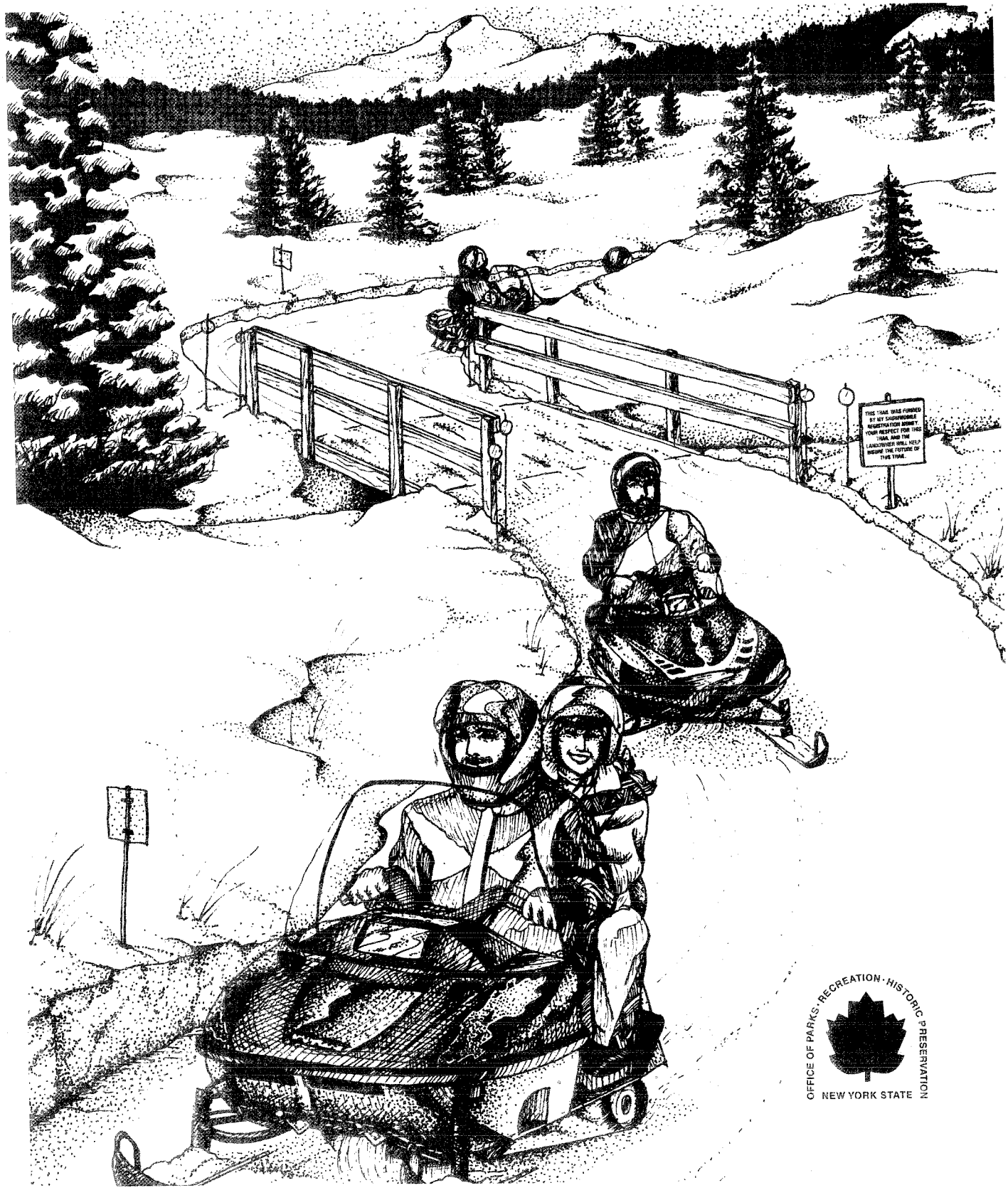
New York State

Snowmobile Trail Manual

Guidelines for Development



OFFICE OF PARKS · RECREATION · HISTORIC PRESERVATION
NEW YORK STATE

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Snowmobile Trail Manual

Guidelines for Development

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New York State
Office of Parks, Recreation and Historic Preservation
Marine and Recreational Vehicles Bureau

With acknowledgments to:

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On The Trail newspaper

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I. Trail Planning

A. Snowmobile Trail Type

Your initial planning must include decisions about what type of trail you need or plan to build. Landowner permission, costs, environmental effects, and quality of the recreation experience are all affected by this first decision, so it is an important one.

There are two general types of snowmobile trails - corridor and non-corridor - each of which may vary in width depending upon the Class of the trail.

1. Corridor trails are high volume primary snowmobile routes through multiple counties that provide access to significant use areas and concentrations of snowmobilers. They are usually groomed.

2. Non-corridor trails (sometimes called "secondary" or "feeder" trails) are usually connect local attractions or neighborhoods to main Corridor trails. They can also be used to connect two Corridors to each other.

Because secondary trails are usually less highly developed than Corridor trails and are sometimes not groomed, they may provide a more primitive recreation opportunity.

B. Trail Classes

Trail classes describe the general level of development of a snowmobile trail including the width of grooming equipment it is designed to handle. Additional specifications for each class are listed in Section II Trail Construction, Part B. Specifications.

1. Class A Trail

Class A trails have trail treads at least 12 feet wide, wider in curves and must be capable of handling groomer power units and drags at least 8 feet wide (Table 1). They are cleared to an effective height of 12 at least feet (Table 2). All culverts and bridges must be sufficiently wide to accommodate grooming equipment 8 feet wide. Bridges must be built according to engineering designs approved by the goverment agency or user group responsible for such matters to accommodate groomers up to 4 tons.

The travelled portion of Class A trails can be much wider than 12 feet and must be capable of handling two lane traffic. Where possible, add an additional 2 feet of width to improve safety in high use areas.

2. Class B Trail

Class B trails are at least 10 feet wide, wider in curves and must be capable of handling groomer power units and drags at least 6 feet wide (Table 1). They are cleared to an effective height of at least 10 feet (Table 2). All culverts and bridges must be sufficiently wide to accommodate grooming equipment 6 feet wide. Bridges must be built according to engineering designs approved by the goverment agency or user group responsible for such matters to accommodate groomers up to 2 tons.

Class B trails can be wider than 10 feet. Where possible, add an additional 2 feet of width to improve safety in high use areas.

3. Class C Trail

Class C trails are at least 5 feet wide, may be wider in curves and should be capable of handling groomer power units and drags at least 4 feet wide (Table 1). In some areas, it may be necessary to compromise width requirements to meet pre-existing regulations. They are cleared to an effective height of at least 8 feet (Table 2). All culverts and bridges must be sufficiently wide to accommodate grooming equipment 4 feet wide. Bridges must be built according to engineering designs approved by the goverment agency or user group responsible for such matters to accommodate groomers up to 1,000 pounds.

Class C trails can be wider than 5 feet. Where possible, add an additional 3 feet of width to improve safety in high use areas.

C. Landowner Relations

Construction and maintenance of snowmobile trails is an ongoing consideration and important to the landowner as well as the club. Trails must be constructed and improved during the months when snow is not present, and regularly groomed during the winter months. Signs are generally put up in the fall and taken down in the spring. Trails must be limbed and brush cut in the summer or fall, and refuse picked up, fences closed, and any structures removed in the spring. Winter work cannot substitute for proper dry season planning, improvement and maintenance.

Excellent trail conditions are the result of long hours of work and indicate a dedicated trails coordinator, good maintenance practices, adequate equipment and willing workers. Good relations will foster more productive partnerships with landowners.

D. Public Information

If you desire a high level of club and community interest and support, you should make sure that your club's snowmobile activities are visible, show progress, and benefit the community as a whole.

If you are proposing to improve or expand a section of trail, let the media know. Chronicle each positive step forward. Publicly thank (although usually not by name) the landowners who have made this possible. Invite media representatives to join in the first ride over the completed trail. Speak to local service clubs and organizations. If you have need of materials, equipment or volunteer help, ask for it. Then, be sure to publicly acknowledge assistance given. (Again, remember that while some people like to see their name in print, others are embarrassed by being singled out).

A good public image is an important asset to any organization and can only result from letting the public know what you are

doing. And, after all, a member of the public may very well become a future club member or important landowner. Trail permissions, access to services, and the use of public rights-of-ways are all things that can be affected by the image of snowmobilers in the minds of non-snowmobilers.

E. Private Landowners

Landowner relationships are the most important consideration in planning a trail system. Your club must obtain permission for each separate parcel of land you plan to cross. The landowner has a right to deny permission to use his/her property. Don't let your attitude be the reason for them denying permission. Respect their right to refuse to grant permission, be patient with their reluctance, and thank them for considering your request if they refuse.

A club that makes an honest effort to maintain its image by supporting community projects, holding charity events, and maintaining a good track record of courteous and responsible trail use, may have more success in acquiring landowner permission.

1. Preliminary Visit To Landowner To Obtain Permission For Trail

You have already identified the owners of the land you wish to cross and are now ready for your preliminary visit. You will be presenting your trail proposal, showing the map with the proposed route, asking for approval of the route (or suggestions for an alternate route), and for permission for the route finally agreed upon. Be sure that the landowner understands the trail construction specifications, for example, cleared width and height, bridges, etc., for which you are requesting permission.

The asking of permission and assurance of responsibility will go far toward allaying landowner fears. Approach them as official representatives of an organized group rather than as individuals, and explain the advantages of an authorized trail in preventing unlawful trespass. Be prepared to discuss liability insurance issues, your grooming and maintenance program, inappropriate uses, trail closure and future plans.

Above all, maintain good relationships — today's refusal may change to tomorrow's approval. Remember that full cooperation with the landowner is a must. It is his land and his wishes must become your law. Be prepared to discuss handshake agreements, revokeable permits, leases, right-of ways, conservation easements and fee ownership.

2. Return Visit

Once the landowner has approved the original concept and has had the opportunity to say exactly where the trail should cross his property, it is usually possible to obtain actual permission on the spot or on a return visit. Keep landowners informed of your activities through a regular newsletter or an annual thank you note. Invite the landowners to supper or other event.

Understand what specific requirements the landowner has. Explain your club's commitment to regular trail maintenance and responsible trail use.

F. Public Landowners

Close working relations with personnel from the appropriate Municipal, State, or Federal agency is very important.

When you are contemplating a project on public lands, contact the appropriate public representative well in advance of your work, preferably before you contact adjacent private landowners. It's a very good idea to start planning for projects a year or more in advance. These representatives are familiar with the rules, regulations and policies applicable to the lands under their jurisdiction and can prevent many "dead ends". They may have staff or funds to help accomplish your work.

If the proposal is approved, you should keep the public land manager up-to-date frequently on your progress throughout the entire project.

II. Trail Layout

A. Before Picking the Trail Location

Always contact the landowner or appropriate land manager to let them know when you will be on their land and what you will be doing. Every landowner/manager likes to know what's happening, and he may be able to assist you.

Become familiar with various types of bridges, waterbars, soil erosion prevention techniques, and other construction details available, many of which are described in this manual. The trail location must be marked directly on the land, but not with permanent markings. Plastic flagging is commonly used.

B. Timing of Trail Layout

Snowmobile trail layout should be done during the late fall or early spring because:

1. there are no leaves on the trees so visibility is much better and;

2. wet, seepy areas needing special construction measures are much more evident at these times of the year.

C. Environmental Considerations

Our natural resources are valuable to all of us. They require our respect and protection. Many areas are sensitive to disturbance, and should be avoided. Some things to be on the watch for are:

1. If possible, avoid forest stands where deer spend the winter.

2. Open and Forested Wetlands. These are important habitats for plants and can serve as breeding and feeding areas for many species of birds and wildlife and are susceptible to physical damage. Terrain which is often or constantly wet should be avoided unless there is absolutely no other alternative. If this is the case, certain methods of construction must be used to minimize damage to the land and to

provide a satisfactory trail base. You must also check to determine if wetland permits are required.

3. Sensitive areas. Avoid areas designated for their special biological, geological, ecological, research or educational value since they can be adversely affected by human intrusion.

