Introduction

Managing wetlands and associated buffers on forest land requires careful assessment of site conditions, application of basic forest ecology principles, creativity and planning. Decisions made by foresters will influence the ability of wetlands to clean and control water and provide habitat for years to come.

Managing Wetlands on State Lands in Washington provides guidance to interpret and apply the Washington State Department of Natural Resources wetland management strategy. This strategy is outlined in two documents; the Forest Resources Plan (FRP) and the Habitat Conservation Plan (HCP). The specific guidance in *Managing wetlands* is a first attempt to translate the FRP and HCP into techniques and procedures to use in designing wetland management.

Correctly applying wetland definitions and determining appropriate wetland management will determine the success of the wetland management strategy on state lands.

Managing Wetlands is a companion volume to the publication *Recognizing Wetlands and Wetland Indicator Plants on Forest Lands in Washington* (Bigley and Hull, 2000). The objectives of *Recognizing Wetlands* are to assist forest managers in identifying and delineating wetlands and to provide a general introduction to wetland functions and considerations for designing wetland buffers.

Managing Wetlands includes field aids for the layout and management of wetland buffers. Graphic illustrations of several management scenarios are provided to help managers interpret the written policy.

Applying Wetland Regulations and Policies

Wetlands in the state of Washington are protected under an umbrella of federal, state and local regulations. For regulations applying to forest practices activities in all wetlands in the state of Washington, please refer to the 1995 *Forest Practices Rules* [1].

In addition, The Washington State Department of Natural Resources is required to abide by a wetland policy, a Forest Resource Plan (FRP) and a Habitat Conservation Plan (HCP) for all activities in or around wetlands on state trust lands.

The DNR wetland policy (Forest Resource Plan policy #21) states that there will be no net loss of wetland acreage or function on state trust lands. This policy is implemented through the FRP and HCP. The management objective and guidance is the same for the FRP and HCP, and is detailed below. It is recommended that forest managers read all the materials in *Recognizing Wetlands* on wetland soils, plants, hydrology, wetland types and considerations for buffer placement before designing management to comply with the HCP and FRP.[2]

FIELD GUIDANCE FOR THE HABITAT CONSERVATION PLAN AND FOREST RESOURCES PLAN

In order to maintain the integrity of wetland acreage and function, the first priority is to maintain wetland hydrology. This is to be accomplished by:

(1) continuously maintaining a plant canopy that provides a sufficient transpiration surface and established rooting;

(2) maintaining natural water flow (e.g. no channelization of surface or subsurface water flow); and

(3) ensuring stand regeneration.

1 W*ashington Forest Practice Rules,* WAC 222, 1995.

2 For full language of the HCP and FRP wetlands strategy, see Appendix A.

Wetland hydrology can be altered significantly by excessive harvest within and adjacent to the wetland. This is because reductions in tree and understory leaf area reduce evapotranspiration and result in increased ground water flow, altering the amount of water removed from the wetland and the rate at which it is removed. Wetland hydrology can also be easily disrupted by soil disturbance, which can channelize water flow, transform subsurface to surface flow, and make the wetland and downstream ecosystems susceptible to scouring during flood events. Ensuring that forested wetlands are able to regenerate after harvest is an important part of protecting wetland hydrology in the long-term because the tree leaf area is required to transpire water. In some cases when the canopy has been removed, the water level rises, preventing conifer establishment. Inability of forested wetlands to regenerate is considered a loss of wetland function.

The requirements of the HCP and FRP are summarized below.

Buffers

Under the HCP and FRP requirements, any wetland 0.25 acre or larger will be protected by a buffer. For wetlands between 0.25 and 1 acre, the buffer will be 100 feet wide; for wetlands larger than 1 acre, the buffer will be determined using site index tables, and will be equal to the height of a dominant conifer in the stand adjacent to the wetland at 100 years of age, or 100 feet, whichever is larger. Buffers should be measured as horizontal distance, perpendicular to the edge of the wetland.

Ground disturbance

Great care must be taken to avoid ground disturbance such as rutting and compaction in wetland areas. This usually precludes the use of ground-based equipment within wetlands. If it is necessary to use ground based equipment within wetland buffers, use low ground pressure equipment and directional falling to keep equipment at least 50 feet from the wetland edge. The HCP and FRP require that wetland drainage be restored to its natural condition if it is altered during management activities. Restoration can be difficult and costly, thus impacts to wetland drainage should be avoided whenever possible. Maintenance of understory vegetation is also key in reducing impacts to wetland functions and hydrology. Harvest activities should be designed to minimize disturbance of understory vegetation in both wetland and buffer areas.

Wetland Mitigation

Wetland mitigation means compensating for impacts to wetlands through the restoration of an existing, degraded wetland or the creation of a new wetland. Mitigating the effects of forest management on wetland areas usually involves time consuming and expensive procedures that often fail to achieve the objectives of replacing or restoring wetland habitat or functions. The department's Forest Resource Plan emphasizes avoiding the loss of wetlands and allows for mitigation if loss occurs. If mitigation is necessary, the policy states that preference will be given to on-site and in-kind replacement of acreage and function.

Department wetland protection procedures do not require buffers for wetlands under 0.25 acre in size. This limitation was based on operational feasibility, because wetlands under 0.25 acre are difficult to find on an air photo. This 0.25 acre exemption applies only to buffers, and does *not* mean, for instance, that roads can be built across wetlands if less than 0.25 acre is filled, or that functional impacts to less than 0.25 acre of a larger wetland are acceptable without mitigation.

Road building around wetlands can pose particular problems. The HCP and FRP state that there will not be road building in wetlands without mitigation. DNR road network implementation procedures identify action steps in road layout and design for road sensitive areas, including wetlands.

Mitigation plans need to include an assessment of the wetland functions and values that are to be lost through the project, and a description of how those functions and any acreage lost are to be restored. Consult region engineers early in the planning phase concerning economic analysis, mitigation and monitoring requirements, to ensure that existing wetland functions and acreage are maintained over time. Region engineers will seek guidance from wetland professionals as necessary.

Salvage logging

Salvage operations are permitted in forested wetlands (except bogs) in areas where there is not evidence of prolonged and periodic flooding. As with any management activity within wetlands, ground disturbance should be avoided as much as possible.

Forested wetlands

Harvesting is permitted in forested wetlands and their buffers under the HCP and FRP, as long as harvest is designed to maintain and perpetuate a stand that is as windfirm as possible, and retains at least 120 ft^2 of basal area per acre. The most windfirm trees are generally the dominant and codominant conifers.

The purpose of the leave trees is to maintain a canopy and large root systems for the uptake and evapotranspiration of ground water, in order to maintain the natural hydrology of the wetland.

Mineral springs

Mineral springs are an important habitat element for band-tailed pigeons. Activities within 200 feet of mineral springs must be planned in cooperation with the U.S. Department of Fish and Wildlife to ensure wildlife needs are met.

Seeps

Seeps over 0.25 acre will be treated as forested wetlands. Those under 0.25 acre will receive the same protection as type 5 streams. At the time of writing, this means that buffers should be placed around seeps if necessary to protect fisheries, water quality, bank stability or other important elements of the aquatic system. For instance, if a seep is part of the inflow of a wetland or other aquatic system, or if it occurs on an unstable slope, it should be buffered however necessary to protect downstream ecosystems.

Research on the effects of management activities on type 5 waters may yield new guidelines for their management in the future, but for now, the protection of seeps relies on professional judgment.

