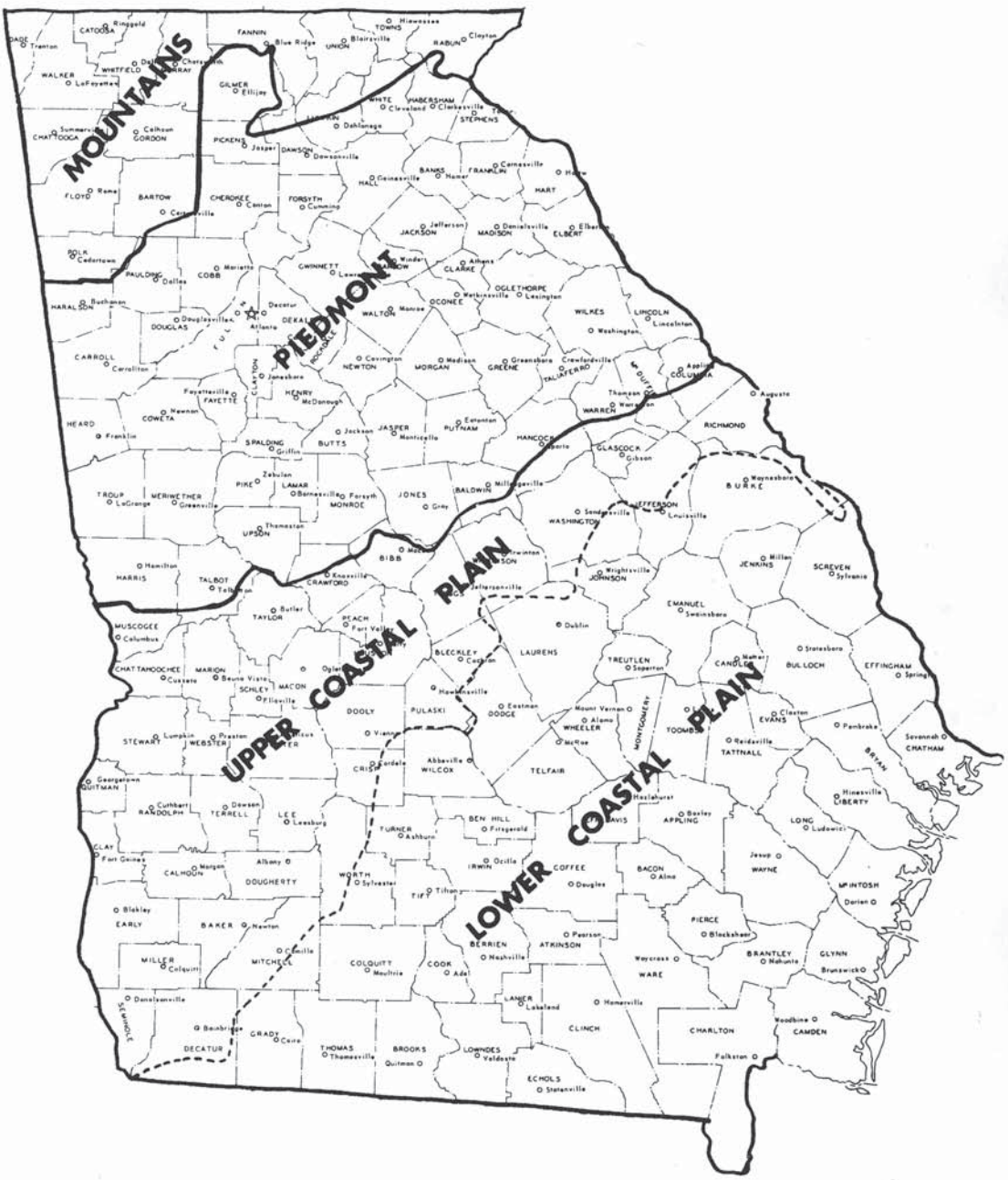
WATER QUALITY
PROGRAM

GEORGIA FORESTRY
COMMISSION

GEORGIA'S
Best Management Practices
for Forestry

Physiographic Regions of Georgia



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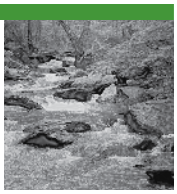

Foreword

Georgia's Best Management Practices for Forestry

The purpose of this manual is to inform landowners, foresters, timber buyers, loggers, *site preparation* and reforestation contractors, and others involved with *silvicultural* operations about common-sense, economical and effective practices to minimize *non-point source pollution* (soil *erosion* and stream sedimentation) and *thermal pollution*. These minimum practices are called **BEST MANAGEMENT PRACTICES** and are commonly referred to as **BMP*s*.** They were initially developed in 1981 by a Forestry N*on-Point Source Pollution* Technical Task Force as required by the Federal Water Pollution Control Act. That act mandated states to develop a program to protect and improve the physical, chemical, and biological integrity of the nation's waters so they remain "fishable" and "swimmable" for today's and future generations.

Due to changes in technology and the rules and regulations governing land disturbing activities, the forestry community and regulators encouraged a revision of the 1981 BMPs. A separate set of wetland BMPs were developed in 1989 which were incorporated into the 1999 comprehensive manual by a similar task force. Since 1999, additional guidance has been developed. This 2009 manual represents the collective best efforts to establish sound, responsible, guiding principles for silvicultural operations in the State of Georgia.

Note: Words in I*talics* are found in the glossary.

Legal justice scale denotes mandated law or requirement.

A "no" symbol indicated practices to avoid.

ACKNOWLEDGMENTS

The Georgia Environmental Protection Division, the Georgia Forestry Commission and the Georgia Forestry Association wish to express appreciation to those organizations and individuals that contributed to the development and review of this publication. These individuals are listed under Contributors and Sources of Information (See page 71).

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MAY 2009

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Section 1.0

Introduction

Georgia's 24.2 million acres of *commercial forests* provide a variety of benefits for the people of the state. In addition to forest products, forests provide clean water, clean air, soil conservation, wildlife habitat, *flora* and *fauna*, and opportunities for recreation, *aesthetics*, education, and research. These forests are managed by landowners with varying objectives and their individual management decisions may be designed to support a broad variety of specific focused benefits related to the list above and others from Section 7.0. Figure 1-A shows the percentage of forest land in the state and Figure 1-B indicates the ownership makeup of that forest land.

Figure 1-A
Georgia's Land Use

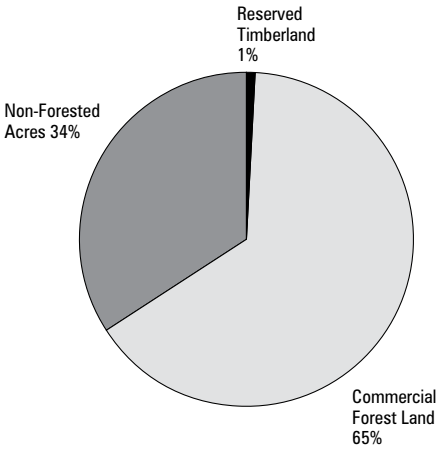
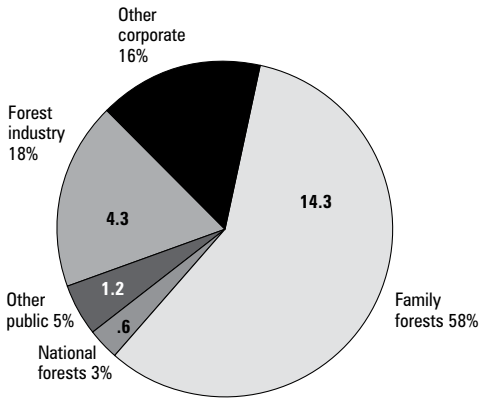


Figure 1-B
Georgia's Commercial Forest Ownership



Note: Numbers on pie chart represent million acres.

Georgia has 44,056 miles of *perennial streams* (approximately 4,000 miles of which are designated as mountain *trout waters*), 23,906 miles of *intermittent streams* and 603 miles of *ditches* and *canals* for a total of 68,565 stream miles. The state also has 425,382 acres of public lakes and reservoirs, 4.8 million acres of *wetlands* (nine percent tidally affected), 854 square miles of *estuaries* and 100 miles of coastline. This document emphasizes the protection of the state's water resources, when conducting forestry operations, through *Best Management Practices* (BMPs) in controlling or minimizing soil *erosion* and stream sedimentation. BMPs are the most appropriate or applicable practices to attain a *silvicultural* goal while protecting the physical, chemical, and biological integrity of the state's waters.

"It is in the best interest of everyone involved in sivicultural operations to properly plan and supervise their operations by consistently following BMPs to prevent any potential water quality problems."

By using proper forest management and sound conservation practices including BMPs, forests can continue to provide benefits for future generations. Failure to follow BMPs may result in civil and criminal fines and penalties. Some counties already require plan reviews, permits, fees, performance bonds and compliance audits. See Appendix 8.3, page 65. Therefore, to prevent any potential water quality problems, it is in the best interest of everyone involved in silvicultural operations to properly plan and supervise their operations. By consistently following BMPs, problems can be avoided or corrected as soon as possible.

Since 1978, the Georgia Forestry Commission (GFC) has been designated by the Georgia Environmental Protection Division (GAEPD) as the lead agency to coordinate the forest water quality program. The program's primary responsibilities include: educating the forestry community on BMPs through training and demonstrations; conducting BMP use and effectiveness monitoring surveys; and investigating and mediating forestry water quality complaints.

For more information about BMPs, contact the Georgia Forestry Commission, P.O. Box 819, Macon, GA, 31202, 1-800-GA-TREES or visit us at www.gatrees.org.

Section 2.0

Planning for Water Quality

Any forest management activity, regardless of potential impact on water quality, should be thoroughly planned. Whether the activity involves seasoned timber buyers or landowners selling timber for the first time, the planning process should address the objectives of the proposed activity as well as potential impacts of all actions that disturb the soil surface or impact water quality. The planning process should help identify sensitive areas and applicable BMPs to be used during timber sales, road construction, stream crossings, harvesting, *site preparation*, reforestation, and *herbicide* applications. The planning process should help identify terms and conditions of a written contract for any forestry practice. While BMPs do not specifically require written plans, it is generally a sound practice to maintain written records of any forest management activity on the land. Plans should include:

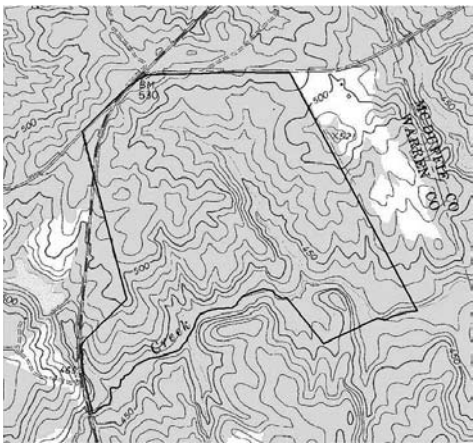
- history of the site including past land use,
- identification of sensitive areas such as *perennial and intermittent streams*, *ephemeral areas*, lakes, ponds, *wetlands*, steep slopes, highly erosive or *hydric soils*, active *gully* systems, etc.,
- regulations and/or permitting requirements and, location, type, timing and logistics of each activity.

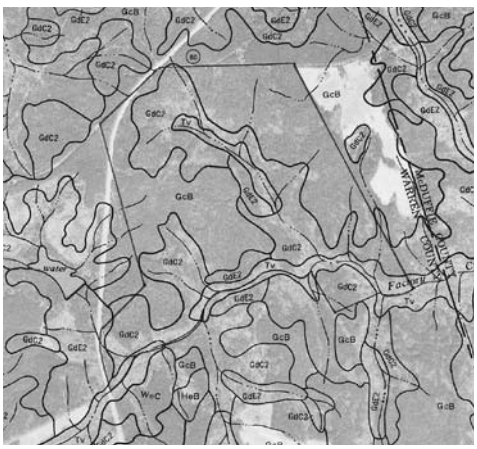
Useful resources for planning forest operations include United States Geologic Survey (USGS) topographic maps, Natural Resource Conservation Service (NRCS) county soil survey maps with interpretations, aerial photographs and tax maps. These maps can help users locate tract boundaries and sensitive areas. Because no map is 100 percent accurate, they should be used as a reference to identify potentially sensitive areas that must then be verified and plotted during field reconnaissance to minimize impacts on them before silvicultural operations begin. Except for tax maps, the GFC maintains these documents at all District Offices. The NRCS maintains soil and topographic maps at local field offices where field personnel can assist in map and resource information interpretation. These maps can be accessed by visiting www.websoilsurvey.nrcs.usda.gov or www.gis.state.ga.us.

Water quality protection begins with recognizing watercourses and water bodies. According to the federal Clean Water Act, "*waters of the* U.S." include lakes, rivers, *perennial* and *intermittent streams*, *wetlands*, *sloughs* or natural ponds. Georgia

law (OCGA 12-7-3.13) defines *"waters of the state"* to mean all rivers, streams, creeks, branches, lakes, reservoirs, ponds, drainage systems, *springs*, wells, and other bodies of surface or subsurface water, natural or artificial, lying within or forming part of the boundaries of the state that are not entirely confined and retained completely upon the property of a single individual, partnership or corporation.

Identifying stream types (*perennial*, *intermittent*, *or ephemeral*) is important in prescribing the level of protection through the implementation of BMPs listed in this manual. USGS topographic maps and NRCS county soil maps can be used as a reference to identify stream types. Where available, they should be cross-referenced and field verified. See Figure 2-A.





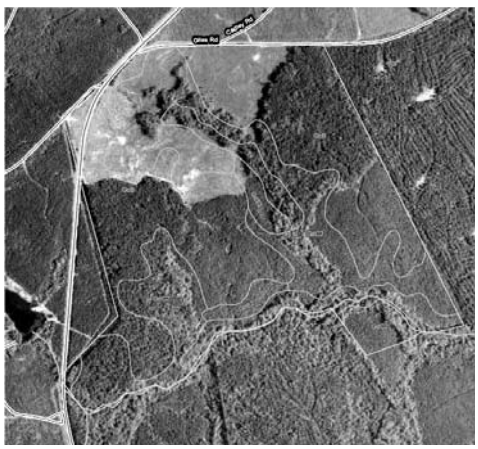


Figure 2-A:
The following examples illustrate the same tract of land showing how streams are identified as they appear in different types of available maps. Left, USGS topo map. Bottom left, NRCS county soil survey map. Bottom right, NRCS web soil survey map.

Stream Types

Perennial streams flow in a well-defined *channel* throughout most of the year under normal climatic conditions. Some may dry up during drought periods or due to excessive upstream uses. They are usually identified as solid blue lines on USGS topographic maps and as either solid black or black lines separated by one dot on NRCS soil maps. Aquatic organisms are normally present and easily found in these streams.

Intermittent streams flow in a well-defined *channel* during wet seasons of the year but not for the entire year. They generally exhibit signs of water velocity sufficient to move soil material, litter and fine debris. They are usually identified as blue lines separated by three dots on USGS topographic maps and as black lines separated by two or more dots on NRCS soil maps. Aquatic organisms often are difficult to find or not present at all in these streams.

Ephemeral areas can direct stormflow into surface waters. Care should be taken to minimize these areas from becoming sources of *pollutants*. For a more detailed description and BMPs for *ephemeral areas*, see page 18.

The landowner or manager may be familiar with a stream's flow characteristics and make the determination of stream type. In some cases there may be uncertainty. For example, *ephemeral areas* may be difficult to locate when they are not actively flowing. In such situations, consult a *qualified professional*.

2.1 STREAMSIDE MANAGEMENT ZONES (SMZs)

Streamside Management Zones (SMZs) are *buffer strips* adjacent to *perennial* or *intermittent streams* or other bodies of water (lakes, ponds, reservoirs, etc.) that should be managed with special considerations to protect water quality. Trees and other vegetation in the SMZ provide shade that buffers water temperatures; woody debris vital to the aquatic ecosystem; natural filtration of *sediment* and other *pollutants* (nutrients and *pesticides*): and travel corridors and habitat for wildlife. SMZs also provide some flood protection by dissipating the velocity of moving water.

When planning and laying out harvest or treatment areas, SMZs should be identified on maps or aerial photos and clearly designated in the field with paint or flagging. You should also identify local, state or federal regulations that may supersede or mandate the use of BMPs, such as those for protected *water-supply reservoirs/watersheds* or *protected river corridors*.

Note: Words in *italics* are found in the glossary.

2.1.1 Perennial and Intermittent Stream SMZ Width Recommendations

There is no uniform formula to determine the appropriate width of an SMZ. In general, however, the steeper the slope and more erosive the soil, the wider the SMZ should be. Slope should be determined at 100-feet perpendicular to the streambank. Therefore, SMZ widths may vary along a stream's course and on opposite sides of the same stream. SMZs should be measured along the ground from the streambank on each side of the stream and not from the centerline of the stream (Refer to Figure 2-B and Table 2-A).

Figure 2-B. Diagram Showing How to Determine Slope

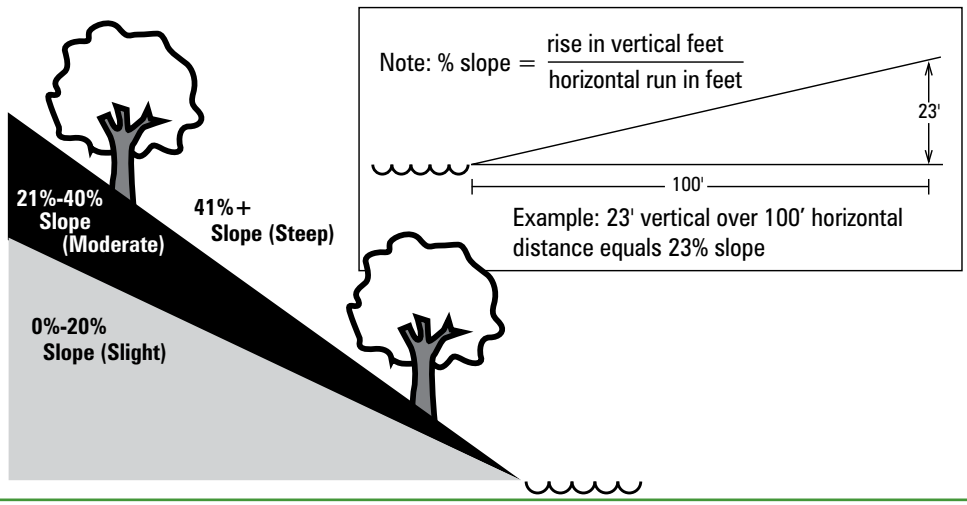


Table 2-A. SMZ Widths by Slope Class and Stream Type

Slope Class	Minimum Width (ft) of SMZ on Each Side		
	Perennial (feet)	Intermittent (feet)	Trout (feet)
Slight (<20%)	40	20	100
Moderate (21%-40%)	70	35	100
Steep (>40%)	100	50	100

Remember that these are recommended minimum widths, and conditions such as unstable or erosive soils or lack of ground cover may warrant a wider SMZ for adequate water quality protection. SMZs also have a limited filtering capacity and are not intended to correct problems created by poor upslope or adjacent practices.