4. Avoid sites for endangered species; habitats for rare plants or animals.

5. Do not disturb historic or cultural sites including burial grounds, homesteads, cemeteries and travel routes.

6. Avoid steep slopes where soil erosion could become a problem (more on this under Trail Development).

7. High elevation areas. These can be subject to high intensity storms, highly erosive soils with a very limited capacity to store runoff. Runoff can be very "flashy", ie, sudden large amount of runoff after rainstorms. Revegetation can also be slower so be especially certain to follow the guidelines below. Erosion control is of utmost importance at high elevations.

8. Stream crossings where small amounts of sedimentation can severely damage fish habitat and water quality (more on this under Trail Development).

9. Conifer stands. Although they can add much scenic variety to a trail, avoid long stretches of trail under conifer stands (evergreens like spruce, pine, fir, and hemlock). These species tend to capture snow and prevent it from reaching the trail below. On wide trails, there is less need to be concerned with this factor.

10. Open water. Do not route trails across ice on open bodies of water. Trails across ice-covered bodies of water are potentially lethal and are not eligible for NYS Trail Fund grants.

Other areas like ponds and lakes also require careful planning to avoid site damage and minimize safety risks to people.

D. Topographic Considerations

To help retain a good snow cover on the trail surface, avoid direct southern exposures and cleared ridge tops.

Trails should be laid out so they "slab" across sideslopes; they should not run straight up or down the slope. Trails running straight up a slope can be difficult to keep drained and are much more susceptible to catastrophic washouts since runoff often cannot get off a trail runnning straight up and down hills. Waterbars and dips must be excessively high, skewed, or long to avoid such erosion. Water buildup in the trails during the winter can also result in unmanageable moguls and ice conditions.

Ridgelines, upper sideslopes, knolls, shoulders of slopes, and other convex shaped "water shedding" topography are preferable to concave area such as swales and lower sideslopes which tend be wet or to collect water. Generally, on higher or more convex terrain, there are fewer seeps, small flowages, and streams to cross which reduces the adverse environmental effects on surface waters, makes it easier to maintain a firm trail tread, and reduces the cost of the project.

E. Aesthetics

Attractive scenery can dramatically improve the enjoyment of a trail. Trails should stimulate the user. Vary altitudes, terrain, and surroundings to add interest to the trip. Take advantage of naturally occurring features like streams, rock outcrops, huge boulders, vista overlooks, attractive stands of forest trees, and similar feature to add interest and variety to a trail. Try to avoid mile after mile of trail inside a "tree tunnel".

Include attractive destinations like lakes, mountain tops, scenic overlooks, public recreation areas, and restaurants along your trail system.

F. Access to Services

Machines need gas, oil, and occasional repairs. People need a place to warm up, get water, food, bathroom conveniences, and perhaps a telephone or medical aid. A storage area for grooming equipment, supplies, and tools should be nearby. In addition, parking and public access (including by other trails) are also very important.

G. Field Methods for Trail Layout

1. Preliminary Mapping of the Trail

First, be sure to get the landowner's permission before beginning mapping and layout. Several steps should be followed during the process of a trail idea to a proposed route on-the-ground.

Step 1. Mark the proposed route on a topographical map. If more than one map is involved, tape them together.

Step 2. Mark critical areas to be avoided and points of interest to be included. This should be done with someone knowledgeable in such things. On public and corporate lands or on lands managed by institutions, the local administrator should assist with this.

Step 3. Connect points of interest considering topography of the land. This gives you the general trail route.

Step 4. Walk proposed trail both ways to get a complete picture. This is best to do in the spring when water levels are high and wet areas are easily identifiable. Revise the map to reflect what you have learned.

Step 5. Identify access to the trail from parking areas.

Step 6. Plot the revised trail location on a clean topographical map to provide to landowner(s).

2. Field Layout Procedure

Take with you the following equipment:

- A clinometer or other instrument to measure % grades;
- Your topographical map showing the proposed location; some land managers have aerial photos that can be very helpful.
- A compass to relate to the map;
- Walkie-talkies to keep in touch with each other;
- A scale or ruler which corresponds to the map scale (for taking distances from your map);

• Red, blue or other brightly colored flagging tape;

• Several small stakes for flagging the trail location where there is no vegetation of sufficient size (an archery quiver is an easy means of carrying the stakes).

Work in pairs. The lead person should scout the terrain ahead looking for the most desirable route. In hilly areas, the lead person must check grades very frequently. to be certain not to exceed the recommended maximum listed in Section III.B. At this stage, try to avoid significant obstacles, large trees, shallow bedrock areas, wet, seepy areas and other similar conditions. The lead person then stations him/herself within sight or sound of the other at the next outstanding feature of the trail (curve, crest of a hill, notable landform, etc.) The partner should then proceed toward the lead person, tying the plastic ribbon to vegetation or stakes along the way. Repeat this procedure until the entire trail length has been flagged. You may encounter obstacles that require going back to relocate and re-flag previous sections.

Pay particular attention to the alignment to avoid sharp bumps and corners. Remember, the tighter the corner, the wider the trail needs to be to accommodate the same width grooming equipment. See the section below concerning Trail Alignment. Adjust flagging here and there as necessary to improve or avoid nuisance or hazardous situations, to include interesting points not previously identified, to reduce steepness of the trail, etc. If you are using public lands, this is a good time to get the local administrator out on the trail. Be sure you can explain your reasons for your choice of terrain and specific locations. This interaction will be beneficial for a good understanding of the needs and restrictions.

Your last step is to mark the final center line by tying additional ribbon at very close (15' to 20') intervals so as to be visible one from the other so the construction crew will know exactly where to place the tread. Your trail design is now complete except for obtaining necessary permits.

H. Crossing Streams and Bodies of Water

If at all possible, route snowmobile trails away from large bodies of water. Many snowmobiles and lives have been lost crossing thin ice, and often it is difficult for a snowmobiler to know if the ice over lakes, ponds, and rivers is safe. This is why trails across frozen bodies of water are not eligible for NYS Trail Grant funding.

If a trail must cross rivers and other moving water, bridges must be installed. Cross streams at right angles to keep bridge lengths down. Cross on straight stretches of stream. Avoid locating culverts and bridges on curves in streams; curves are subject to more intense scouring than straight sections.

If a bridge is required, try to cross at a location where the bottom of the bridge stringer will be well above the high water level. On trails that will be groomed, be sure that the approaches and the alignment of the bridge itself allow enough distance to run out off each end of the bridge without having to turn the groomer while still on the bridge.

See the section on bridges in Section III below.

I. Road and Railroad Crossings

You must use existing railroad crossings on active railroads unless you obtain permission to cross them at other locations. Choose road or railroad crossings for clear visibility and safety over convenience. Always try to cross at right angles since most snowmobiles do not steer well on pavement or could become entangled in railroad tracks on angled crossings. Adequate sight distance along the road in both directions is required as shown in Table 1. Do not cross at curves where sight distance is reduced.

Avoid crossing roads or railroads where they lie above the surrounding area (where you have to climb a steep bank to get to the road or railroad). Approaches should be no steeper than +/- 3% grade for 20 feet from the shoulder of the road or railroad if possible. Talk to State or local highway officials for help in determining safe crossing locations.

J. Using Existing Travelways

To keep overall impacts to a minimum, try to use existing travelways such as existing trails, unplowed town roads, old logging roads, utility corridors, etc. as trail locations when appropriate. Try to avoid using roads that will be plowed.

K. Permits/Approvals

You must be aware of local, State, and Federal laws and permit requirements affecting trail operations. Such laws and permit requirements vary from jurisdiction to jurisdiction. Before you begin actual construction, investigate the legal situation. Find out what permits must be obtained (perhaps none!) , and what laws and ordinances must be complied with.

It is better to learn these things in advance and, thus, avoid an unintentional violation. This is an important reason to develop a good working relationship with the goverment officials in your area.

Construction of a new trail is an action that is subject to review under Part 617 of 6 NYCRR, the Rules and Regulations implementing the Statewide Environmental Quality Review Act (SEQR). Consult a local government sponsor (county or town) for environmental review. They will serve serve as the lead agency for review of the trail construction plan developed and fill out the Environmental Impact Statement (EIS) required by New York State law.

Other review requirements may apply. If the proposed trial is within an area designated as an agricultural district, the local government sponsor must determine if the trail is an action subject to Section 304.5 of the Agriculture and Markets Law requiring filing a Notice of Intent. If the trail is within the Adriondack Park, it must comply with regulations such as the Adirondack Park State Land Master Plan. If any part of the trail crosses state land, it must comply with the appropriate state agency's plan for that area (such as Department of Environmental Conservation Unit Management Plans).

Other agencies that should be consulted for any new trail include Regional offices of the Department of Environmental

Conservation (for wetlands, wildlife habitat, and similar issues), and county and town environmental and conservation commissions and historians. Local government sponsors can assist in this effort.

III. Trail Construction

The following provides detail on construction methods and specifications.

A. Timing of Construction

Snowmobile trails should be built during the summer when the ground is dry and snow does not hide the terrain. Just as the trail should be laid out during spring when the ground is the wettest, actual construction should be done during the summer when the ground is the driest.

B. Trail Specifications

Snowmobile trails should be built to the specifications listed below for several reasons:

— safety for both snowmobilers and groomer operators

— protection of the environment by choosing locations with the least impact and by reducing soil erosion or sedimentation into streams

— to protect the investment in the trail

1. Trail Grade (steepness)

Optimum grades are less than 25%. Avoid grades over 25%. Excessively steep trails can be difficult to groom and are more susceptible to erosion than gentler trails.

Recommended grades for any trail class are:

	Easiest	Most Difficult
Maximum sustained	8%	15%
Maximum pitch	25%	35%

2. Trail Width - See Figure A.

There are three parts to trail width - the cleared width, the tread width, and curve widening.

a. Cleared width

This is the width of the cleared area through wooded area. It includes the tread width, the space necessary for ditches plus enough additional clearing to avoid leaving trees along the tops of cutbanks with root systems largely removed and subject to toppling over. It also depends upon the steepness of sidehills the trail crosses; steep sidehills require additional cleared width since cutbanks and fill slopes are longer on steep sidewhills. The cleared width will be highly variable within any class of trail.

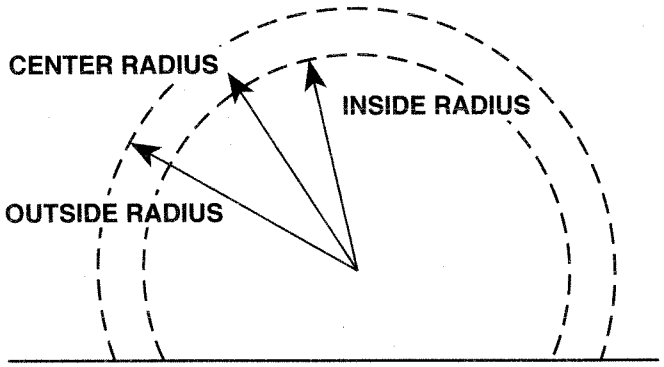
b. Tread width

The trail tread width is determined based upon the class of the trail and the anticipated width of grooming equipment. The minimum width for each class of trail is established to provide 2 feet on either side of grooming equipment for safety and improve visibility.

c. Curve widening

In corners, grooming vehicles require a greater trail width than on straight sections of trail. An 8 foot wide Tucker Sno Cat towing a drag (assume a total unit length of 40 feet) needs trail 19 feet wide in the curve in order to negotiate a 25 foot turning radius.

CURVE RADIUS DEFINITION



An added factor in curve widening is the design speed for the trail with higher design speeds requiring added widths in curves.

Table 1 lists standards for widths on each class of trail, with examples of increased widths needed for curve widening. Note that the cleared widths refer to trails with no side slope and that additional widths will be needed to allow for sideslope steepness.

Use this Table as a guideline only.

Table 1 - Trail Widths

Minimum Trail Width at 10 MPH [1]

Trail Class	Minimum Trail Width	a Curve With Inside Radius of: 25ft[2]	35ft	50ft	60ft	75ft	100ft
A	12'	19'	17'	15'	14'	13'	13"
B	10'	19'	17'	15'	14'	13'	12.5'
C	5'	[3]11'	10'	9'	—	—	—

1 Assumes grooming vehicle lengths of 40' for Class A trails, 30' for Class B trails, and 20 feet for Class C trails.
2 25 foot turning radius is the minimum that should be used.
3 Maximum equipment width 4 feet.

3. Effective Cleared Height

The effective cleared height is that height which will allow safe passage of grooming equipment and snowmobiles after taking into account the effects of snow loads on branches,

the species of trees, snow buildup on the trail, and the height of the equipment to be used on the trail.