Steps in Implementing the FRP and HCP for Wetlands

1) Identify the wetland

a) Read *Applying wetland criteria* in *Recognizing Wetlands*. Confirm that you can observe at least one of the field indicators for each of the wetland criteria.

b) Confirm that it meets the Forest Practices wetland definition. (Also see *Defining wetlands* in *Recognizing Wetlands.*)

c) Determine the wetland type, and find out if there are special management considerations for this wetland type (see *Recognizing wetland types* in *Recognizing Wetlands*).

2) Locate the wetland boundary

a) When locating a wetland boundary, remember that it is a water body. Wetlands follow intuitive drainage patterns, although the water may be beneath the surface much of the year.

b) Use the guidelines and technical criteria in the Forest Practices Board Manual, pages M43-66.

c) Note location and type of all inflows and outflows. Is drainage channelized or occupying a broad swale? Is it surface or subsurface drainage? Is there a hydraulic connection to other aquatic systems downstream? The answers to these questions will help you design an effective buffer. See *Considerations for buffer placement* in *Recognizing Wetlands*.

d) Estimate the wetland size. If it is close to either 0.25 acre or 1 acre measure the wetland because of the regulatory consequences under the FRP and HCP.

3) Design the buffer

a) Use the method described under Buffers (above, page 3) to determine the buffer width if the wetland is 1 acre or greater (see *Appendix B1* for determining height at 100 years). If the wetland is greater than 0.25 acre and less than 1 acre, the buffer will be

100 feet wide, measured in horizontal distance perpendicular to the wetland edge (see *Appendix B4* for aid in converting slope distance to horizontal distance).

b) Include in the buffer any areas you discovered in step 2c that may require extra protection to avoid negative impacts to wetland hydrology, or other aspects of wetland function (see *Considerations for buffer placement* in *Recognizing Wetlands*).

c) Evaluate the adequacy of protection afforded by the required buffer. Step back and imagine how the water flows through the wetland and consider the objectives of the buffer function and placement. Do the buffers fall in areas where they will not contribute to the stability of the wetland? Are there significant small isolated wetlands that are not encompassed by the buffer? You have the flexibility under the HCP to position the buffer area for the wetland's maximum benefit. If the buffer does not encompass small isolated wetlands that you feel may have some importance, consider clumping some leave trees to give the wetlands some protection.

4) Design management activities

a) In forested wetlands and buffers, measure the basal area of the most windfirm dominant and codominant conifers. At least 120 ft^2 of basal area per acre of these most robust and windfirm trees must be maintained (see *Appendix B3* for aid in determining leave tree basal area). In windthrow prone areas, consider leaving extra trees in buffers and wetlands to anticipate future windthrow.

b) In considering the specific thinning within forested wetlands and wetland buffers remember the target of 120 ft^2 per acre basal area is a minimum average. Small patch cuts and various levels of thinning need to be considered in concert with unmanaged forest to best reach the conservation goal of developing and maintaining wetland forest and buffer canopy integrity and also provide habitat complexity. Consider using variable density thinning to achieve conservation goals and provide operational flexibility.

c) Avoid ground disturbance such as compaction and rutting in wetlands and their buffers (see Ground disturbance, pg. 3).

Wetland drainage must be restored to its natural condition if it is altered in the course of management activities.

d) Be sure that any new roads are designed to avoid impacts to wetland hydrology. Culvert placement is very important. No roads can be built in wetlands or their buffers without mitigation.

e) If the wetland is a bog, consider clustering leave trees up slope of the wetland, to avoid releasing sediments from harvest activities into the wetland (see *Recognizing wetland types* in *Recognizing Wetlands*). Do not harvest trees from within bogs.

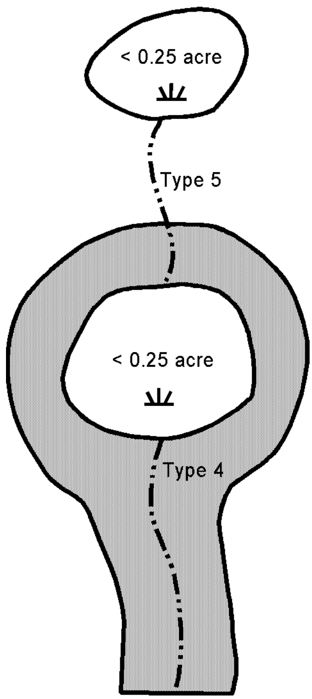
f) Salvage operations are permitted in wetlands that are not periodically flooded with surface water. Do not salvage timber from bogs.

g) Activities within 200 feet of mineral springs must be coordinated with the U.S. Department of Fish and Wildlife to ensure the needs of wildlife are adequately met.

h) Seeps greater than 0.25 acre will be treated as forested wetlands. Those under a quarter of an acre will be given the same consideration as type 5 streams (see *Forest Resource Plan,* page 35).

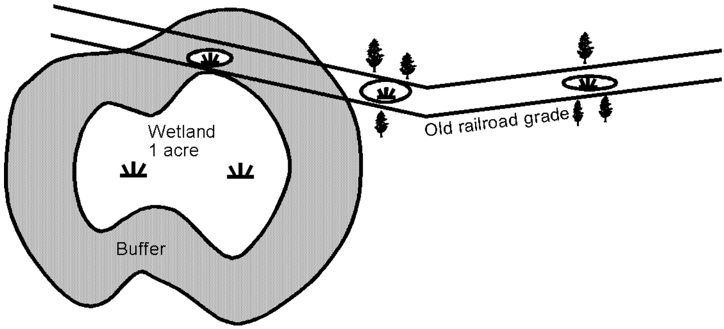
Forested wetland with skunk cabbage understory. RICHARD BIGLEY.

Illustrations of Selected Management Scenarios



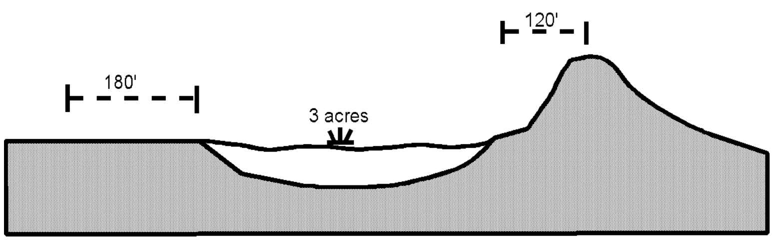
Example 1: Small wetlands associated with surface waters

If wetlands <0.25 acre are associated by a surface connection to a protected stream, extend the buffer (shaded area) of the stream to include the wetland. Use the same buffer width as is used on the stream, measured from the wetland's high water mark. Protect other small (<0.25 acre) wetlands as you would type 5 streams to ensure water quality and fish and other wildlife habitat as needed. Keep ground equipment from type 5 streams and unprotected wetlands. (Drawing not to scale.)



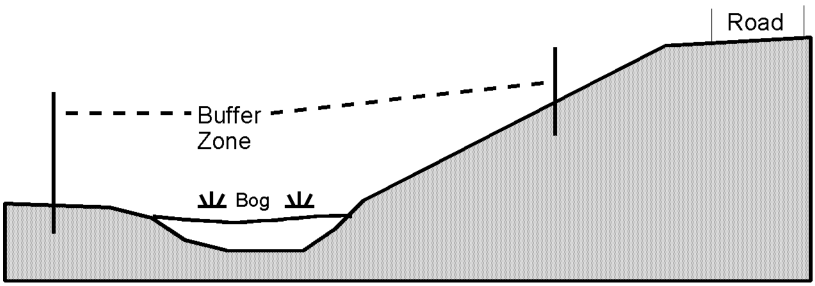
Example 2: Abandoned road beds impound water

The old railroad grade has small patches of wetland every 60 feet. These wetlands are smaller than 0.25 acre and probably result from historic soil compaction on the railroad grade. Less than 50% of the railroad grade is wetland. If possible, clump leave trees around the small isolated wetlands on the railroad grade, to avoid the inadvertant creation of more wetlands and promoting overland flow. No specific buffering is required for these isolated wetlands because of their size. (Drawing not to scale.)



