SILVICULTURE

SILVICULTURE MANAGEMENT PRACTICES CATALOGUE

FOR

NONPOINT SOURCE POLLUTION PREVENTION

AND

WATER QUALITY PROTECTION

IN

NEW YORK STATE

Prepared By:

Silviculture Management Practices Sub-Committee
of the
New York State Nonpoint Source Management Practices
Task Force

Summary Sheets Developed By:

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Division of Water
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SILVICULTURE MANAGEMENT PRACTICES FOR NONPOINT SOURCE POLLUTION PREVENTION AND WATER QUALITY PROTECTION IN NEW YORK STATE

I. INTRODUCTION

A. Nonpoint Source Management Practice Task Force

Background

The Water Quality Act of 1987 placed increased attention on the development and implementation of nonpoint source control programs. Section 319 of the Act required states to prepare an Assessment Report identifying waterbodies affected by nonpoint source pollution, determining categories of nonpoint sources that are significant problems in the state and listing state programs available for the control of nonpoint source pollution. States were also required to prepare a Management Program which explained how they planned to deal with the source categories causing the major problems.

The New York State Department of Environmental Conservation (DEC) by virtue of its statutory authority for the management of water resources and control of water pollution in the state, has assumed the lead responsibility for control of nonpoint source pollution. One action taken by DEC to carry out its NPS responsibility was the development of a Nonpoint Source Management Plan in January 1990. The Management Plan outlines how DEC will identify, describe and evaluate management practices to be used to reduce nonpoint sources of pollution and make recommendations for additional control options needed to address nonpoint source pollution.

Candidate Management Practices

In New York, a list of candidate management practices was developed in 1989 by the Nonpoint Source Working Group, a task force under DEC leadership, composed of federal and state agencies and groups representing a broad range of issues and source categories. The Working Group recognized that there are numerous practices available with potential to control nonpoint source pollution, however, the management practices were not systematically inventoried or evaluated for effectiveness in preventing or remediating nonpoint water quality problems in a statewide context. In

addition, they were not catalogued in a form that facilitated their widespread use throughout the state.

A Nonpoint Source Management Practice Task Force was created in early 1990 according to the guidelines contained in Chapter IV of the Nonpoint Source Assessment Report. Agencies listed in that chapter were invited to participate in a meeting of the Task Force on February 1, 1990. At that meeting there was a discussion of the process to be followed for establishing the list of management practices, and each agency was given an opportunity to identify sub-committees on which they wanted to participate.

B. Silviculture Management Practices Sub-Committee

In October 1992, a Silviculture Management Practices Sub-Committee was formed under DEC leadership to address silviculture as a source of nonpoint source pollution. Members of the Sub-Committee represented federal and state agencies, research institutions, and forest industry organizations.

The primary task of the Sub-Committee was to identify and evaluate management practices for controlling nonpoint source pollution from silviculture activities. As an initial step, the Sub-Committee assessed the preliminary list of candidate management practices developed by the Nonpoint Source Working Group, the NYS Timber Harvesting Guidelines,and the best management practices established per Section 208 of the Clean Water Act. Summary sheets of the management practices deemed to be valuable were drafted by a DEC staff member, reviewed by the Sub-Committee, revised based on comments, and assembled to form the basis of the Catalogue's Silviculture Section.

C. NPS Pollution in New York State

The NPS Assessment

In early 1989, a process was established to enhance DEC's list of segments having water quality problems. Among the goals of this process was to use additional data sources to identify possible nonpoint source impacts, to provide an opportunity for everyone with a knowledge of water quality problems to present this information and to expand the list to include segments that are threatened by nonpoint source pollution.

DEC, working in conjunction with the New York State Soil and Water Conservation Committee, initiated a two phased approach to identify problems waterbodies. The first phase had each County Soil and Water Conservation District conduct a survey of nonpoint source pollution in their

county. Meetings were held in the first half of 1989. Districts invited agencies, groups, and individuals from within the county to participate in identifying water quality problems. Districts collected information and presented it to DEC during the next phase of the process.

The second phase consisted of meetings of representatives from the key agencies within each county to discuss the results of the NPS survey. These meetings, held during the summer of 1989, provided the County Soil and Water Conservation District personnel and DEC Regional Water and Fisheries staff with an opportunity to discuss water quality problems in each county. When there was a consensus that a water quality problem existed on a specific waterbody, information regarding the problem was recorded.

Recognition of a water quality problem was the starting point for discussion. The existence of a land use which may be associated with nonpoint source was not sufficient to be considered a problem. A classified use of a surface waterbody or groundwater must be precluded, impaired, stressed or threatened to be regarded as a problem (the definitions of these terms are given below).

Precluded	*Water quality and/or associated habitat degradation pre-cludes, eliminates or does not support a classified use; natural ecosystem functions may be significantly disrupted. This category is used for the most severe impacts.*
Impaired	*Water quality and/or habitat characteristics frequently impair a classified use. Also applied when the designated use is supported, but at a level significantly less that would otherwise be expected. Natural ecosystem functions may be disrupted. These waters have severe impacts.*
Stressed	*Reduced water quality is occasionally evident and desig-nated uses are intermittently or marginally restricted; natural ecosystem may exhibit adverse changes. These waters have moderate impacts.*
Threatened	*Water quality presently supporting designated use and eco-system experiencing no obvious signs of stress; however, existing or changing land use patterns may result in re-stricted*

usage or ecosystem disruption. These waters have the least impact.

The Bureau of Water Quality Management merged the information collected during the update process with the segment information contained in the Division of Water's 1988 Priority Water Problem list and compiled it in a series of databases. During the fall and winter of 1990, that information underwent a verification process which was conducted at each DEC Regional office. Division of Water and Fisheries staff verified the degree of the problem, and the uses that are affected. In December of 1991, the Division of Water's Bureau of Monitoring and Assessment, in conjunction with the Bureau of Water Quality Management, published the Priority Water Problem List (PWP).

According to the 1991 PWP, nearly 1,500 waterbody segments, affecting over 2.8 million acres were identified as having water quality impacts from nonpoint sources of pollution. Nearly 500 segments were identified as being "precluded" as a result of nonpoint source pollution, with over 200 segments "impaired", more than 400 "stressed", and over 200 "threatened".