The actual cleared height, the height to which limbs and branches must be removed to allow for snow and ice loads, is usually much greater than the effective cleared height. See Figure A.

All branches and limbs hanging less than the height above the ground as shown below must be removed to allow snowmobiles and grooming equipment to pass safely. When determining what branches to remove, remember that snow and ice loads will cause branches to hang lower during the winter. Spruces, firs, hemlock, and white pine branches and limbs can be weighted down considerably by snow and ice requiring much greater actual cleared heights. Species like American beech and some birches can form long slim branches that can also be weighted down easily by ice. Snow buildup on the trail itself will reduce the effective cleared height. Also, take into consideration the height of warning beacon lights on the groomers to be operated on the trail. When trying to obtain an effective cleared height of 10 feet during the winter, the actual cleared height during snow free season may need to be much greater - as much as several feet greater than the minimum effective cleared heights shown in Table 2.

Table 2 - Minimum Effective Cleared Heights

Trail Class	Minimum Effective Cleared Height
A	12 feet
B	10 feet
C	8 feet

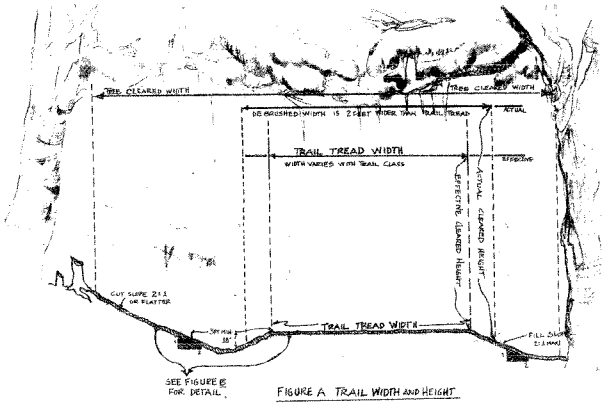


FIGURE A TRAIL WIDTH AND HEIGHT

4. Horizontal Alignment

Horizontal alignment refers to how curvy a trail is.

Avoid sharp curves if possible. Note the minimum curve radius in Table 1 above.

Avoid creating curves with blind spots.

Where the terrain allows, trail can be banked inward where there are sharp drop-offs or other hazards on the outside of curves, but, banking may just increase the speed at which a snowmobiler feels comfortable taking a curve. Thus, appropriate warning signs should be used where such hazards exist.

5. Vertical Alignment

Vertical alignment refers to the rise and fall (bumps and dips) in the trail tread.

Avoid rises over which a snowmobiler cannot see (blind spots). Also avoid dips that are so abrupt that a snowmobile could be thrown airborne and possibly out of control at normal trail speeds.

Never leave bumps and dips in curves.

6. Tread Smoothness

A smooth trail tread allows a trail to be groomed and ridden upon much earlier and later in the season. On corridor trails, all trees, saplings, shrubs, blow downs, vines, stumps, rocks, and roots which protrude more than 1 inch above the overall trail tread should be removed over the entire width of the trail tread surface. Consider smoothing non-corridor trail treads to the same standard.

Hazardous trees outside the trail tread should be removed.

7. Sight Distances at Road and Railroad Crossings

The sight distances recommended in Table 3 apply to all road and railroad crossings for all trail classes.

Table 3 - Sight Distances at Road and Railroad Crossings

Design Speed (mph)	Assumed Speed For Condition (mph)	Recommended Minimum Sight Distance In Both Directions From Trail (ft)
20	20-20	125-125
25	24-25	150-150
30	28-30	200-200
35	32-35	225-250
40	36-40	275-325
45	40-45	325-400
50	44-50	400-475
55	48-55	450-550
60	52-60	525-650
65	55-65	550-725
70	58-70	625-850

8. Aesthetics In Trail Construction

The appearance of the trail after it is built is extremely important. It leaves a strong message with landowners, non-snowmobilers, and public administrators about the level of care that went into the project. It greatly affects the image of the sport of snowmobiling. A technically good trail con-

struction project that is not aesthetically pleasing is a job poorly done.

There are a number of things that can be done to affect the final appearance of the project. Aesthetic considerations are so important that some of these items will be referred to in other sections of this manual.

a. Cut stumps along the sides of trails as low as possible if they will not be removed. High stumps look odd.

b. If stumps are removed, bury them or leave them standing upright, well off the trail with the roots down.

c. If trees are pushed over by equipment, remove the root wad and treat as described in "b."

d. Drop all trees that have fallen into and are still leaning on other trees as a result of the construction. Likewise, remove all trees and tops that have become hung up in other trees along the trail. Beside being very unsightly, "leaners" and "hangers" are extremely dangerous.

e. Lop all downed trees and their tops so that the trunk and branches lie no more than 3-4 feet above the ground. Brush and small branches should be scattered below the trail.

f. Brush should be cut flush with the ground. Cut all branches flush with the stem of the tree for both aesthetics and to avoid leaving stabbing hazards. If more than 2/3 of the branches must be removed from a tree, remove the entire tree.

g. Avoid leaving large piles of stones and boulders, or mounds of soil. Smooth them out to appear as natural as possible. Push larger stones and boulders dislodged during construction well off the trail. Remove all bridge materials, refuse, and other construction debris.

h. Keep aesthetics in mind when installing signs to avoid oversigning and sign "pollution". Refer to Section V, Signage, for more information.

C. Snowmobile Trail Construction Methods and Techniques

1. Choosing the Right Excavating Equipment

To make best use of the funds available and to efficiently finish the work needed, it's important to have the right equipment for the type of work to be done and the soil and terrain conditions in the project area.

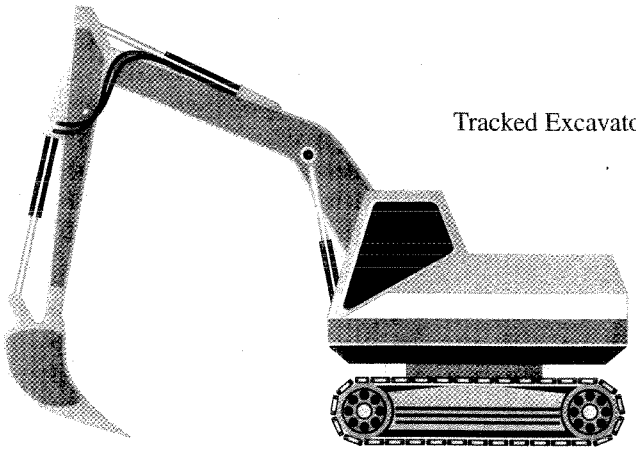
a. Tracked excavators

Tracked excavators are one of the most versatile pieces of equipment for snowmobile trail construction especially in hilly or mountainous terrain. They often have the least amount of environmental affect while leaving the neatest appearing final product.

Tracked excavators are available in sizes that are suitable for all three classes of trail, and they can be used on grades up to 35% and sometimes steeper. Their ability to directional-fall trees and push them to the ground is a great labor saver and safety factor in dense woods. They can pick up large stumps or whole logs and place them in a manner that is aesthetically pleasing. They can push even larger materials well off the trail. They can dig out large stumps and boulders more easily than any other type of equipment because of their ability to pry upward with great leverage. With the ability to swivel and reach, excavators can place stones and boulders over the side of a trail for cribbing or for rip-rap at bridge sites. They cause less disturbance while preparing stream crossings because they do not need to work directly in the stream. Tracked excavators are also well suited to working in soft muddy conditions. Since it does not have to travel back and forth repeatedly over muddy areas, the soils stay firmer and are less likely to turn to "soup". Thus, even if the conditions are very soft, it can leave a smooth finished surface behind it. A 22 ton tracked excavator will often leave a shallower imprint in mud than a person.

A particularly effective combination is a tracked excavator with a "twist-a-wrist" grade style (toothless) bucket. Contrary to intuition, with a good operator at the controls, a toothless bucket is quite effective at removing boulders. It has the added advantage, when combined with the twist-a-wrist of being able to ditch and turnpike or inslope a trail behind itself versus having to work out to the side which is very important in wooded areas. It leaves smooth, neat ditches, cutslopes, and trail treads behind it. It can quickly and neatly remove excess soil, stone, and other debris off to the side of the trail without leaving debris berms as a bulldozer often does. The toothless bucket leaves a fine smooth finished product as it moves on and makes excellent waterbars even in muddy areas.

Although tracked excavators look big and expensive, in wooded, stony, or muddy conditions, they are the most efficient piece of equipment to use especially with the correct type of attachments.



Tracked Excavator

b. Wheeled excavators and tractor style backhoes

Because of their poor maneuverability and high bearing pressure, wheeled excavators or not suitable for use in

wooded, steep, or muddy conditions. They can be very useful in open areas on firm ground.

Four wheel drive and other backhoes can be useful for a variety of small fixup and repair jobs, but generally are not well suited to heavy construction or re-construction except in an accessory capacity in limited situations.

c. Bulldozers

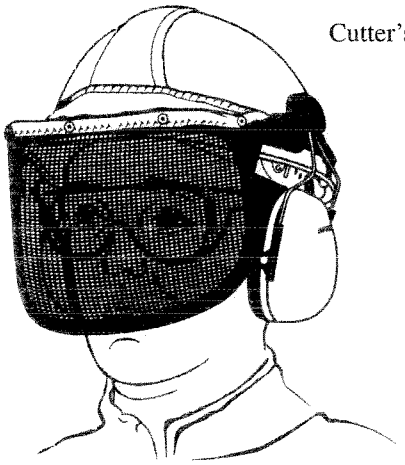
Traditionally, bulldozers have been thought of as the most useful type of equipment for constructing snowmobile trails. With the advent of today's tracked excavator, bulldozers are no longer the preferred piece of equipment in mountainous terrain but they still are useful in gentle terrain, for towing heavy bridge parts to remote locations, and similar jobs.

2. Cutting and Debrushing Equipment

a. Power equipment

Most trail construction or reconstruction projects will require chain saws to fell trees and cut them into manageable pieces. Chain saws are also needed to lop branches from downed trees for aesthetics and to flush cut stumps left in the trail tread. Crew members using chain saws should have a good knowledge of directional felling techniques especially in dense woods. An excavator can be used to significantly reduce the danger resulting from hung up trees. An excavator can push a tree to the ground leaving only the root wad to be severed once it is down. However, if trees must be be removed with a chainsaw, only experienced and well trained operators should do so.

Chain saws can inflict serious injuries. Chain saw operators should wear cutter style hard hats (with built-in eye screen and ear muffs), chaps that extend to the boot tops, leather gloves, and sturdy leather boots.



Cutter's Hard Hat

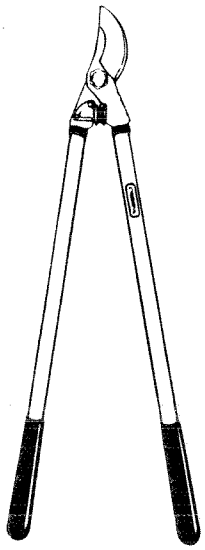
Never attempt to cut on a tree that is wholly or partly pinned down by another tree; remove the overlying tree first. Never drop start a chain saw and never attempt to cut anything that requires putting the chain saw higher than your head height. These are all high risk operations.

Gasoline powered rotary brush cutters, string trimmers, sickle bar mowers, and bush hogs are most useful for trail maintenance but may have some application during construction in brushy or grassy areas.

b. Hand tools

Some hand tools are very effective at removing light brush along the edges of the trail or pruning off limbs or branches to obtain the correct effective cleared height.

Loppers very effectively remove small brush, low branches and roots protruding into the trail. Choose quality loppers and learn how to sharpen them. Sharpening may be needed as often as every day where the are many roots to be cut. The more expensive loppers with steel handles can be much easier to use and last much longer than some of the less expensive wooden handled loppers. Levered or other fancy jaws are not necessarily the best.



Loppers

Pole pruners are usually needed to remove branches to obtain the correct effective cleared height. An effective cleared height of 12 feet may require an actual cleared height of 14 feet or more. When used properly, pole pruners are quick and efficient. Always wear a hard hat and eye protection since falling branches or sawdust from above can easily inflict head or eye injury.

3. Tread Construction Techniques

Snowmobile trail treads should be free of obstructions as described in the Specifications, section II.B. above. Trail tread construction should attempt to:

•Provide a tread surface that will safely accomodate grooming equipment;

•Control surface water and groundwater runoff to reduce soil erosion and reduce the chance for ice buildup (boils), especially on hills, and;

•Provide a firm tread surface.