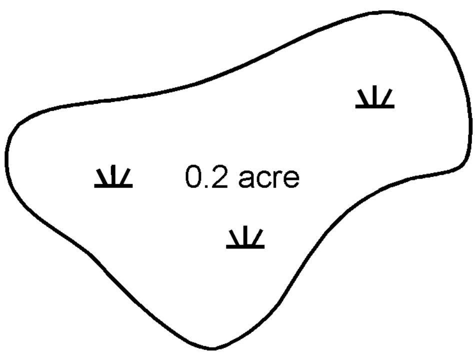
Example 3: Topographic breaks within wetland buffers

Based on the site index, the dominant trees in the stand adjacent to this wetland will be 150 feet tall at 100 years of age. The HCP buffer requirement would be a 150 foot buffer around this 3 acre wetland. The horizontal distance to the top of the hill is 120 feet. Buffer located beyond the crest of the hill may contribute to habitat benefits of the buffer, but is unlikely to serve any of the intended hydrological functions. Managers should consider reducing the buffer dimension to the crest of the hill and compensating with added area on the remaining buffer, or opting not to harvest within the buffer. (Drawing not to scale.)



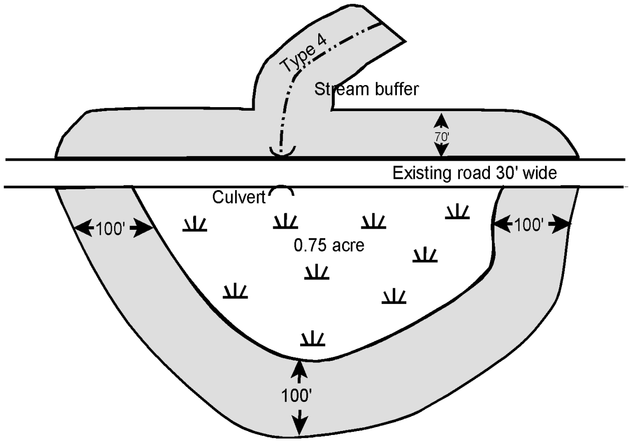
Example 4: Protecting bogs from ground disturbance

Bogs are sensitive to overland flow. Managers should consider expanding buffers on the upslope side of bogs to increase filtration of runoff from road or harvest activities. (Drawing not to scale.)



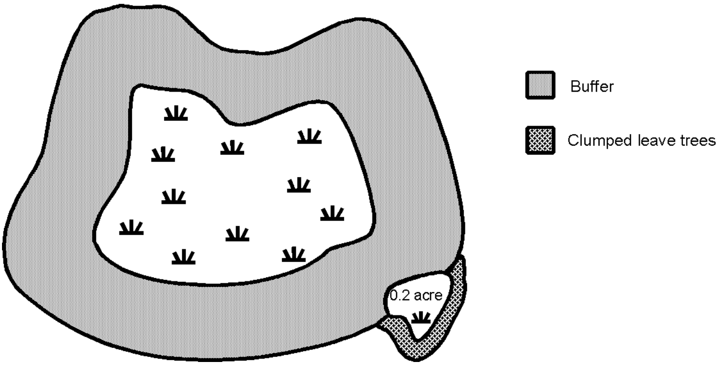
Example 5: Small isolated wetlands

This small, isolated wetland is under 0.25 acre in size, and is not required to have a buffer under the HCP. If possible, clump leave trees around the perimeter to help maintain the soil and water table recharge and discharge relationships and protect soil and vegetation at the wetland edge. (Drawing not to scale.)



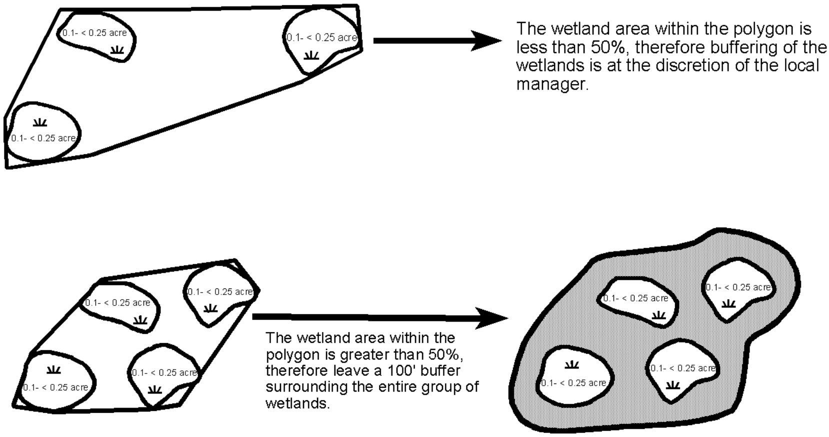
Example 6: Wetlands bordering roads

This wetland was inadvertantly created during road construction. A wetland buffer on the opposite side of the road from the wetland is required by the HCP so that the outer edge of the buffer is a minimum of 100 feet from the wetland edge. (Drawing not to scale.)



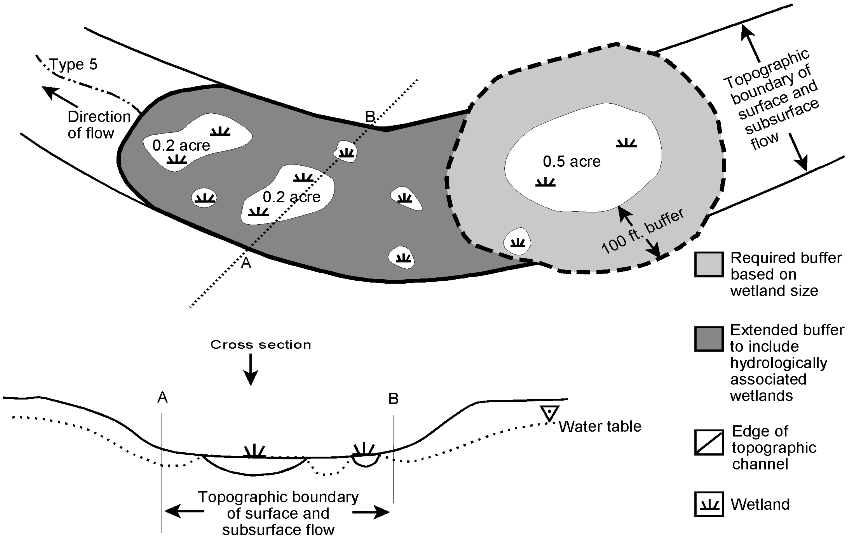
Example 7: Wetlands contiguous with wetland buffers

A small wetland laps over the edge of the wetland buffer. Managers should consider extending the buffer to include the small wetland, or clumping leave trees on the outer edge to protect water quality and reduce soil displacement. (Drawing not to scale.)