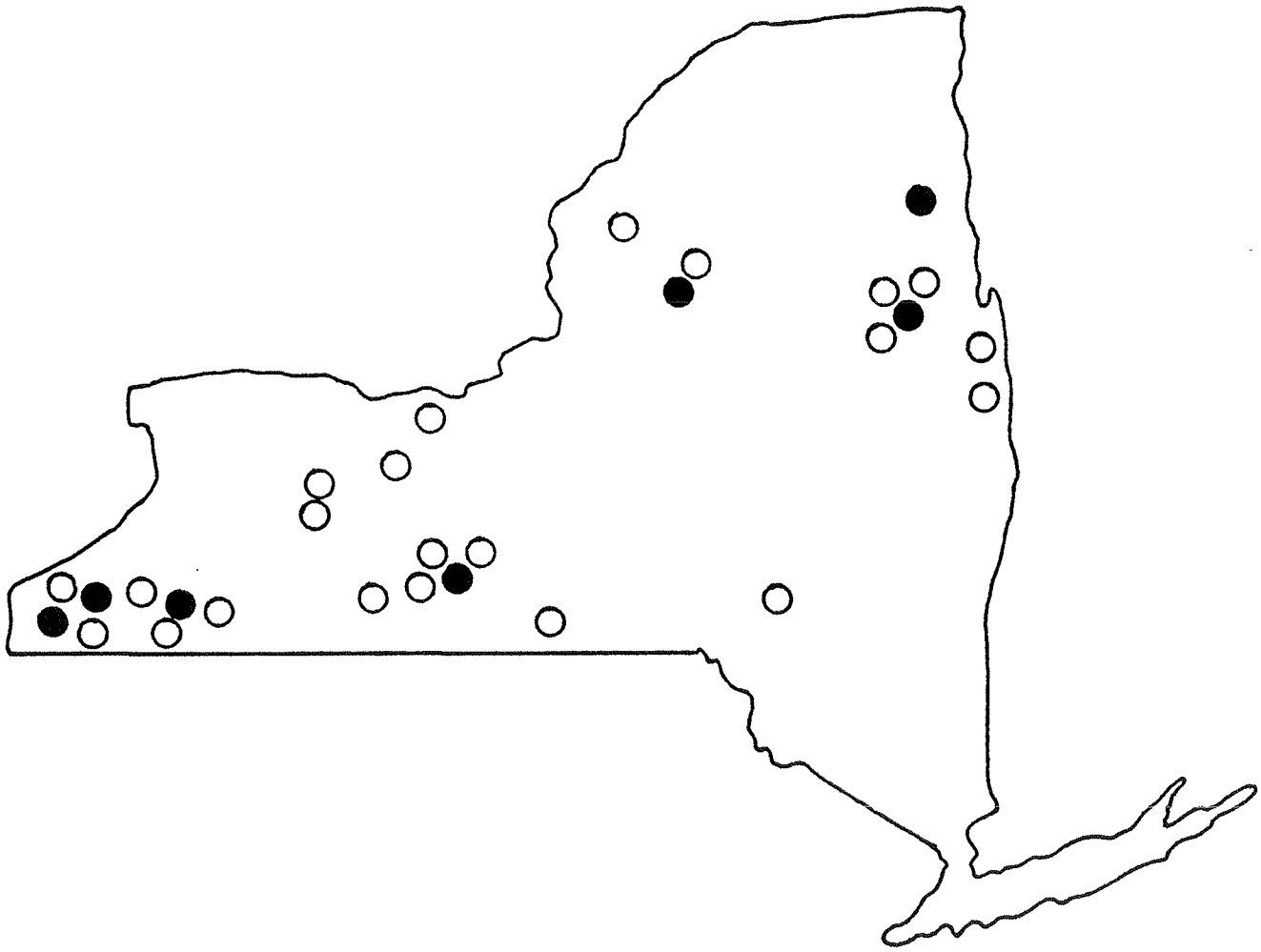
The Assessment indicated that low pH, from acid rain, was by far the primary pollutant affecting the largest number of waterbody segments (397), followed by sediment (301), nutrients (272), and pathogens (153). Similarly, atmospheric deposition (acid rain) was the primary source affecting the most segments (397), followed by failing on-site sewage systems (182), agriculture (182), and urban runoff (161) (Note: See the New York 1991 Priority Water Problem List, for additional information).

Silviculture as a Source of Nonpoint Source Pollution

According to the 1991 Priority Water Problem List, silviculture is the primary source of water quality problems on a relatively small number of waterbodies. Seven (7) segments of waterbodies were identified where silviculture was the primary source of a water quality problem. Sixty-one (61) miles of streams or rivers, and twenty (20) acres of lakes were impacted. All were regarded as either threatened or stressed. An additional 22 segments were affected by silviculture as a secondary source of pollution. The majority of these impacted waterbodies are located in the northern and western portions of New York State. (See Figure 1.)

Figure 1.

Geographic Distribution of 1991 Silviculture PWP Segments



● **Silviculture as Primary Source**

○ **Silviculture as Secondary Source**

Approximately 15.4 million acres in the state are commercial forest land, of which about 1% is involved with some form of harvest operation each year. Recent inventories have indicated that approximately one-half of harvested areas may involve streams, ponds or lakes. Given the small number of identified water quality problems and their lack of severity, it is apparent that most harvest operations do not significantly impact the usage of water resources in New York State. The voluntary application of silviculture management practices is effectively limiting water quality problems in most cases.

In all identified PWP cases, sediment was listed as the primary pollutant. It was described as originating from skid trails, log roads and stream crossings. Other potential pollutants from silviculture activities include petroleum products, organic matter, and pesticides. Thermal modifications along stream corridors are another potentially important water quality concern.

Sediment is a major pollutant in New York State. It destroys fish spawning areas, eliminates aquatic food sources, and causes gill abrasion. The flow capacity of natural channels is reduced, recreational values are compromised, and treatment costs of water supplies rise from increased sediment loads. In addition, nutrients and other pollutants may become attached to sediment particles and be transported to waterbodies by stormwater runoff.

D. What Are Silviculture Management Practices?

Silviculture management practices can prevent or reduce the availability, release, or transport of substances which adversely affect surface and ground waters. They act generally to diminish the generation of pollutants from specific sources, in this case, silviculture. While a management practice can have standards associated with its installation, operation or maintenance, it does not impose effluent limits for specific substances. Rather, it provides an effective means of reducing or preventing the impact of nonpoint pollutants from a specific source category.

Silviculture management practices are means of achieving desired results, whether they are implemented by a private, commercial or governmental entity, and whether through voluntary action, financial incentives, or regulatory requirements. They can have a broad, generic application or can be highly specific to certain geographic, climatologic, hydrologic and chemical factors.

The Silviculture Management Practices Sub-Committee evaluated eight (8) practices for their effectiveness in controlling nonpoint source pollution. They are listed in Table #3. Summary sheets of the management

practices follow the table and describe how each practice functions, how groundwater and surface water is impacted, and how effective each practice is for controlling certain pollutants. Also outlined on the sheets is the practice's advantages and disadvantages, its relative cost, and its operation and maintenance requirements. Where appropriate, the references listed for each practice include sources of standards and specifications.