2.1.1.1 BMPs for Perennial and Intermittent Stream SMZs

(Does NOT include trout streams. Trout stream BMPs are discussed in 2.1.2)

Management activities may occur within an SMZ provided that the disturbance to soil or ground cover is minimized. Water quality objectives should prevent movement of soil or other potential *pollutants* from within the SMZ into the watercourse and protect streambank integrity. The BMPs associated with typical *silvicultural* activities are listed below.

- Identify any local, state, or federal regulations that may supersede or mandate the use of BMPs.
- Determine and designate the appropriate SMZ widths on site prior to conducting any timber sale or forest practice.
- Along *perennial streams*, leave an average of 50 square feet of *basal area* per acre evenly distributed throughout the zone or at least 50% *canopy cover* after a harvest to provide shade.
- Along *intermittent streams*, leave an average of 25 square feet of *basal area* per acre evenly distributed throughout the zone or at least 25% *canopy cover* after a harvest to provide shade.
- Minimize stream crossings. (See Section 3.3 page 30 and 4.3 page 40)
- Except at planned stream crossings, locate new *access roads* outside the SMZ.
- Maintain existing roads within SMZs with adequate *water control structures* and stabilization measures as needed. (See Section 3.2 page 27) If not possible, consider relocating road.
- Locate *log decks*, *staging areas*, and *skid trails* outside the SMZ, preferably on well-drained, stable soils.
- Where used, *firebreaks* should be installed parallel to streams and outside SMZs. (See Section 5.5 page 49)
- Minimize the intensity of a *prescribed fire* in the SMZ to maintain forest floor cover and protect the soil surface.

- Periodically inspect the SMZ and evaluate the effectiveness of the BMPs, adjusting practices when necessary.

2.1.1.2 Practices to Avoid Within SMZs of Perennial and Intermittent Streams

- Cutting streambank trees.
- Unnecessary *access roads* and main *skid trails*.
- *Log decks*.
- Portable sawmills.
- Significant soil compaction and rutting by harvesting equipment.
- Removal of ground cover or understory vegetation.
- *Felling* trees into the streambed or leaving *logging debris* in the stream.
- Servicing or refueling equipment.
- Mechanical *site preparation* and *site preparation* burning.
- Mechanical tree planting.
- Broadcast application of *pesticides* or *fertilizers*.
- Handling, mixing, or storing toxic or hazardous materials (fuels, lubricants, solvents, *pesticides*, or *fertilizers*).

2.1.2 Trout Streams

Trout require cool (less than 70°F), high-quality water. They, and the insects they eat, are extremely sensitive to *sediment* and *thermal pollution* (elevated water temperatures). Therefore, *trout streams* require additional protection. Streams designated as Primary Trout Waters are waters supporting a self-sustaining population of rainbow, brown or brook trout. Streams designated as Secondary *Trout Streams* are those in which trout can survive but there is no evidence of natural trout reproduction. The Georgia DNR Wildlife Resources Division publishes a list of Georgia's *trout streams*, available at www.georgiawildlife.com. For regulation purposes, the Georgia EPD maintains a list of *trout streams* at www.gaepd.org.

2.1.2.1 SMZ Width Recommendation and BMPs for Trout Streams

- Establish 100-feet SMZs on both sides of designated streams and tributaries according to the following options:

Option A: A minimum 100-feet SMZ that includes a no-harvest zone within the

first 25-feet of primary or secondary *trout streams*. Timber harvests within the remaining 75-feet of the SMZ should leave an average of 50 square ft of *basal area* per acre or at least 50% *canopy cover*.

Option B: Within the 100-ft. SMZ, leave an average of 50 square feet of *basal area* per acre evenly distributed throughout the zone to provide shade. Option B may be selected if a *qualified professional* is consulted.

- Follow all other BMPs for *perennial* and *intermittent streams* noting the 100-ft. zone.

2.1.2.2 Practices to Avoid Within SMZ of Trout Streams

- Any forestry activity within 25 feet of the stream, unless using Option B.
- Mechanical *site preparation* and high intensity burns on *ephemeral areas* above trout waters.

2.2 SPECIAL MANAGEMENT AREAS

Some water bodies in upland and bottomland areas have particular characteristics or regulatory requirements that require different management approaches. These include, but are not limited to *canals* and *ditches*, *floodplain* features, *headwater* areas, *lakes* and *ponds*, *protected mountain tops*, *protected river corridors*, *sinkholes*, *water supply reservoirs/watersheds*, and *wetlands*. In such situations, consult a *qualified professional*.

2.2.1 Canals and Ditches

Minor drainage to temporarily lower the water level on a wetland site during road construction, timber harvesting and *site preparation* is considered normal and exempt from 404 permitting. Most *canals* were established for flood control purposes prior to Section 404 guidance. Today, the construction of *canals* would most likely be considered major drainage and require Section 404 permits.

Construction of minor drainage *ditches* in wetlands is exempt from Section 404 permitting, provided:

- it does not result in the immediate or gradual conversion of a wetland to a non-wetland;

- it does not facilitate the conversion from one wetland use to another;
- it does not significantly modify a stream, lake, swamp, bog, or any other wetland or aquatic area constituting *waters of the* U.S.;
- it is not located in a SMZ.

2.2.1.1 BMPs for Canals and Ditches

- Maintenance of existing *canals* and *ditches* (C&Ds) is allowed, provided the original dimensions are not exceeded. This is normally conducted at the end of each timber stand rotation.
- In order to conduct maintenance dredging, access for equipment and the placement of spoil materials (sidecasting) is permitted along banks. Therefore, there may not be a tree canopy on one or both sides immediately adjacent to C&Ds.
- D*itches* constructed through non-wetland areas are not normally associated with natural stream *channels*. They dry out and water temperature violations should not be a problem. Therefore, no SMZ with *basal area* requirements is practical.
- Where C&Ds were established in old perennial and *intermittent stream channels* that are now acting as the stream, the establishment of SMZs with *basal area* requirements is appropriate. Evaluate on a case by case basis.
- Maintenance should occur during the dry season to prevent *turbidity* problems. If *sediment* is likely to move from C&Ds into a stream, consideration should be given to stabilization and *sediment* control measures, such as sloping and grassing of *ditch* banks and spoil piles. The need for *sediment* control will be determined by soil type, the distance to a stream, and the amount of vegetated filter between the *ditch* and the stream.

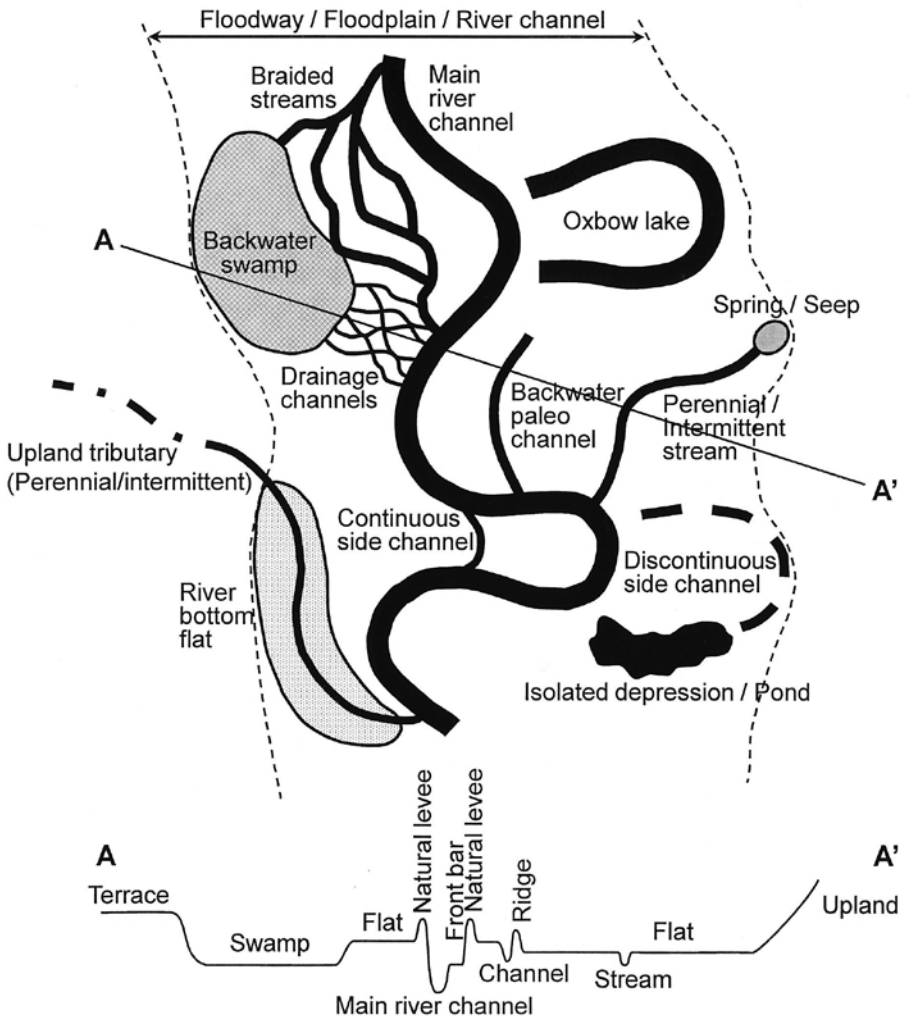
2.2.1.2 Practices to Avoid in Canals and Ditches

- B*edding* that channels surface runoff into C&Ds, including road *ditches*.
- Placing logging and *site preparation* debris in C&Ds.
- Excessive crossings; where necessary, fill over *culverts* should be stabilized.
- Applying chemicals that are not labeled for aquatic applications directly to C&Ds with standing or flowing water.

2.2.2 Floodplain and Riparian Landforms

Floodplains support a wide variety of fluvial features, which perform diverse hydrologic, biological, and ecological functions. The objectives of this guidance are to better characterize floodplain features in terms of *hydrology*, geomorphology, and biology and also to provide better BMP guidance to protect water quality and biological integrity of these features.

Figure 2-C: Schematic of Floodplain Physiographic Features and Elevational Cross-Section



(Modified from Mitsch and Gooselink, 1993 and Hodges, 1998.)

The general goals of this guidance are to:

- Prevent movement of soil, fertilizer, and *herbicide* from forest operation areas into the surface water system.
- Maintain water temperatures and dissolved oxygen levels adequate for biotic survival.
- Maintain input of organic matter and coarse woody debris into water bodies.
- Maintain structural integrity of floodplain features.

Floodplain Features

Overbank mainstem flows, mainstem backwater flow, floodplain groundwater drainage, and tributary inflows create many different features in floodplains (Figure 2-C). Such features include the main river *channel*, upland tributaries, *springs* and *seeps*, *continuous side channels*, *braided streams*, *drainage channels*, *floodway*, *river bottom flats*, *discontinuous side channels*, *backwater paleo channels*, *backwater swamps*, isolated depressions, oxbows/ponds, front bars, natural levees, and ridges. Although many of these features are broadly described as "*sloughs*," there is obviously great variation in their origin and form.

The water quality effects of *silvicultural* activities along these features depend on the flood frequency and durations, flow regime or energy, and the types of forestry operations conducted. All of these factors should be considered when evaluating floodplain management. For example, if a discontinuous side *channel* is rarely connected to *perennial streams*, then it may serve as breeding habitat for amphibians, but is unlikely to serve as fish habitat. In this case, maintaining a stringer of bank trees to protect the stability of the feature and to provide some woody debris input is desired, but a larger *streamside management zone* (SMZ) for shade or for chemical adsorption and filtration is not necessary.

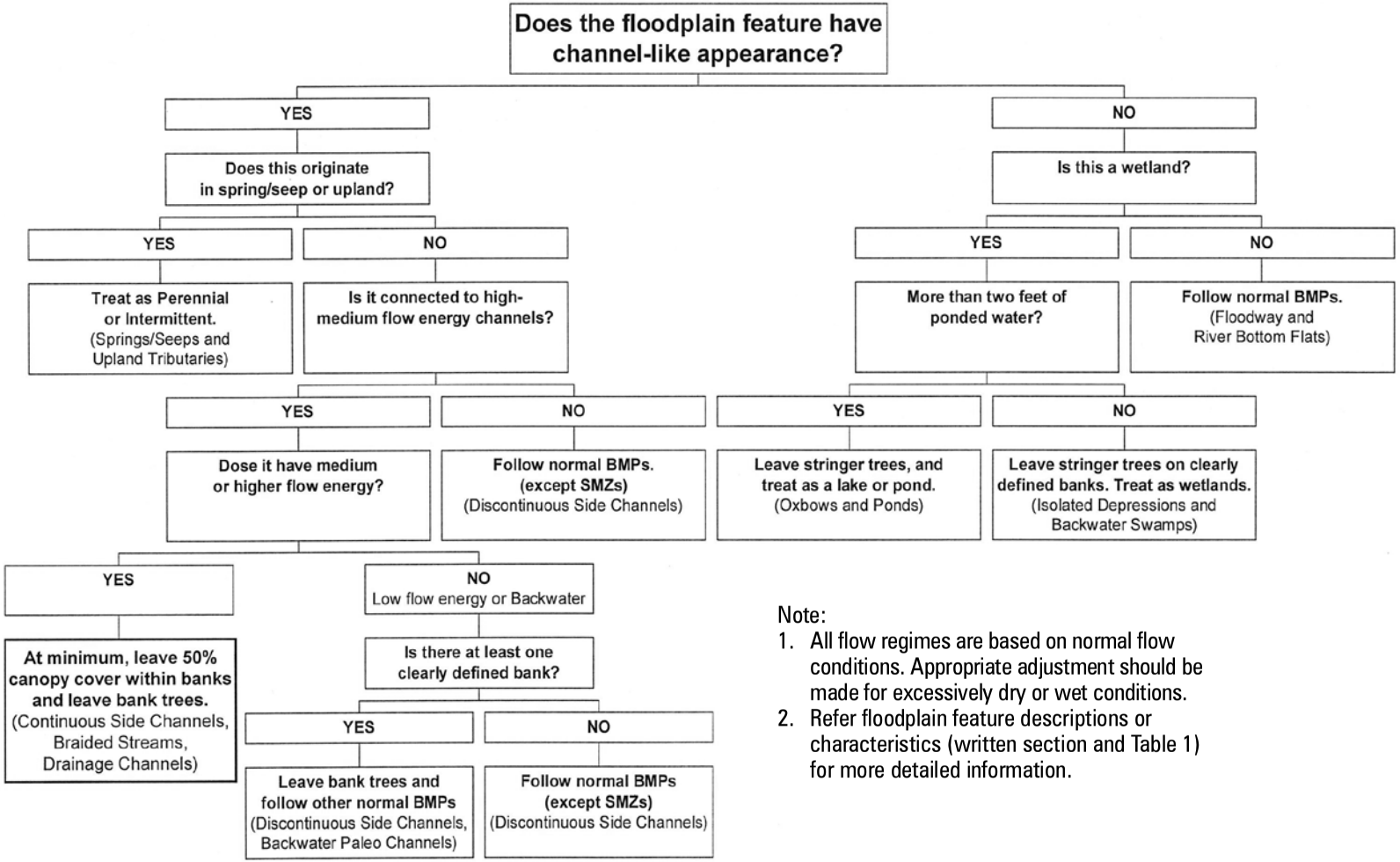
Determining all the relevant water body characteristics in a single site visit can be difficult. For guidance in determining the appropriate floodplain feature, see Figure 2-D. (The corresponding BMPs for each can be found in Table 2-B: Summary Characteristics of Floodplain Features and the Corresponding BMPs, on page 18.) These water types are:

- **Tributaries that originate in uplands and flow across floodplain:** These usually well-defined *channels* with sandy substrate originate in the uplands and flow across the floodplain to the main river in continuous *channel* features.
- **Springs and Seeps:** Water emerges from these features within the flood-

plain and flows all or part of year in most years. *Channel* structure and substrate of *springs* are usually well defined and sandy, but those of *seeps* are less defined and mixed. If they flow all year long, treat them as *perennial streams* or otherwise as intermittent.

- **Continuous side channels and Braided streams:** These less distinct *channels* and banks flow intermittently and are connected to the main *channel* network at both ends. The *channels* often contain mixed substrates (sand, organics, fine *sediments*). Treat each *channel* individually, depending upon whether the stream is *perennial, intermittent or ephemeral*. These unique streams require highly site-specific management planning and recommendations. In some cases, the potential for wind throw of trees left in the SMZ will dictate variances in the removal of the *canopy cover*. Seek the assistance of a *qualified professional*.
- **Drainage channels:** These less distinct *channels* begin on the floodplain and usually flow intermittently during periods of high water tables via a continuous linear drainage system to the main river. The *channels* often contain mixed substrates (sand, organics, fine *sediments*).
- **Floodway and River bottom flats:** Area of floodplain with significant water velocities during frequent overbank flows (flows less than the two-year low flow). Evidence of scour and debris movement can be found. The *floodway* is usually identified on FEMA floodplain maps. Smaller *floodway* or riparian areas in minor streams are also called *river bottom flats*.
- **Discontinuous side channels:** *Channel* features that may or may not be connected, on at least one end, to medium or higher flow energy *channels*. May have distinct or indistinct *channel* features, but the *channel* features disappear and reappear.
- **Backwater paleo channels:** Usually well-defined deep *channel* features that are remnants of earlier river and side *channel* configurations. Mixed *channel* substrates (sand, organics, fine *sediments*). Flow usually backs into these features from the main river. Organic debris is often found piled against the "wrong" side of obstructions.
- **Backwater swamps.** *Backwater swamps* are wetland areas formed in old overflow *channels* on the margins of floodplains at the base of the adjacent slopes. They feature wetland vegetation, *hydric soils*, and fine and organic substrates, but they may show evidence of scour and debris movement.