Example 8: Small associated wetlands

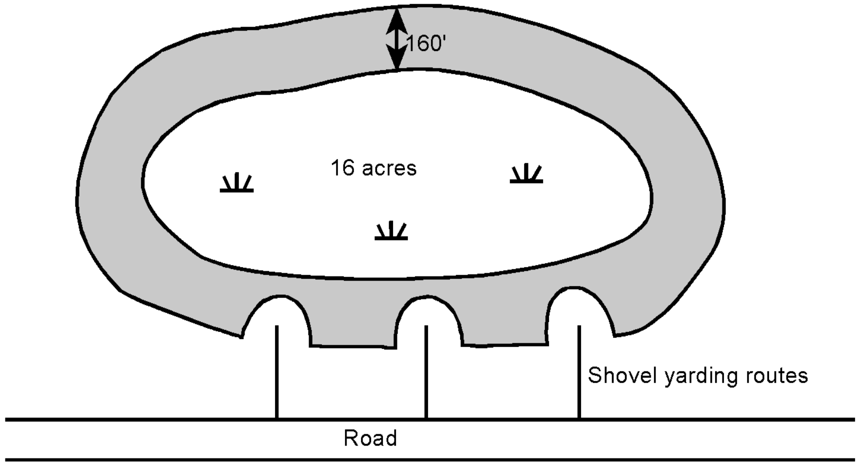
Without extensive study, it is not possible to determine to what extent closely situated wetlands are hydrologically connected and what impact timber harvest and ground traffic have on water flow and quality. In the absence of scientifically based guidance, protect groups of wetlands between 0.1 and 0.25 acre by measuring the area that encompasses the group of wetlands. If the wetland area within the polygon containing wetlands is greater than 50% of the total area, then protect the wetlands by leaving a 100 foot buffer around the entire group of wetlands. The above figures are two separate examples of this idea. (Drawing not to scale.)



Example 9: Small associated wetlands

This topographic channel is a headwater area, characterized by seasonal surface and year-round subsurface flow. The 0.5 acre wetland requires a 100 foot buffer because its size exceeds 0.25 acre. The 50% wetland area rule (see example 8) applies to some parts of the area included in the extended buffer. The remaining wetlands are included in this buffer because they are hydrologically all part of the same watercourse, and within close proximity of each other.

The objective of this extended buffer is to avoid disrupting waterflow through the soil. Soil disturbance in this case could easily force subsurface water to the surface. Harvesting is allowed within the buffer to a minimum of 120 ft^2 of basal area per acre of buffer. No ground equipment should enter the required or extended buffer area. (Drawing not to scale.)



Example 10: Patch thinning in wetland buffers

When harvesting timber from wetland buffers, it may be advantageous in some cases to thin patches within the buffer rather than thin the buffer uniformly. Some individual areas within the thinned buffer may end up with less than 120 ft^2 of basal area per acre, but the average basal area in the buffer as a whole will be at least 120 ft^2 per acre.

This approach has several advantages:

- It can minimize ground equipment in the outer buffer
- It allows the harvest of problem areas such as root rot pockets
- It leaves some areas in the buffer undisturbed
- It allows a more efficient harvest design

Ground equipment must be kept at least 50 feet from the wetland edge. (Drawing not to scale.)

Appendix A: Complete language of DNR wetland regulations and policies

FOREST RESOURCES PLAN POLICY NO. 21: WETLANDS[1]

The department will allow no overall net loss of naturally occurring wetland acreage and function.

DISCUSSION

This policy represents a continuation of current department policy, adopted in 1991.

Wetlands are transition areas between water and land, where the water is at or near the surface of the soil. Some wetlands, such as marshes and estuaries, are easy to identify, while others are less obvious and may require knowledge of plants or soil testing to provide positive identification.

Wetlands have many functions and values, including flood water storage, fish and wildlife habitat and plant diversity. The area of wetlands on state forest lands varies with each region.

In January 1991, the department adopted a policy of "no overall net loss of wetlands on state lands." The department's policy recognizes that some loss of function may occur in the course of its forest management activities. The policy emphasizes avoiding the loss of wetlands and allows for mitigation of loss if it occurs. If mitigation is necessary, preference will be given to on-site and in-kind replacement of acreage and function.

1 Forest Resource Plan, 1992. Pg. 36.

HABITAT CONSERVATION PLAN RIPARIAN CONSERVATION STRATEGY FOR FIVE WEST–SIDE PLANNING UNITS

Wetlands Protection[2]

Management activities in and around wetlands shall be consistent with the Forest Resource Plan policy No. 21 (DNR 1992 p. 36) which states that DNR "will allow no overall net loss of naturally occurring acreage and function". The primary conservation objective of the wetlands protection strategy is to maintain hydrologic function. This will be achieved through:

(1) continuously maintaining a plant canopy that provides a sufficient transpiration surface and established rooting;

(2) maintaining natural water flow (e.g. no channelization of surface or subsurface water flow); and

(3) ensuring stand regeneration.

The primary wetland functions that will be protected are the augmentation of stream flow during low-flow seasons and the attenuation of storm peak flow.

Wetlands to receive protection are those that fit the definition used by the state Forest Practices Rules (WAC 222-16-010). All wetlands 0.25 acre or larger shall be protected by a buffer. The minimum size of wetlands to be protected was based on operational feasibility because wetlands smaller than this are difficult to locate. Wetlands that are larger than one acre shall have a buffer width approximately equal to the site potential tree height of trees in a mature conifer stand or 100 feet, whichever is greater. For the purposes of this HCP, the height shall be derived from standard site index tables (King, 1966) using 100 years as the age at breast height of a mature conifer stand. Wetlands from 0.25 acre to 1 acre shall have a 100 foot wide buffer. In the field, the width of the wetlands buffer shall be measured as the horizontal distance from, and perpendicular to, the edge of the wetland. Seeps and wetlands smaller than 0.25 acre will be afforded the same protection as Type 5 waters. That is, such

2 Habitat Conservation Plan, 1997. Pg. IV 69.

features will be protected where part of an unstable hillslope. Research to study the effects on aquatic resources of forest management in and around seeps and small wetlands will be included in research programs for Type 5 waters.

Timber harvest within the forested portions of forested wetlands and wetland buffer areas shall be designed to maintain and perpetuate a stand that:

(1) is as wind-firm as possible;

(2) has large root systems to maintain the uptake and transpiration of ground water; and

(3) has a minimum basal area of 120 ft^2 per acre.

No road building shall occur in wetlands or wetland buffers without mitigation. Roads constructed within wetlands or wetland buffers shall require on-site and in-kind equal acreage mitigation in accordance with DNR's wetland policy. The effects on natural surface and subsurface drainage shall be minimized.

Forestry operations in wetlands and wetland buffers shall be in accordance with DNR's policy of no overall net loss of wetland function. Forest management in forested wetlands and in buffers of nonforested wetlands will minimize entries into these areas and utilize practices that minimize disturbance, such as directional felling of timber away from wetlands and using equipment that causes minimal soil disturbance (e.g. tractors with low pressure tires). If ground disturbance caused by forest management activities alters the natural surface or subsurface drainage of a wetland, then restoration of the natural drainage shall be required. Soil compaction and rutting usually preclude the use of ground-based equipment in wetland areas. Salvage operations will be allowed within wetland buffers in areas that are not periodically flooded.