Silviculture management practices can be categorized as *operational*, *vegetative*, or *structural*, depending upon their purpose, function and design.

Operational practices are practices that involve changes in management, usually resulting in a change in day-to-day decision-making. Hazardous Material Management is an example of an operational management practice.

Vegetative practices increase the amount of herbaceous and/or woody vegetation on a construction site or critically eroding area. Vegetation Establishment is an example of such a silviculture management practice.

Structural practices are practices that can require engineering design, and usually control surface runoff, the primary transporter of most Silviculture pollutants. Road Water Management and Planned Watercourse Crossings are examples of structural management practices.

With few exceptions, the practices listed in the Catalogue are currently used by most segments of New York's forest management community, where necessary and applicable.

Depending on the lifespan of the management practice, they may be temporary or permanent in their ability to control pollutants from Silviculture nonpoint sources.

The tables which follow were prepared to help users of the Catalogue understand how and where the management practices function best.

Table #1 outlines the silviculture-related pollutants commonly controlled by each practice. Sediment is the pollutant of greatest interest, as described in previous sections.

Table #2 describes where on logging jobs the management practices are most appropriately used. As with the other tables, more detailed information is provided in the summary sheets for the specific management practices.

Table 1.

SILVICULTURE MANAGEMENT PRACTICES AND PRINCIPAL NONPOINT SOURCE POLLUTANTS CONTROLLED

Management Practice	Sediment	Organic Material	Dissolved Nutrients (1)	Toxics	Thermal Stress
Planned Harvest Operations	●	●	●	●	●
Planned Access Routes	●				
Riparian Buffer Protection	●	●	●	●	●
Planned Watercourse Crossings	●			●	
Road Water Management	●				
Sediment Barriers	●				
Hazardous Material Management			●	●	
Vegetation Establishment	●		●		

(1) Management practices controlling sediment will also control attached nutrients.

Table 2.

SILVICULTURE MANAGEMENT PRACTICES AND APPLICABILITY TO SPECIFIC LOGGING SITES

Management Practice	Skid Trails	Log Roads	Stream Crossings	Landing Areas	Road Ditches
Planned Harvest Operations	●	●	●	●	●
Planned Access Routes	●	●	●	●	●
Riparian Buffer Protection	●	●	●	●	o
Planned Watercourse Crossing	●	●	●	N/A	o
Road Water Management	●	●	o	o	●
Sediment Barriers	o	o	o	●	N/A
Hazardous Material Management	o	o	o	●	o
Vegetation Establishment	●	●	o	●	●

● Very applicable.
o Somewhat applicable.
N/A Not applicable.

MANAGEMENT PRACTICE SUMMARY SHEET

* MANAGEMENT PRACTICE TITLE *	i.

DEFINITION	ii.
WATER QUALITY PURPOSE	iii.
SOURCE CATEGORY	iv.
POLLUTANTS CONTROLLED	v.
WHERE USED	vi.
PRACTICE DESCRIPTION	vii.
PRACTICE EFFECTIVENESS	viii.
IMPACT ON SURFACE WATER	ix.
IMPACT ON GROUNDWATER	x.
ADVANTAGES	xi.
DISADVANTAGES	xii.
PRACTICE LIFESPAN	xiii.
COST	xiv.
OPERATION AND MAINTENANCE	xv.
MISCELLANEOUS COMMENTS	xvi.
REFERENCES	xvii.

Figure 2. Sample Management Practice Summary Sheet

E. Silviculture Management Practice Summary Sheet Overview

***FIGURE #2* is a sample outline for a management practice summary sheet.**

i.	*Title*:	is the management practice name found in the block at the top of the summary sheet.
ii.	*Definition*:	is a brief statement that defines the management practice to be summarized.
iii.	*Water Quality Purpose:*	states why the practice is used for NPS pollution control.
iv.	*Source Category:*	in all cases, Silviculture is the source category for this Catalogue.
v.	*Pollutants Controlled*:	identifies the NPS pollutants controlled by the management practice.
vi.	*Where Used*:	identifies the land uses or situations where the management practice can be applied.
vii.	*Practice Description*:	describes the management practice in terms of its vegetative, structural and/or operational components.
viii.	*Practice Effectiveness*:	summarizes the documented practice effectiveness for controlling the NPS pollutants identified. This information is based on written national water quality research findings, university and agency research, water quality monitoring and water quality modeling. Practice effectiveness can be quite variable, due to watershed location, specific site conditions (soils, drainage, slope, vegetative cover, rainfall, runoff, etc.), individual management techniques, and the contribution of additional management practices used in a best management system. This section presents practice effectiveness as a range of quantitative values, or where that information is not available, in qualitative terms. The information provided should be used as guidance when estimating the potential effectiveness of the

management practice within a specific watershed planning situation.

ix. *Impact on Surface Water*: defines what impacts, if any, the practice will have on surface water quality. Impacts may be defined as None (neutral), Beneficial (positive), Slight (negative), Moderate (nega-tive), and Severe (negative).

x. *Impact on Groundwater*: defines what impacts, if any, the practice will have on groundwater quality. Impacts may be defined as None (neutral), Beneficial (positive), Slight (negative), Moderate (negative), and Severe (negative).

xi. *Advantages*: are selling points for the manage-ment practice; they address cost-effectiveness, additional practice benefits, and other tangible and intangible benefits.

xii. *Disadvantages*: are projected unfavorable conditions associated with the installation of the management practice; they address economics, operations and maintenance, and potential problems associated with the management practice.

xiii. *Practice Lifespan*: described in quantitative or qual-itative terms.

xiv. *Cost*: described primarily in qualitative terms. Agencies involved with management practice planning and installation can provide greater detail.

xv. *Operation and Maintenance*: the successful control of silviculture NPS pollutants depends upon conducting the required O&M practices. In each case, where a management practice requires a specific course of O&M, it is detailed, or referenced in the management practice summary sheet.

xvi. *Miscellaneous Comments:* this section deals with a variety of topics, including regulatory requirements affecting installation of the management practice; special fish and wildlife concerns; timing requirements of the practice; and other pertinent information.

xvii. *References:* those references used in the evaluation of the management practice are cited in this section. Many publications are nationally recognized sources of management practice evaluations and information. Every effort was made to utilize existing information from university research and agency information from New York State. When that information was not available, and other states had appropriate information, it was cited. Management practice design standards and specifications are located in the references with the appropriate bold notation. Certain cited standards and specifications may only apply to components of a particular practice.

F. Use Of this Catalogue

The Silviculture Management Practices Catalogue is intended to be used by those involved with educating and providing technical assistance to forest owners, loggers and equipment operators. Nonpoint source pollution problems from various forms of silvicultural activity are addressed by the practices in this Catalogue, but its focus is primarily on controlling disturbances associated with logging operations.