Figure 2-D. Decision Tree for Application of Forestry Best Management Practices to Floodplain and Riparian Landforms in Georgia.



Note:

1. All flow regimes are based on normal flow conditions. Appropriate adjustment should be made for excessively dry or wet conditions.
2. Refer floodplain feature descriptions or characteristics (written section and Table 1) for more detailed information.

Table 2-B. Summary Characteristics of Floodplain Features and the Corresponding BMPs.

Hydroperiod	Floodplain Feature	Flow Energy[1]	Channel Characteristics (Bank Structures, Substrate Materials, and Other Features)	Biological Values	Floodplain Protection Measures / SMZs[2]	Mechanical Site Prep. w/in SMZs[3]	Herbicide, Fertilizer, and Burning w/in SMZs
Perennial	• **Tributaries originating in uplands and flowing across floodplain** • **Springs**	High-Medium	Well defined channel, sandy substrate.	Aquatic fauna	Perennial stream BMPs	No	Not allowed
Intermittent	• **Tributaries originating in uplands and flowing across floodplain** • **Seeps,** • **Continuous side channels,** • **Braided stream, or** • **Drainage channels**	Medium -Low	Less distinct channel, mixed substrate (sand, organics, fines). These may be connected to the mainstem directly or indirectly.	Aquatic and terrestrial fauna, Off channel rearing habitat, High-flow refugia	For tributaries, intermittent stream BMPs. For other floodplain features, at minimum, leave 50% canopy cover within banks and leave bank trees.	No	Not allowed
Ephemeral	• **Floodway** • **River bottom flats**	High-Medium	Area of floodplain. Occasional evidence of scour and debris movement.	Terrestrial fauna	N/A	Low impact	Avoid
	• **Discontinuous side channels**	Medium -Low	Channels appear and disappear, and may or may not be connected on at least one end.	Terrestrial fauna	Leave bank trees if one end is connected and/or has a clearly defined bank.	Low impact	Avoid
	• **Backwater paleo channels**	Medium -Low	Well defined, deep channel. Mixed substrate (sand, organics, fines). Debris piled on "wrong" side of obstructions.	Terrestrial fauna, High flow refugia	Maintain trees on banks, maintain channel stability	No	Avoid
Ponded	• **Backwater swamps**	Medium -Low	Located on floodplain margins. Usually no channel. Wetland vegetation. Hydric soils. Organic and fine substrate. Sometimes evidence of debris movement.	Aquatic and terrestrial fauna, Off channel rearing habitat, High-flow refugia	Treat as wetlands. Leave stringer trees if defined banks apparent	N/A[4]	Only wetland approved herbicides
	• **Isolated depressions**	Low	No channel. Wetland vegetation. Hydric soils. Organic and fine substrate.	Aquatic and terrestrial fauna, Off channel rearing habitat, High-flow refugia	Treat as wetlands. Leave stringer trees if defined banks apparent.	N/A[4]	Only wetland approved herbicides
	• **Oxbows** • **Ponds**	Low	Deep (>2 feet) standing water. Wetland vegetation. Hydric soils. Organic and fine substrate.	Aquatic and terrestrial fauna, Off channel rearing habitat, High-flow refugia	Treat as lakes or ponds. Leave stringer trees on banks.	N/A[4]	Only wetland approved herbicides

[1] Flow energy under normal flow conditions.
[2] Floodplain protection measure includes SMZs (GA Forestry BMP manual Pg. 8, 63) and special management areas (GA Forestry BMP manual Pg. 12).
[3] Follow EPA/COE memorandum to field (GA Forestry BMP manual Pg. 34)
[4] See wetlands section of GA Forestry BMP manual.

- **Isolated depressions:** Feature wetland vegetation, *hydric soils*, fine and organic substrates, no evidence of fluvial scour.
- **Oxbows and Ponds:** Ponded deep water (>2 feet deep), fine and organic substrates, no evidence of fluvial scour.

As a rule of thumb, if the following conditions exist, corresponding BMPs should be considered for *all* flooplain features. If the area has:

- perennial or intermittent water flows; establish SMZs.
- potential surface runoff inputs from adjacent lands (exception of flooding); establish SMZs.
- steep, unstable, and/or well defined banks; protect banks by bank trees or undisturbed zone.
- wet or ponded depression areas; shade water by bank trees.
- prolonged flooding areas; treat as a wetland and apply wetland BMPs.
- surface water; do not spray any chemicals.

N*ote*: All flow regimes described above are based on normal flow conditions. Appropriate BMP adjustments should be required during excessively dry or wet conditions.

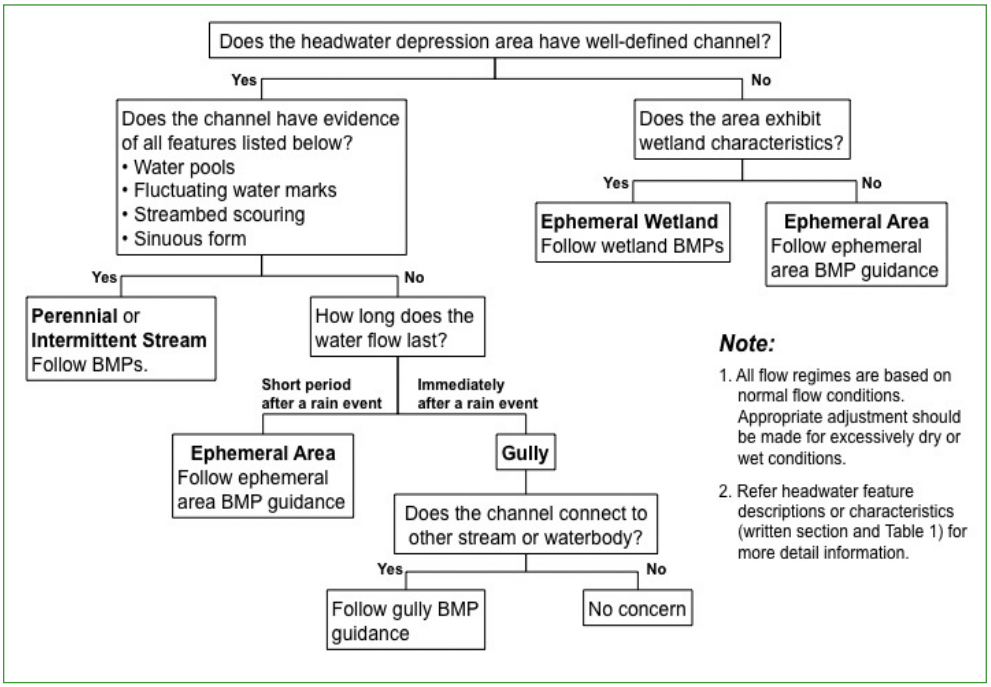
2.2.3 Headwater Areas

Headwaters include two types of conveyences: *ephemeral areas* and gullies. Refer to Figure 2-E, Headwater Decision-Making Tree on page 20 to determine conveyance type. See Table 2-C: Headwater Stream Types and the Hydrological and Biological Characteristics, pg. 21.

2.2.3.1 Ephemeral Areas

E*phemeral areas* are depressions or swales (sometimes called drains, draws, or *dry washes*) that have no defined continuous *channel*, and that are well-connected to intermittent or *perennial streams*. E*phemeral areas* are characterized by water tables that often rise to the surface during high water table months, and these areas produce surface flow for short periods during and following rainfall. Forest floors in *ephemeral areas* are intact, and hydrophytic vegetation may or may not be present. Aquatic insects are usually not present in these areas. Soils in these areas may quickly become saturated during rainy or thawing periods. Soils in *ephemeral areas* feature finer textures and higher organic contents

Figure 2-E. Headwater Decision-Making Tree



than soils in adjacent uplands. Fluvial power is generally low, but there may be evidence of small debris jams of leaf litter and other small organic matter deposited after surface flows. These areas are usually not identified on USGS or NRCS maps. Water from *ephemeral areas* may carry *sediment* and other contaminants directly into streams. Ephemeral Wetlands are a part of E*phemeral* A*reas*, which exhibit partial or full wetland characteristics.

Silvicultural activities should:

- Minimize soil disturbance, litter layer removal, and avoid high-intensity fire within *ephemeral areas*. These activities can increase the possibility of introducing *pollutants* to intermittent or *perennial streams*.
- Cover inadvertently exposed soils with *logging debris*, grass, or mulch.
- Minimize equipment trafficking within and around *ephemeral areas*. Should trafficking be justifiable due to site constraints, take precautions to minimize soil disturbance and litter layer removal. Placement of *logging debris* or logging mats in traffic areas may be appropriate. Debris, mats, and other soil protecting structures should not interfere with the natural flow of water.

Table 2-C. Headwater Stream Types and the Hydrological and Bioloical Characteristics.

Characteristics	Perennial	Intermittent	Ephemeral Area	Ephemeral Wetland	Gully
Hydroperiod	Year-round (>90% of the time)	During the wet season	Short period after a rain event	Moist year-round, wet during the wet season	Immediately after a rain event
Channel definition	Well defined	Somewhat defined	Somewhat – not defined	Not defined	Clear
Sediment and litter movement	Clearly observable	Partially observable	Minimum	Minimum	Clearly observable
Streambed scouring	Evident	Somewhat evident	Not evident	Not evident	N/A
Water pools	Present	Transition	Absent	Mostly absent	Absent
Stream shape	Sinuous	Less sinuous	Mostly straight	Not observable	Straight
High water marks	Present	Transition	Absent	Transition	Absent
USGS topographic map marker	Solid or dotted blue line	Dotted blue line or concave contour line	Concave contour line	Concave contour line	N/A
Energy level	High	Medium	Low	Very Low	High-Low
Erosion potential	Low-Medium	Low-Medium	Medium-Low	Non	High
Vegetation	Wetland plants at edge or in a stream	Wetland and mesic plants at edge or in a stream	Mesic plants around and in an area	Wetland and mesic plants in and around an area	No vegetation in an active gully
Aquatic insects	Present	Present	Transition	Transition	Absent
Fish	Present	Transition	Absent	Absent	Absent

- Avoid direct tie-in of turnouts and outfall of *water bars*/breaks to *ephemeral areas*. Extra care should be taken where a *skid trail* crosses an *ephemeral area*.
- See Section 5.3, page 48, for *herbicide* application.
- See Section 6.3, page 52, for fertilizer application.

2.2.3.2 Gullies

Gullies are narrow ravines, often caused by past land cultivation. They are typically V- or U-shaped *channels* that may or may not have exposed soil surfaces within the *channel*. They carry water only during and immediately following rainstorms or thawing events. D*ry wash*, draw, swale, arroyo, and gulch are other common names for gullies. Old agricultural gullies often have mature trees growing within their banks. Gullies often occur in uplands, upper slopes of *ephemeral areas*, at relatively steep stream-sideslopes, or on exposed erodible soils. Gullies may or may not be directly connected to *ephemeral areas*, intermit-

tent, or *perennial streams*. Because of their short hydroperiod, gullies do not generally provide suitable habitat for aquatic *flora* and *fauna*.

Gullies with a contributing area (catchment/watershed above the *gully*) larger than 0.2 acres and directly connected to *ephemeral areas*, intermittent or *perennial streams* may require special attention because they can be activated by forestry operations. For these types of gullies, the following BMPs are recommended, but soil, slope, and other topographic characteristics should be considered to address local conditions:

- Protect soil and litter layers within a *gully* and the banks during forestry operations[1]. Low impact operational methods should be used for harvesting and *site preparation* in and around a *gully*.
- Placement of *logging debris* and slash in a *gully* is recommended to provide hydraulic resistance to flow and thus promote *sediment* deposition[2].
- Avoid high-intensity *prescribed burning* in a *gully* to protect decomposed litter layers from burning and minimize exposure of mineral soils.
- Minimize trafficking within and around gullies, especially within and adjacent to severely eroded areas.
- Avoid direct tie-in of turnouts and outfall of *water bars*/breaks to gullies.
- See Section 5.3, page 48 for *herbicide* application.
- See Section 6.3, page 52 for fertilizer application.

[1] *Leaving some trees and shrubs on the banks and inside of gullies may serve as a marker for subsequent harvesting, site preparation, planting, herbicide application, and other forestry operations.*

[2] *Avoid creating an impoundment behind logging debris or slash placed in a gully.*

2.2.4 Lakes, ponds, and other bodies of flowing water

Follow the BMPs recommended for *perennial streams* if they could potentially move *sediments* or other *pollutants* off site.

2.2.5 Protected Mountain Tops

Forestry activities on mountain tops above 2,200-ft. elevation with slopes greater than 25% including the reforestation requirement shall comply with BMPs. (See Appendix Section 8.2.3.4 with map, page 63.)

2.2.6 Protected River Corridors

Forestry activities within the 100-ft. buffers along those rivers at a point and below where the flow is 400 cubic feet per second (cfs) shall comply with BMPs. (See Appendix Section 8.2.3.3 with map, page 62.)

2.2.7 Sinkhole

A geologic feature, typically found in Karst geology, that might provide a direct connection between land surface and groundwater. Treat as *perennial streams*.

2.2.8 Water Supply Reservoir/Watershed

(See Appendix Section 8.2.3.1 with map, page 60.)

- For government-owned impoundments or intakes within a 100-square mile or larger watershed, forestry activities within a 150-ft. buffer adjacent to all reservoirs and 100-ft. buffer adjacent to all *perennial streams* within a seven-mile radius above intakes shall comply with BMPs.
- For government-owned impoundments or intakes within a watershed of less than 100-square miles, forestry activities within a 150-ft. buffer adjacent to the reservoir, a 100-ft. buffer adjacent to *perennial streams* within a seven-mile radius, and a 50-ft. buffer adjacent to all *perennial streams* above the seven-mile radius shall comply with BMPs.

2.2.9 Wetlands

For regulatory purposes, *wetlands* are defined by the presence or absence of specific plant communities, *hydric soils* and hydrologic conditions. Because of the generally wet soil conditions associated with forested *wetlands*, these areas are sensitive to forestry activities. For instance, bottomland hardwood sites, Carolina bays, cypress domes, other swamps, and some pine savannas differ from upland forest types because their soils are wet most of the year. They frequently are connected directly to a larger aquatic system, often have overbank flow from nearby stream flooding, and may accumulate *sediments* and nutrients from upstream *erosion* and runoff.

To properly manage forested *wetlands*: plan for *regeneration*; consider the areas beyond the actual harvest site; and remember that special harvesting

techniques may be necessary to protect water quality. Any stream *channels* should be identified and the appropriate SMZs established. The BMPs that apply to any other forest type generally apply to forested *wetlands*. For more information on harvesting and site-preparing *wetlands*, refer to Section 4.7 page 42 and Section 5.2 page 46.

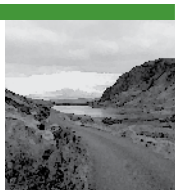
Benefits of Planning

Forest managers, landowners, foresters, timber buyers, loggers, *site preparation* and reforestation contractors should clearly identify water bodies, Special Management Areas and *streamside management zones* (SMZs) in the field to decide which BMPs apply, when and where to apply them, and to carefully design *access roads*, *log decks*, and stream crossings. They should supervise these operations to make sure BMPs are followed where necessary, so that water quality is not compromised.

Forest health issues such as fire management, *integrated pest management*, disease control and natural disasters may also require a *qualified professional* to prescribe appropriate actions.

The benefits of a well written plan and/or written contract include: better communications of expectations between the landowner and forestry professionals; maximum return from the harvest; potential longer term productivity; better infrastructure; economic efficiency; minimal environmental impacts; compliance with federal, state and local laws; and avoidance of fines or penalties. For information regarding sample contracts and management planning, contact the GFC. Planning for the protection of water quality makes good sense.

Notes:



Section 3.0

Road Location, Construction, Stream Crossings, Maintenance, Retirement

Access roads are an essential part of any forest management operation and provide access for other activities on forestland. With proper planning, location, construction, and maintenance techniques, well-constructed *access roads* allow for productive operations and cause minimal soil and water quality impacts. However, poorly located, poorly constructed, or poorly maintained access roads, especially at stream crossings, can result in sediment-laden streams, changing stream-flow patterns, degraded fish and aquatic organism habitats, and adversely affected *aesthetics*.

There are two types of *access roads* typically constructed in the state. In mountainous and hilly terrain, the *broad-based dip* road is used. In the flatwoods and along major flood plains, the *crown and ditch* road is commonly used.

3.1 BMPs FOR ROAD LOCATION

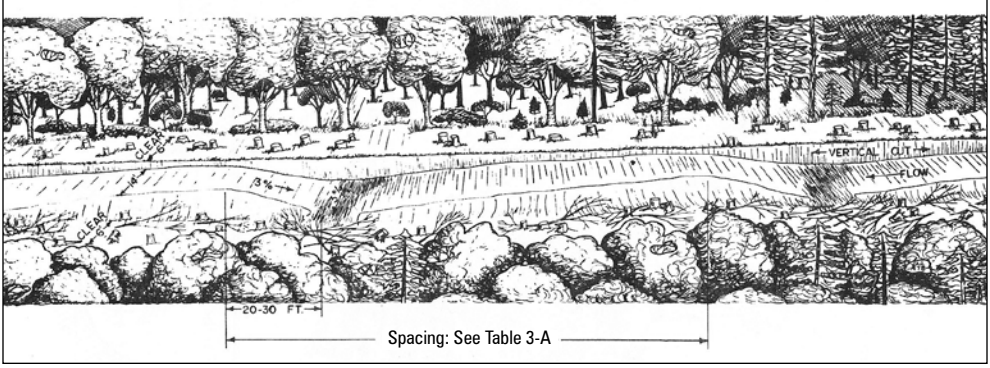
- Identify federal, state and local laws, regulations or ordinances that apply to road purpose, construction, and maintenance prior to construction and operation. Include needed considerations and measures to meet requirements.
- Use soil surveys and topographic maps to identify soils, stream locations and other natural features (rocky areas, steep slopes, wet areas, etc.) on the property that might pose problems.
- Locate potential control points, i.e. *log decks* and stream crossings on topographic maps prior to designing *access roads* in the field.
- New permanent *access roads* should follow the *contour* as much as possible with grades ideally kept below 10%. An engineer's divider can be used to lay out roads with the desired grade on a topographic map. Grades can run up to 12% for short distances. If soil is highly erosive, reduce grades. Plan to install *water control structures*.
- Temporary *access roads* should follow the *contour* as much as possible. Grades can run up to 25% for short distances provided that *water control structures* are properly installed.
- Except for planned stream crossings, locate new roads outside of SMZs.
- Minimize stream crossings. Where crossings are necessary, see Section 3.3, page 30.
- Minimize the number, length, and width of *access roads*.
- Locate new *access roads* on high ground, preferably on the sides of ridges, for proper surface drainage.