Appendix B: Buffer Design

APPENDIX B.1: SITE INDEX TABLES FOR BUFFER WIDTH DETERMINATIONS

DOUGLAS FIR
Eastern Washington
50-year site index table
Source: Cochran, 1979

Breast Height Age	Site index						
	50	60	70	80	90	100	110
10	10.6	10.7	10.8	10.9	11.1	11.2	11.3
12	16.7	18.5	20.3	22.2	24.0	25.8	27.6
14	18.2	20.7	23.1	25.6	28.0	30.5	32.9
16	19.9	23.0	26.0	29.1	32.1	35.2	38.3
18	21.6	25.3	28.9	32.6	36.2	39.8	43.5
20	23.4	27.6	31.8	36.0	40.2	44.4	48.6
22	25.3	30.0	34.7	39.5	44.2	48.9	53.6
24	27.1	32.4	37.6	42.8	48.0	53.2	58.5
26	29.0	34.7	40.4	46.1	51.8	57.5	63.2
28	30.9	37.0	43.2	49.3	55.5	61.6	67.8
30	32.7	39.3	45.9	52.5	59.1	65.7	72.3
32	34.6	41.6	48.6	55.6	62.6	69.6	76.6
34	36.4	43.8	51.2	58.6	66.0	73.4	80.8
36	38.2	46.0	53.8	61.5	69.3	77.1	84.9
38	40.0	48.1	56.3	64.4	72.5	80.7	88.8
40	41.7	50.2	58.7	67.2	75.7	84.2	92.7
42	43.5	52.3	61.1	69.9	78.7	87.6	96.4
44	45.1	54.3	63.4	72.5	81.6	90.8	99.9
46	46.8	56.3	65.7	75.1	84.6	94.0	103.5
48	48.4	58.4	67.8	77.6	87.3	97.0	106.7
50	50.0	60.0	70.0	80.0	90.0	100.0	110.0
52	51.5	61.8	72.1	82.3	92.6	102.8	113.1
54	53.0	63.5	74.1	84.6	95.1	105.6	116.1
56	54.5	65.2	76.0	86.7	97.5	108.2	119.0
58	55.9	66.9	77.9	88.9	99.9	110.8	121.8
60	57.3	68.5	79.7	90.9	102.1	113.3	124.5
62	58.7	70.1	81.5	92.9	104.3	115.7	127.1
64	60.0	71.6	83.2	94.8	106.4	118.1	129.7
66	61.3	73.1	84.9	96.8	108.6	120.4	132.2
68	62.5	74.5	86.5	98.5	110.5	122.5	134.5
70	63.7	75.9	88.1	100.2	112.4	124.5	136.7
72	64.9	77.2	89.6	101.9	114.2	126.6	138.9
74	66.1	78.5	91.0	103.5	116.0	128.5	141.0
76	67.1	79.8	92.4	105.1	117.7	130.3	143.0
78	67.9	80.6	93.3	106.1	118.8	131.5	144.2
80	69.2	82.2	95.1	108.0	121.0	133.9	146.8
82	70.2	83.3	96.3	109.4	122.5	135.5	148.6
84	71.2	84.4	97.6	110.8	124.0	137.1	150.3
86	72.1	85.4	98.7	112.0	125.4	138.7	152.0
88	73.0	86.5	99.9	113.3	126.7	140.2	153.6
90	73.9	87.4	101.0	114.5	128.0	141.6	155.1
92	74.7	88.4	102.0	115.7	129.3	143.0	156.6
94	75.5	89.3	103.0	116.8	130.5	144.3	158.0
96	76.3	90.2	104.0	117.9	131.7	145.6	159.4
98	77.0	91.0	104.9	118.9	132.8	146.7	160.7
100	77.8	91.8	105.8	119.8	133.9	147.9	161.9

PONDEROSA PINE Eastern Washington 100-year site index table Source: Barrett, 1978								
Breast Height Age	Site Index							
	70	80	90	100	110	120	130	140
20	21.0	24.2	27.5	30.7	34.0	37.2	40.5	43.7
22	22.6	26.2	29.8	33.4	37.0	40.6	44.2	47.8
24	24.3	28.2	32.1	36.0	39.9	43.8	47.7	51.6
26	26.0	30.2	34.4	38.6	42.8	47.0	51.2	55.4
28	27.7	32.2	36.7	41.2	45.7	50.1	54.6	59.1
30	29.5	34.2	39.0	43.7	48.5	53.2	58.0	62.7
32	31.2	36.2	41.2	46.2	51.2	56.2	61.2	66.2
34	32.8	38.1	43.3	48.6	53.8	59.0	64.3	69.5
36	34.5	40.0	45.4	50.9	56.4	61.9	67.3	72.8
38	36.1	41.8	47.5	53.2	58.9	64.6	70.3	76.0
40	37.8	43.7	49.6	55.5	61.4	67.3	73.3	79.2
42	39.4	45.5	51.6	57.7	63.8	69.9	76.0	82.1
44	40.9	47.2	53.5	59.9	66.2	72.5	78.8	85.1
46	42.4	48.9	55.4	61.8	68.3	74.8	81.3	87.8
48	43.9	50.6	57.3	63.9	70.6	77.3	84.0	90.7
50	45.3	52.2	59.0	65.9	72.7	79.6	86.4	93.3
52	46.7	53.7	60.7	67.8	74.8	81.8	88.8	95.8
54	48.1	55.3	62.5	69.7	76.9	84.0	91.2	98.4
56	49.4	56.8	64.1	71.5	78.8	86.2	93.5	100.9
58	50.7	58.2	65.7	73.2	80.7	88.2	95.7	103.2
60	52.0	59.6	67.3	75.0	82.6	90.3	97.9	105.6
62	53.2	61.0	68.8	76.6	84.4	92.2	100.0	107.8
64	54.3	62.3	70.2	78.1	86.1	94.0	102.0	109.9
66	55.5	63.6	71.6	79.7	87.8	95.9	104.0	112.0
68	56.6	64.8	73.1	81.3	89.5	97.7	105.9	114.2
70	57.7	66.0	74.4	82.7	91.1	99.4	107.8	116.1
72	58.7	67.2	75.7	84.2	92.6	101.1	109.6	118.1
74	59.7	68.3	76.9	85.5	94.1	102.7	111.3	119.9
76	60.7	69.4	78.2	86.9	95.6	104.4	113.1	121.8
78	61.7	70.5	79.4	88.2	97.1	105.9	114.8	123.6
80	62.5	71.5	80.4	89.4	98.4	107.3	116.3	125.2
82	63.4	72.5	81.6	90.7	99.7	108.8	117.9	127.0
84	64.3	73.5	82.6	91.8	101.0	110.2	119.4	128.6
86	65.1	74.4	83.7	93.0	102.3	111.6	120.9	130.2
88	65.8	75.2	84.6	94.0	103.4	112.8	122.2	131.6
90	66.6	76.1	85.6	95.2	104.7	114.2	123.7	133.2
92	67.3	76.9	86.6	96.2	105.8	115.4	125.0	134.6
94	68.0	77.7	87.5	97.2	106.9	116.6	126.3	136.0
96	68.7	78.5	88.3	98.2	108.0	117.8	127.6	137.4
98	69.4	79.3	89.2	99.1	109.0	119.0	128.9	138.8
100	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0
102	70.6	80.7	90.8	100.9	111.0	121.0	131.1	141.2
104	71.2	81.3	91.5	101.7	111.9	122.1	132.2	142.4
106	71.7	82.0	92.3	102.5	112.8	123.1	133.4	143.6
108	72.3	82.6	93.0	103.4	113.7	124.1	134.4	144.8
110	72.8	83.3	93.7	104.2	114.6	125.1	135.5	146.0
112	73.3	83.8	94.4	104.9	115.4	125.9	136.5	147.0
114	73.8	84.4	95.0	105.6	116.2	126.8	137.4	148.0
116	74.2	84.9	95.6	106.3	117.0	127.7	138.3	149.0
118	74.6	85.4	96.2	107.0	117.7	128.5	139.3	150.0
120	75.1	85.9	96.8	107.6	118.5	129.3	140.2	151.0
122	75.5	86.4	97.4	108.3	119.2	130.1	141.1	152.0
124	75.8	86.8	97.8	108.8	119.8	130.8	141.8	152.8
126	79.2	87.3	98.4	109.5	120.6	131.6	142.7	153.8
128	76.6	87.7	98.9	110.0	121.2	132.3	143.5	154.6
130	76.9	88.1	99.3	110.6	121.8	133.0	144.2	155.4