"Best" management practices (BMPs) can be selected from the Catalogue based on the application of professional judgment to solve a particular nonpoint source problem for a specific harvest operation or for a wider watershed area. It should be noted that this Catalogue is neither a regulatory tool nor a design manual to be used in place of practice standards and specifications.

A well-developed timber harvesting plan should form the basis of nonpoint source management on logging jobs. The planning aspect is key to establishing effective controls. Management practices alone are simply scattered "building blocks". They must be properly placed and timed to provide a well-coordinated "structure" for controlling pollutants. In most situations the services of a professional forester are needed to properly integrate the required management practices with the silvicultural needs of the site.

As important as thorough planning is, it is no more important than the proper execution of the timber harvesting plan. The specific components of the plan need to be effectively communicated to each individual involved with their implementation. Management practices need to be installed, maintained and removed, if necessary, according to proper design. On-site assistance with the design and layout of practices is often provided by the County Soil and Water Conservation District, NYSDEC foresters or other professional foresters.

G. Updating the Silviculture Management Practices Catalogue

New York Nonpoint Source Coordinating Committee

The member agencies and organizations of the New York Nonpoint Source Coordinating Committee (NYNPSCC) will be the entity to conduct the updating of all sections of the Management Practices Catalogue.

Members of the NYNPSCC include the following representatives:

- NYS Department of Agriculture and Markets
- NYS Department of Environmental Conservation
- NYS Department of State, Division of Coastal Resources
- NYS Soil and Water Conservation Committee
- NYS Department of Health
- NYS Department of Transportation
- NYS Water Resources Institute
- Cornell Cooperative Extension
- NYS Sea Grant Extension
- NYS Department of Law
- NYS Office of Rural Affairs
- NYS Legislative Commission on Water Resource Needs of Long Island
- New York City Department of Environmental Protection
- U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service
- U.S. Department of Agriculture, Soil Conservation Service
- U.S. Geological Survey
- U.S. Environmental Protection Agency, Region II

The New York State Department of Environmental Conservation (DEC) by virtue of its statutory authority for the management of water resources and control of water pollution in the state, has assumed the leadership role for the New York Nonpoint Source Coordinating Committee. DEC provides a staff member to assist with the Coordinating Committee activities. The staff member is located at the NYS Department of Environmental Conservation, Division of Water, Bureau of Water Quality Management, 50 Wolf Road, Albany, New York 12233-3508.

DEC will convene a meeting of the NYNPSCC annually to review management practices for inclusion in the Catalogue, and to discuss their responsibilities in the Updating Process.

The responsibilities of the NYNPSCC will be to:

* Review proposed additions, deletions, and revisions to the Management Practices Catalogue.

* Identify additional categories of nonpoint source pollution that have not been adequately addressed in the list of management practices.

* Suggest research or demonstration projects on unproven or new management practices that appear to have potential for protecting water quality.

* Periodically review the state list of management practices to verify the status of each practice. This review should be based on recently published literature and new or previously unknown research or demonstration projects.

Although the NYNPSCC meets quarterly, one meeting a year will be devoted to an annual review of proposed additions, deletions, and revisions to the Catalogue. Any agency, organization, or group may propose an addition, deletion, or revision to the Catalogue, provided that it meets the following conditions described below.

Conditions For Updating The Catalogue

The NYNPSCC will recognize four conditions for updating the Catalogue:

* Creation of a new management practice by an agency, university, or recognized group.

* Modification of an existing management practice, either in its design requirements or operation and maintenance, requiring a modification of the practice definition, water quality purpose, practice description, practice effectiveness, impacts on surface or groundwater, advantages/disadvantages, practice lifespan, or cost.

* Emerging research data which indicates a change in management practice effectiveness and/or pollutants controlled, requiring modifications of water quality purpose, practice description, practice effectiveness, practice impacts on surface or groundwater, advantages/ disadvantages, practice lifespan, or cost.

* Revisions in state or national water quality policy that necessitate a higher level of waterbody protection, resulting in higher management practice performance standards. Policy revisions would result in additions or deletions of management practices, modifications of practice description, design requirements, operation and maintenance requirement, practice effectiveness, impacts on surface and groundwater, cost and miscellaneous comments.

How To Propose An Update Of The Catalogue

1. By December 31 of each year, proposed updates should be stated in writing, and submitted to the attention of the New York Nonpoint Source Coordinating Committee, NYS-DEC, Bureau of Water Quality Management, 50 Wolf Road, Albany, New York 12233-3508.

2. The Coordinating Committee will review the proposed updates at their next regularly scheduled meeting. A subcommittee of the Coordinating Committee may be formed to study the update and request input from groups not represented on the Coordinating Committee.

3. The subcommittee of the Coordinating Committee will review the proposed updates and determine if they meet the conditions for updating the Catalogue. In consultation with other interested groups, it will make a recommendation to the members of the New York Nonpoint Source Coordinating Committee by May 1 of the following year.

4. When the proposed update is approved, staff of the New York Nonpoint Source Coordinating Committee will make the appropriate changes and distribute copies of the addition to all Coordinating Committee members and holders of the current Catalogue.

II. SILVICULTURE MANAGEMENT PRACTICE LISTING

Summary Page (following page)

Management Practice Summary Sheets (attached)

Table 3.

SILVICULTURAL MANAGEMENT PRACTICES FOR NONPOINT SOURCE POLLUTION CONTROL

PLANNED HARVEST OPERATIONS

RIPARIAN BUFFER PROTECTION

PLANNED WATERCOURSE CROSSINGS

PLANNED ACCESS ROUTES

ROAD WATER MANAGEMENT

SEDIMENT BARRIERS

VEGETATION ESTABLISHMENT

HAZARDOUS MATERIAL MANAGEMENT

MANAGEMENT PRACTICE SUMMARY SHEET

PLANNED HARVEST OPERATIONS

DEFINITION	Harvesting forest products according to a well-developed plan.
WATER QUALITY PURPOSE	To minimize pollutant delivery to waterbodies and to protect riparian buffer areas.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Primarily sediment. Organic matter, thermal modification, nutrients, pesticides and toxics are also controlled.
WHERE USED	Used for all harvest operations which could impact water resources.
PRACTICE DESCRIPTION	Proper planning of harvest operations involves the thorough collection and use of information about the harvest area. The plan integrates the harvest needs of the managed forest with the need to protect water resources. The plan incorporates soil, slope, and water resource information with the silvicultural aspects of the harvest. The type of equipment to be used, the operation's timing, the spatial limits and the intensity of the harvest are adjusted based on needs to minimize soil disturbances and watercourse crossings in a particular harvest area. The needs for other management practices are also identified. Landings are located on gentle sloping, well-drained sites which are distant from waterbodies. Hazardous materials are properly managed. Felled trees and logging debris are kept out of streams. Consideration is given to the sensitivity of the water resources, and the long-term use of the harvest area and its transportation system. Plans are made to retire logging roads and to remove watercourse crossings, as needed.
PRACTICE EFFECTIVENESS	Careful preharvest planning can prevent most water quality impairments. Proper planning of access routes and watercourse crossings are of particular importance.
IMPACT ON SURFACE WATER	Beneficial.