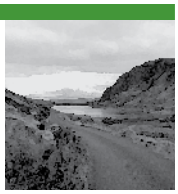
- Locate new *access roads* on southern or western sides (*aspect*) of ridges if possible, to expose the roadbed to more sunlight.
- Conduct site reconnaissance to verify road layout with potential soil problems, stream locations, sensitive areas (see Section 7.4, page 57), and *watershed* conditions.
- Evaluate the condition of existing roads and potential water quality impacts. If necessary, plan for improvements or replace with new routes.

3.2 BMPs FOR ROAD CONSTRUCTION

- Construct *access roads* only wide enough (usually 12-16 feet) to safely handle equipment that will use the road.
- Schedule construction during favorable weather.
- Maximize sunlight exposure along roadsides where surface drainage is a problem.
- On permanent *access roads* with three percent or more grade, *broad-based dips* should be installed at proper intervals; at 30-degree angles across road surfaces; have reverse grades of three percent; and the bottom of the dips should be *outsloped* about three percent. If necessary, outfall of dips may need *sediment* barriers such as rock, hay bales, or *silt fence* installed. (See Figure 3-A for a schematic of a *broad-based dip* road and Table 3-A for recommended spacing of dips.)
- On temporary access or spur roads that have little traffic at low speeds, rolling dips can be installed. They resemble "stretched out" *water bars*. See Figure 3-B and Table 3-A for spacing.

Figure 3-A: Recommended Spacing for Broad Based Dips in Permanent Access Roads and Rolling Dips in Temporary Access Roads

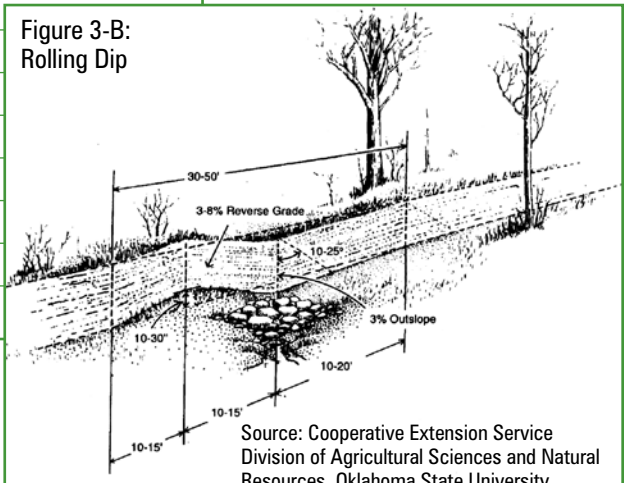




Road Grade (percent)	Distance Between Dips and Turnouts (feet)
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140
12	135

Table 3-A:
Recommended spacing for Broad-based Dips in Permanent Access Roads and rolling Dips in Temporary Access Roads

Figure 3-B:
Rolling Dip



Source: Cooperative Extension Service Division of Agricultural Sciences and Natural Resources, Oklahoma State University.

- On *crown and ditched* roads, install *water turnouts* at proper intervals. See Figure 3-C and Table 3-B. Turnouts should never tie directly into streams or water bodies. If necessary, outfall of turnouts may need *sediment* barriers such as rock, hay bales, or *silt fence* installed.

Figure 3-C: Design and Installation of Turnouts

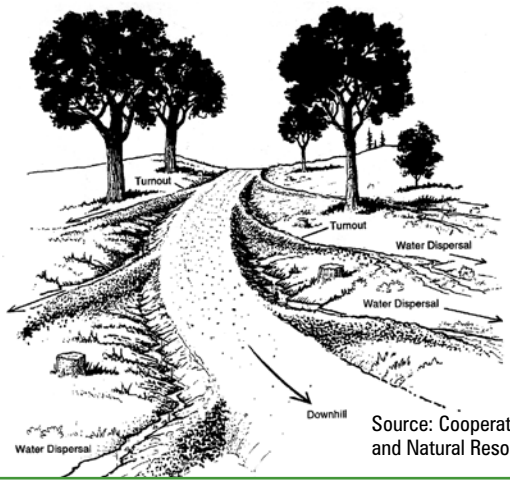


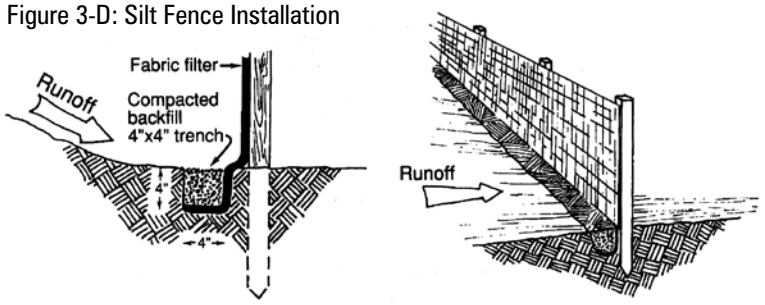
Table 3-B: Spacing of Turnouts

Road Grade (percent)	Spacing (feet)
2 – 5	500-300
6 – 10	300-200
11 – 15	200-100
16 – 20	100

Source: Cooperative Extension Service Division of Agricultural Sciences and Natural Resources, Oklahoma State University.

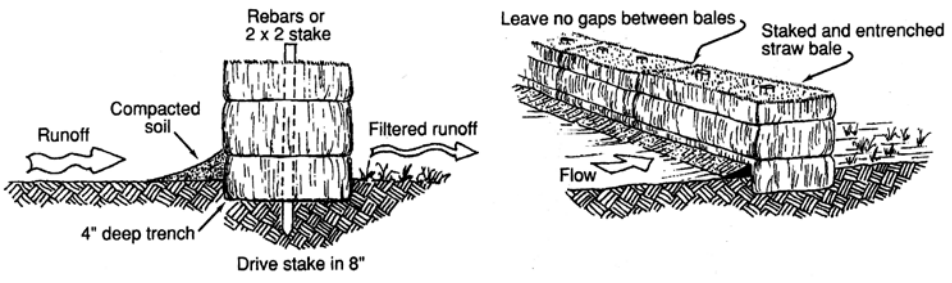
- Keep roads free from obstructions and *logging debris*.
- Roadbeds on erosive soils should be stabilized with appropriate measures.
- Stabilize exposed soil on shoulders of permanent or temporary *access roads* located within SMZs, *wetlands* or at stream crossings as soon as possible with any one or combination of the following: seed and mulch; *silt fence*; hay bales; *excelsior blankets*; *geotextiles*.
    1. See Section 6.4 for grassing recommendations.
    2. Type A (36 inch) or Type B (22 inch) *silt fence* can be used. Wooden stakes should be fastened to the fence every six feet on the down slope side. The bottom edge of the fence should be installed in a four-inch deep trench with the bottom two inches of the fence facing upslope in the trench. See Figure 3-D.
    3. Hay bales should be placed on sides in four-inch deep trenches and staked down. See Figure 3-E.

Figure 3-D: Silt Fence Installation



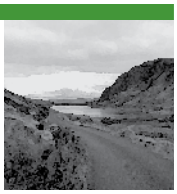
Source: Bureau of Forestry, Wisconsin Department of Natural Resources

Figure 3-E: Installation of Hay Bales



Source: Bureau of Forestry, Wisconsin Department of Natural Resources

- For more information refer to Georgia Soil and Water Conservation Commission's Field Manual for E*rosion* and S*ediment* Control in Georgia, page 79.

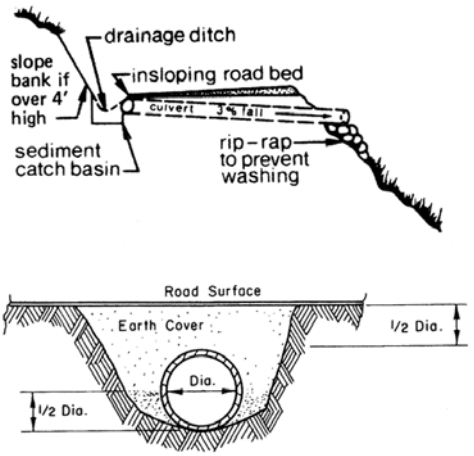


Section 3.0
Road Location, Construction, Stream Crossings, Maintenance, Retirement

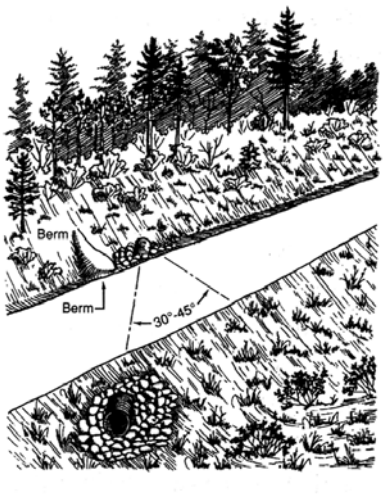
3.2.1 Practices to Avoid during Road Construction

- Road construction inside the SMZ, except at planned stream crossings.
- Insloping of roads. Where unavoidable, use *cross-drain culverts* positioned under the road at a 30 degree angle and spacing as in Table 3-B for proper inside road drainage. Place *riprap* at *culvert* outfall to prevent washing. See Figure 3-F.
- Using *ditches* on steep roads. Some *ditches* may have to be lined with rock to prevent *gullying* and sedimentation.
- Turnouts tied directly into *perennial* and *intermittent streams* or *ephemeral areas*.

Figure 3-F: Cross-drain Culvery Design and Installation



Source: Georgia Forestry Commission



Source: Bureau of Forestry, Wisconsin Department of Natural Resources

3.3 STREAM CROSSINGS FOR ROADS

Stream crossings are often necessary for access to forestlands. From a water quality standpoint, stream crossings are the most critical aspect of the road system. Failure of a stream crossing, due to improper planning or construction, can result in *erosion* and introduction of *sediment* into a stream, adversely affecting water quality.

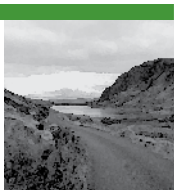
Where crossings are necessary, planning should address the type of road and road-use pattern, stream *channel* characteristics, stream flow levels and the aquatic organisms in the stream. Minimizing impacts is critical. Permanent and temporary stream crossings should be based on expected applicable

storm-flow return intervals and *watershed* acreage above the crossing. See Table 3-C, page 34.

3.3.1 Clean Water Act Provisions and Requirements for Stream Crossings

The Federal Clean Water Act, Section 404, (40 CFR Part 232.3), exempts normal, established, ongoing *silvicultural* activities from the permitting process for discharges of dredged or fill material in jurisdictional *wetlands*. However, fifteen (15) baseline provisions for forest road construction and maintenance in and across *waters of the* U.S. (lakes, rivers, *perennial* and *intermittent streams*, *wetlands*, *sloughs* and natural ponds) are mandated to qualify for the forest road exemption:

1. Permanent roads, temporary access roads and *skid trails* (all for forestry) in *waters of the* U.S. shall be held to the minimum feasible number, width and total length consistent with the purpose of specific *silvicultural* operations, and local topographic and climatic conditions;
2. All roads, temporary or permanent, shall be located sufficiently far from streams or other water bodies (except for portions of such roads that must cross water bodies) to minimize discharges of dredged or fill material into *waters of the* U.S.;
3. The road fill shall be bridged, *culverted* or otherwise designed to prevent the restriction of expected flood flows;
4. The fill shall be properly stabilized and maintained during and following construction to prevent *erosion*;
5. Discharges of dredged or fill material into *waters of the* U.S. to construct a road fill shall be made in a manner that minimizes the encroachment of trucks, tractors, bulldozers or other heavy equipment within *waters of the* U.S. (including adjacent *wetlands*) that lie outside the lateral boundaries of the fill itself;
6. In designing, constructing and maintaining roads, vegetative disturbances in the *waters of the* U.S. shall be kept to a minimum;
7. The design, construction and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body;
8. Borrow material shall be taken from upland sources wherever feasible;
9. The discharges shall not take or jeopardize the continued existence of a threatened or endangered species as defined under the Endangered Species



Act, or adversely modify or destroy the critical habitat of such species;

10. Discharges into breeding and nesting areas for waterfowl, spawning and *wetlands* shall be avoided if less harmful alternatives exist;
11. The discharge shall not be located in the proximity of a public water supply intake;
12. The discharge shall not occur in areas of concentrated shellfish production;
13. The discharge shall not occur in a component of the National Wild and Scenic River System;
14. The discharge of material shall consist of suitable material free from toxic *pollutants* in toxic amounts; and,
15. All temporary fills shall be removed in their entirety and the area restored to its original elevation.

N*ote*: The ultimate determination of whether activities are exempt can only be made by the US Army Corps of Engineers and the US Environmental Protection Agency.

There are three types of stream crossings to consider in forest management operations: bridges, *culverts*, and fords.

Bridges, whether permanent or temporary, typically create the least disruption to stream flow and have less effect on fisheries than other stream-crossing methods.

Culverts can be either temporary or permanent. C*ulvert* sizing is critical to minimizing problems. Consider both the purpose of the crossing and the duration of use. Sizing may increase if the need is permanent.

Fords can be used for haul roads only where the streambed is firm, banks are low and stable and the stream is shallow.

3.3.2 General BMPs For Stream Crossings

In addition to the 15 CWA mandated provisions

- Approaches to all permanent or temporary stream crossings should be made at gentle grades of slope (three percent or less) wherever possible.
- Approaches should be made at right angles to stream flow where practical.
- Approaches should have *water control structures*, such as *water turnouts* or *broad-based dips*, on both sides of a crossing to prevent road runoff from

entering the stream.

- If necessary, approaches should be stabilized with rock extending at least 50 feet from both sides of the streambank during the operation.
- For temporary *access roads*, temporary bridges or spans are favored over *culverts* or fords.
- Wetlands fill roads should be built outside the SMZ, except when crossing the channel. Cross-drainage structures (*culverts*, bridges, portable spans, etc.) may be necessary in the fill road to allow for surface water movement across the site.
- Exposed soil around permanent or temporary stream and wetlands crossings should be stabilized with any one or a combination of the following: seed and mulch; hay bales; rock; *silt fence*; *geotextiles*; and/or *excelsior blankets*. (See Section 3.2, page 27)

3.3.3 Specific BMPs for Bridges

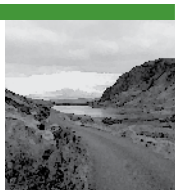
- Use bridges to cross streams with 300 + acre or larger *watershed*s if other alternatives are not suitable for containing storm flows.
- Remove temporary bridges and stabilize approaches and streambanks when operations are completed.

3.3.4 Specific BMPs for Fords

- Use fords only for haul roads (not *skid trails*).
- Locate fords where stream banks are low and the bottoms are relatively hard and level.
- Where necessary, establish a smooth, hard-surface, low water crossing. For a permanent ford use gravel or rock filled *geowebb*, or concrete pads. For temporary fords use dragline mats or logs to armor (protect) the stream bottom.
- Material should not significantly impound stream flow, impede fish passage or cause erosive currents. Remove temporary crossings from the *channel* when operations are completed.

3.3.5 Specific BMPs for Culverts

- Where fords or bridges are not appropriate, use *culverts* to cross streams with approximate 300-acre or less watersheds, depending on physiographic region, including *braided streams* in broad flats. See the figure on the



inside cover of this manual.

- When crossing streams with a *watershed* larger than 300 acres, consult a *qualified professional*.
- Size permanent *culverts* so that the cross-sectional area will accommodate expected 25-year, 24-hour storm flows. See Table 3-C for recommended diameters.
- Size temporary *culverts* so that the cross sectional area will accommodate the two-year, 24-hour storm flows. See Table 3-C for recommended diameters.