DOUGLAS FIR
Western Washington
50-year site index table

Source: King, 1966

Breast Height Age	Site Index (top)/Site Class (bottom)									
	60	70	80	90	100	110	120	130	140	150
	V		IV		III		II		I	
6	10.7	11.8	12.9	14.1	15.2	16.5	17.8	19.1	20.5	21.9
8	13.1	14.7	16.3	18.0	19.7	21.5	23.3	25.2	27.2	29.1
10	15.7	17.8	20.0	22.3	24.5	26.8	29.2	31.6	34.1	36.6
12	18.7	21.4	24.1	26.9	29.7	32.5	35.4	38.3	41.3	44.3
14	21.7	24.9	28.2	31.5	34.7	38.1	41.5	44.9	48.3	51.8
16	24.7	28.4	32.1	35.9	39.7	43.5	47.4	51.3	55.2	59.2
18	27.5	31.7	36.0	40.3	44.5	48.8	53.1	57.4	61.8	66.2
20	30.3	35.0	39.7	44.4	49.1	53.9	58.6	63.4	68.2	73.0
22	32.9	38.1	43.3	48.4	53.6	58.8	64.0	69.2	74.4	79.7
24	35.5	41.0	46.7	52.3	57.8	63.5	69.1	74.7	80.3	86.0
26	37.9	43.9	49.9	55.9	61.9	68.0	74.0	80.0	86.0	92.1
28	40.2	46.6	53.1	59.5	65.9	72.3	78.7	85.1	91.5	97.9
30	42.4	49.3	56.1	62.9	69.7	76.4	83.2	90.0	96.8	103.5
32	44.5	51.8	58.9	66.1	73.3	80.4	87.5	94.7	101.8	109.0
34	46.6	54.1	61.7	69.2	76.8	84.2	91.7	99.3	106.7	114.3
36	48.5	56.4	64.3	72.2	80.1	87.9	95.8	103.6	111.4	119.3
38	50.4	58.6	66.8	75.0	83.2	91.4	99.6	107.8	116.0	124.1
40	52.2	60.7	69.3	77.8	86.3	94.8	103.3	111.9	120.4	128.8
42	53.9	62.7	71.6	80.4	89.3	98.1	106.9	115.7	124.6	133.4
44	55.5	64.6	73.8	83.0	92.1	101.3	110.4	119.5	128.6	137.7
46	57.0	66.5	76.0	85.4	94.8	104.3	113.7	123.1	132.5	142.0
48	58.5	68.3	78.0	87.7	97.4	107.2	116.9	126.6	136.3	146.0
50	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0
52	61.4	71.6	81.9	92.1	102.4	112.7	122.9	133.2	143.5	153.8
54	62.7	73.2	83.7	94.3	104.7	115.3	125.8	136.4	147.0	157.5
56	64.0	74.7	85.5	96.2	107.0	117.8	128.6	139.4	150.2	161.1
58	65.2	76.2	87.2	98.2	109.2	120.2	131.3	142.4	153.4	164.5
60	66.4	77.6	88.8	100.1	111.3	122.6	133.9	145.2	156.5	167.9
62	67.5	79.0	90.4	101.9	113.4	124.9	136.4	148.0	159.6	171.1
64	68.6	80.3	91.9	103.6	115.3	127.1	138.8	150.6	162.5	174.3
66	69.7	81.5	93.4	105.3	117.2	129.2	141.2	153.2	165.3	177.4
68	70.7	82.8	94.8	106.9	119.1	131.3	143.4	155.7	168.0	180.4
70	71.7	83.9	96.2	108.5	120.9	133.2	145.7	158.2	170.7	183.3
72	72.6	85.1	97.6	110.0	122.6	135.2	147.8	160.6	173.3	186.1
74	73.6	86.2	98.8	111.5	124.3	137.1	149.9	162.8	175.8	188.8
76	74.5	87.2	100.1	113.0	125.9	138.9	151.9	165.0	178.2	191.4
78	75.3	88.3	101.3	114.4	127.5	140.6	153.9	167.2	180.6	194.0
80	76.2	89.3	102.5	115.7	129.0	142.4	155.8	169.3	182.9	196.5
82	77.0	90.3	103.6	117.0	130.5	144.0	157.6	171.3	185.2	199.0
84	77.8	91.2	104.7	118.3	131.9	145.6	159.4	173.3	187.3	201.4
86	78.5	92.1	105.8	119.5	133.3	147.2	161.2	175.3	189.4	203.7
88	79.2	93.0	106.8	120.7	134.7	148.8	162.9	177.2	191.5	206.0
90	80.0	93.9	107.8	121.9	136.0	150.2	164.5	179.0	193.5	208.2
92	80.7	94.7	108.8	123.0	137.3	151.7	166.2	180.8	195.5	210.3
94	81.3	95.5	109.8	124.1	138.6	153.1	167.7	182.5	197.4	212.4
96	82.0	96.3	110.7	125.2	139.8	154.5	169.3	184.3	199.3	214.5
98	82.6	97.1	111.6	126.2	141.0	155.8	170.8	185.9	201.1	216.5
100	83.2	97.8	112.5	127.2	142.1	157.1	172.2	187.5	202.9	218.4

WESTERN HEMLOCK
Western Washington
50-year site index table
Source: Flewelling, 1995