IMPACT ON GROUNDWATER	Beneficial.
ADVANTAGES	*Improves the efficiency of the harvest operation. *Promotes use of safe loading sites and hauling routes. *Provides opportunities to protect sensitive wildlife resources and consider aesthetic needs.
DISADVANTAGES	*Requires additional time prior to harvest of forest products.
PRACTICE LIFESPAN	Variable.
COST	Relatively low. Preventative practices are the most cost-effective.
OPERATION AND MAINTENANCE	Consistent, clear communication takes place among the landowner, forester, and logger before, during, and after the harvest operation. Contracts are often used. Cutting and removal procedures are periodically checked. Regular inspection of management practices takes place. Periodic post-harvest inspections are also planned.
MISCELLANEOUS COMMENTS	The need for local, state, and federal permits should be considered when planning harvest operations. (See *Planned Access Routes, Riparian Buffer Protection, Planned Watercourse Crossings,* and other appropriate management practice summary sheets.)
REFERENCES	NYS Department of Environmental Conservation. Timber Harvesting Guidelines. Albany, NY. July 1992. U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, DC. January 1993. USDA Soil Conservation Service. National Handbook of Conservation Practices. Forest Land Erosion Control System. Syracuse, NY. January 1983. **(Management Practice Design Standard and Specifications)** Maine Forest Service. Erosion and Sediment Control Handbook for Maine Timber Harvesting Operations, Best Management Practices. Augusta, ME. June 1991. Brynn D. and Clausen, J. Postharvest Assessment of Vermont's Acceptable Silvicultural Management Practices and Water Quality Impacts. Northern Journal of Applied Forestry, Vol. 8, No. 4. December 1991. USDA Forest Service. Hornbeck, J. and Leak, W. Ecology and Management of Northern Hardwood Forests in New England. Radnor, PA. July 1992. North Carolina Division of Forest Resources. Forestry Best Management Practices Manual. September 1989. Adirondack Park Agency. Citizen's Guide to Adirondack Forestry. Raybrook, NY. October 1985.

MANAGEMENT PRACTICE SUMMARY SHEET

RIPARIAN BUFFER PROTECTION

DEFINITION	Preservation of natural vegetation and soil cover adjacent to streams or other waterbodies.
WATER QUALITY PURPOSE	To maintain thermal buffering capabilities, streambank stabilization, and pollutant filtering benefits of natural forests along the margins of waterbodies.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Primarily sediment, organic matter, and thermal modification. Nutrients, pesticides and toxics are also controlled.
WHERE USED	Used adjacent to streams, ponds, lakes and wetlands.
PRACTICE DESCRIPTION	Riparian buffer protection involves the identification and preservation of corridors along streams and other waterbodies. Riparian buffer areas are identified early during harvest planning. Aerial photos, topographic maps, soil surveys, forest-type maps, stream classification maps, and field reconnaissance are used. Standard buffer distances are often designated for different types of silvicultural activities. Distances may vary according to soil type, slope, cover and season. New York guidelines discourage any disturbance within 10 feet of a waterbody. Trees are felled away from streams. Clearcut operations maintain an uncut 50-foot wide buffer on each side of a stream. Skidders operate at least 50 feet away from waterbodies (100 feet or more for slopes greater than 10%). Roads and trails are kept at least 100 feet from streams, ponds and wetlands. For slopes greater than 30% they are kept back 150 feet or more. Landings are located at least 200 feet from waterbodies.
PRACTICE EFFECTIVENESS	Estimated to be 75% to 85% effective in preventing impacts. Road runoff which drains directly to the stream network limits effectiveness. Maintaining buffer zones along intermittent streams increases effectiveness.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.

ADVANTAGES	*A low-cost, effective practice which can be easily implemented. *Protects habitat for aquatic organisms and riparian wildlife. *Flood control benefits.
DISADVANTAGES	*Merchantable timber within the riparian buffer is left standing. *Special removal techniques may be required. *Longer road/trail network may be needed.
PRACTICE LIFESPAN	Duration of the silvicultural operation.
COST	Low.
OPERATION AND MAINTENANCE	Riparian buffer area boundaries need to be thoroughly understood by loggers and equipment operators before logging begins. Where appropriate, boundaries may be marked with paint or ribbon.
MISCELLANEOUS COMMENTS	If windthrow problems are anticipated, buffer widths should be increased. Special restrictions apply in Wild, Scenic, and Recreational River Areas and the Adirondack Park. Natural drainage channels or wetland areas should not be altered without proper approvals from local, state and federal authorities. (See *Planned Harvest Operations, Planned Access Routes,* and *Planned Watercourse Crossing.*)
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MANAGEMENT PRACTICE SUMMARY SHEET

PLANNED WATERCOURSE CROSSING

DEFINITION	A stable structure installed across a watercourse to provide temporary access for logging equipment.
WATER QUALITY PURPOSE	To prevent logging equipment from damaging the bed and banks of waterways, and to control the tracking of sediment and other pollutants into waterways.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Sediment, fuel and lubricants.
WHERE USED	Used to cross permanent or intermittent watercourses where the banks are low and stable, the bed is firm, and there is minimal surface runoff. Used only when crossing a waterway is absolutely necessary.
PRACTICE DESCRIPTION	Planned watercourse crossings may be bridges, culverts, or fords installed for use by skidders, trucks, and other logging vehicles. Fords are used only where the substrate is hard and stable, where low flow conditions exist, and where light use is expected. Crossings are perpendicular to the watercourse and the approaches are as straight as possible for 50 ft. on each side of the crossing. Road and skid trail runoff is diverted away from the watercourse with a waterbar or similar structure. In-stream excavation is limited to that which is necessary for installation of the practice. All disturbed areas are stabilized immediately after installation. Planned watercourse crossings control sedimentation by limiting vehicle traffic in the vicinity of the watercourse and by stabilizing the sites where crossings must be made. A thorough analysis of the harvest operation, vehicle access requirements, and natural resource limitations is conducted prior to determining locations and types of crossings.
PRACTICE EFFECTIVENESS	Planned watercourse crossings can prevent turbidity, streambed disturbances, and pollution resulting from logging equipment. Bridges, particularly portable bridges, are normally the most effective means of crossing because channel disturbances are limited and vehicles are kept out of the watercourse. Fords are the least effective means of crossing. Improper use of this practice can actually increase sedimentation problems.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.
ADVANTAGES	*Bridge crossings are usually removed easily and are often portable and re-usable.
DISADVANTAGES	*Fords and culvert crossings may interfere with fish migration and spawning during certain times of the year. *Flooding and channel erosion can result from constrictions in the watercourse.