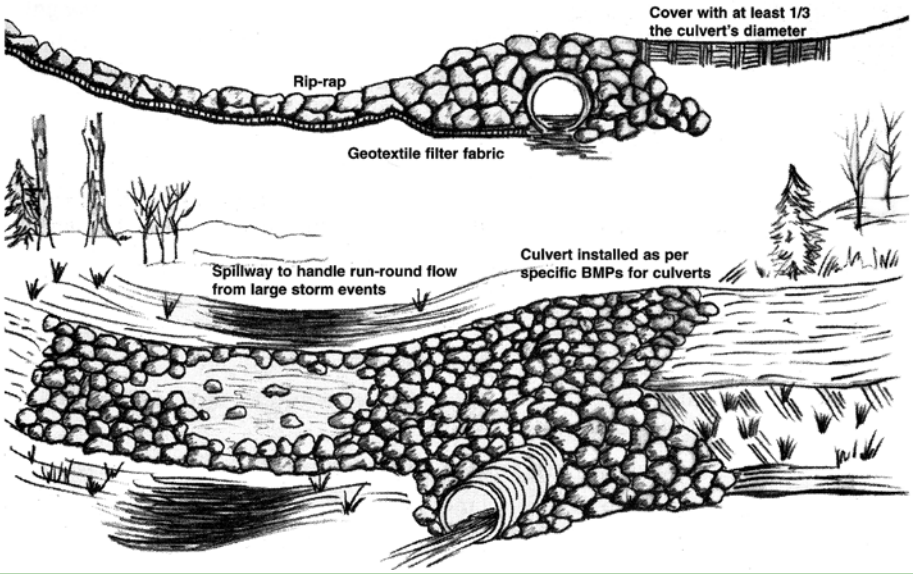
Table 3-C: Recommended Diameters for Permanent/Temporary Culverts

Drainage Area (acres)	Lower Coastal Plain (inches)	Upper Coastal Plain (inches)	Piedmont (inches)	Mountains and Ridge and Valley (inches)
PERMANENT	BASED ON 25-YEAR, 24-HOUR STORM FLOWS)			
10	24	15	30	24
50	36 or (2-30")	18	48 or (2-36")	48
100	48	24	54 or (2-42")	60 or (2-48")
200	60	36	72 or (2-54")	72
300	2-48"	54	84 or (2-60")	78 or (2'60")
Drainage Area (acres)	Lower Coastal Plain (inches)	Upper Coastal Plain (inches)	Piedmont (inches)	Mountains and Ridge and Valley (inches)
TEMPORARY	BASED ON 2-YEAR, 24-HOUR STORM FLOWS)			
10	15	15	18	15
50	18	15	30	24
100	24	18	36	30
200	30	24	42 or (2-30")	36
300	48	30	48	42

Under normal conditions, two alternative methods are acceptable:

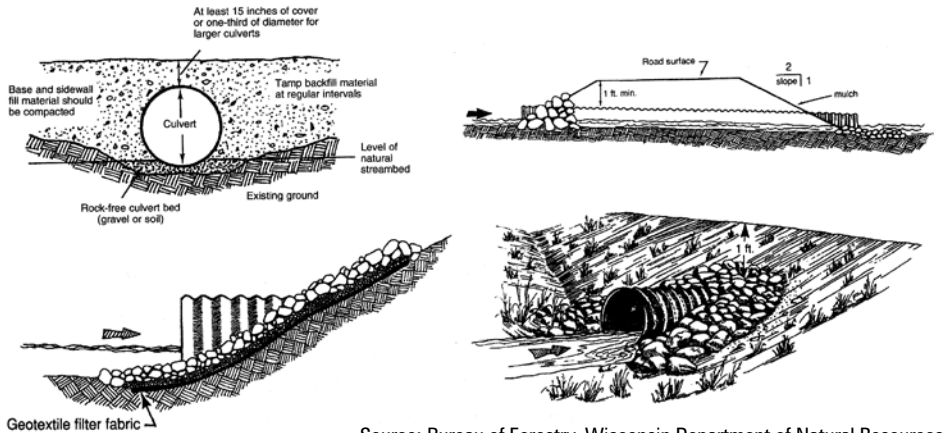
1. Smaller multiple *culverts* can be substituted to provide for the same cross-sectional area of pipe required as shown in the table above.
2. A combination of a smaller *culvert*(s) with rock surfaced road dips constructed in the roadbed to handle the run-around flow from larger storm events. See Figure 3-G.

Figure 3-G: Combination of Smaller Culvert and Rock Surfaced Road Dip

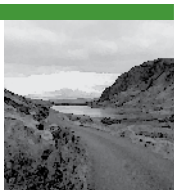


- *Culverts* less than 15 inches in diameter are not recommended.
- Multiple *culverts* should be spaced a distance of at least 1/2 the *culvert*'s diameter apart.
- Place the *culvert* in a straight section of the stream, free of obstructions.
- Place the bottom of the *culvert* at the same elevation as the bottom of the stream. (See Figure 3-H, page 35, for proper *culvert* installation.)

Figure 3-H: Stream Culvert Installation with Specifics of Slope, Placement, Fill, etc.



Source: Bureau of Forestry, Wisconsin Department of Natural Resources



- Place fill dirt around the lower half of the *culvert* and pack during installation.
- Place at least 15 inches or at least 1/3 the *culvert*'s diameter, whichever is greater, of fill dirt over the top of the *culvert* so that the fill over the *culvert* is the high spot in the stream crossing. This creates an emergency run-around for high flows.
- The *culvert*'s ends should be long enough to achieve no more than a 2:1 slope on the fill.
- Stabilize fill at ends of a *culvert* with *riprap*, geoweb, *excelsior blankets*, *gabions*, headwalls, grass seed and mulch, hay bales, etc.
- Periodically inspect *culverts* and remove any debris inside.
- Remove all temporary *culverts* and fill material used in stream or wetland crossings and stabilize streambanks when operations are completed. (See Section 3.2 for stabilization recommendations.)

3.3.6 Practices To Avoid When Constructing Stream Crossings

- Using steep approaches greater than three percent into the stream *channel*.
- Crossings at bends in the stream.
- Using fords in streams for *skid trails*.
- Constructing hard surface crossings on streams with mucky, muddy or unstable bottoms.
- Using asphalt materials for low-water crossings.
- Anything that impedes the free or expected flow of water.
- Temporary crossings of logs and brush "topped" with soil.
- Using undersized *culverts*.

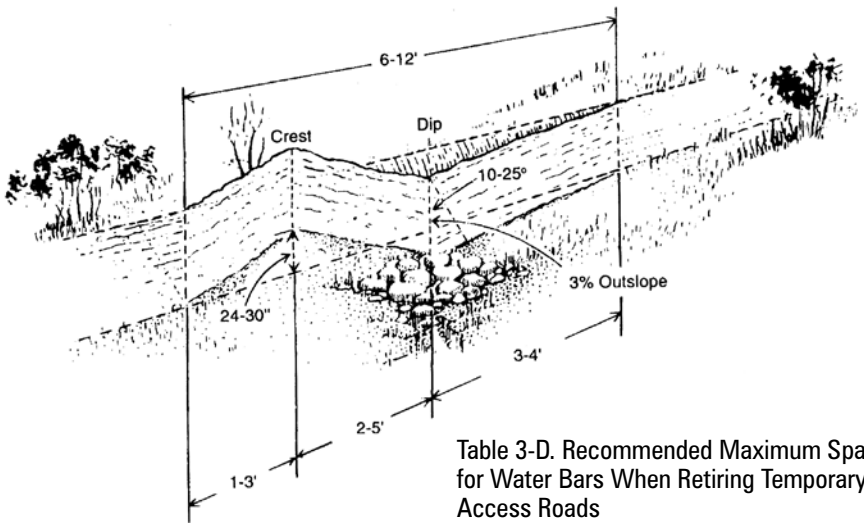
3.4 BMPs FOR THE MAINTENANCE AND RETIREMENT OF ROADS

- Maintain existing roads in accordance with BMPs.
- Maintain points of ingress from county roads or highways to prevent the introduction of mud and debris onto these roads.
- Minimize road grading and reshaping on hilly or mountainous terrain unless required to repair damaged road sections.
- Keep outfall of *broad-based dips*, *water bars*, and *water turnouts* open at all times during logging operations. If necessary, install *sediment* barriers such as rock, hay bales, or *silt fence* just below outfall.
- Retire temporary *access roads*, *log decks*, *skid trails*, by re-shaping and/or

constructing *water bars* at recommended intervals. Stabilize as necessary by seeding and *mulching* or scattering *logging debris* over the road surface. (See Figure 3-I and Table 3-D for spacing recommendations.)

- Periodically inspect retired roads to assure stabilization techniques are still effective and permanent stream crossings are clear and operating properly.

Figure 3-I: Profile of Retired Temporary Access Road Showing Water Bars



Source: Cooperative Extension Service Division of Agricultural Sciences and Natural Resources, Oklahoma State University

Table 3-D. Recommended Maximum Spacing for Water Bars When Retiring Temporary Access Roads

Road Grade (percent)	Distance Between Water Bars (feet)
2	245
5	125
10	80
15	60
20	50
25	40

3.4.1 Practices To Avoid During Road Maintenance and Retirement

- Excessive traffic on wet roads.

Section 4.0

Timber Harvesting

Timber harvesting encompasses several operations. In addition to cutting trees, it typically includes the layout of *access roads*, *log decks*, and *skid trails* and the construction and stabilization of these areas. Timber harvesting can be accomplished while protecting water quality and site productivity and improving the composition and quality of future forests. Evolving timber harvesting technology, equipment, and procedures will provide for better protection of Georgia's waters.

Potential water quality impacts can be avoided or minimized if the harvest plan addresses seasonal weather conditions, stand composition, soil type, soil moisture, topography, and type of equipment used. In order to maintain the integrity of stream banks, water flow, and stream biology, it is important to stay out of streams. Specific BMPs for *log decks* and *skid trails* are provided in this section. BMPs for roads are presented in Section 3.

4.1 LOG DECKS

L*og decks*, also called brows and landings, are areas of concentrated equipment and traffic resulting in a high degree of soil disturbance, soil compaction, and rutting. Storm water runoff and surface *erosion* may increase on these exposed areas and, depending on their locations, could impact water quality. Runoff may contain toxic materials from fuels and lubricants. The following BMPs should be implemented to prevent runoff from reaching nearby watercourses.

4.1.1 BMPs for Log Decks

- Locate *log decks* when planning the road system.
- Minimize the number of *log decks* necessary for the operation.
- Minimize the size of *log decks* to minimize the affected area.
- Locate *log decks* uphill and *skid* up to them. This results in a cone-shaped pattern of *skid trails*, which disperses water running downhill. If trees must be skidded downhill, *erosion* can be minimized using smaller *log decks* with fewer, shorter and less-traveled *skid trails* leading to any one deck. To disperse water, install *water bars* with *water turnouts* in *skid trails* prior to final approach to deck.
- Locate *log decks* in a stable, well-drained area away from gullies when possible.
- When the harvest is completed, stabilize as needed, using *water bars*, logging slash or vegetative cover. (See Section 6.4 for seeding recommendations.)

Control and minimize site-damaging effects to soil stability and water quality, such as rutting, puddling and compaction from harvest equipment.

4.1.2 Practices to Avoid for Log Decks

- Locating *log deck* within the SMZ.
- Allowing decks to concentrate storm runoff onto roads, trails, etc. leading to a watercourse.

4.2 SKID TRAILS

Skid trails are for temporary use during the timber harvest. You should strive to control and minimize site-damaging effects to soil stability and water quality, such as rutting, puddling, and compaction from harvest equipment. If trails will remain after the harvest for vehicular access, upgrade them to road building standards.

4.2.1 BMPs for Skid Trails

- *Skid* uphill to *log decks* on ridges or hills.
- Have periodic breaks in grade to help disperse surface flow.
- Use temporary closure techniques, such as *water bars* or covering with logging slash, if significant *erosion* may occur before permanent closure techniques are installed.
- Retire, as needed, as soon as possible with properly installed *water control structures*. For *water bars* see Figure 3-I, page 37, and Table 4-A for proper spacing.
- When grades exceed 15%, use *water bars* with *water turnouts*.

Table 4-A. Spacing of Water Bars on Skid Trails and Firebreaks

Grade of Skid Trail or Firebreak (percent)	Distance Between Water Bars (feet)
2	250
5	135
10	80
15	60
20	45
25	35
40*	30

** Use grades of 40% and steeper only for short stretches.*

4.2.2 Practices to Avoid With Skid Trails

- Trails over 40% grade except for short stretches.
- Bladed trails unless required on side slopes to create the appropriate grade for safe operations.
- Using stream and drains with defined *channels* as *skid trails*.
- Main *skid trails* within SMZs.

4.3 SKID TRAIL STREAM CROSSING

In certain situations, crossing a stream with a temporary *skid trail* may be preferable to a permanent road crossing. Factors to consider include the value of the timber to be accessed relative to the cost of a permanent crossing, topographic features limiting construction of permanent crossings, and the size of the stream and/or the upstream watershed. Regardless of the factors, the considerations for protecting water quality are critical to maintain the integrity of the stream bank, to use water-permeable fill materials that are easy to recover in the restoration process, and to minimize the amount of fill dirt entering the stream.

4.3.1 BMPs For Skid Trail Stream Crossings

- Follow Federal mandates. (See Section 3.3.1, page 31)
- Minimize the number of crossings.
- Cross stream at right angles.
- Maintain stream bank integrity.
- Approach streams at gentle grades of slope, ideally at less than three percent.
- Use of temporary bridges or spans rather than temporary *culverts*.
- If temporary *culverts* are used, make sure they are properly sized for the *watershed*. (See Table 3-C, page 34.)
- Stabilize *culvert* fill during and after construction using any one or a combination of: hay bales; seed and *mulch*; *silt fence*; rock; *excelsior blankets*; *geotextiles*; etc. (See Section 3.2, page 27)
- Use logs or stems as fill over temporary *culverts* instead of fill dirt whenever possible.
- Remove all temporary fills and restore the *channel* to its original elevation. Stabilize approaches during and after construction.

4.3.2 Practices to Avoid For Skid Trail Stream Crossings

- Stream crossings whenever possible.
- Use of fords.
- Blocking stream flow.
- Blocking the migration of aquatic organisms.
- Using *sloughs* as *skid trails*.

Portable steel bridge

- Random crossings with mechanized equipment.
- Leaving logs or stems in stream crossing.

4.4 RUTTING

During harvesting, some soil disturbance and rutting is inevitable, due to the mechanized nature of most harvesting systems. Excessive or inappropriate rutting can impact water quality when it causes *sediment* or silt-laden runoff to enter a stream or when it interrupts or changes the natural flow of water to the stream. Rutting that results in the discharge of *sediment* to a stream may violate federal and state water-quality laws.

4.4.1 BMPs to Minimize Rutting

- Use low ground pressure equipment, logging mats, or other techniques on saturated soils where practical.
- Minimize the grade of *skid trails*.
- Follow the BMPs recommended for *skid trails* in Section 4.2, page 39.

4.4.2 Practices to Avoid For Rutting

- Facilitating the potential movement of *sediment* to a stream or water body.
- Breaking down the integrity of a stream bank.

4.5 EQUIPMENT WASHING AND SERVICING

Improper equipment washing and servicing can introduce hazardous or toxic materials to the harvest site, which can affect water quality.

4.5.1 BMPs for Washing and Servicing Equipment

- Wash and service equipment away from any area that may create a water

Natural pole bridge

Portable timber bridge

quality hazard, especially within SMZs and along *ephemeral areas*.

- Dispose of oils, lubrications, their containers and other wastes according to local, state and federal regulations.
- Remove all used tires, batteries, oil cans, and trash from logging operations before leaving the site.
- Clean up and/or contain fuel and oil spills immediately. Comply with state and federal regulations when reporting spills. Report any fuel, oil or chemical spills to the DNR EPD HAZARDOUS SUBSTANCES OFFICE. (1-800-241-4113)

4.5.2 Practices to Avoid When Washing and Servicing Equipment

- Washing or servicing equipment where it could affect water quality.

4.6 PROTECTING STREAMSIDE MANAGEMENT ZONES (SMZs) DURING HARVESTING

4.6.1 BMPs for Harvesting Streamside Management Zones

In addition to the BMPs listed in Section 2.1, page 8:

- Use techniques that minimize soil disturbance, such as backing trees out with machine using low ground pressure equipment, using equipment with booms, or cable winch.
- Maintain the integrity of stream banks.
- Minimize the exposure of mineral soil by spreading logging slash and using it to drive over.

4.6.2 Practices to Avoid When Harvesting Within SMZs

In addition to the avoidance guidelines listed in Section 2.1, page 8:

- Using trees or de-limbing gates in the SMZ.
- Leaving tops in stream *channels*.
- Rutting.

4.7 PROTECTING WETLANDS DURING TIMBER HARVESTING

4.7.1 BMPs FOR HARVESTING FORESTED WETLANDS

In addition to the recommendations in Section 2.2.9, page 23:

- Plan the timber harvest for the dry season of the year when possible.
- Use site-specific equipment and methods to minimize water quality impacts, including high-flotation, low-pressure harvesting equipment, shovel logging or cable yarding.
- Concentrate *skid trails* and use logging slash, mats or other techniques to minimize soil compaction and rutting.
- Use practices conducive to rapid *regeneration*.
- Follow federally mandated stream and wetland crossings. (See Section 3.3.1, page 31.)

4.8 MAT (SHOVEL) LOGGING

- Minimize the width of *skid trail* mats. Mats should not exceed an average 20 feet in width, except for sections of the trail where it is necessary for equipment to pass; in these sections the minimum width may be doubled.
- Minimize the number of *skid trail* mats. Typically, trails should not be spaced closer than 200 feet, on average. Where conditions prohibit tracked machines from operating off the mat and to minimize site disturbance, spacing may be reduced to 50 feet. However, under no conditions should *skid trail* mats exceed 25% of the harvest area.
- Timber for *skid trail* mats should be laid down in the direction of the trail under normal conditions.
- Use only one layer of timber for *skid trail* mats, except where multiple layers are necessary to prevent site disturbance.
- Where multiple layers of timber are necessary to construct the *skid trail* mat and to maximize weight distribution, the bottom layer may be laid down perpendicular to the trail, and may exceed 20 feet in width.
- Merchantable material in *skid trail* mats should be removed after logging operation is complete.
- For stream crossings with *skid trail* mats, refer to the stream crossing section of the BMP Manual.

Section 5.0

Site Preparation and Reforestation

Site preparation facilitates the *regeneration* process and is the first step toward successful *regeneration*. Typical methods prepare harvested and non-forested areas for desired tree species and stocking. *Site preparation* may be used for both natural and artificial forest *regeneration*. Methods chosen should reduce *logging debris*, lessen logging impacts, control competing vegetation, and enhance seedling survival.

The *site preparation* technique used depends on soils, slope, condition of the site, vegetation, crop tree species, cost, location and landowner goals. Analyze the *erosion* potential of the site prior to any *site preparation*. Topography, soil type and residual ground cover determine *erosion* potential.

Topography – The steepness and length of the slope are major considerations when determining the treatment intensity. Intensive treatments that are acceptable in areas of little or no slope may be unacceptable in areas of steep slope.

Soil Type – Soil types or mapping units differ in texture, slope, stoniness, erodibility, wetness or other characteristics that affect the use of the soils by man. Soil surveys describe these limitations as slight, moderate, or severe. Any limitations should receive extra attention in order to prevent soil degradation.

Residual Ground Cover – The amount, species and size of ground vegetation, *logging debris* and other organic matter should be a consideration in prescribing the type and intensity of the treatment.