The following sections provide guidance to accomplish these three items.

a. Trail tread structures to control erosion and "harden" trail surface

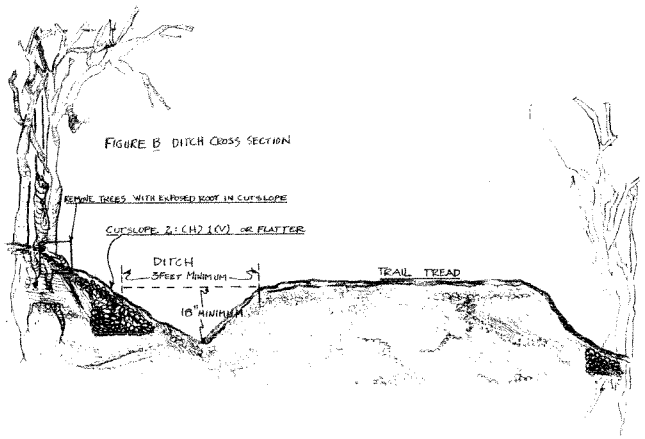
1. Ditches

Ditches shaped as shown in Figure B should be excavated along the edges of any section of trail where surface or groundwater creates seepy or muddy trail surfaces. Seeps during the winter can turn into serious ice buildups that can be exceedingly dangerous for snowmobilers and especially dangerous for large grooming equipment. Muddy trail surfaces are subject to rutting and erosion by other trail users during snow free months.

Well-drained trail surfaces also require less cold weather and snow than do muddy, wet trails for early and late season snowmobiling. Snow will also last longer late in the season if water cannot accumulate underneath the snowpack and melt it from below. Leaves, branches, and natural silt loads tend to fill new ditches relatively quickly, therefore ditches correctly made may appear to be too large at the time of construction. The smallest ditches should be 18-24 inches deep and 3 feet wide at the top. This will help maintain stable ditch slopes. Larger ditches also are less likely to be plugged by debris like leaves and twigs. Many times, ditches carrying water year round will need to be deeper and wider than the minimums described above.

On sideslopes, ditches will only be needed on the uphill side of the trail. On level areas, or where trails run straight up hills (not recommended), ditches may be needed on both sides of the trail.

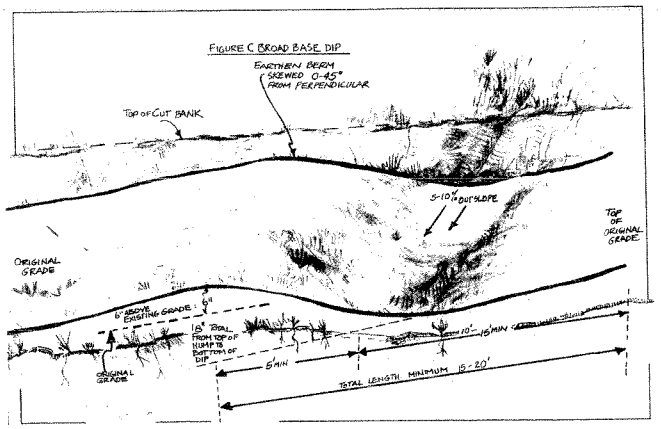
If groundwater control is needed, but, space is not available for ditches as described here, a different trail configuration will be needed. See the section on "Insloping" below.



2. Broad based dips

Broad based dips, Figure C, are a type of waterbar that helps to control erosion when installed at regular intervals along trails, especially on hills. A properly constructed broad based dip will leave a depression in the trail tread but will not leave a bump protruding above the prevailing surface of the trail.

See Table 4 below for dip spacing guidelines.



3. Reinforced waterbars

Broad based dips and waterbars having berms reinforced with rocks or logs should not be used on snowmobile trails. Under low snow conditions, they can be an obstruction causing serious damage to snowmobiles and injury to the operators. Grooming equipment can snag on rocks and logs frozen into the berms causing serious equipment damage.

4. Bridges

Bridges are one of the highest risk and most expensive parts of snowmobile trails. Use only the standard plan(s) in this Manual, plans provided by State or Federal administrators, or plans prepared by professional engineers for specific sites or applications. Always consider both the static load (snow load) and the live load (groomer and drag) when determining the design weight of bridges. Be certain to look to the future and design bridges to handle the weight of grooming equipment that might be using the bridge during its life.

A sample approved plan for a bridge in varying lengths is enclosed at the back of this manual. See Appendix B.

Remember that bridges should not be visually overpowering and materials, colors, forms, and textures should all be subdued and blend well into the character of the surrounding area.

When deciding whether to use a bridge or culvert, take into account the volume and "flashiness" of flows, cost of materials and installation, effects on fish passage, the amount of sedimentation of aquatic habi-

tats, and other factors. Bridges are often used in place of larger culverts or where culvert size is impractical because of the waterway area.

Also see the section on stream crossings in Section II above.

5. Culverts

Culverts are used where the flow of water across a trail during the winter is such that it permanently or periodically melts the snow surface creating a hazardous melt-out area.

Culverts have advantages and disadvantages to carefully consider before using them. A manufactured culvert can be expensive. It can be subject to frost heaving in cold climates especially if it is backfilled with native soil (which may be all that is practically available in remote areas). After it heaves, water can "pipe" down the side outside of a culvert and wash out the backfill around it. Culverts can be plugged by downed trees or branches which then cause the culvert to be overtopped and washed out.

The velocity of water can suddenly increase in a culvert because the stream channel is constricted and the friction of the stony stream bottom is eliminated in the culvert. Thus, "plunge pools" form at the outlet end of many culverts. The combination of high water velocities inside the culvert and a drop of up to several feet at the outlet into a plunge pool can create a block to migrating and spawning fish. Properly sized culverts installed on gentle grades can reduce the chance of blocking fish passage.

On the other hand, culverts can be less expensive and labor intensive to install than a bridge. Open bottom culverts can eliminate the problem of plunge pool formations and increaded water velocity that impedes fish passage.

Culverts must be laid so that the bottom is at the same elevation as the stream bed. Make a "bed" for the culvert by removing stones that create flow spaces under it. Add gravel to the bed if available to create a tighter seal around the bottom of the culvert. To prevent it from being crushed by traffic, the depth of fill over the top of a culvert should be at least one half the culvert diameter and not less than one foot deep for culverts less than 24 inches in diameter. Soil around the culvert must be firmly tamped in 6 inch layers. Stone should be used around both the upper and lower ends of the pipe to avoid erosion.

There are several types of culverts. Corrugated plastic and corrugated or spiral metal culverts are manfactured in many shapes and sizes and are useful in many applications. Corrugated plastic culverts should be used instead of metal culverts (if feasible) where the acidity of the soils or groundwater cause them to rust out quickly.

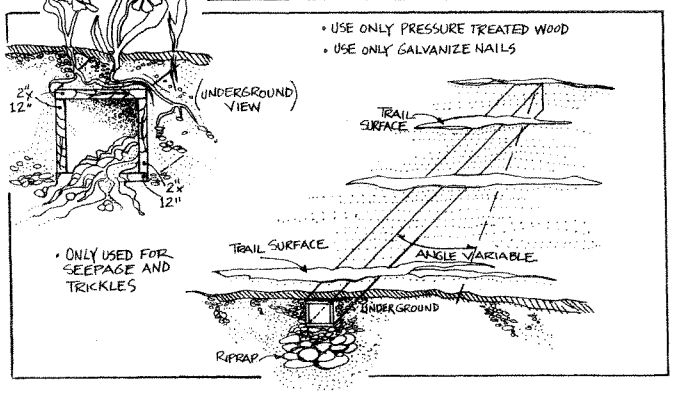
Wooden box culverts can be an inexpensive alternative where flows are small. Open topped culverts of any type should not be used on snow trails. They can melt out just as readily as a broad based dip with no culvert.

Closed box culverts, Figure D, can be used very satisfactorily as long as the size of the open end of the culvert is sufficient to pass the anticipated flows.

Multiple small culverts should not be used in place of one larger culvert. Smaller culverts plug more easily. Also, friction resisitance to water flow through them reduces there ability to pass the same quantity of water as one bigger culvert.

Culverts must be cleaned annually. Remove upstream debris that could be washed into a culvert and plug it.

FIGURE D CLOSED BOX CULVERT



See Tables 4 and 5 below for size and spacing guidelines.

6. Culvert size guidelines

Use the following guide to determine culvert size. Avoid using culverts less than 15 inches in diameter since they are highly prone to plugging.

Table 4 - Guide For Determing Culvert Size

Number of Acres Feeding Stream in Well Drained Soils	Number of Acres Feeding Stream in Shallow Soils with Frequent Bedrock Outcrops or Impermeable Soils	Recommended Culvert Diameter (inches)
16	4	15
25	7	18
40	12	21
55	16	24
84	27	30
130	47	36
190	64	42
260	90	48
335	120	54
400	166	60
550	205	66
650	250	72

7. Cross drainage frequency

Table 5 offers guidelines on the distance interval between broad based dips. Use this table as a guide. Dips should be placed at intervals close enough together so that runoff is diverted before it concentrates and picks up velocity enough to erode soil from the trail tread. Good judgement and experience is required to determine the location for dips. Wet, seepy areas of trail may require more dips than Table 5 calls for, especially on hilly sections. Small streams may need their own dip or culvert regardless of the distance to the next dips.

Some soils require many more waterbars than others. At high elevations, it is nearly impossible to install too many waterbars since the rainfall intensity is often much greater than at lower elevations, and since the soils there have a limited water holding capacity. A single storm can suddenly generate large amounts of runoff. An adequate number of broad based dips and ditches are necessary to avoid trail tread erosion.

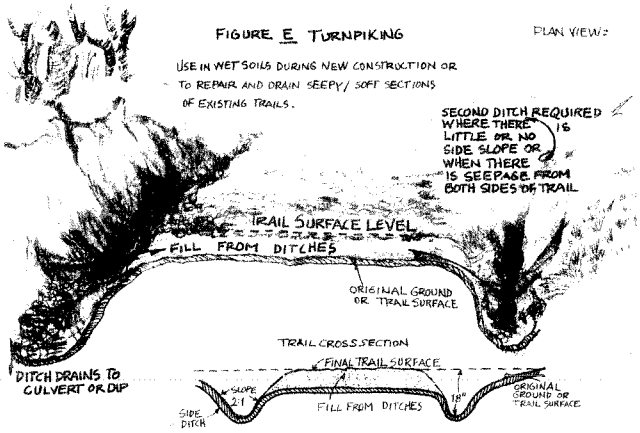
Cross drainage (broad based dips and culverts) is extremely important. If you do not have experience at determining cross drain locations, you should get help from others in your club, from local public land administrators, or from other government agency or private experts.

Table 5 - Cross Drainage Spacing

Trail Grade (%)	Distance Between Dips (ft)	Distance Between Culverts (ft)
1	400	450
2	250	300
5	135	200
10	80	140
20	45	120
25	40	65
30	35	60
40	30	50

8. Turnpiking

Turnpiking, Figure E, is the process of removing soil material from ditches in wet and seepy areas and placing it on the trail tread to raise the elevation of the tread above the bottom of the ditch or above the prevailing ground level. This can greatly improve drainage. Turnpiking is best done with an excavator since the native soil material removed from ditches sometimes can be "soupy." This material will normally firm up in a few days to a week or two depending upon the nature of the soil. Once it firms up, it stays firm. Turnpiking is very effective if used in combination with ditches.



b. Snowmobile trail tread configuration

1. Level side-to-side

Preferably, snowmobile trail treads should be level side-to-side to ease the task of grooming. Where the tread is level side-to-side, ditches are used to intercept groundwater, drain the tread base, and carry the water to the nearest broad based dip, culvert, or otherwise off the trail. Turnpiking can also be used.

2. Insloping

Where there is seepage into the trail tread but becaue of terrain limitations or other factors, there is not room to construct a ditch, the tread can sloped inward at about a 10% grade toward the uphill side of the trail. The insloped section of the trail forces water to flow along the uphill side of the trail until it reaches the next broad based dip or culvert. This will prevent seepage from crossing the trail but does not provide a level travel surface and a clearly defined edge between the water and the trail surface.