PRACTICE LIFESPAN

Normally two years or less.

COST

Moderate to high.

OPERATION AND MAINTENANCE

Trapped sediment and debris is removed periodically. Periodic inspections are also performed for the stability of the crossing and the watercourse. Bridges normally require the least amount of maintenance. Fords usually require the most maintenance. In all cases maintenance, removal, and cleanup should be accomplished without equipment working in the waterway. Required removal work should be completed within 14 days of the crossing's last day of use. All disturbed areas should be stabilized immediately after the crossing's removal.

MISCELLANEOUS COMMENTS

Watercourse crossings should be avoided whenever possible. They should be installed during low flow conditions and be in service for the shortest practical time period. A natural stream bottom is preferred beneath crossings where fish migration or spawning needs to be considered. Each crossing should be designed to meet its specific loading, structural utility, and safety requirements. Special designs are required for permanent crossings. Natural drainage channels or wetland areas should not be altered without proper approvals from local, state, and federal authorities. (See *Planned Harvest Operations, Planned Access Routes, Riparian Buffer Protection, and Road Water Management.*)

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MANAGEMENT PRACTICE SUMMARY SHEET

PLANNED ACCESS ROUTES

DEFINITION	The proper location and design of logging road/skid trail systems.
WATER QUALITY PURPOSE	To minimize the potential for sediment delivery from logging access routes to waterbodies.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Sediment.
WHERE USED	Used where efficient removal of forest products requires the repeated use of roads or trails by logging equipment.
PRACTICE DESCRIPTION	Access routes are planned by determining the size, location and future use of the area to be harvested. Critical site features are identified using aerial photos, topographic maps, soil maps and field reconnaissance. These features include places to avoid (wet soils, steep slopes, rock outcrops, riparian buffer zones) and places to utilize (good stream crossing sites, saddles, safe points of access to highways). Existing roads and trails are utilized where feasible and are adequately modified. Roads are generally designed with grades of 10% or less - 3% to 5% is desirable. Primary skid trail grades are normally less than 15%. Roads and trails are planned cross-slope to minimize erosion and to provide cross-drainage. Long, sustained grades and sharp curves are avoided. Cuts and fills and the number of stream crossings are minimized. Roads are surfaced with gravel, stone, or wood chips for long-term use, to overcome special drainage problems, or when nearing highway access points. Where feasible, roads connect with landing areas from below to avoid drainage problems.
PRACTICE EFFECTIVENESS	Careful planning is the most important aspect of controlling soil erosion and water movement on logging roads. This practice can reduce erosion by as much as 50%. Total length of skid trails can be reduced by up to 40% with good planning.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.

ADVANTAGES	*Improves the efficiency of construction and hauling operations. *Provides an opportunity to address aesthetic and wildlife needs. *Promotes safe road design and operation.
DISADVANTAGES	*Requires additional time to plan road layout prior to construction.
PRACTICE LIFESPAN	Variable.
COST	Relatively low. (A 1984 Northeastern Forest Experiment Station Study indicated that average costs of road planning and layout were 8% of total road costs. Road costs in that study averaged $8,119per mile.)
OPERATION AND MAINTENANCE	Well-planned, well-constructed roads minimize the need for repair and maintenance. Construction operations are timed to avoid wet conditions whenever possible. Routine inspection is planned, especially during periods of wet weather or heavy use. When harvest operations cease, access routes are stabilized and stream crossings are removed where appropriate.
MISCELLANEOUS COMMENTS	Access through adjacent land holdings may be advantageous - written permission should be obtained. The need for local, state and federal permits should also be considered when planning access routes. (See *Planned Harvest Operations, Riparian Buffer Protection, Planned Watercourse Crossing,* and *Road Water Management*).
REFERENCES	West Virginia University Extension Service. Kochenderfer, J., Wendel, G. and Kidd, W. Woodlot Management: Building Roads. USDA Forest Service. Permanent Logging Roads for Better Woodlot Management. Broomall, PA. September 1978. USDA Forest Service. Kochenderfer, J. Erosion Control on Logging Roads in the Appalachians. Upper Darby, PA. 1970. NYS Department of Environmental Conservation. Timber Harvesting Guidelines. Albany, NY. July 1992. USDA Forest Service. Kochenderfer, J., Wendel, G., and Smith, H. Cost of and Soil Loss on "Minimum-Standard" Forest Truck Roads Constructed in the Central Appalachians. Broomall, PA. 1984. U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, DC. January 1993. USDA Soil Conservation Service. National Handbook of Conservation Practices. Forest Land Erosion Control System. Syracuse, NY. January 1983. **(Management Practice Design Standard and Specifications).** New Hampshire Department of Resources and Economic Development. Cullen, J.B. Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire. Circa 1990. Vermont Department of Forests, Parks and Recreation. Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont. Waterbury, VT. August 1987. Martin, C. Wayne. Soil Disturbance by Logging in New England - Review and Management Recommendations. USDA NE Forest Experiment Station. Durham, NH. March 1988.

MANAGEMENT PRACTICE SUMMARY SHEET

ROAD WATER MANAGEMENT

DEFINITION	The control of water on log roads and skid trails.
WATER QUALITY PURPOSE	To minimize sediment delivery from roads and trails to waterbodies.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Sediment.
WHERE USED	Used where access routes cross drainageways, approach streams, or have erosive slopes.
PRACTICE DESCRIPTION	Road water management involves the properly integrated use of component measures such as drainage dips, skid turnups, waterbars, cross-drain culverts, road ditches and road grading. Drainage dips are broad-based depressions normally constructed on roads with long slopes of 10% or less. Recommended spacing varies with road slope (ranges from 140' to 500'). Skid turnups, or skid humps, are created by periodically turning the skidder slightly uphill on downhill runs. Recommended spacing varies with skid trail slope (ranges from 100' to 300'). Waterbars are narrow, earthen ridges constructed across roads or trails. Their width varies with the type of traffic expected, and their spacing varies with the road slope (ranges from 30' to 400'). Cross-drain culverts may be open-top or closed. They are usually installed to control seeps or to carry small flows from segments of long, sloping road ditches. Road ditches are best constructed during grading operations. They are stable, have side slopes of 2:1 or flatter, and do not outlet directly into streams. Road grading involves crowning where possible. Soil conditions and topography may require the use of insloping or outsloping. Road banks are normally 2:1 or flatter and are maintained in stable condition. Disturbance of leaf litter and root systems on adjacent areas is minimized. Proper integration of practice components provides control of water movement and stabilization of soils on access routes. Erodible soils require special attention, particularly when outletting concentrated flows.
PRACTICE EFFECTIVENESS	This practice normally provides good control of rill and gully erosion. Timely implementation is important to prevent concentrated flows from eroding newly constructed roads.
IMPACT ON SURFACE WATER	Beneficial.

