sensitive acreage to vegetation (e.g., riparian buffers). Contact your local FSA office. [http://www.fsa.usda.gov/dafp/cepd/crp.htm](http://www.fsa.usda.gov/dafp/cepd/crp.htm)


**USDA Natural Resource Conservation Service**


Individual States

- **State foresters**—offer direct technical assistance and leveraging of State and local resources to develop programs and forest protection measures. Contact your State’s department of forestry or natural resources. For a list of State foresters, contact the National Association of State Foresters. 202-624-5415. http://www.stateforesters.org/

- **State extension services (usually university related)**—offer technical knowledge and skills, inspiration, and awareness and understanding about rules, forestry, water issues, tax and financial options, and basic decision-making processes. Contact your State university or agricultural college.

Private Organizations


- **Forest Landowners Association**—follows legislation before Congress that affects forest landowners and their property; provides advocacy and education to support responsible forest management. 1-800-325-2954. http://www.forestlandowners.com/

- **Forest Stewards Guild**—works to develop forest management solutions that work from economic, environmental, and social perspectives. 505-983-3887. http://www.foreststewardsguild.org/

- **Land Trust Alliance**—promotes voluntary land conservation; provides resources and training to help protect open space. 202-638-4725. http://www.lta.org

- **National Network of Forest Practitioners**—provides a clearinghouse of information and technical assistance, to promote the well-being of the environment, communities, and workers. 401-273-6507. http://www.nnfp.org/

- **National Woodland Owners Association**—promotes forestry and the interests of woodland owners. 1-800-GRN-TREE. The NWOA Web site has links to State affiliates and other local woodland owners associations. http://www.woodlandowners.org/

Guide to the guidance

*Privateforest.org* offers an online guide to the multitude of available resources. Developed by The Nature Conservancy (TNC), with financial support from the Forest Service’s Forest Stewardship Program, this Web site includes a library, information exchange, links to individual State forestry resources, and current information about forest management. Go to http://www.privateforests.org/.
Policies and research to take private forests into a sustainable future

Achieving public objectives for water protection on private forest lands ultimately requires more than landowner assistance and public education. Effective public policy that promotes incentives, flexible and understandable rules, in-depth information, and old-fashioned inspiration all can help improve the stability of private forest enterprises and empower private forest landowners to resist the pull to pull out.

Public policy that fosters education and financial assistance is evident in the multitude of programs described above. In addition, many States have initiated programs that offer preferential tax treatment and other incentives to help preserve forest lands. For example, Pennsylvania’s Clean and Green program provides for lowered taxes on land devoted to Forest Reserves. Indiana’s Classified Forest Program allows landowners with at least 10 forested acres to keep the land in forest in exchange for property tax breaks, forestry literature, and free assistance from a professional forester.

Informed policymaking requires a thorough understanding of not only the complex technical issues but also the environmental and social costs and benefits of private forests. A few identified research areas that could help provide that understanding include:

- **Long-term monitoring** of water quality and habitat modification associated with urbanization.

- **Watershed-scale studies** to compare relatively undeveloped watersheds to similar watersheds with greater disturbances due to roads.
● **Studies of the impact** of taxes and other economic pressures on landowners’ decisions to retain or sell their land; one nationwide study is already being supported by the Forest Service to determine the tax burden on private forest landowners in each State.

● **Research** that would allow us to better quantify the tangible and intangible values of private forests to the Nation.

Sustainable management and retention of private forests will continue to be tough challenges as these landowners face mounting pressures, as forested and aquatic ecosystems undergo environmental change, as social values and management decisions shift, and as competition for water resources increases. Education, support, and dedicated leadership at all levels will be needed to help ensure that private forests and their diverse landowners remain firmly in place, on the frontline of water protection efforts far into the future.
People on the frontline

On lands of every size, type, and condition, private forest landowners are applying an array of management styles and objectives that protect and enhance water quality. Here’s a sampler of some private forest challenges and opportunities being met with creativity and flair across the country. For more details on each story, go to http://www.fs.fed.us/wildlandwaters/.

Pushing the envelope: George Fenn, Oregon

“We have no problems with erosion, our streams are all shaded with conifers, and we’re creating a lot of biomass that wildlife can use,” explains George Fenn of Oregon, who converted a 425-acre sheep pasture into 390 acres of profitable yet protected forest that includes coastal redwood trees planted, and harvested, along the streams. “Our riparian areas are all planted,” he notes, pushing the envelope of conventional wisdom but operating well within the strict requirements of Oregon’s Forest Practices regulations, which he enthusiastically supports.

Stewardship first: Pat McFadden, Georgia

“What we’re doing is a bit radical for this area,” admits Pat McFadden of his Lokchasassa Wilderness Project, located in rural Georgia where commercial pine plantations and pivot irrigated row croplands are the norm. McFadden’s approach is to harvest trees in favor of wildlife and native plants, not for timber production. “Here, it’s stewardship first,” he says. “On Lokchasassa, biodiversity is our goal.” McFadden’s 700 acres of riparian and upland forest and 120 acres of restored wetlands harbor diverse species, including some that are threatened or endangered. McFadden’s active stewardship plan earned him recognition as a Certified Steward under Georgia’s Forest Stewardship Program.
TreeArt: Jean Shaffer, Washington

“If you meet the needs of your forest, your forest will meet your needs,” believes Jean Shaffer. A practitioner of ecological, or natural selection, forestry, Shaffer takes clues from the condition of individual trees and naturally occurring events to decide what trees to remove. She and her husband individually select, cut, and mill each tree from their 20-acre western Washington forest to create unique high-end furniture and wooden sculptures from mostly small-diameter trees. Off limits are the stately Douglas-firs and madrones surrounding the spring and pond that provide a wildlife watering hole. This small, isolated forest, surrounded by mushrooming housing developments, is certified by SmartWood, under the Forest Stewardship Council.