Site preparation techniques can be grouped into three categories: mechanical, chemical, and *controlled burning*. Combinations of these techniques are common.

5.1 MECHANICAL SITE PREPARATION

Mechanical *site preparation* includes *shearing*, *raking*, subsoiling, *chopping*, *windrowing*, piling, *bedding* and other physical methods to cut, break apart or move *logging debris*, or to improve soil conditions following harvest. This category is often described by its impact on the soil. Methods vary from low intensity to high intensity. High-intensity methods such as disking and *bedding* expose the soil on more than 50% of the site. *Chopping* is a low-intensity method. *Erosion* potential usually increases with higher-intensity methods, especially in areas with steep slope. Therefore, high-intensity methods are appropriate for flat and gentle slopes, used with caution on moderate slopes, and avoided on steep slopes. Low-intensity

methods are preferred on moderate to steep slopes.

5.1.1 BMPs FOR MECHANICAL SITE PREPARATION

- Thoroughly plan the *site preparation* before beginning the job to ensure that the best treatment is implemented.
- Use the minimum intensity of *site preparation* required.
- On slopes of 6%-10%, intensive mechanical methods should follow the *contour* of the land.
- On slopes of 11%-20%, mechanical methods other than *chopping* should follow the *contours* of the land. On soils with moderate to severe *erosion* potential, strips of untreated areas or *windrows* should be left to slow water and soil movement down the slope.
- On slopes of 21%-30% with severely erosive soils, use only low-intensity mechanical methods that follow the *contour*. Drum *chopping* should be perpendicular to the slope.
- On slopes greater than 30%, use only hand tools (chain saw *felling*).
- Where accelerated *erosion* is likely, use methods that leave *logging debris* and other litter scattered evenly over the site.
- When constructing beds on slopes greater than five percent, follow land *contours*.
- Protect forest floor and limit soil disturbance in stabilized gullies that are not eroding.

5.1.2 Practices to Avoid During Mechanical Site Preparation

- Any mechanical methods except drum roller *chopping* or spot cultivation on slopes greater than 30%. Drum *chopping* should not follow the *contour*.
- Intensive mechanical methods on slopes greater than 20% with severe *erosion* potential.
- W*indrow* construction that could direct runoff into waterways.
- Mechanically preparing sites when soils are saturated.
- Mechanical methods in SMZs.
- Blocking any drainage with beds, *windrows*, or similar structures.
- B*edding* that channels surface runoff into waterways and roadbeds.
- Moving soil into *windrows* and piles.
- Re-activating stabilized gullies.

5.2 MECHANICAL SITE PREPARATION IN WETLANDS

Forested *wetlands* offer unique challenges for *site preparation*. The EPA and Army Corps of Engineers have determined that major drainage in jurisdictional wetlands will require a Section 404 permit from the Army Corps of Engineers. Also a 404 permit may be required for mechanical *site preparation* for pine establishment in the following forested wetland types, unless they no longer exhibit their unique distinguishing characteristics due to past practices:

1. **Permanently flooded, intermittently exposed and semi-permanently flooded wetlands**: Examples include Cypress-Gum Swamps, Muck and Peat Swamps, and Cypress Strands/Domes.
2. **Riverine Bottomland Hardwood wetlands**: Seasonally flooded or wetter bottomland hardwood sites within the first or second bottoms where overbank flooding has resulted in alluvial features such as natural levees. Soils are listed in NRCS surveys as poorly or very poorly drained. Bottomland hardwoods do not include sites in which greater than 25% of the canopy is pine.
3. **White Cedar Swamps**: *Wetlands* greater than one acre in headwaters and greater than five acres elsewhere, underlain by peat of greater than 40 inches, where natural white cedar represents more than 50 % of the *basal area* and where the total *basal area* for all tree species is 60 square feet or greater.
4. **Carolina Bay wetlands**: Oriented, elliptical depressions with a sand rim, either underlain by (a) clay-based soils and vegetated by cypress or (b) peat of greater than 20 inches and typically vegetated with an overstory of Red, Sweet, and Loblolly Bays.
5. **Non-riverine Forest wetlands**: Rare, high quality (undisturbed) wet forests, with mature vegetation, located on the Southeastern coastal plain, whose *hydrology* is dominated by high water tables. Two forest community types fall into this group:

Wet Hardwood Forests — interstream flats comprising ten or more contiguous acres typically found on the margins of large peatland areas that are seasonally flooded or saturated by high water tables. Soils are listed as poorly drained mineral soils. Vegetation is dominated (greater than 50% of *basal area*) by mature swamp chestnut oak, cherrybark oak, or laurel oak, alone or in combination.

Swamp Forests — flats comprising five or more contiguous acres found on sites that are seasonally to frequently flooded or saturated by high water tables. Soils are listed as very poorly drained. Vegetation is dominated by

mature bald cypress, pond cypress, swamp tupelo, water tupelo, or Atlantic white cedar, alone or in combination.

Note: Sites dominated by red maple, sweetgum, or loblolly pine alone or in combination are not considered to be of high quality, and therefore do not require a permit.

6. **Low Pocossin wetlands**: Central, deepest parts of domed peatlands on poorly drained interstream flats, underlain by peat soils greater than 40 inches, typically vegetated by a dense layer of short shrubs.
7. **Wet Marl Forest**: Hardwood forest *wetlands* underlain with poorly drained marl-derived, high pH soils.
8. **Tidal Freshwater Marshes**: *Wetlands* with dense herbaceous vegetation located on the margins of estuaries or drowned rivers and creeks regularly or irregularly flooded by freshwater.
9. **Maritime Grasslands, Shrub Swamps, and Swamp Forests**: Barrier island *wetlands* in dune swales and flats, underlain by wet mucky or sandy soils vegetated by wetland herbs, shrubs, and trees.

These forested wetland areas are more precisely described in an EPA and Corps November 1995 memorandum concerning Application of *Best Management Practices* to Mechanical Silvicultural *Site Preparation* Activities for the Establishment of Pine Plantations in the Southeast. Consult a *qualified professional* for additional information to determine if one of these wetland types is on a site.

5.2.1 Other Wetlands

Other jurisdictional forested *wetlands* do not require a Section 404 permit if conducted according to the following six federally mandated minimum BMPs.

5.2.1.1 Federally Mandated BMPs for Mechanical Site Preparation in Wetlands

1. Position shear blades or rakes at or near the soil surface. *Windrow*, pile and move logs and *logging debris* by methods that reduce dragging or pushing through the soil to minimize soil disturbance associated with *shearing*, *raking* and moving trees, stumps, brush and other unwanted vegetation.
2. Activities should avoid excessive soil compaction and maintain soil tilth.

3. Arrange *windrows* to limit *erosion*, overland flow and runoff.
4. Prevent disposal or storage of logs or *logging debris* in SMZs.
5. Maintain the site's natural *contour* and ensure that activities do not immediately or gradually convert the wetland to a non-wetland.
6. Conduct activities with appropriate water management mechanisms to minimize off-site water quality impacts.

5.3 CHEMICAL SITE PREPARATION

H*erbicides* are a valuable tool in forest management and are used to control competing vegetation in the establishment and management of natural and planted pine stands. If conducted properly, *herbicide* treatments are acceptable *site preparation* methods on all slopes.

Proper planning and execution are key to safe *herbicide* use. Follow label directions and applicable state and federal laws in the storage, transportation, handling and application of all *herbicides*. Apply *restricted-use herbicides* only under the supervision of a certified *pesticide* applicator.

5.3.1 BMPs For Chemical Applications

- Establish appropriate buffers along *perennial* and *intermittent streams* and flowing bodies of water.
- Consider weather conditions such as temperature, wind speed and *precipitation*, equipment capabilities and *pesticide* formulations to avoid *pesticide* drift into the SMZ.
- Conduct all on-site *pesticide* handling, such as tank mixing, loading and rinsing equipment, away from streams, ponds, wells and roadside *ditches*.
- Dispose of *pesticide* containers and/or excess *pesticides* according to label requirements and local, state and federal regulations.
- Clean up and/or contain all *pesticide* spills immediately and comply with local, state and federal regulations for reporting hazardous materials spills. Report spills to the DNR EPD Hazardous Substance Office (1-800-241-4113).

5.3.2 Practices to Avoid During Chemical Applications

- Applying a *pesticide* directly to water bodies (streams, lakes, and swamps), unless it is specifically prescribed and labeled for aquatic management.
- Broadcast applications of *pesticides* within SMZs.

5.4 SITE PREPARATION (CONTROLLED) BURNING

Controlled fire is often used alone or in conjunction with chemical or mechanical *site preparation* to prepare sites for *regeneration*. A properly executed site prep burn only slightly increases the chance for *erosion*. Fires that expose significant mineral soil on steep slopes, however, may increase *erosion* potential. Other factors also must be taken into consideration. If in doubt about appropriate *site preparation* treatment, consult a *qualified professional*.

5.4.1 BMPs for Site Preparation Burning

- Unless protected by natural barriers, the area to be burned should be protected by *firebreaks* installed following BMP recommendations. (See Section 5.5)
- Moisture levels within the soil, forest fuels and the air should be sufficient to prevent major exposure or damage to the mineral soil, especially on moderate to severely erosive soils.
- Exclude high-intensity *site preparation* fires from the SMZ. Cool, low-intensity, hazard-reduction fires that do not consume the *duff* layer are allowed.

5.5 PRE-SUPPRESSION FIREBREAKS

Pre-suppression *firebreaks* aid in *site preparation* (controlled) burning, *prescribed burning* and in controlling wildfires. Proper planning and BMP implementation for pre-suppression *firebreaks* can minimize *sediment* delivery to surface water. Aerial photographs, topographic maps, or county soil survey maps should be used to locate tract boundaries, streams, *wetlands*, rock outcrops, gullies, cemeteries, etc. that require extra precautions.

5.5.1 BMPs for Firebreaks

- Where possible, use natural barriers such as roads, streams, and fields as *firebreaks*.
- Install *firebreaks* on the *contour* as much as possible.
- When *firebreaks* cannot be installed on the *contour*, use a gradual grade.
- Use bladed or harrowed *firebreaks* instead of plowed *firebreaks* whenever possible.
- On slopes exceeding three percent, install *water bars* with *water turnouts* in *firebreaks* according to the BMP recommendations for *skid trail* retirement. (See Table 4-A page 39.)

- Use hand tools or *back blade firebreaks* away from the edge of streams, roads, or *gullies*.
- Install *water bars* and *water turnouts* at approaches to streams, roads, and *gullies* to prevent channeling water from *firebreaks* into these areas.
- Treat active *gullies* the same as streams, using appropriate buffers and plowing practices.

5.5.2 Practices to Avoid During Firebreak Construction

- F*irebreaks* that channel surface runoff into streams, roads, or *gullies*.
- Plowing inside the SMZ.

5.6 REFORESTATION

Reforestation can be accomplished artificially or naturally. Natural *regeneration* and hand planting generally pose less of a threat to water quality than mechanical methods. Complete artificial *regeneration* projects as quickly as practical. A *qualified professional* can provide advice on reforestation choices.

5.6.1 BMPs for Reforestation

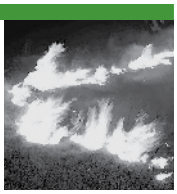
- Hand plant on >21% slopes with severely erosive soils.
- Machine plant on the *contour* on slopes between 2% and 20%.

Mechanical Tree Planting

5.6.2 Practices to Avoid During Mechanical Reforestation

- Machine planting up and down slopes greater than five percent.
- Machine planting within SMZs.

Notes:



Section 6.0

Management and Protection

6.1 PRESCRIBED BURNING/HAZARD REDUCTION

Prescribed burning is used to reduce hazardous accumulations of forest fuels, manage competing plant vegetation, improve wildlife habitat and perpetuate certain endangered plant and animal ecosystems. When properly planned and conducted, *prescribed burning* has minimal impacts on water quality. These burns should follow federal, state, county and local regulations.

6.1.1 BMPs for Prescribed Burning

- Follow same BMPs as in 5.4 and 5.5 page 49.

6.2 WILDFIRE SUPPRESSION

Wildfires are suppressed aggressively with the safety of personnel and equipment a primary concern. After suppression, when safety allows, BMPs should be installed during mop up or as soon as possible.

6.2.1 BMPs for Wildfire Suppression Firebreaks

- Locate camps and *staging areas* on upland sites.
- Stabilize areas designated for *water supply points* and dip sites for helicopters to prevent excessive rutting from support equipment.
- Mix and/or handle fire retardants, lubricants, etc. away from streams, ponds, wells and roadside *ditches*.
- Repair wildfire suppression *firebreaks* as soon as practical after the fire is under control to meet BMPs for pre-suppression plowing.

6.3 FERTILIZATION

Forest fertilization is a valuable *silvicultural* practice that enhances tree survival and growth. The primary nutrients applied are nitrogen and phosphorus. Plan any forest fertilization to prevent direct applications and runoff into water bodies. When conducted properly, forest fertilization poses little threat to water quality. Fertilizer applications should not result in the exceeding of state water quality standards for nitrates and phosphorous for lakes. For more information, contact the DNR EPD Water Protection Branch for those standards.

6.3.1 BMPs for Fertilization

- Consider weather conditions (such as temperature, wind speed and *precipi-*

tation) and equipment capabilities to avoid *fertilizer* drift into the SMZ.
- Conduct all on-site *fertilizer* handling, such as mixing and loading, away from streams, ponds, wells and roadside *ditches*.
- Clean up and/or contain all *fertilizer* spills immediately and comply with any local, state and federal regulations for reporting spills of hazardous materials.
- Dispose of *fertilizer* containers and/or excess *fertilizer* according to local, state and federal regulations and label requirements. In case of accidental spills, call 1-800-241-4113.

6.3.2 Practices to Avoid When Applying Fertilizers

- Applying *fertilizer* directly to water bodies (streams, lakes, and swamps) unless specifically prescribed and approved for aquatic management.
- Applications of *fertilizer* within SMZs.

6.4 REVEGETATION AND STABILIZATION OF SITES

Forest management often creates openings in the form of roads, stream crossings, *log decks*, *skid trails*, and *firebreaks*. Establishing a vegetative cover as soon as possible on these sites reduces *erosion* and prevents sedimentation. In addition to protecting the soil, vegetative cover can enhance wildlife habitat. Establishing a vegetative cover may include selecting the proper plant species, preparing the site, liming, fertilizing, seeding and *mulching*. This section provides managers with a variety of seeding mixtures that stabilize sites quickly and also provide benefits to wildlife. Table 6-A on page 54 provides a quick reference to help with the selection and establishment of seeding mixtures. Selection of plant species, establishment methods and maintenance procedures should be based on site characteristics, including climate, soils, *aspect* and land-use objectives.

6.4.1 Land Preparation

Site preparation, such as smoothing or reshaping rutted roads and landings, may be necessary before conventional equipment can prepare seedbeds, which are important for vegetation establishment. Disc *harrowing* and dragging will firm and smooth soil and promote good germination. Heavily compacted areas may require *sub-soiling*, ripping or *disking* to allow water infiltration and to provide a suitable seedbed for root growth.

Table 6-A. Seeding Mixtures for Erosion Control Plantings

Fall Plantings		Planting Date					
Recommended Planting[1]	Seeding[2] Rate (lb/acre)	Coastal	Piedmont	Mountains	Fertilizer (lb/acre)	Wildlife Value	Remarks
Ladino Clover[3] Red Clover Ryegrass Rye Wheat	5 10 15 30 30	September 15 to November 15	September 1 to November 1	August 1 to October 15	500 10-10-10	Excellent	Well drained clayey or loamy soils. Perennial clover can persist for several years. Inoculate clover seed. Maintaining pH above 6.0 is critical.
Crimson Clover Hairy Vetch Wheat	15 15 60	September 15 to November 15	September 1 to November 1	September 1 to October 15	500 10-10-10	Excellent	Well drained clayey or loamy soils. Inoculate clover. Tolerates lower soil pH. Disk lightly in September to encourage re-seeding and overseed with wheat.
Arrowleaf Clover or Crimson Clover Ryegrass Wheat	15 15 40	September 15 to November 15	September 1 to November 1	September 1 to October 15	500 10-10-10	Good	Well drained sandy or loamy soils. Inoculate clover. Disk lightly in September to encourage re-seeding of clover and overseed with wheat and rye.
Wheat or Rye Unhulled Bermuda in sandy soil or Fescue in clayey soil	50 10 25	September 1 to December 15	September 1 to December 1	September 1 to November 15	500 10-10-10	Poor	Cool season annuals provide value for wildlife during fall and winter of first year. Maintain by mowing for weed control and fall fertilization.

Spring Plantings		Planting Date					
Recommended Planting	Seeding Rate (lb/acre)	Coastal	Piedmont	Mountains	Fertilizer (lb/acre)	Wildlife Value	Remarks
Ryegrass Kobe Lespedeza	20 30	Feb. 15 to April 1	Feb. 15 to April 1	March 1 to April 15	500 10-10-10	Excellent	Low maintenance, reseeding annuals. Inoculate Kobe Lespedeza.
Bahiagrass Brown Top Millet	25 25	March 25 to July 1	April 15 to July 1	XXXXXX	500 10-10-10	Good	Include hulled Bermuda at a rate of 10 lb. per acre on sandy sites. Kobe Lespedeza can be added at 10 lb. per acre to increase wildlife value.
Bermuda grass Brown Top Millet	10 25	March 15 to July 1	March 15 to July 1	April 15 to July 1	500 10-10-10	Fair	Does well in dry, sandy sites.

Footnotes for Erosion Control Plantings Table

1) To maximize wildlife value, avoid plantings with Fescue, weeping love grass, Bermuda grass, and sericea Lespedeza.
2) Seeding depths should be 1/4 inch unless otherwise noted.
3) For mixtures including Ladino clover, lime at the rate indicated by soil test or at the rate of 2 tons per acre.

6.4.1.1 Fertilizer and Lime

A soil test can determine fertility and pH. If a soil test is not available and lime has not been applied in the past three years, apply it at the rate shown in Table 6-B. Lime and *fertilizer* are most efficient when incorporated into the soil. Spread them uniformly over the site prior to land preparation and mix them completely with the soil. Lime takes several months to react with the soil and become fully effective.