3. Outsloping

Never outslope a winter trail. Runoff is free to flow cross the trail tread and can freeze onto the trail surface. Snowmobiles and grooming equipment can slide off the trail in this very hazardous situation.

c. Erosion, sediment control and revegetation

Controlling erosion and sediment transport into streams and water bodies is important to protect the productivity of the land, to keep surface waters clean, and to avoid introducing sediment that can harm aquatic life. Controlling erosion and sediment are environmentally responsible goals reflecting wise stewardship of natural resources.

1. Cutbank and fill slope stability

Constructing trails across a slope will require "bench" construction, ie, excavating a level trail tread out of the sideslope. This will leave a cut bank on the upper side of the trail and a fill slope on the downhill side of the trail. The angle of cutbanks and fill slopes needs to be flat enough so they remain stable and do not slump (collapse).

In general, for every vertical foot of height, cutbanks and fill slopes should be sloped back at least 2 feet (otherwise noted as a 2:1 slope). This means that when the top of a cut slope that is 5 feet vertically above the bottom of a the ditch or trail tread, it should be sloped back at least 10 feet from the edge of the trail or the bottom of the ditch if there is one.

Many factors can affect slope stability: 1. the texture of the soil (silts, fines sands, highly organic layers), 2. surface or groundwater movement over or through cutbanks and fill slopes, 3. the presence of certain type of soil layers, and 4. the vertical rise. These factors can greatly reduce cut and fill slope stablity requiring much flatter slopes. Conversely, some soils can be very stable even at much steeper angles.

2. Retaining walls and cribbing.

Retaining walls are structures made with a variety of materials that are used to stabilize cut banks and fill slopes where they cannot be laid back flat enough to keep them stable. Retaining walls are also used to stabilize sideslopes under extenuating circumstances.

Effective long lasting materials include rocks or old tires. Wood can also be used but should be pressure treated to prevent decay. Stabilizing slopes with retaining walls is an expensive, time consuming process so native logs and untreated wood should be used only if no other alternative exists. See Figures F, G, and H. Steel and concrete, though quite expensive, can be used on more accessible areas.

A solid foundation is essential to make a retaining wall stable. Be sure that loosely placed materials like stones or tires sit on a firm hard base.

The base of a stone retaining wall should be at least 2 feet thick and if the wall is to be high, should be as thick as half the height of the wall. The outer face should slant inwards 3 inches per foot.

If rocks are used they should be large and flat on the top and bottom. Knock off any projecting points on the top and bottom so stones will lie flat and make maximum contact. They should be strong, and durable. At least 25% of the rocks in the faces of the wall should be header stones which are at least 2-1/2 times as long as they are thick uniformly distributed throughout the wall. Headers should extend back into the wall, not parallel to it. All joints should be staggered.

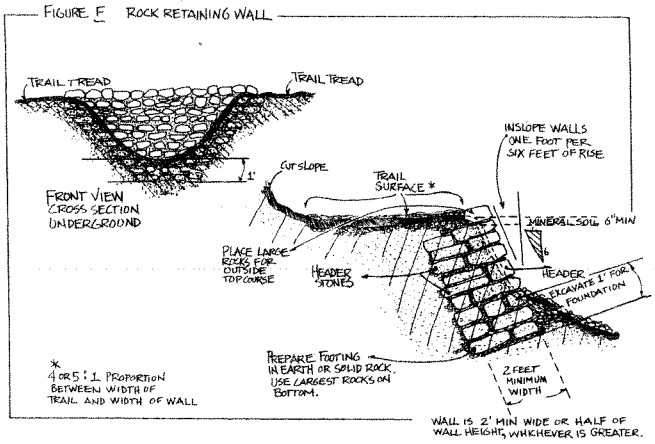
Round stones should not be used in an unmortared wall.

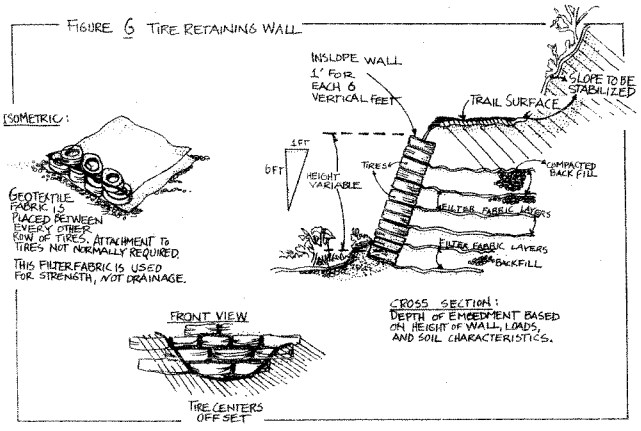
Use porous native soil materials fill behind any retaining wall to provide free drainage.

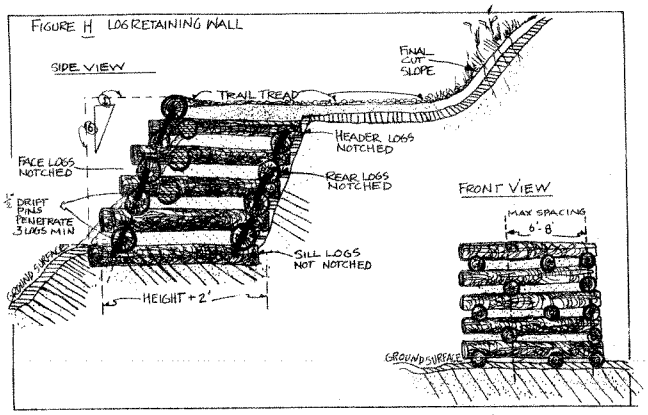
Walls built to support a trail must be built up at least to the level of the trail surface and can be built higher if desired to provide a curb. Normally, the thickness of the retaining wall should not be a part of the trail tread.

Pressure treated wood should be used if possible, but, in very remote areas, it may be necessary to use native logs. If native logs are used, they should be reasonably straight, cut from live, sound trees (spruce, hemlock, beech or maple, in order of preference), peeled and trimmed. Obtain the landowner's permission before cutting.

First, provide a firm foundation with proper drainage. Then cut the logs to the length required and at least 6 inches in diameter, individually cut to fit their final positions, and with ends cut neatly. Embed the first, or outside log firmly into the ground base to hold it in its proper place. Wherever one log lies upon another, the upper log should be offset toward the fill by 2 or 3 inches to give good stability.







3. Filter strips

Filter strips are areas of undisturbed soil that separate streams, trails, parking lots, and other constructed areas from streams and other water bodies - Figure I. Filter strips trap sediment naturally before it reaches surface waters.

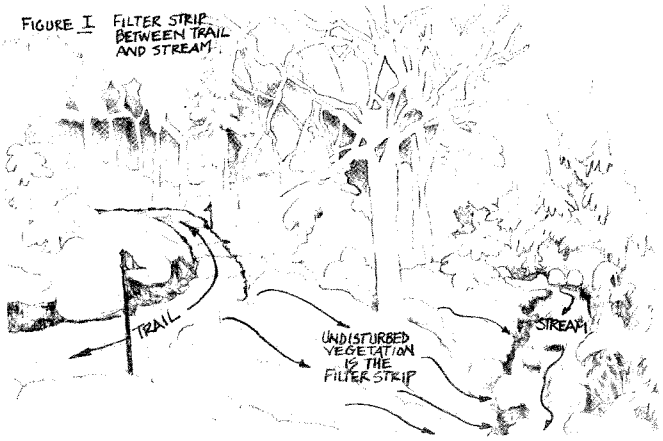


Diagram of a filter strip in a forested area

Filter strip width is based upon steepness of the slopes along the water body and the erodibility of the soils.

Table 6 - Filter Strip Width

Streambank Slope (%)	1	10	20	30	40	50	60
Width (feet)[1]	50	65	95	125	155	185	215

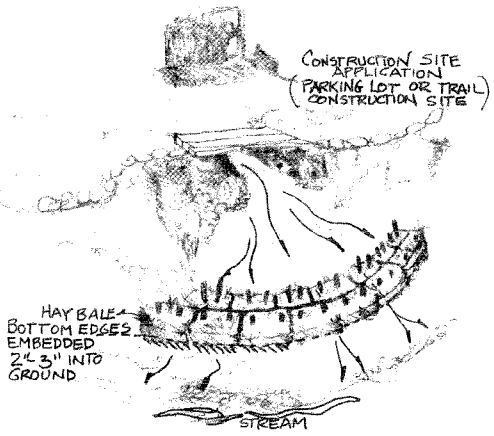
1Add 20% to the width of filter strip in highly erodible soils.

4. Sediment traps

In areas where soils will remain disturbed for long periods of time such as near bridge sites, parking lots during construction, or other critical areas along streams, lakes, or ponds, sediment traps should be installed to collect sediment before it reaches streams or bodies of water. These sediment traps can be made of bales of hay laid end-to-end across drainage ways. Stake the bales to the ground so running water cannot move them. Similarly, geotextile fabric can be attached to stakes to act as check dams to collect sediment.

Sediment traps must be maintained to remain effective. Before they overtop, clean out collected sediment and remove it to a location where it cannot harm surface waters.

FIGURE J
HAYBALE SEDIMENT TRAPS



HAYBALE SEDIMENT TRAPS USED TO PREVENT SEDIMENT AND CONSTRUCTION-SITE DEBRIS FROM ENTERING STREAMS AND SURFACE WATER

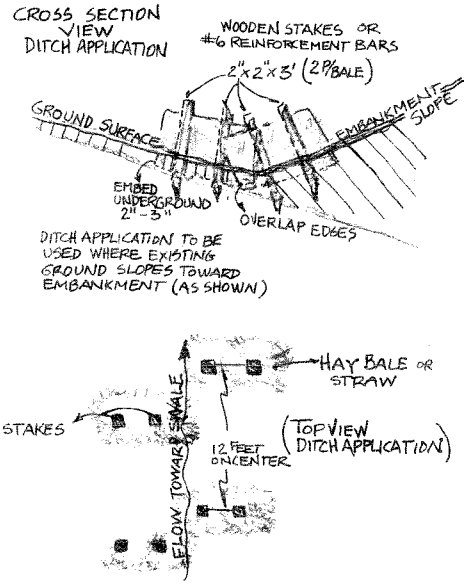
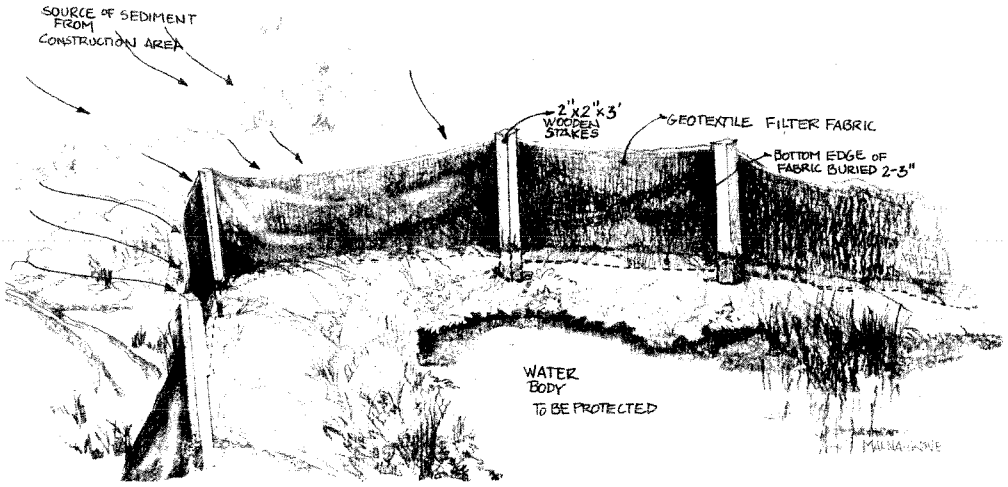


FIGURE K GEOTEXTILE FABRIC SEDIMENT TRAP



5. Revegetation

For best revegetation results, it's best to spread seed mix as you progress with construction while the soil is still soft. All disturbed areas and trails should be seeded. In some cases, such as near stream crossing or in soils subject to intense heating and drying, trails or cutbanks and fill slopes should be mulched also. Hay mulch should be spread at 2 tons per acre (100 pounds or 2 average size bales per 1,000 square feet) immediately after seeding. This protects the sprouting seed from the heat of the sun, retains moisture in the soils and helps prevent rain from washing seed away.

In densely wooded areas, a seed mix suitable for shady areas will be required.