Breast Height Age	Site Index (top)/Site Class (bottom)								
	70	80	90	100	110	120	130	140	150
	V	IV		III		II		I	
6	8.8	10.3	12.3	14.6	17.2	19.9	22.3	24.6	26.8
8	10.7	12.8	15.5	18.7	22.1	25.7	29.0	32.1	34.9
10	12.7	15.5	18.9	22.8	27.1	31.5	35.6	39.4	42.7
12	14.9	18.3	22.4	27.1	32.2	37.3	42.2	46.4	50.2
14	17.3	21.2	26.0	31.5	37.3	43.2	48.5	53.2	57.5
16	19.7	24.3	29.8	35.9	42.5	49.0	54.7	59.7	64.4
18	22.3	27.5	33.6	40.4	47.7	54.6	60.6	66.0	71.1
20	25.0	30.8	37.5	45.0	52.7	59.9	66.2	72.1	77.6
22	27.8	34.1	41.5	49.6	57.7	65.1	71.7	77.9	83.8
24	30.7	37.6	45.6	54.1	62.4	70.0	77.0	83.5	89.8
26	33.6	41.2	49.7	58.5	66.9	74.8	82.0	88.9	95.5
28	36.7	44.8	53.7	62.7	71.3	79.4	86.9	94.1	101.1
30	39.8	48.4	57.7	66.8	75.5	83.8	91.6	99.1	106.4
32	43.0	52.1	61.5	70.7	79.6	88.1	96.1	103.9	111.5
34	46.2	55.7	65.2	74.5	83.5	92.2	100.5	108.6	116.5
36	49.5	59.1	68.7	78.1	87.3	96.2	104.7	113.0	121.3
38	52.7	62.5	72.1	81.6	90.9	100.0	108.7	117.3	125.9
40	55.9	65.7	75.4	85.0	94.4	103.6	112.6	121.5	130.3
42	58.9	68.8	78.5	88.2	97.7	107.2	116.4	125.5	134.5
44	61.8	71.7	81.6	91.3	101.0	110.6	120.0	129.3	138.6
46	64.7	74.6	84.5	94.3	104.1	113.8	123.4	133.0	142.6
48	67.4	77.3	87.3	97.2	107.1	117.0	126.8	136.6	146.4
50	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0
52	72.5	82.5	92.6	102.7	112.8	122.9	133.1	143.3	153.5
54	74.9	85.0	95.1	105.2	115.4	125.7	136.1	146.5	156.9
56	77.2	87.4	97.6	107.7	118.0	128.5	138.9	149.5	160.2
58	79.5	89.7	99.9	110.1	120.5	131.1	141.7	152.5	163.3
60	81.6	91.9	102.1	112.4	122.9	133.6	144.4	155.3	166.4
62	83.7	94.0	104.3	114.6	125.2	136.0	146.9	158.0	169.3
64	85.7	96.0	106.4	116.8	127.4	138.3	149.4	160.7	172.1
66	87.6	98.0	108.4	118.8	129.5	140.6	151.8	163.2	174.8
68	89.5	99.8	110.3	120.8	131.6	142.7	154.1	165.6	177.4
70	91.3	101.7	112.1	122.7	133.6	144.8	156.3	168.0	179.9
72	93.0	103.4	113.9	124.6	135.5	146.8	158.4	170.2	182.3
74	94.7	105.1	115.6	126.3	137.3	148.7	160.4	172.4	184.6
76	96.3	106.7	117.3	128.0	139.1	150.6	162.4	174.5	186.8
78	97.8	108.3	118.9	129.7	140.8	152.3	164.3	176.5	189.0
80	99.3	109.8	120.4	131.2	142.4	154.1	166.1	178.5	191.1
82	100.7	111.2	121.9	132.8	144.0	155.7	167.9	180.3	193.1
84	102.1	112.6	123.3	134.2	145.5	157.3	169.5	182.1	195.0
86	103.4	114.0	124.7	135.6	146.9	158.8	171.2	183.9	196.8
88	104.6	115.3	126.0	137.0	148.4	160.3	172.7	185.5	198.6
90	105.9	116.5	127.3	138.3	149.7	161.7	174.2	187.2	200.3
92	107.0	117.7	128.5	139.5	151.0	163.1	175.7	188.7	202.0
94	108.2	118.8	129.7	140.7	152.3	164.4	177.1	190.2	203.6
96	109.3	120.0	130.8	141.9	153.5	165.7	178.4	191.6	205.1
98	110.3	121.0	131.9	143.0	154.6	166.9	179.7	193.0	206.6
100	111.3	122.1	133.0	144.1	155.8	168.1	181.0	194.3	208.0

APPENDIX B.2: BUFFER SEGMENT LENGTHS THAT ENCOMPASS 1 ACRE

The following table can be used to determine the horizontal distance of buffer segments that encompass an acre (43,560 ft^2). For example, if a buffer has a horizontal width of 150 feet, 290 linear feet of the buffer is required to equal 1 acre of buffer area. The segment length can be used as a guide for meeting leave tree requirements within the buffer.

Buffer width (ft)	Segment length (ft)[1]
100	436
110	396
120	363
130	335
140	311
150	290
160	272
170	256
180	242
190	229
200	218
210	207
220	198

1 In linear feet to equal one acre

APPENDIX B.3: BASAL AREA BY TREE DIAMETER

Leave tree basal area requirements are intended to be averages for the buffer and affected forested wetland, and need not be rigorously applied to each acre. In cases where variable radius plots might be impractical, tree tallies could be used to mark leave trees.

The following table can be used to determine how many trees must be left in forested wetlands and wetland buffers to satisfy the leave tree requirement of 120 ft^2 of basal area per acre. Tally the diameters of the most windfirm dominant and codominant conifers and determine their area using this table.

Diameter (in)	Area[1] (ft^2)	Diameter (in)	Area[1] (ft^2)	Diameter (in)	Area[1] (ft^2)	Diameter (in)	Area[1] (ft^2)
6.0	0.2	12.5	0.9	19.0	2.0	25.5	3.6
6.5	0.2	13.0	0.9	19.5	2.1	26.0	3.7
7.0	0.3	13.5	1.0	20.0	2.1	26.5	3.8
7.5	0.3	14.0	1.1	20.5	2.3	27.0	4.0
8.0	0.4	14.5	1.2	21.0	2.4	27.5	4.1
8.5	0.4	15.0	1.2	21.5	2.5	28.0	4.3
9.0	0.4	15.5	1.3	22.0	2.6	28.5	4.4
9.5	0.5	16.0	1.4	22.5	2.8	29.0	4.6
10.0	0.6	16.5	1.5	23.0	2.9	29.5	4.8
10.5	0.6	17.0	1.6	23.5	3.0	30.0	4.9
11.0	0.7	17.5	1.7	24.0	3.1		
11.5	0.7	18.0	1.8	24.5	3.3		
12.0	0.8	18.5	1.9	25.0	3.4		

1 Basal area in square feet equals DBH in square inches times 0.005454

APPENDIX B.4: RELATIONSHIP OF BASAL AREA AND SPACING TO RELATIVE DENSITY AND QUADRATIC MEAN DIAMETER

Relative density provides the easiest way to prescribe selective harvesting in appropriate forested wetlands and wetlands buffers. The required leave tree basal area for wetland and wetland buffers falls within existing department thinning guidelines in most situations.

Variable density thinning could prove a good approach to achieving the conservation strategy and providing operational flexibility. The relative density ranges prescribed for heavy thinnings as part of variable density thinnings (see department Forestry Handbook) or for stands consisting of dense small diameter trees, may need additional basal area constraints added to the RD target. Keep the average basal area at or above 120 ft^2 per acre.

The following method allows quick estimation of relative density (RD) or quadratic mean diameter (Dq) of forested wetlands or wetland buffers. Also in this appendix are 1) tables to aid in checking borderline trees while using variable radius plots to determine plot basal area and 2) tables to quickly estimate RD and Dq once basal area and tree density are known.

Quick field method for determining relative density (RD) and quadratic mean diameter (Dq)

1) Tools needed:
   a prism or relaskop
   a rewind diameter tape (50 ft. minimum).

2) Using the same plot center, take:
   a variable plot to determine the basal area per acre
   a fixed radius plot to determine the number of trees per acre

3) Choose either the look up or the calculation technique.

Look up technique (use table on page 27)
   locate basal area on the left column,
   locate trees per acre on the top,
   read the value from the table which is common to your BA and TPA

Calculation technique

Calculate the average basal area per tree (BAPT):

BAPT = BA per acre ÷ TPA,

Calculate the quadratic mean diameter (Dq) of a tree of average basal area:

Dq = the square root of (BAPT ÷ 0.005454)

Calculate the Relative Density (RD):

RD = BA ÷ the square root of Dq

Calculating distance to borderline trees (for use with variable radius plots)

1) Measure the distance from plot center to the *face* of the tree.

2) Measure the tree DBH to the nearest tenth.

3) Multiply the "limiting distance factor" from the table by the DBH.