Forest soils are typically low in phosphorous and/or potassium and usually require lime. Clovers are not productive in acid sites (below pH 6.0) with low fertility unless *fertilizer* and lime are added.

Table 6-B. Rate of Lime to Use When a Soil Test is Unavailable

Soil Texture	Tons/Acre	Pounds/1000 sq. ft.
Sands and loams	2	100
Clayey, acidic	3	150
Clayey, alkaline	0	0

Base additional applications of lime on soil test recommendations.

6.4.1.2 Seeding and Mulching

Seeding can be done in a number of ways. The most common method utilizes a farm tractor and a broadcast seeder. On steep or severely erosive sites, use a hydroseeder. Seed should be covered by pulling a section harrow, cultipacker, or brush.

Mulch should be used on slopes greater than five percent, on sites where vegetation will establish slowly, or on deep sands or heavy clay soils. Mulch helps prevent *erosion* and allows vegetation to become established. Structural measures such as a diversion, which moves concentrated runoff, usually require mulch. Where there is a danger of mulch being blown or washed off-site, anchor it by running over the mulched area with a disk harrow with the discs set to run straight. On steep slopes, anchor mulch with netting and tack-down staples or spray it with a tackifier.

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Additional Management Objectives

The *Best Management Practices* recommendations in this publication are directed at maintaining water quality, which is critical for the conservation of all natural resources. Forest management practices such as timber harvesting, *site preparation*, tree *regeneration*, and within-stand treatments may be conducted in ways that enhance fish and wildlife habitat, *aesthetics* and recreational opportunities, while accommodating sensitive sites and endangered species. Landowners may have other resource objectives that can be achieved only through the use of practices that vary but are consistent with the protection of water quality. The following comments describe additional management options that landowners may wish to consider.

7.1 WILDLIFE MANAGEMENT

- Compare your current habitat conditions and those on adjacent lands to your wildlife management objectives before making land management decisions.
- Some fish and wildlife species benefit from SMZs wider than the minimum widths specified for water quality BMPs.
- Manage for a diversity of forest types and age classes to enhance wildlife habitat quality.
- Maintain mature mast producing hardwoods in groups or stands.
- Leave corridors of trees connecting mature forest stands to provide food, cover and travel avenues for wildlife while adjacent stands are regenerating.
- Leave snags, dead and down woody debris, brush piles or *windrows* throughout timber harvest areas.
- Use *prescribed fire*, which is one of the most cost-effective forest and wildlife management practices.
- Use wildlife-friendly plantings for *log decks*, roads and *skid trails* following logging operations.
- For more information on any of the above recommendations, contact the Georgia DNR Wildlife Resources Division.

7.2 PROTECTED SPECIES

The University of Georgia Cooperative Extension Service, the College of Agricultural and Environmental Sciences, and the Georgia Department of Natural Resources Wildlife Resources Division have publications with listings.

If you suspect the presence of an endangered species, contact the Georgia Department of Natural Resources Wildlife Resources Division or the U.S. Fish and Wildlife Service for verification and management considerations.

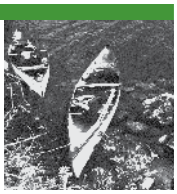
7.3 AESTHETICS

Aesthetics can influence public perception of forestry.

- Consider *aesthetics* during forest management activities and be aware that appearance may influence public opinion.
- Use forest management methods that can minimize visual impacts such as single tree and group selection, *seed tree* and *shelterwood regeneration*, and small patch clearcuts.
- Leave corridors of trees along well-traveled public roads to enhance visual quality.
- Shape harvest areas with natural features of the landscape.
- Re-seed bare soil areas promptly.
- Maintain a mixed tree species composition.
- During artificial *regeneration*, establish tree rows parallel to the road and avoid 90-degree angles.
- Minimize the "skylining" of residual snags and cull trees.
- For more information, see the American Pulpwood Association's *Forestry Aesthetics Guide, Image and Opportunity*.

7.4 SENSITIVE SITES

- Consider protective management prescriptions for unique cultural (Native American sites), ecological (protected species), archeological (civil war breastworks), geological (rock formations), or historical (old forts and cemeteries) sites. They may need special consideration to manage their values. Contact the DNR.



Section 8.0

Appendix

8.1 FEDERAL LAWS AND REGULATIONS AFFECTING FOREST LANDOWNERS

8.1.1 The Federal Clean Water Act, Section 404, 40 CFR Part 232.3

- Exempts normal, established, on-going, *silvicultural* operations from permitting.
- Requires *silvicultural* operations to adhere to BMPs and 15 baseline provisions for forest road construction and maintenance in and across *waters of the* U.S. (lakes, rivers, perennial and *intermittent streams*, *wetlands*, *sloughs* and natural ponds) in order to qualify for the *silvicultural* exemption from the permitting process. See Section 3.3.1 page 31.
- Requires Army Corps of Engineers permit for the conversion of forested *wetlands* to other uses such as agriculture or development.
- A Memorandum of Understanding dated November 28, 1995, between the Army Corps of Engineers and the U.S. Environmental Protection Agency requires permits for the conversion of specific high-quality bottom land hardwood *wetlands* to pine plantations by mechanical *site preparation* methods. It also mandates the use of six BMPs in other jurisdictional *wetlands*. See Section 5.2.1.1, page 47.
- Provides for civil and criminal penalties up to $125,000 per day.

8.1.2 USDA Programs

Participation by landowners in various loan, price support, agriculture, forestry incentive and assistance programs subject them to rules and regulations regarding the Federal Farm Bill (Swampbuster and Sodbuster Provisions).

- Prohibits landowners from converting forested *wetlands* to agricultural uses.
- Provides for penalties including program payments plus interest to be paid back from the time of the conversion, loss of benefits and loss of eligibility in future programs.

8.2 STATE LAWS and REGULTIONS AFFECTING FOREST LANDOWNERS

8.2.1 The Georgia Water Quality Control Act (O.C.G.A. 12-5-29)

- Makes it unlawful to discharge excessive *pollutants* (*sediment*, nutrients, *pesticides*, animal waste, etc.) into *waters of the state* in amounts harmful to

public health, safety, or welfare, or to animals, birds or aquatic life or the physical destruction of stream habitats. See Section 1 or glossary for definition of *waters of the state*.

- Provides for civil and criminal penalties up to $100,000.00 per day.

8.2.2 (Excerpt from Georgia Rules and Regulations for Water Quality Control Chapter 391-3-6-.03 Water Use Classifications and Water Quality Standards) Amended.

General Criteria for All Waters. The following criteria are deemed to be necessary and applicable to all *waters of the state*:

Turbidity. All waters shall be free from *turbidity*, which results in a substantial visual contrast in a water body due to a man-made activity. The upstream appearance of a body of water shall be as observed at a point immediately upstream of a *turbidity*-causing man-made activity. That upstream appearance shall be compared to a point, which is located sufficiently downstream from the activity so as to provide an appropriate mixing zone.

For land disturbing activities, proper design, installation, and maintenance of ***best management practices*** and compliance with issued permits shall constitute compliance.

Temperature: Not to exceed 90°F. At no time is the temperature of the receiving waters to be increased more than five degrees Fahrenheit above intake temperature, except that in estuarine waters the increase will not be more than one-point-five degrees Fahrenheit. In streams designated as primary trout or smallmouth bass waters by the Wildlife Resources Division, there shall be no elevation of natural stream temperatures. Streams designated as primary trout waters are waters supporting a self-sustaining population of rainbow, brown or brook trout. In streams designated as secondary trout waters, there shall be no elevation exceeding two degrees Fahrenheit natural stream temperatures. Streams designated as secondary *trout streams* are those with no evidence of natural trout reproduction, but are capable of supporting trout throughout the year.

Trout streams are classified in accordance with the designations and criteria established by the Georgia Environmental Protection Division. This list may be updated every two years. For the most current list, visit www.gaepd.org or call the Georgia EPD at 404-656-4708.

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8.2.3 The Georgia Growth Planning Act (O.C.G.A. 12-2-8)

- Authorized the Georgia Department of Natural Resources to develop minimum planning standards and procedures that local city and county planning and zoning jurisdictions could adopt and enforce pertaining to the protection of *river corridors*, *mountain tops*, *water supply reservoirs/watersheds* and *wetlands*.
- Requires local governments to use these minimum standards in developing and implementing local comprehensive growth development plans.
- *Silvicultural* practices are exempt from permitting requirements according to the guidelines, but the activity must comply with BMPs within these sensitive areas. The rules for environmental planning for each of these sensitive areas are:

8.2.3.1 Water Supply Reservoir/Watershed (Chapter 391-3-16-. 01)

- Provides local governments criteria to allow development of a *water supply reservoir* or *watershed* without contaminating the water source to a point where it cannot be treated to meet drinking water standards.
- The criteria establishes buffer zones and requirements for land disturbing activities along *perennial streams* and lakes and applies to existing and future *water supply reservoirs* and *watersheds*. See Figures 8-A and 8-B.
- Local governments may exempt specific forestry activities from the stream and lake corridor buffers, provided the activity complies with *Best Management Practices*.

Figure 8-A. Water Supply Reservoir/Watershed Buffer Zones

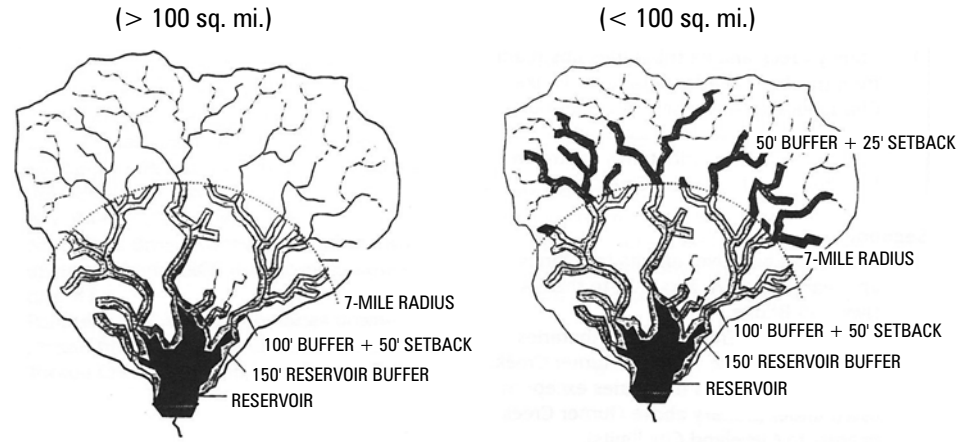
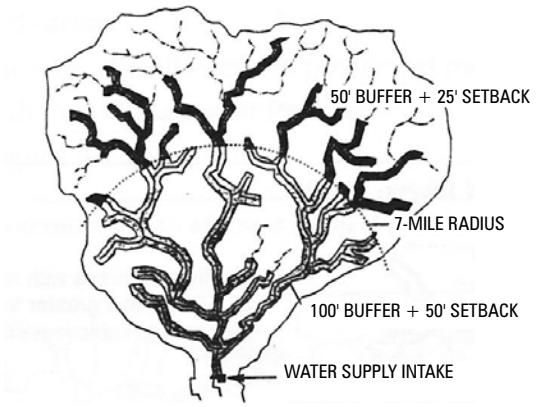


Figure 8-B. Water Supply Intake Watershed (< 100 sq. mi.)



8.2.3.2 Wetlands Protection Act (Chapter 391-3-16-. 03)

- Requires local governments and regional development centers to acknowledge the importance of *wetlands* for the public good in the land-use planning process.
- Where *wetlands* exceed five acres, local governments are encouraged to protect them.
- Timber production and harvesting are considered acceptable uses.

8.2.3.3 River Corridor Protection Act (Chapter 391-3-16-. 04)

- Requires local governments and regional development centers to use standards for the protection of river corridors in developing and implementing local comprehensive development plans.
- Applies to any *perennial* river or watercourse, at that point and below, where the average annual flow is at least 400 cubic feet per second (cfs) as determined by appropriate U.S. Geological Survey documents.
- Protected buffers include all land within 100 feet horizontally on both sides of the river, as measured from the riverbanks.
- Plans shall allow for timber production and harvesting, provided the activity complies with *Best Management Practices*.
- See map. (Figure 8-C)

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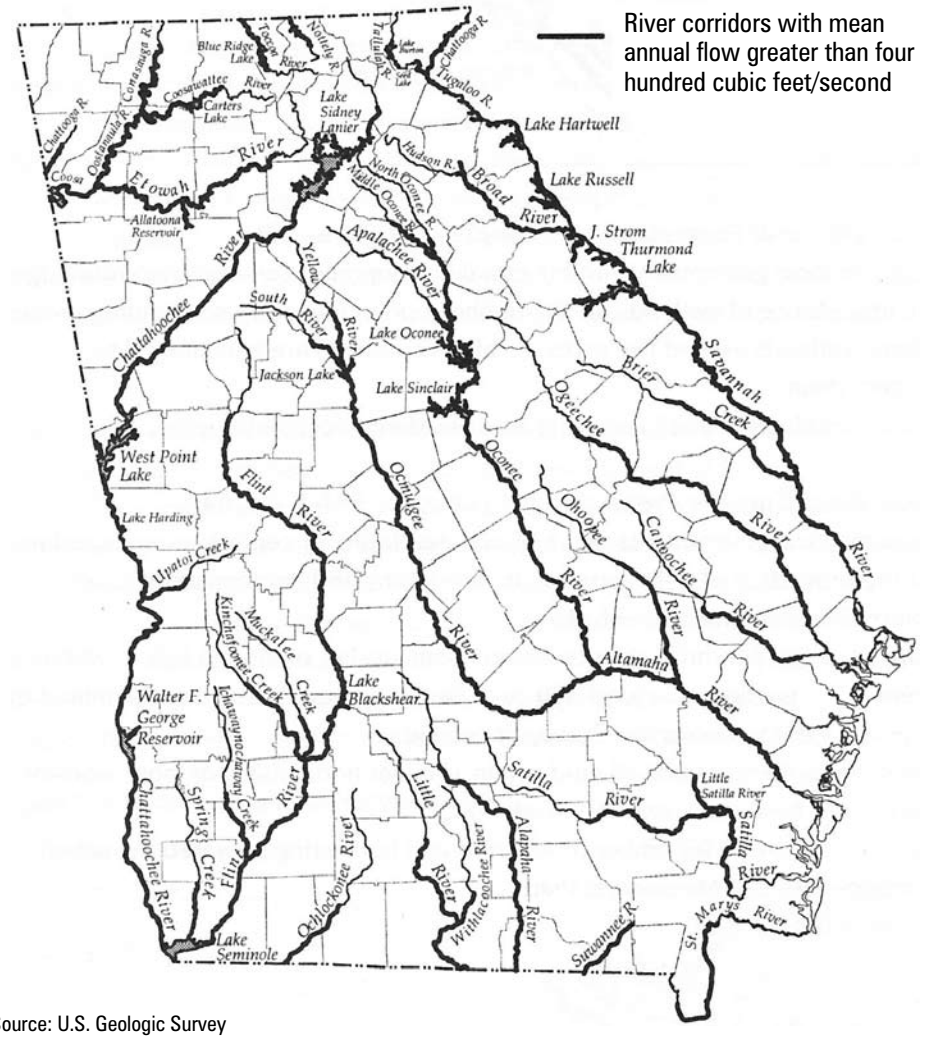
Figure 8-C. State Designated Protected Rivers, 1992



Source: U.S. Geologic Survey

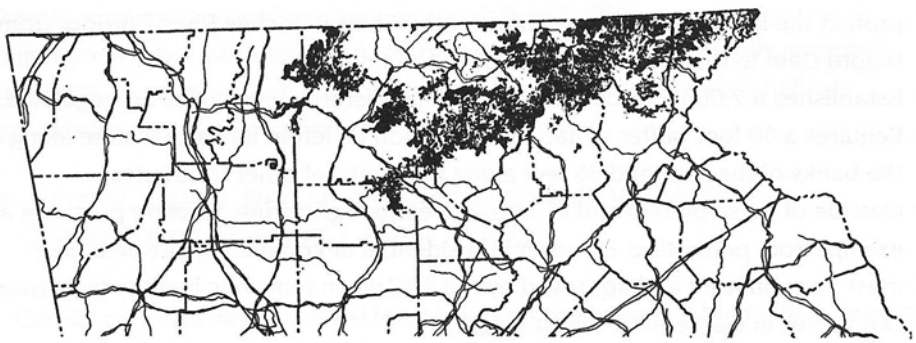
8.2.3.4 Mountain Protection Act Chapter 391-3-16-. 05)

- Requires local governments and regional development centers to use planning standards for the protection of mountain areas in developing and implementing local comprehensive plans.
- Applies to all land area 2,200-feet or more above mean sea level that has a percentage slope of 25 percent or greater for at least 500-feet horizontally,

and shall include the crests, summits, and ridge tops that lie at elevations higher than any such area.