On critical areas, fertilizer should be applied at the time of seeding. Nearly any commercially available granular fertilizer like 10-10-10 at a rate of 250 pounds per acre (6 pounds per 1,000 square feet) will suffice. However, some of the new slow release fertilizers, made in varying formulations, are particularly well suited to sandy, gravelly areas or to otherwise poor soils. Using a slow release fertilizer at a rate of 250 pounds per acre (6 pounds per 1,000 square feet) can eliminate the need for adding ground limestone when soil acidity inhibits revegetation.

Use the seed mix recommendations provided by the local governments or soil conservations agencies. Ask for shade tolerant seed mix recommendations for wooded areas.

IV. Trail Reconstruction/Rehabilitation

Sometimes a section of trail is so badly damaged from natural events, like major storms and floods, that repairs could be more costly and cause greater impacts on the environment than relocating the trail. Always consider both options before making plans to reconstruct a trail.

However, try to stabilize the old route to the extent feasible before abandoning it.

V. Signage

Snowmobile trail signs are a very important part of a safe trail. To allow maximum sign readability and comprehension, trail signage should be well planned and as uniform as possible in both design and placement, without oversigning the trail.

Consult the New York State Snowmobile Trail Signing manual to obtain practical guidelines for signage along trails. This publication is also available from the New York State Office of Parks, Recreation and Historic Preservation, Marine and Recreational Vehicles Bureau.

VI. Safety

Safety is easy to ignore. Some trail workers feel that applying safety precautions shows a lack of experience or lack of fortitude. Contrary to those beliefs, using safety precautions indicates wisdom, good common sense, a desire to avoid disabling injury, and a strong desire to live to a ripe old age.

Safety of the trail workers and snowmobilers is the number one most important consideration. The trail layout guidelines and specifications above are meant to protect the environment - our natural resources - and also to protect snowmobile operators, riders, and the trail construction and maintenance workers.

Some important safety precautions are:

- Never work alone!
- Know what the potential hazards are in the work you are doing.

• ALWAYS wear the proper personal protective equipment for the particular task you are doing. Some commonly used personal protective equipment for nearly all trail work are leather gloves, protective eyewear, and sturdy leather boots.

Some tasks require special protective equipment. When using chain saws, always wear a cutter's hard hat with built on eye and hearing protection. Always wear chaps that extend down to the tops of your boots. When cutting branches and limbs with pole pruners, always wear eye protection and a hard hat. Be alert constantly while trees are being cut or pushed over even if you are not directly involved.

Always wear a hard hat when working around people or equipment falling trees. Many injuries are caused by dead limbs breaking off falling trees or trees that they fall against. These broken branches can be flung great distances.

When prying on rocks or standing near equipment that is handling rocks, always wear protective eyewear. Stone chips can fly at very high speeds into your eyes before you can blink. Eye injuries are excrutiatingly painful, ugly, and often permanent. When handling rocks, cables, and chains, always wear leather gloves. Other specialized tools require their own special protective equipment. Know what those requirements are for every activity you do on trails.

• Make sure you and your co-workers are in good physical condition. Good physical conditioning, working together, and limiting work to match your ability will reduce the risk of injuries.

• Never approach working power equipment unless you have eye contact with the equipment operator. NEVER assume the equipment operator knows where you are.

• Chain saws can be very dangerous in the wrong hands. A chain saw operator with insufficient training and experience is a hazard to him/herself and to everyone nearby.

Most people using chainsaws think they know more about safe cutting techniques than they actually do. Formal training courses are available. If you are going to use a chain saw, get formal training on proper cutting and felling techniques no matter how much experience you have.

Never take short cuts with a chain saw. Common, high risk mistakes include drop starting the chain saw, improper notching techniques or inability to recognize hazardous felling situations, cutting strongly leaning trees with standard notch cut (leads to "barberchairing" and serious tree kick backs), cutting trees or branches weighted down by other trees or branches, reaching higher than head height with the saw, and poor saw maintenance (dull or loose chain, chain brake non-functional, hand grips loose).

It is vital that all machine operators be knowledgeable, experienced persons, who have a healthy respect for the power of their equipment and for the fragility of the natural environment in which they are working. Safety considerations are too important to be left to chance; they should be discussed and agreed upon before the work is commenced.

Last, but certainly not least, knowledge of first aid and a first aid kit are absolutely essential. Every person or crew doing trail work have one. The kit should contain the items listed in Figure L at a minimum for backcountry work and should also include a pocket knife, flashlight, dry matches, and a candy bar. Basic tools, a tow rope, and extra basic parts for your equipment might save a long walk out.

THINK SAFETY, whether you are laying out, maintaining or riding your snowmobile trail.

Figure L - Content List For Backcountry First Aid Kit

First Aid Kit Item	Quantity
2x3" non-stick bandaids for eye injuries	4
Providone Iodine, sm.	1
2x2" gauze pads(cleaning/compress)	6
Regular bandaids	10
Knuckle (lg.Butterfly)	2
Small Butterfly (skin closures)	5
Kling, 4" roll	2
Surgi pad compress (Kotex or similar sanitary napkin)	2
Ace bandage, 6" roll	1
Alcohol/Betadine wipes	2
Triangular muslin (sling)	3
Compress gauze pads (4"x4")	4
Adhesive tape (10 yd. roll)	1
Moleskin	1
Cold pack	1
Eye wash (sterile saline solution)	1
Tincture-green soap, sm.bottle/cake	1
Latex gloves (good quality)	2
Rescue breather	1
Insect (bite only):"Sting kill"	2
Insect (allergic): Benedryl or chlorpheniramine maleate	2 tabs
Medi-haler (extremely allergic)	1
Aspirin (sm. bottle)	1
Tweezers	1 pr.
Scissors	1 pr.
Large safety pins	6
Lead pencil	1
Small pad of paper (patient info)	1
INSTRUCTIONS (paper)	
Rescue breather Instructions	1
Insect Sting Instructions	1
First Aid Manual booklet	1
Contents List	1

VII. Trail Grooming

Smooth winter trails are dependent upon summer ground surfaces which are free from stumps, rocks, roots, or other debris, because the winter snow surface will reflect the summer ground surface. Winter trails are dependent upon three things in particular: (1) smooth, even ground surface; (2) dense, uniform base of snow; and (3) regular grooming. Grooming fre-

quency depends upon your traffic and snowfall, but should be done once a week at a minimum.

Trail grooming is not difficult, but it requires a lot of time, effort, and an understanding of snow mechanics. Since grooming is usually done either at night or during midweek when traffic is lightest, many snowmobilers have never seen a trail being groomed. They can, however, immediately tell the difference when they go from an ungroomed to a groomed section of trail.

An ungroomed trail will be rough and uneven, with moguls, drifts and soft snow. When a snowmobile rider goes from such surfaces to a firm, uniform base of packed snow, it is immediately and pleasantly noticeable. In addition, the wear and tear on the snowmobile is sharply reduced and fuel economy can be nearly doubled on groomed trails.

To properly groom a trail you must be familiar with the basics of moving snow and providing a long-lasting smooth surface. When this knowledge is skillfully combined with adequate equipment, operator experience and equipment technique, proper timing, snow conditions, wind and air temperatures, the art of snowmobile trail grooming quickly becomes a science.

A. Mechanics of Grooming

Two methods are used to obtain a dense uniform snow base. At times, one method will produce the best results, and at other times, the other method will be preferable. Again, there will be times when it is necessary to employ both.

- Snow Compaction: Any process which produces mechanical compression of loose new-fallen snow by repeatedly applying a weighted surface until no further compaction is observed. Snow can be compressed to less than one half of its original depth.
- Snow Conditioning: The mechanical process of moving snow back and forth in an effort to break down the points on individual ice crystals. Such intercrystalline collisions produce a slight rise in the surface temperature of the ice crystals, creating a small amount of surface melting. Through the resultant lubrication, better packing into a dense condition is possible. Typically, moguls are cut off to redeposit the snow into low areas. A packing pan in the back of the drag produces a compacted surface.

Whichever method is used, snow must then rest for a few hours after grooming in order to facilitate freezing. Once the snow has set, preferably overnight, the surface typically becomes very hard and is not easily disturbed.

Grooming should start when the snow depth has reached about 12 inches. Begin by initially compacting the snow. No attempt should be made at this time to move or plane the snow. Normal snowmobile traffic will compact the snow if it isn't too deep, and is one of the most popular methods. However, a roller can more effeciently pack a trail and will create a dense cover evenly from the top of a bump to the bottom. Very deep powder snow may have to be initially compacted by the trail grooming equipment especially in mountainous terrain, if the trail has not been broken out and if flotation over the snow is difficult by snow machine. Grooming equipment with rollers does an excellent job on snow compacting, providing you don't try to compact too much snow at any one time. A fairly light roller has significant compaction because of the road surface that touches the snow at a very narrow strip along the bottom of the roller.

The compacted snow will form a suitable base for the trail once allowed to set and freeze down. The most important point to remember is to build your trails from the bottom up. It is very difficult to build from deep snow because you will get a bridging effect with packed snow lying over loose snow. Work and compact the snow with each storm and as frequently as needed to maintain a dense base.

Ideally, it would be nice to have 4 to 6 inches of snow fall each week with which to work. This is not always the case, so you will have to work with what you have. Fresh snowfall should always be compacted and smoothed as quickly as possible. Trail grooming between substantial snowfalls requires snow conditioning and smoothing rather than snow compaction. Generally, fresh snow needs compaction and old trail snow requires conditioning.

The following tips are helpful for successful grooming:

- Use snowplow wax on groomer blades and rolls to prevent snow from sticking to metal parts. Silicone works but is not very durable.
- Try to groom during or shortly after a storm to build your trail from the bottom up.
- Ideal air temperatures for grooming are between -5° and +15° F (-20.5° to -9.5°C).
- Wet snow grooms best at night.
- Dry snow grooms best during the day or early evening.
- Groom when snowmobile traffic is lightest, so your trails can set up. Do not groom during heavy traffic. Usually this results in more damage than benefit.
- When conditioning snow, adjust your cutting depth so you will carry a full blade of snow and try to get the snow to roll and tumble in front of the blade similar to the way a grader plows snows off the road. Do not carry snow in the drag that overflows the cutting blade, side rails, or rear pan. This practice is not only inefficient but strains the grooming equipment unnecessarily.
- Cut all moguls off at the bottom of the dips and rework the snow into a uniform layer. Do not cut moguls half-way down or uneven base density will be the result. You may not be able to cut the entire mogul with one pass. Drags with muiltiple cutting blades at angles are much more efficient than one of two straight grade blades.
- If you lack snow in the tread of the trail, set the groomer blades so as to pull snow from the edges toward the center. This is where V blades or U blades in the drag are most effective.
- On narrow, one-way trails, try to set your groomer blades so as to leave the groomed surface higher in the center. The crowned surface will provide more wearability.

• Use grooming speeds between 3 and 10 MPH. Travel at a speed below that may cause the groomer unit to bounce; too fast grooming speed will result in a washboard trail or snow being cut and pulled over the hole or out of the trail.

B. Grooming Equipment

Trail grooming equipment represents the largest single expenditure in any trail program and — depending upon the size and type of equipment chosen—could run up to one hundred thousand dollars per groomer. It is also important to consider not only the initial cost, but the cost of operation, maintenance and repairs as well.

Today there are many types of grooming equipment available to snowmobile clubs for trail use. These range from individual snowmobiles towing a light groomer, to utility size machines towing a heavier groomer, to large heavy vehicles equipped with tracks, either towing a separate groomer or equipped with hydraulically-operated grooming attachments. A listing of trail grooming equipment suppliers is included for your convenience in the back of this manual. See Appendix C.

Towed groomers may be equipped with ripper teeth, adjustable cutting blades, rolls, and smoothing teeth—whatever options are necessary to compact and condition snowmobile trails.

Smaller units, 3 to 4 feet wide, are best suited to light traffic areas. Some of the newer drag designs are fairly effective at removing moguls especially on narrow or winding trails.

The larger pieces of equipment work best where trails are 8 to 10 feet wide and extensive snow conditioning is required. Remember that the more features are added, the heavier the equipment will be, and that more power will be necessary for towing, as well as more room for maneuvering. Avoid investing in grooming equipment that is unnecessarily large and cumbersome.