Hats off for water quality: Ed Fite, Oklahoma

Private forest landowner Ed Fite—along with his cousin, Julian Fite—is steward of some 1,400 acres of oak-hickory forest and pasture lands adjacent to the Illinois River. Fite’s approach to forest and farm management reflects not only his personal philosophy but also his priorities when he’s wearing a different hat, that of Oklahoma Scenic Rivers Commission director: “I manage number 1 for water quality,” he says. Fite follows his stewardship management plan to exclude livestock from the riparian area and ensure careful harvest practices on the upland forest, where wildlife find refuge. “There’s so much help out there,” he advises other private forest landowners while wearing his landowner-advocate hat. “Go out and solicit education and technical assistance from agencies like the Natural Resources Conservation Service, State forestry departments, State and local farm agencies, State conservation commissions, and the U.S. Environmental Protection Agency.” Ed recommends asking public servants like himself to help smooth the way.
Preserving paradise: Lloyd Keisler and family, Indiana

Located just a few minutes from the city of Bloomington’s 70,000 people and a bustling airport, a 300-acre private forest is under increasing development pressure from the surrounding community. Lloyd Keisler and his family are resisting that pressure, though. Their land will remain forested forever as part of the Forest Legacy Program, with a conservation easement on their Little Richland Creek property. The Keislers will continue to manage their forest for wildlife habitat, soil conservation, air and water quality, timber, and aesthetic values.

—Adapted from USDA Forest Service/Forest Legacy Program, www.fs.fed.us/na/durham/legacy/

It begins with a vision: Jim and Jenness Robbins, Maine

“The Nicatous Lake project began with a vision held by Jim and Jenness Robbins, [who] believed there had to be a way to keep their lands undeveloped, a place the public could enjoy and wildlife could thrive, while generating a sustained flow of forest products” observed Alan Hutchinson of the Forest Society of Maine. This nonprofit conservation group is part of a coalition of organizations that helped landowners, Robbins Lumber, and Champion International protect more than 20,000 acres of Maine forest lands from future development through a conservation easement on the property. “We believe in a balance between ecology and economics,” declared landowner Jenness Robbins.

—Adapted from USDA Forest Service/Forest Legacy Program, http://www.fs.fed.us/na/durham/legacy/
Planting trees, protecting water: Stanley and Kathy Guest, Pennsylvania

Stanley and Kathy Guest had tried for years to engage a strong partner organization and secure financial support to correct nonpoint source pollution problems and restore the riparian areas on their Century Oak Farm in southeast Pennsylvania. When the nonprofit Green Valleys Association (GVA) stepped forward, the scale tipped. Fencing, moving cattle crossings to adjacent pastures, and installing a nutrient containment structure all helped improve both the new riparian buffer and stream quality. And the Guests got into agroforestry—planting trees, lots of trees, with the help of local volunteers, students, and neighboring farmers. They removed exotic vegetation from the streamside and planted instead native trees and shrubs and native warm-season grasses, with the goal of planting a fully functioning and sustainable ecosystem on the streambank.

—adapted from GVA Watershed Stewardship Award Application, 2002.
Key Issues

- Private forests are vital for the protection of water quality and quantity, yet they are at risk of development, conversion, and ecological damage.

- Sound watershed management, protection, and restoration on private forests are important for maintaining and achieving healthy aquatic, riparian, and wetland ecosystem function and condition.

- Private forest landowners are key to the successful implementation of water protection measures.
Land Management Implications

- As land uses and ownerships change over time, management decisions that emphasize the retention of sustainable working private forests will be important to protect these sources of clean water.

- Training, technical, and financial assistance provided to private forest landowners, loggers, and managers can help ensure compliance with BMPs, increase knowledge and skills of forest practitioners, and provide social and economic support for working forests.

- Policies and regulations can foster stewardship by being flexible, well-grounded in science, accessible, understandable, and cost-effective.

- Conservation education programs can help raise awareness of forest resources and can foster understanding of diverse ideas, values, and forest management goals.
References


Oregon Forest Resources Institute [no date]. Drinking water and forestry: How a healthy forest ecosystem helps keep streams clean and water quality high. Portland, OR: Oregon Forest Resources Institute:15 pp.


Participant Evaluation

Please answer the following questions and add any additional comments below each one:

1. How much of the information in this presentation was new?
   1  2  3  4  5
   None  Some  All

2. Could you explain the information that was presented to a friend or neighbor?
   1  2  3  4  5
   Definitely not  Not sure  Definitely so

3. Will this information help you as a volunteer?
   1  2  3  4  5
   Definitely not  Not sure  Definitely so

4. How likely are you to use the information that you learned today during the next year?
   1  2  3  4  5
   Very unlikely  Not sure  Very likely

5. How would you rate the presentation skills of the speaker?
   1  2  3  4  5
   Poor  Fair  Excellent

6. Did you complete any of the activities or assignments associated with this lesson?
   ___ Yes (which ones? __________________________________________)
   ___ No

7. If you answered yes, did the activities/assignments enhance your understanding of the topic?
   1  2  3  4  5
   Definitely not  Not sure  Definitely so

8. List three things that you learned from today’s presentation/activities:
   1. ________________________________________________________________________
   2. ________________________________________________________________________
   3. ________________________________________________________________________

9. Was there any topic not covered that you were hoping to learn about?
   __________________________________________________________________________
2 Forests and Water Resources