Basal area factor	Limiting distance factor
10	2.708
20	1.903
30	1.333

4) If the measured distance is *greater* than the calculated distance the tree is *out*. If the measured distance is *less* than the calculated distance the tree is *in*.

Table of fixed plot radii measurements

Acreage of plot	Radius of plot in feet	Acreage of plot	Radius of plot in feet
1	117.8	1/25	23.5
1/2	83.3	1/40	18.6
1/4	58.9	1/50	16.7
1/5	52.7	1/100	11.8
1/10	37.2	1/250	7.45
1/20	26.3		

The formula for calculating fixed plot radii is:

Plot radius equals 117.8 times the square root of the acreage of the plot.

Relationship of Basal Area & Trees/acre or Spacing to Relative Density

Tree/acre & Spacing

Basal Area	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450
	42x42	30x30	24x24	21x21	19x19	17x17	16x16	15x15	14x14	13x13	13x13	12x12	12x12	11x11	11x11	10x10	10x10	10x10
40	10	11	13	14	14	15	16	16	17	17	18	18	18	19	19	19	20	20
60	13	16	17	19	20	21	21	22	23	23	24	24	25	25	26	26	27	27
80	16	19	21	23	24	25	26	27	28	29	30	30	31	31	32	33	33	33
100	19	23	25	27	29	30	31	32	33	34	35	36	36	37	38	38	39	40
120	22	26	29	31	33	34	36	37	38	39	40	41	42	43	43	44	45	45
140	25	29	33	35	37	39	40	42	43	44	45	46	47	48	49	49	50	51
160	27	33	36	39	41	43	44	46	47	49	50	51	52	53	54	55	56	56
180	30	36	39	42	45	47	49	50	52	53	54	56	57	58	59	60	61	62
200	32	38	43	46	48	51	53	54	56	57	59	60	61	63	64	65	66	67
220	35	41	46	49	52	54	56	58	60	62	63	64	66	67	68	69	70	71
240	37	44	49	52	55	58	60	62	64	66	67	69	70	72	73	74	75	76
260	39	47	52	56	59	62	64	66	68	70	72	73	75	76	77	79	80	81
280	42	49	55	59	62	65	68	70	72	74	76	77	79	80	82	83	84	86
300	44	52	58	62	66	69	71	74	76	78	80	82	83	85	86	88	89	90
320	46	55	61	65	69	72	75	77	80	82	84	86	87	89	90	92	93	95
340	48	57	63	68	72	75	78	81	83	86	88	90	91	93	95	96	98	99
360	50	60	66	71	75	79	82	84	87	89	91	93	95	97	99	100	102	103
380	52	62	69	74	78	82	85	88	91	93	95	97	99	101	103	105	106	108
400	54	65	72	77	81	85	88	91	94	97	99	101	103	105	107	109	110	112

Relationship of Basal Area & Trees/acre or Spacing to Quadratic Mean Diameter (Dq).

Tree/acre & Spacing

Basal Area	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450
	42x42	30x30	24x24	21x21	19x19	17x17	16x16	15x15	14x14	13x13	13x13	12x12	12x12	11x11	11x11	10x10	10x10	10x10
40	17.1	12.1	9.9	8.6	7.7	7.0	6.5	6.1	5.7	5.4	5.2	4.9	4.8	4.6	4.4	4.3	4.2	4.0
60	21.0	14.8	12.1	10.5	9.4	8.6	7.9	7.4	7.0	6.6	6.3	6.1	5.8	5.6	5.4	5.2	5.1	4.9
80	24.2	17.1	14.0	12.1	10.8	9.9	9.2	8.6	8.1	7.7	7.3	7.0	6.7	6.5	6.3	6.1	5.9	5.7
100	27.1	19.1	15.6	13.5	12.1	11.1	10.2	9.6	9.0	8.6	8.2	7.8	7.5	7.2	7.0	6.8	6.6	6.4
120	29.7	21.0	17.1	14.8	13.3	12.1	11.2	10.5	9.9	9.4	8.9	8.6	8.2	7.9	7.7	7.4	7.2	7.0
140	32.0	22.7	18.5	16.0	14.3	13.1	12.1	11.3	10.7	10.1	9.7	9.3	8.9	8.6	8.3	8.0	7.8	7.6
160	34.3	24.2	19.8	17.1	15.3	14.0	12.9	12.1	11.4	10.8	10.3	9.9	9.5	9.2	8.8	8.6	8.3	8.1
180	36.3	25.7	21.0	18.2	16.2	14.8	13.7	12.8	12.1	11.5	11.0	10.5	10.1	9.7	9.4	9.1	8.8	8.6
200	38.3	27.1	22.1	19.1	17.1	15.6	14.5	13.5	12.8	12.1	11.5	11.1	10.6	10.2	9.9	9.6	9.3	9.0
220	40.2	28.4	23.2	20.1	18.0	16.4	15.2	14.2	13.4	12.7	12.1	11.6	11.1	10.7	10.4	10.0	9.7	9.5
240	42.0	29.7	24.2	21.0	18.8	17.1	15.9	14.8	14.0	13.3	12.6	12.1	11.6	11.2	10.8	10.5	10.2	9.9
260	43.7	30.9	25.2	21.8	19.5	17.8	16.5	15.4	14.6	13.8	13.2	12.6	12.1	11.7	11.3	10.9	10.6	10.3
280	45.3	32.0	26.2	22.7	20.3	18.5	17.1	16.0	15.1	14.3	13.7	13.1	12.6	12.1	11.7	11.3	11.0	10.7
300	46.9	33.2	27.1	23.5	21.0	19.1	17.7	16.6	15.6	14.8	14.1	13.5	13.0	12.5	12.1	11.7	11.4	11.1
320	48.4	34.3	28.0	24.2	21.7	19.8	18.3	17.1	16.1	15.3	14.6	14.0	13.4	12.9	12.5	12.1	11.7	11.4
340	49.9	35.3	28.8	25.0	22.3	20.4	18.9	17.7	16.6	15.8	15.1	14.4	13.8	13.3	12.9	12.5	12.1	11.8
360	51.4	36.3	29.7	25.7	23.0	21.0	19.4	18.2	17.1	16.2	15.5	14.8	14.3	13.7	13.3	12.8	12.5	12.1
380	52.8	37.3	30.5	26.4	23.6	21.6	20.0	18.7	17.6	16.7	15.9	15.2	14.6	14.1	13.6	13.2	12.8	12.4
400	54.2	38.3	31.3	27.1	24.2	22.1	20.5	19.1	18.1	17.1	16.3	15.6	15.0	14.5	14.0	13.5	13.1	12.8

APPENDIX B.5: TABLE FOR CONVERSION OF SLOPE TO HORIZONTAL DISTANCE

Multiply the slope distance by the conversion factor to obtain horizontal distance.

Slope percent	Conversion factor		Slope percent	Conversion factor
5	0.999		58	0.865
10	0.995		60	0.857
15	0.989		62	0.850
20	0.981		64	0.842
22	0.977		66	0.835
24	0.972		68	0.827
26	0.968		70	0.819
28	0.963		72	0.812
30	0.958		74	0.804
32	0.952		76	0.796
34	0.947		78	0.788
36	0.941		80	0.781
38	0.935		82	0.773
40	0.928		84	0.766
42	0.922		86	0.758
44	0.915		88	0.751
46	0.908		90	0.743
48	0.902		92	0.736
50	0.894		94	0.729
52	0.887		96	0.721
54	0.880		98	0.714
56	0.872		100	0.707

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