It is always wise to check with other snowmobile clubs and equipment dealers before making a final decision. They will suggest makes and models suitable for your particular needs, share valuable information on costs, advise on the availability of parts and service, and on maintenance problems and solutions. You should also determine the expected working life of the equipment (depreciation factor—will the equipment hold up for at least five years?).

All equipment should be kept in good mechanical condition and be stored under cover, if possible. You will want to consider equipment access to the trail—is there a nearby storage area? Is refueling conveniently possible? Does your neighborhood have a vandalism problem? It is also very important that grooming equipment be operated by a skillful operator who has both experience and common sense.

Some clubs make it a practice to have at least one other member follow the grooming equipment so a snow machine will be available in case of sickness or breakdown. Other clubs have their groomer carry or tow a snowmobile for emergency use. Many groomers are also equipped with a CB radio or cellular telephone. In any event, all safety precautions should be observed whenever grooming equipment is being operated.

C. Operator Training and Safety

Grooming equipment operators should be chosen not by popularity nor willingness, but because of ability. They should be thoroughly instructed and tested on the operating features of the equipment, maintenance schedules, and safe operating procedures. Operators should be knowledgeable in grooming theory and should have mechanical aptitude in case of breakdowns on the trail. Train several individuals for grooming duty so that grooming schedules are not interrupted by sick leave or absence.

Be prepared to do minor equipment repairs while out grooming. DO NOT GROOM ALONE. Be prepared to stay overnight if you have disabled equipment in remote terrain, and be familiar with and prepared to put into effect winter survival techniques. Always let someone know where you will be grooming and your anticipated time of return. The installation of CB radio units or cellular phones in large grooming equipment can be a wise and practical move.

Install safety chains on large hydraulically-operated, towed groomers. If the groomer ever gets hung up and is abruptly stopped, it is possible to tear the hydraulic hose connections apart and put you out of commission. Newly developed drags generally have spring loaded cutting blades. It's an excellent feature that can reduce risk of personal injury and equipment damage.

Watch your speed when you are grooming with the smaller units being towed by a single or double-track snow machine, as any trail obstruction such as a stump or root can stop your forward motion and throw you off the snow machine. Carry a shovel with you and shovel out snow banks at all road crossings before you attempt to cross. These snow banks can hang you up right in the middle of a road crossing and be very dangerous.

When you are grooming with full-width equipment during daylight hours, it is a good idea to have one or two individuals on snowmobiles riding ahead of and to the rear of grooming equipment to warn and alert all approaching traffic. Head and tail lights and visual and aural warning beacons should be used at all times.

Road crossings are particularly dangerous because of the length and slow speed of grooming equipment. If you have restricted sight distance on road crossings, post an individual on the highway to flag down the traffic and assist in a safe crossing.

D. Climate and Weather Conditions

It makes a difference in trail conditions whether snowfall is generally heavy or light; whether snow is wet, dry or icy; whether prevailing winds are from the north or east (colder) or from the south or west (warmer), and are strong (causing drifting or bare spots) or light; whether the sun shines directly on the trail (it should not); and whether the normal winter temperatures run in the teens or the 30's.

1. Snow Cover

Snow is the raw material which is to be groomed. How much do we know about snow? Sure, it is white, cold, and wet, and sometimes inconveniently located. What else?

Snow starts out as water vapor which freezes into ice crystals as it falls toward earth. These multi-faceted ice crystals are commonly called "snowflakes". New-fallen snow is loose because the myriad separate points prevent close packing. Of course, these points do interconnect, binding the separate crystals together into what appears to be uniform snow cover.

However, snow is not uniform. It is constantly changing, being affected by ground heat, air temperature, radiation heating, and melting from the sun, wind and humidity—and, thus, may be dry, wet, warm, cold or even very icy. Just as a skier is interested in whether snow is powder or granular, you must learn to recognize various snow conditions and the techniques necessary to work with each.

2. Timing

If you have ever tried to build a snowman, an igloo, or a stockpile of snowballs for your child's fort, you already know that sometimes conditions for working with snow are perfect, and sometimes, they are nearly impossible. Keep this in mind as you schedule the grooming of your trail.

Remember, wet snow grooms best at night; dry snow grooms best during the day; and ideal air temperatures are between -5° and +15° Fahrenheit. Try to time your grooming operations to match the snow conditions.

3. Temperatures

Probably no climatic condition fluctuates as greatly as air temperatures, which may easily range from 50 above to 40 below. And as the thermometer goes up or down, so is the snow being affected by the varying degrees of cold or warmth. Experience will be the best teacher when it comes to anticipating what effect will be had upon your trail system by a howling blizzard at 30 below, or a soft, gentle snowfall at 30 above.

If your club does not have that experience, conversation with local highway crews, other snowmobile clubs, or anyone who has had practice in moving or compacting snow in varying weather conditions will be helpful.

Do not try to groom when air temperatures are conducive to melting. It is best to leave the snow alone when it is sticky.

E. Grooming Cost Analysis

Trail grooming may represent from 40% to 60% of the total trail maintenance costs and can amount to a large expenditure of money.

Many snowmobile clubs do not keep any cost records on their grooming efforts. In order to demonstrate to your membership the cost per hour or cost per trail mile for grooming, you should. These figures can, in turn, be converted to show what proportion or percentage of your income or dues are used for trail grooming.

Each club should set up a simple bookkeeping system and tabulate the following:

1. Total hours groomer was used.
2. Cost of operator, if paid.
3. Cost of fuel, oil, filters and grease.
4. Cost of registration and insurance.
5. Cost of all parts, supplies and repairs (including an hourly rate for repair labor).
6. Cost of storage, if any.
7. Cost of moving equipment between grooming areas, if service was hired.
8. Annual depreciation of equipment.

Annual depreciation may be determined by the following example (which should be adapted to fit your individual circumstances): If your groomer cost $7,000 new and will have a trade-in value in five years of $2,000, then the annual depreciation will be $1,000 per year ($7,000 - $2,000 = $5,000 ÷ 5 years, or $1,000 per year).

TOTAL COST is determined by adding up the costs of the various categories and arriving at a grand total or total cost. This should be done at the end of each season.

COST PER HOUR is arrived at by dividing the grand total cost by the total number of hours the equipment was used. Or, you may find the:

COST PER MILE by dividing the same grand total cost by the number of miles groomed. The answer will be the cost per mile for grooming for the season. Do not use the number of miles the groomer was driven, but instead, use the measured trail miles within your club area.

By keeping good records of your grooming costs each year, you can determine the opportune time for trading your equipment (particularly if cost per hour or cost per mile rises rapidly). It is also a good way to evaluate different types of grooming equipment by comparing operating costs per hour for the terrain and snow conditions found in your area. This information will also assist clubs with determining what funds are needed for trail programs, will justify trail facility cases to local governments, Chambers of Commerce and state and federal programs.

APPENDIX A

Equipment and Tool Valuations for Estimates

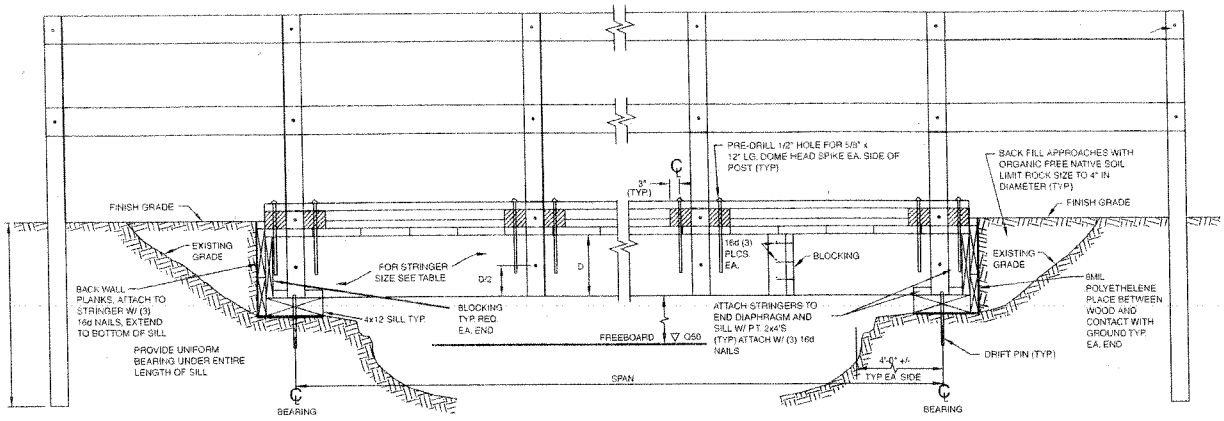
Approximate Rental Rates

Tracked excavator, large	$ 750. per day
Tracked excavator, small	$ 225. per day
Bulldozer, large	$ 350. per day
Bulldozer, medium	$ 225. per day
Backhoe, medium	$ 225. per day
Brush hog	$ 200. per day
Chipper	$ 125. per day
Generator	$ 35. per day
Chain saw	$ 35. per day
Gas brush cutter	$ 30. per day
Screw gun	$ 15. per day

NOTE: Actual rental rates will vary considerably with locale and brand of equipment. Shopping around is strongly suggested.

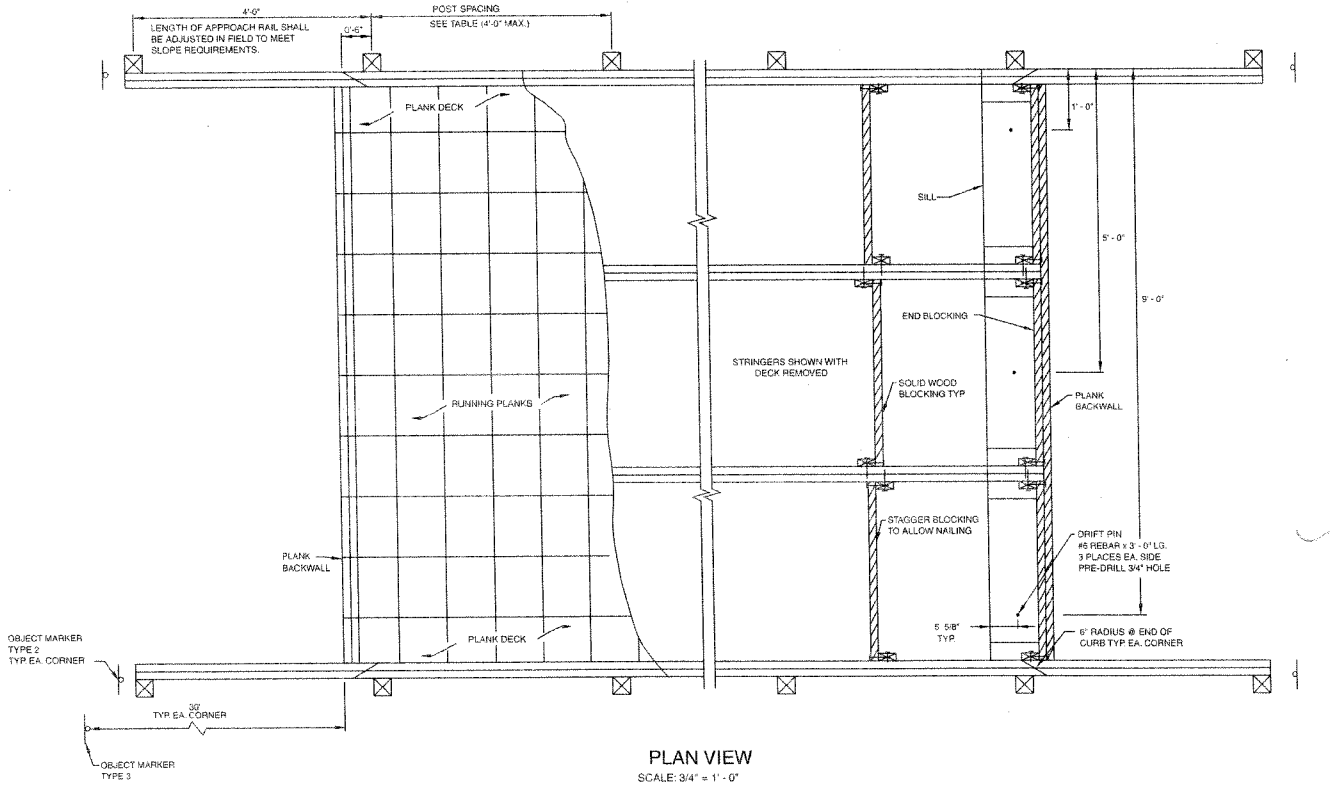
Approximate Value of Donated Equipment for "In Kind" Services