- Forestry practices are allowed on protected mountains, provided the activity complies with *Best Management Practices*.
- See map. (Figure 8-D)

Figure 8-D. Generalized Map of Areas Subject to "Mountain Protection"

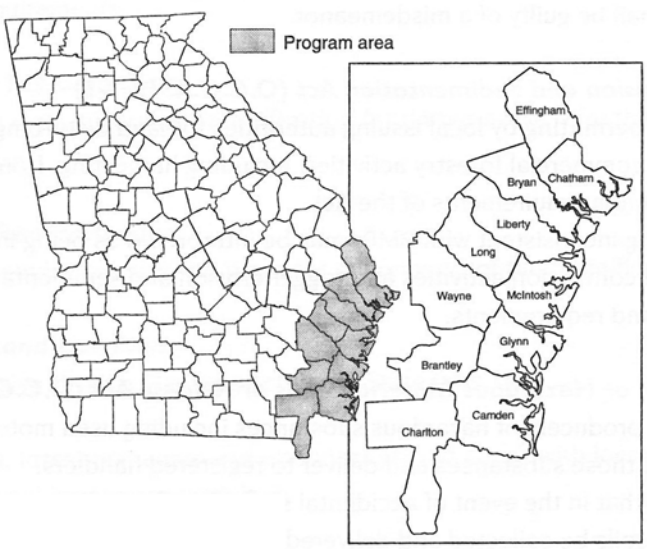


Source: U.S. Geologic Survey

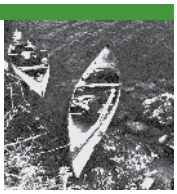
8.2.4 Coastal Management Act (O.C.G.A. 12 -5-260)

- Requires existing authorities in the 11-county coastal area to execute the full range of policies and management techniques identified as necessary for coastal management purposes.
- See map. (Figure 8-E)

Figure 8-E Coastal Zone Management Program Area,1997



Source: Georgia Coastal Resources Division



8.2.5 Metropolitan River Protection Act (O.C.G.A. 12-5-440)

- Requires the Atlanta Regional Commission (ARC) to adopt a Plan that would protect the land and water resources of the Chattahoochee River Corridor from Buford Dam to the southwest edge of Fulton County.
- Establishes a 2,000-ft. buffer in which land disturbing activities are regulated.
- Requires a 50-ft. buffer of natural vegetation be left in its natural state along the banks of the river and 35-ft. along the banks of other tributaries.
- Outside of these buffers and in areas zoned for agriculture, forestry practices are exempt from permitting. However in residential or commercial areas, a plan must be submitted and approved by the ARC when removing healthy trees over two inches in diameter at breast height.
- Establishes civil penalties of $1,000.00 per acre per day or part thereof on which such violation occurs.

8.2.6 Georgia Forest Fire Protection Act (O.C.G.A. 12-6-90)

- Requires any person, firm, corporation, or association entitled to burn any woods, lands, marshes, or any other flammable vegetation, whether in cultivated or uncultivated areas, to notify, prior to burning, and/or obtain a permit from the county office of the GFC wherein such burning is to be made.
- Any person who makes a burn and fails to give notice and/or obtain required permit shall be guilty of a misdemeanor.

8.2.7 Erosion and Sediment Control Act (O.C.G.A. 12-7-1)

- Provides permitting by local issuing authorities for land disturbing activities.
- Exempts commercial forestry activities, including harvesting, from permitting and minimum requirements of the act.
- Harvesting inconsistent with BMPs may be interpreted as being in association with land conversion activities and trigger E*rosion & Sediment* Control permits and requirements.

8.2.8 Oil or Hazardous Material Spills or Release Act (O.C.G.A. 12 -14-1)

- Requires producers of hazardous substances including used motor oils or fuels to collect those substances and deliver to registered handlers.
- Requires that in the event of accidental spills, the spill be contained, contaminated soils be collected and delivered to approved waste handling facility, and EPD be notified. (1-800-241-4113)

8.2.9 State Board of Registration for Foresters Standards of Practice (O.C.G.A. 43-1-19) Chapter 220-5.01

- It is the responsibility of each *registered forester* to practice professional forestry in a manner which protects the public welfare and safety and which meets generally accepted standards of practice.
- Generally accepted standards of practice shall include, but are not limited to, adherence to *Best Management Practices* published periodically by the Georgia Forestry Commission and available from the Board office.
- Failure to practice professional forestry in accordance with generally accepted standards of practice shall constitute unprofessional conduct and shall be grounds for disciplinary action as provided for by law.

8.3 LOCAL LAWS, REGULATIONS, AND ORDINANCES AFFECTING FOREST LANDOWNERS

Certain counties have adopted local laws and ordinances, which affect forestry activities. These come under the following categories:

8.3.1 Road Protection

May require permits and bonds before harvesting can begin. The Georgia Forestry Association, the Georgia Forestry Commission and the University of Warnell School of Forestry and Natural Resources Extension Service maintains current list of those counties.

8.3.2 Zoning

Timber harvesting, in other than agriculture zones, may require permits and specific harvesting requirements.

8.3.3 Timber Tax Collection

Certain counties require permits or notification for timber harvest for the collection of timber tax.

8.3.4 Watershed Protection

Some counties require permits and plans for the removal of timber in floodplains.

8.3.5 Local Land Use Plans

See Comprehensive Growth Planning Act under State Laws.

Landowners, forest managers and operators should check with local authorities before undertaking forestry activities.

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8.4 GLOSSARY

Access Road – A permanent or temporary woods road over which timber is transported from a felling site to a public road. Also known as a haul or system road.

Aesthetics – The study or practices designed to maintain the beauty of forests.

Aspect – The compass direction that the slope of the land faces (north, northwest, south, etc.)

Back blading – The practice of laying the bulldozer blade on the ground while operating a crawler tractor or other bulldozer equipment in reverse. This practice is commonly used for smoothing rough soil or for pulling soil or debris away from an area when pushing is not practical.

Backwater paleo channels – Usually well-defined deep channel features that are remnants of earlier river and side channel configurations. Mixed channel substrates (sand, organics, fine sediments). Flow usually backs into these features from the main river. Organic debris is often found piled against the "wrong" side of obstructions.

Backwater swamps – Backwater swamps are wetland areas formed in old overflow channels on the margins of floodplains at the base of the adjacent slopes. They feature wetland vegetation, hydric soils, and fine and organic substrates, but they may show evidence of scour and debris movement.

Basal Area – The area of the cross-section of a tree stem near its base, generally at breast height (4 ½ feet above the ground), inclusive of bark. Expressed in square feet per acre. Stand *basal area* is generally expressed as the total *basal area* per unit area.

Bedding – A site preparation technique in which a small ridge of surface soil is formed to provide an elevated planting or seedbed. It is used primarily in wet areas to improve drainage and aeration for seedlings.

Best Management Practices (BMPs) – Methods, measures or practices to prevent or reduce water pollution, including but not limited to, structural and non-structural controls, operation and maintenance procedures, and other requirements, scheduling, and distribution of activities. Usually BMPs are applied as a system of practices rather than a single practice.

Braided stream – A stream flowing in several dividing and reuniting *channel*s resembling the strands of a braid. The divisions are caused by obstruction from sediment deposited by the stream.

Broad-Based Dip – A surface drainage diversion built into the bed of a permanent haul road that consists of a long approach section, a low, out-sloped middle section, and a short terminal section with a reverse grade. They are specifically designed to intercept and divert surface water flow out of a dirt road while allowing vehicles to maintain normal haul speeds. Also called a rolling dip.

Broadcast Burn – A controlled fire within well-defined boundaries to reduce forest fuel hazards.

Brush Barrier – A linear pile of limbs, tops, logs, and other forest debris which is arranged along the lower edge of a road, log deck, or site prepared area to slow, diffuse, or intercept sediment moving off the disturbed site.

Buffer Strip – A transitional area between two different land uses which mitigates the effects of one land use on another. For water quality purposes they are intended to filter surface runoff and trap sediment and associated pollutants before entering water bodies. Some state and local regulations require them.

Canal – A man-made waterbody constructed for the purpose of flood control.

Canopy cover – Indices of percent ground surface shaded by a combination of overstory and midstory trees.

Channel – A natural water-bearing trough cut vertically into low areas of the land surface by erosive action of concentrated flowing water.

Chopping – A mechanical treatment in which vegetation is concentrated near the ground and incorporated in the soil. Chopping may be used to facilitate burning.

Clearcutting – A *silvicultural* system in which all merchantable trees are harvested over a specified area in one operation.

Continuous Side Channels – These less distinct channels and banks flow intermittently and are connected to the main channel network at both ends. The channels often contain mixed substrates (sand, organics, fine sediments).

Commercial Forest land – Forest land bearing or capable of bearing timber of commercial character, currently or prospectively available, and not withdrawn from such use.

Contour – An imaginary line on the surface of the earth connecting points of the same elevation. Also a line drawn on a map connecting points of the same elevation.

Controlled burning (fire) – See prescribed burning

Cross-Drain Culvert – A metal, wooden, plastic or concrete conduit through which ditch flow is directed underneath the road surface to the opposite side of the road.

Culvert – A metal, concrete or plastic pipe, or a constructed box-type conduit through which water is carried under roads or trails.

Discontinuous side channels – Channel features that may or may not be connected, on at least one end, to medium or higher flow energy channels. May have distinct or indistinct channel features, but the channel features disappear and reappear.

Ditch – A man-made feature constructed for the purpose of minor surface water drainage.

Drainage channels – These less distinct channels begin on the floodplain and usually flow intermittently during periods of high water tables via a continuous linear drainage system to the main river. The channels often contain mixed substrates (sand, organics, fine sediments).

Dry Wash – A stream bed that carries water only during and immediately following rainstorms. Sometimes referred to as a gully or ephemeral stream.

Duff – Partially decayed organic matter on the forest floor.

Ephemeral area – Depressions or swales, sometimes called drains, draws, or dry washes, that have no defined continuous channel and that are well-connected to intermittent or perennial streams. Please see page 19 for a more detailed description.

Erosion – The process by which soil particles are detached and transported by water, wind and gravity to a point downslope or downstream.

Estuary – An inlet or arm of the sea where the tide meets the current at the mouth of a river.

Excelsior blanket – A machine produced mat of curled wood excelsior bonded with polymer netting.

Fauna – The animals of a specified region or time.

Felling – Cutting down standing trees.

Fertilizers – Any substance or combination of substances used primarily as a source of plant nutrition or soil amendments.

Firebreaks (Fire Lines) – Artificial barriers that contain fires within an area that typically are established by plowing and/or harrowing.

Floodway and River bottom flats – Area of floodplain with significant water velocities during frequent overbank flows (flows less than the two-year low flow). Evidence of scour and debris movement can be found. The floodway is usually identified on FEMA floodplain maps. Smaller floodway or riparian areas in minor streams are also called river bottom flats.

Flora – The plant of a specified region or time.

Forest Chemicals – Chemical substances or formulations that perform important functions in forest management, including fertilizers, herbicides, insecticides, fungicides and repellents.

Gabion – Large, multi-celled, welded wire or rectangular wire mesh boxes, used in stream *channel* revetments, retaining walls, abutments, check dams, etc to stabilize steep or highly erosive slopes.

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Geotextiles – Fabrics used to improve the load bearing capacity of roads with weak base material.

Geowebb – A heavy-duty polyethylene cellular confinement system used to improve and stabilize structural fill in roads and embankments.

Gully – Narrow ravines, often caused by past land cultivation. Please see page 21 for a more detailed description.

Harrowing (Disking) – A mechanical method of scarifying the soil to reduce competing vegetation and to prepare a site for seeding or planting.

Herbicide – Any chemical or mixture of chemicals intended to prevent the growth of or promote the removal of targeted tress, bushes, and/or herbaceous vegetation.

Humus layer – The organic layer of the soil formed by the decay of organic matter.

Hydric Soils – Soils exhibiting a considerably wet nature, typically characterized by dark or gray mottled colors and associated with wetlands.

Hydrology – The scientific study of the properties, distribution and effects of water on the earth's surface, in the soil and underlying rocks and in the atmosphere.

Inslope – The feature of a road surface, established during construction or maintenance, that slants the roadbed to the inner or uphill side to facilitate drainage of storm runoff from the road in more concentrated flow into a ditch line.

Integrated Pest Management – The maintenance of destructive agents, including insects, at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory tactics and strategies that are ecologically and economically effective and socially acceptable.

Intermittent stream – A watercourse that flows in a well-defined *channel* during wet seasons of the year but not the entire year. They generally exhibit signs of water velocity sufficient to move soil material, litter and fine debris. Aquatic insects often are difficult to find or not present at all.

Log deck – A place where logs or tree-length material is assembled for loading and transporting.

Logging Debris – The unused and generally unmarketable accumulation of large limbs, tops, cull logs, and stumps that remain after harvesting.

Mulching – Any loose covering of forest soil with organic residues such as grass, straw or wood fibers that checks erosion and stabilizes exposed soil.

Non-point source (NPS) pollution – Water pollution that is (1) induced by natural processes including precipitation, seepage, percolation and runoff; (2) not traceable to any discrete or identifiable facility; and (3) better controlled by using BMPs.

Outslope – The feature of a road surface, established during construction or maintenance, that slants the roadbed to the outer or downhill side to facilitate drainage of storm runoff from the road in more diffuse flow than occurs at dips and water bars. Outsloping is a contrasting road design to the crowned roadbed or to an inslope toward a ditch line.

Perennial Stream – A watercourse that flows in a well-defined *channel* throughout most of the year under normal climatic conditions. Some may dry up during drought periods or due to excessive upstream uses. Aquatic insects are normally present and easily found.

Pesticide – Any chemical substance used to control undesirable insects, diseases, vegetation, animals or other life forms. Herbicides, insecticides, fungicides and nematicides are considered pesticides.

Pollutants – Natural or manmade waste material that contaminates air, soil or water.

Precipitation – Any form of water that falls to the ground from the atmosphere, including drizzle, rain, snow, snow pellets, ice crystals, etc.

Prescribed Burning (fire) – The use of planned fire that is deliberately set under specific fuel and weather conditions to accomplish any variety of management objectives and is under control until it burns out or is extinguished.

Protected Mountain Top – Mountain tops above 2,200-ft. elevation and greater than 25% slope.

Protected River Corridors – One hundred-foot buffers along those rivers at a point and below where the flow is at 400 cubic feet per second (cfs).

Qualified Professional – A person whose training and experience qualifies him/her to make forestry and water quality recommendations. Examples include foresters, hydrologists, soil scientists, forest engineers, fishery and wildlife biologists, or technically trained individuals such as those who have completed the Master Timber Harvesters workshops.

Raking – A mechanical site preparation method to remove trees and shrubs by raking and piling debris. Raking usually moves less soil into windrows than bulldozing.

Regeneration – A young tree crop that replaces older trees removed by harvest or disaster; also the process of replacing old trees with young ones.

Registered Forester – A person who is registered and licensed to engage in professional forestry practices as determined by the Georgia State Board of Registration for Foresters.

Restricted Use Pesticide – A pesticide that is applied only by certified persons for specific uses.

Retirement of Roads – Preparing a road for a long period of non-use by methods including mulching, seeding and installing water bars.

Riprap – Rock or other large aggregate that is placed to protect streambanks, bridge abutments or other erodible sites from runoff or wave action.

Rotation Period – The period of time needed to establish, grow and harvest a crop of trees at a specified condition of maturity.

Sediment – Soil particles that have been detached and transported into water during erosion.

Seed Tree Cut – A timber harvesting method that provides for the natural regeneration of a site by leaving single trees, or small groups of seed-bearing trees, evenly distributed throughout the harvest area. Generally results in an even-aged stand

Seep or spring – A place where groundwater flows slowly to the surface and often forms a pool; a small spring.

Selection cut – Removal of select trees in a forest stand based on some economic or physiological criteria. Generally results in an uneven-aged stand.

Shearing – A mechanical site preparation method of removing large numbers of stems too large for disking or drum chopping. Shear blades, mounted on crawler tractors, are angled or V-shaped, have straight or serrated edges and have a "stinger" for splitting larger trees and stumps.

Shelterwood Cut – Removal of mature timber in a forest stand in a series of harvests that extend over a relatively short portion of the rotation. This cut encourages essentially even-aged reproduction under the partial shade of seed trees.

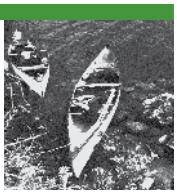
Side cast – The act of moving excavated material to the side and depositing it.

Silt fence – A lofty web of mechanically or melt bonded polymer netting, monofilament or fibers that are entangled to form a strong and dimensionally stable matrix to catch storm runoff and soil particles.

Silviculture – The science and art of growing forest crops. More particularly, the principles, theories and practices for protecting and enhancing the regeneration, growth, development and use of forests for multiple benefits.

Sinkhole – A geologic feature that may provide a direct connection between land surface and groundwater.

Site preparation – A forest activity to remove unwanted vegetation and other material, and to cultivate or prepare soil for reforestation.



Section 8.0
Appendix

Skid – The short-distance moving of logs or felled trees along the surface of the ground from the stump to the point of loading.

Skid Trail – A temporary, non-structural pathway over forest soil for dragging felled trees or logs to a log deck.

Slough – A poorly defined *channel* in a swamp, bog, marsh, or riverine system, often without a clearly defined inlet or outlet.

Staging area – An area designated for the concentration of vehicles and equipment for a specific activity.

Streamside Management Zone (SMZ) – A designated area of varying width adjacent to the banks of streams and bodies of water where management practices that might affect water quality, fish, or other aquatic resources are modified.

Sub-soiling – A mechanical site preparation method for ripping apart compact soils or soils with plow pans, hard pans, or fragi-pans under the soil surface.

Thermal Pollution – A temperature rise in a body of water sufficient to harm aquatic life.

Trout stream – A perennial stream and its tributaries inhabited by trout. Streams designated as Primary Trout Waters are waters supporting a self-sustaining population of rainbow, brown or brook trout. Streams designated as Secondary Trout Streams are those with no evidence of natural trout reproduction, but are capable of supporting trout throughout the year.

Turbidity – An optical measurement of water clarity.

Water bar – A hump or small dam-type surface drainage structure used to close abandoned roads, skid trails, and fire lines.

Water Control Structure – Any structure used to regulate surface or subsurface water flows.

Watershed– All land and water within a drainage divide.

Waters of the State – Any and all rivers, streams, creeks, branches, lakes, reservoirs, ponds, drainage systems, springs, wells and other bodies of surface or subsurface water, natural or artificial, lying within or forming part of the boundaries of the state, which are not entirely confined and retained completely upon the property of a single individual, partnership or corporation.

Waters of the U.S. – Includes lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.

Water Supply Point – An easily accessible location used to pump water into fire-suppression vehicles.

Water Supply Reservoir/Watersheds – Governmentally owned impoundments of water and the watersheds above such impoundments used primarily to provide water to one or more governmentally owned public drinking-water systems.

Water Turnout – The extension of an access road's drainage ditch or skid trail's or fire line's water bar into a vegetated area to disperse and filter storm water runoff.

Wetlands – Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils and hydrology. Wetlands generally include swamps, marshes, bogs, river floodplains, Carolina bays, cypress domes and stringers, pine hammocks and similar areas.

Windrow – Logging debris and unmerchantable woody vegetation that is piled into rows to decompose or be burned.

8.5 CONTRIBUTORS

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www.acf-foresters.org

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