IMPACT ON GROUNDWATER

None.

ADVANTAGES

*Improves operating conditions/operating costs of logging jobs. *Increases lifespan of road/trail network.

DISADVANTAGES

*Heavy equipment traffic can quickly destroy water diversion devices. *Improperly constructed road ditches can worsen erosion and sedimentation problems.

PRACTICE LIFESPAN

Varies considerably. Depends upon the expected life of the road or trail.

COST

Varies considerably. Low for skid turnups and waterbars. Higher for roads needing extensive use of culverts or ditch/roadbank stabilization.

OPERATION AND MAINTENANCE

Frequent maintenance is often required, especially during harvest operations. Waterbars, drainage dips, and road surfaces may need periodic re-shaping. Drainage outlets, roadbanks, and road ditches need to be inspected often for stability. Permanent water management practices require less maintenance after logging ceases.

MISCELLANEOUS COMMENTS

Road water management should be planned prior to road construction and logging. Road and skid trail layout, harvest timing, and the overall logging plan need to be well thought-out prior to planning the road water management system. Certain component measures may qualify for cost-sharing (contact local USDA or DEC offices for details). Recent evaluations in New York and Vermont indicate that recommended spacings for water diversion structures may be overly conservative-more study is needed. (See *Planned Harvest Operations, Planned Access Routes, Riparian Buffer Protection, and Planned Watercourse Crossing*.)

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MANAGEMENT PRACTICE SUMMARY SHEET

SEDIMENT BARRIERS

DEFINITION	Temporary structures installed cross-slope to trap sediment before it reaches watercourses.
WATER QUALITY PURPOSE	To intercept and detain small amounts of sediment from disturbed areas during sheet flow.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Sediment.
WHERE USED	Used near roads, skid trails, landings, or other disturbed areas where sediment could enter streams or other surface waters. Used to trap sediment from small drainage areas (1/2 acre per 100 linear feet of barrier, or less). Placed away from the toe of the slope where possible.
PRACTICE DESCRIPTION	Sediment barriers normally consist of silt fences or straw bale dikes. Silt fences are constructed of geotextile fabric supported with steel or wooden posts, and sometimes wire fence. The silt fence is 2 to 3 feet high with 6 to 8 inches embedded in the soil. Posts are spaced no more than 10 feet apart. Woven wire fencing is secured to the posts to support the fabric, unless pre-fabricated units are used. Straw bale dikes consist of bound bales of straw or hay which are tightly abutted to each other. The wire or string binding does not contact the ground. Bales are embedded in 4 inches of soil and staked with re-bar or 2" x 2" stakes. Loose straw is wedged between bales and is often scattered above them to improve trapping efficiency. Sediment barriers are installed as close to the contour as possible. They serve to reduce the velocity of sheet flow, thereby limiting its capacity to transport sediment.
PRACTICE EFFECTIVENESS	The effectiveness of silt fence for trapping sediment is a function of the fabric's equivalent opening size in relation to the soil particle size. For most soils an equivalent opening size of 70 will trap 90% or more of the sediment in runoff without clogging. If properly installed and maintained, straw bale dikes provide good control of coarse-textured sediment. A study under controlled conditions indicated that trapping efficiency averages 68%. Poor maintenance can reduce trapping efficiency to 16%.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	None.

ADVANTAGES	*Easy to install. *Silt fences may be re-used. *Straw bales can be used for mulch once the area above the dike is stabilized.
DISADVANTAGES	*Not suited to large drainage areas, long slopes, or channel flow. *Field studies have indicated a high percentage of straw bale dike failures due to undercutting, end flow, and washouts. *Ultraviolet radiation may affect the stability of geotextiles over time.
PRACTICE LIFESPAN	Up to one year for silt fences. Three months or less for straw bale dikes.
COST	Relatively inexpensive.
OPERATION AND MAINTENANCE	Routine maintenance is required to preserve effectiveness. Inspect after each rainfall for end flow, undercutting, and bulges. Repair immediately. If sediment reaches 1/2 the height of the barrier, it should be removed and stabilized. When the contributing drainage area is stabilized, the barrier should be removed and the installation site seeded and/or mulched.
MISCELLANEOUS COMMENTS	The success of sediment barriers can be enhanced by minimizing the disturbance of the site's leaf litter and root systems. Brush barriers are occasionally used to reduce runoff velocities and trap sediment from small roadside drainage areas. Brush, logs, and other slash from road clearing operations is piled in a row parallel to the road. Care is required to allow wildlife movement, to keep slash piles out of riparian areas, and to avoid drainageways.
REFERENCES	Vermont Department of Forests, Parks and Recreation. Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont. Waterbury, VT. August 1987. Maine Forest Service. Erosion and Sediment Control Handbook for Maine Timber Harvesting Operations, Best Management Practices. Augusta, ME. June 1991. New Hampshire Department of Resources and Economic Development. Cullen, J.B. Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire. Circa 1990. Montana Department of State Lands. Montana Forestry Best Management Practices. Missoula, MT. July 1991. Ontario Ministry of Natural Resources. Environmental Guidelines for Access Roads and Water Crossings. Toronto, Ontario. 1990. Minnesota Pollution Control Agency. Protecting Water Quality in Urban Areas, Best Management Practices for Minnesota. October 1989. Empire State Chapter. Soil and Water Conservation Society. New York Guidelines for Urban Erosion and Sediment Control. Syracuse, NY. October 1991. **(Management Practice Design Standard and Specifications)** State of Washington Department of Ecology. Stormwater Management Manual for the Puget Sound Basin (Public Review Draft). Olympia, WA. June 1991.

MANAGEMENT PRACTICE SUMMARY SHEET

VEGETATION ESTABLISHMENT

DEFINITION

Seeding grasses and legumes on exposed forest soils.

WATER QUALITY PURPOSE

To stabilize erodible areas and prevent sediment and nutrients from entering waterbodies.

SOURCE CATEGORY

Silviculture.

POLLUTANTS CONTROLLED

Sediment and nutrients.

WHERE USED

Landings, sloping skid trails and haul roads, road ditches, approaches to stream crossings, and other disturbed areas which could contribute sediment to waterbodies.

PRACTICE DESCRIPTION

Vegetation establishment involves the rough grading, mulching, and application of lime, fertilizer and seed to exposed forest soils. Site preparation may include smoothing ruts and removing logging debris. Water control devices, such as waterbars, are in place to properly manage concentrated flows. Unless recently roughened, the soil is scarified to a depth of 2 inches. In lieu of soil test data, lime is applied at approximately 2 tons/acre and 5-10-10 fertilizer at about 600 lbs/acres. Mixtures of legumes and cool-season grasses are normally seeded by hand or with a cyclone seeder on smaller sites, and with a hydroseeder or other commercial equipment on larger sites. Legumes require the use of special inoculum prior to seeding. Species selection varies based on local climate, shade conditions, soil drainage and wildlife considerations. Approximately 2 tons/acre (80 bales/acre) hay or straw mulch is applied to the site. Seedings are established immediately after logging activities cease. During fall and winter, mulch alone may be used for temporary protection. "Frost seedings" may be done from February through April if there is no snow cover, but success is variable.

Two seed mixtures commonly recommended in New York:

Tall fescue	10 lbs/acre	Creeping red fescue	15 lbs/acre
Red top	2 lbs/acre	Tall fescue	10 lbs/acre
Perennial ryegrass	5 lbs/acre	Crownvetch	15 lbs/acre
Flatpea	30 lbs/acre		

PRACTICE EFFECTIVENESS

Established seedings can reduce soil loss by up to 95%, and nitrogen loss in surface runoff by up to 90%. Practice effectivness for sediment control may drop to 40-60 percent if seeding establishment is delayed due to weather, season or other causes.

IMPACT ON SURFACE WATER

Beneficial.

IMPACT ON GROUNDWATER

None to beneficial. There is the potential for seedings to increase the utilization of residual N from the soil, thereby reducing leaching losses.

ADVANTAGES	*Provides food and cover for wildlife. *Flatpea and crownvetch restrict the invasion of woody species where open areas are desired. *Improves the appearance of logged areas. *Relatively inexpensive.
DISADVANTAGES	*Large sites may require specialized equipment for seeding establishment. *Absentee landowners sometimes have difficulty providing timely maintenance. *Uncontrolled vehicle traffic quickly damages seedings.
PRACTICE LIFESPAN	This practice has a long lifespan provided the integrity of the vegetation is maintained.
COST	Normally low. May be higher if specialized seeding equipment or extensive site preparation is required.
OPERATION AND MAINTENANCE	Protect from traffic. Areas with poor initial establishment may require re-seeding. Areas of special concern may require periodic topdressing with fertilizer at ½ the establishment rate.
MISCELLANEOUS COMMENTS	Soil tests improve seeding success and allow more efficient use of lime and fertilizer. Some sites may qualify for cost-sharing (contact USDA-ASCS for details). On larger logging jobs consideration should be given to establishing vegetation in stages. Certain sites may benefit from temporary seedings of small grains or the planting of trees and shrubs.The use of slash and forest litter may eliminate the need to seed disturbed areas with marginal erosion potential.
REFERENCES	Thompson, C. and Kyker-Snowman, T. Evaluation of Nonpoint Source Pollution Problems from Crossing Streams with Logging Equipment and Off-Road Vehicles in Massachusetts: 1987-88. Amherst, MA. March 1989. Vermont Department of Forests, Parks and Recreation. Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont. Waterbury, VT. August 1987. Maine Forest Service. Erosion and Sediment Control Handbook for Maine Timber Harvesting Operations, Best Management Practices. Augusta, ME. June 1991. Dutchess County Soil and Water Conservation District. Best Management Practices for Silviculture. Millbrook, NY. January 1990. New Hampshire Department of Resources and Economic Development. Cullen, J.B. Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire. Circa 1990. USDA Forest Service and USDA Soil Conservation Service. Woodlands of the Northeast, Erosion and Sediment Control Guides. Broomall, PA. 1977. U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, DC. January 1993. USDA Soil Conservation Service. A Guide to Conservation Plantings on Critical Areas for New York. Syracuse, NY. June 1991. USDA Soil Conservation Service. National Handbook of Conservation Practices. Forest Land Erosion Cotnrol System. Syracuse, NY. January 1983. **(Management Practice Design Standard and Specifications)**

MANAGEMENT PRACTICE SUMMARY SHEET

HAZARDOUS MATERIAL MANAGEMENT

DEFINITION	The proper storage, handling and application of materials defined as hazardous in the Department of Transportation Code of Federal Regulations, Title 49 or in NYS Rules and Regulations, Part 371.
WATER QUALITY PURPOSE	To minimize the opportunity for hazardous materials to contaminate surface or ground waters.
SOURCE CATEGORY	Silviculture.
POLLUTANTS CONTROLLED	Toxics, nutrients and pesticides.
WHERE USED	All silvicultural operations using hazardous products.
PRACTICE DESCRIPTION	Hazardous material management involves the control of pesticides, fertilizers, petroleum products, road salt, and other potential chemical pollutants. These products are used only when deemed necessary and only according to the label. Less hazardous products or procedures are substituted whenever possible. Equipment is maintained and materials are stored in locations distant from waterbodies where flooding is unlikely, soils are well-drained, and surface runoff is controlled. Spill contingency plans are in place. Pesticides and fertilizers are applied at the proper times and according to their labels. Restricted pesticides are only applied by certified applicators. Applications are not made when wind or expected runoff conditions could cause drift or contamination. Buffer strips around waterbodies are identified for pesticide applicators. An anti-siphon device is used when surface waters are used to fill application equipment. Waste oil, hydraulic fluid, and related materials are collected and transported off-site for proper disposal. Salt storage areas are properly covered and lined with impermeable materials. Surface runoff is diverted away from storage areas with a well-planned drainage system. All federal, state, and local rules and regulations are followed regarding the use, transport, storage, spillage and disposal of these materials, their containers, and their wash water.
PRACTICE EFFECTIVENESS	Estimated to be 95% effective in preventing hazardous materials from reaching waterbodies. "Good housekeeping" is the most effective and economical means of controlling pollutants other than sediment. Good erosion and sediment control increases effectiveness against the movement of phosphorus, certain pesticides, petroleum products and other soil-attached pollutants.
IMPACT ON SURFACE WATER	Beneficial.
IMPACT ON GROUNDWATER	Beneficial.

ADVANTAGES	*Protects aquatic organisms and wildlife. *Improves aesthetics. *Benefits human health.
DISADVANTAGES	*Requires continuous attention.
PRACTICE LIFESPAN	Duration of the silvicultural operation.
COST	Normally low.
OPERATION AND MAINTENANCE	Check equipment, storage facilities and containers daily for leaks, corrosion and other dangerous conditions. Check application equipment for proper calibration. Ensure that riparian buffer zones are recognized by loggers and equipment operators.
MISCELLANEOUS COMMENTS	Attention must be given to the safety and health of the public and the timber harvesters -- follow appropriate federal, state and local rules and regulations.
REFERENCES	U.S. Environmental Protection Agency. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, DC. January 1993.

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