Bulldozer, medium or small	$ 35. per hour
Backhoe, medium or small	$ 35. per hour
Tractor, small, or ATV with brush hog	$ 25. per hour
ATV with cart	$ 8. per hour
Pick-up truck with trailer	$ 12. per hour
Pick-up truck	$ 10. per hour
Generator	$ 5. per hour
Chain saw	$ 5. per hour
Gas brush cutter	$ 5. per hour
Screw gun	$ 2. per hour
Class A or B groomer with drag	$ 35. per hour
Class C groomer with drag	$ 20. per hour



ELEVATION OF STRUCTURE

SCALE: 3/4" = 1' - 0"



PLAN VIEW

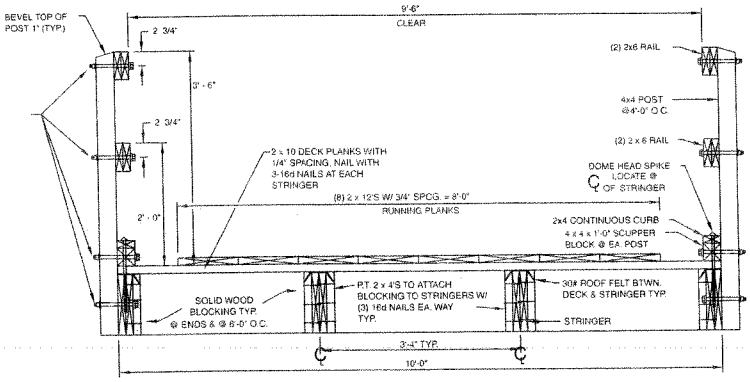
SCALE: 3/4" = 1' - 0"

	LUMBER LIST - SUPERSTRUCTURE * *																				HARDWARE LIST - SUPERSTRUCTURE *						
	DECK PLANKS			BACKWALL PLANKS			RUNNING PLANKS			SCUPPER BLOCKS			CONTINUOUS CURB			RAILS			POSTS				DRIFT PINS		SPIKES		CARRIAGE BOLTS 5/8" W/NUTS & WASHERS		16d NAILS (lbs.)
SPAN	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	NO.	SIZE	LENGTH	SPACING	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH		
8	11	2x10	10'-0"	2	2x10	10'-0"	4	2x12	8'-0"	4	4x4	1'-0"	2	2x4	8'-0"	4	(2)2x4'S	16'-0"	6	4x4	4'-0"	3'-6"	5	3'-0"	12	1'-0"	32	0'-8"			11
10	13	2x10	10'-0"	2	2x10	10'-0"	4	2x12	10'-0"	6	4x4	1'-0"	2	2x4	10'-0"	6	(2)2x4'S	9'-0"	8	4x4	4'-0"	3'-0"	6	3'-0"	16	1'-0"	40	0'-8"			12
12	16	2x10	10'-0"	2	2x10	10'-0"	4	2x12	12'-0"	6	4x4	1'-0"	2	2x4	12'-0"	8	(2)2x4'S	10'-0"	8	4x4	4'-0"	3'-6"	6	3'-0"	16	1'-0"	40	0'-8"			13
14	19	2x10	10'-0"	2	2x10	10'-0"	4	2x12	14'-0"	8	4x4	1'-0"	2	2x4	14'-0"	8	(2)2x4'S	11'-0"	10	4x4	4'-0"	3'-3"	6	3'-0"	20	1'-0"	48	0'-8"			14
16	21	2x10	10'-0"	2	2x10	10'-0"	4	2x12	16'-0"	8	4x4	1'-0"	2	2x4	16'-0"	8	(2)2x4'S	12'-0"	10	4x4	4'-0"	3'-9"	6	3'-0"	20	1'-0"	48	0'-8"			15
18	24	2x10	10'-0"	2	2x10	10'-0"	6	2x12	9'-0"	10	4x4	1'-0"	4	2x4	9'-0"	8	(2)2x4'S	13'-0"	12	4x4	4'-0"	3'-5"	6	3'-0"	24	1'-0"	56	0'-8"			16
20	26	2x10	10'-0"	3	2x8	10'-0"	6	2x12	10'-0"	10	4x4	1'-0"	4	2x4	10'-0"	8	(2)2x4'S	14'-0"	12	4x4	4'-0"	3'-10"	6	3'-0"	24	1'-0"	56	0'-8"			17
22	29	2x10	10'-0"	3	2x10	10'-0"	6	2x12	11'-0"	12	4x4	1'-0"	4	3x4	11'-0"	8	(2)2x4'S	15'-0"	14	4x4	4'-0"	3'-6"	6	3'-0"	28	1'-0"	64	0'-8"	(132) 1/2" 3" LG. BOLTS		18
24	32	2x10	10'-0"	3	2x10	10'-0"	6	2x12	12'-0"	12	4x4	1'-0"	4	2x4	12'-0"	8	(2)2x4'S	16'-0"	14	4x4	4'-0"	3'-10"	6	3'-0"	28	1'-0"	64	0'-8"	(144) 1/2" 3"LG. BOLTS		19
26	34	2x10	10'-0"	2	2x10	10'-0"	6	2x12	13'-0"	14	4x4	1'-0"	4	2x4	13'-0"	12	(2)2x4'S	11'-4"	16	4x4	4'-0"	3'-7"	6	3'-0"	32	1'-0"	72	0'-8"	(156) 1/2" 3" LG. BOLTS		20
28	37	2x10	10'-0"	2	2x10	10'-0"	6	2x12	14'-0"	14	4x4	1'-0"	4	2x4	14'-0"	12	(2)2x4'S	12'-0"	16	4x4	4'-0"	3'-10"	6	3'-0"	32	1'-0"	72	0'-8"	(168) 1/2" 3" LG. BOLTS		21
30	39	2x10	10'-0"	2	2x10	10'-0"	6	2x12	15'-0"	15	4x4	1'-0"	4	2x4	15'-0"	12	(2)2x4'S	12'-8"	18	4x4	4'-0"	3'-7"	6	3'-0"	36	1'-0"	80	0'-8"	(180) 1/2" 3" LG. BOLTS		22

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
EASTERN REGION
ENGINEERING

DESIGNED DKK DATE 2/4/93
DRAWN RMG 2/4/93
CHECKED HEB 2/4/93

RECOMMENDED: FOREST ENGINEER _____ DATE _____
RECOMMENDED: DISTRICT RANGER _____ _____
APPROVED: FOREST SUPERVISOR _____ _____

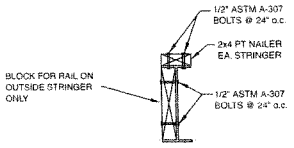


CROSS-SECTION DECK

SCALE: 3/4" = 1'-0"

STRINGER OPTION TABLE

SPAN	FULL LENGTH DIMENSION LUMBER	WEIGHT (LBS.)	BUILT-UP PARALLAMS	WEIGHT (LBS.)	STEEL BEAMS	WEIGHT (LBS.)
8	(1) 2x12	38				
10	(2) 2x12'S	94	DIMENSION LUMBER IS MORE PRACTICAL DUE TO WEIGHT			
12	(3) 2x12'S	169				
14	(3) 2x12'S	197			DIMENSION LUMBER & PARALLAMS ARE MORE PRACTICAL DUE TO WEIGHT	
16	(4) 2x12'S	300	(2) 1 3/4"x12'S	192		
18	(6) 2x12'S	506	(2) 1 3/4"x14'S	252		
20			(2) 1 3/4"x16'S	320		
22			(2) 1 3/4"x16'S	396	W10x12	264
24	WEIGHT IS NOT PRACTICAL TO HANDLE IN FIELD		(2) 1 3/4"x18'S	432	W10x12	288
26					W12x14	364
28			WEIGHT IS NOT PRCATICAL		W12x14	392
30					W12x16	480



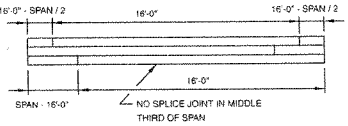
STEEL STRINGER / NAILER DETAIL

NTS

ADDITIONAL MATERIAL LIST FOR STEEL STINGERS * *

(4) PCS. 2x4 NAILER FOR FULL LENGTH OF STRINGER
(2) PCS. 2x10 BLOCKING FOR W10 STRINGERS, LENGTH TO MATCH STRINGER
(2) PCS. 2x12 BLOCKING FOR W12 STRINGERS, LENGTH TO MATCH STRINGER

NOTE: THREE MEMBERS ARE SHOWN. DETAIL APPLIES TO ALL BUILT-UP MEMBERS.



PLAN VIEW - TYPICAL STRINGER SPLICE

NTS

GENERAL NOTES & SPECIFICATIONS

Loading

1. Deck Snow Load-BOCA Code reduced ground snow load 50 PSF.

2. Deck Live Load - 8900 lbs. trail groomer on two 12'-8" x 2'-4" tracks.

3. Posts & Rails - Post & Rails were designed for BOCA Code Pedestrian Load only. Rail is not a guard for vehicular traffic.

Specifications

1. National Design Specifications for Wood Construction, 1991 Edition, by National Forest Products Assoc.

2. Council of American Building Officials, Report No. NER-126, Laminated Veneer Lumber, Sept.1, 1990.

3. Parallam Technical Note, Number US-02, CCA Treated Parallam, PSL, February 1991.

4. American Wood Preservers Association Standards, Waterborne Preservative Standard P5 Type A, Standard C2, and Standard C14.

Lumber

1. Lumber for solid sawn stringers, deck, backwall, rail, posts, curbs, and mud sill shall be No.2 Non-Dense Southern Yellow Pine, CCA, pressure treated to a retention of 0.60 lbs/cft.

2. Parallam stringers shall be CCA pressure treated to a retention of 0.60 lbs/cft. Grade shall be 2.0 x 10E6 PSI modulus of elasticity with allowable stresses for Service Level 2 Condition.

3. Drawings are prepared using S4S finished dimensions. If rough sawn lumber is used adjust dimensions as required.

4. All lumber shall be sawn and fabricated prior to pressure treatment with respective preservative.

Steel

1. Steel stringers shall conform to ASTM A-36. Shop prime with two coats of zinc oxide primer, after fabrication.

2. Once steel is situated in field, apply zinc oxide primer to all areas where primer had been removed due to placement.

Hardware

1. All bolts, washers, nuts and miscellaneous metal hardware shall be ASTM A307 hot dipped galvanized.

2. Nail and drift pins are to be hot dipped galvanized.

Glue

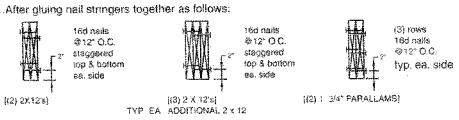
1. Apply glue between each lamination using a water repellant construction adhesive compatable with CCA such as PL-500 by Contech or approved equal. Apply 3/8" continuous bead @ 1 1/2" o.c.

ApproachMaterial

1. Approach rail not included in adjacent table areas follows: (4) posts 4" x 4" x 8'-0" LG.

Laminations

1. After gluing nail stringers together as follows:



Construction

1. Locate the clear opening of the bridge at least 2 feet above any known steam high water mark or the 50 year flood elevation if known. Streams with average water depths greater than 2 feet or evidence of wide fluctuations between low water and annual spring runoff will require hydraulic calculations by a USFS Forest Engineer.

2. Mud sills shall bear on native soil or ledge rock free from compressible organic material and capable of supporting the bridge under full load. Other foundation conditions require approval with a USFS Forest Engineer.

3. Stringers with camber shall be positioned so that camber is up and knots near near the edge will be in the top half of the stringers.

4. Deck planks shall be laid heartside down.

5. Treat all field fabrications, drilling, cuts and abrasions by soaking or brushing three coats of CCA, or other approved preservative.

6. Railing is optional and shall be determined by USFS Engineer on a site specific basis.

7. Blocking varies with bridge length.

Signing Criteria *

1. Install (4) Type 3 Object Markers (8" x 24"). Place one at each corner of the bridge approach as indicated on plans.

2. Install (4) Type 2 Object Markers (6"x12"). Place one at each corner of bridge as indicated on plan.

H. EDMUND BERGERON
CIVIL ENGINEERS, P.A.
NORTH CONWAY, N.H.
(603) 356-6936

REVISIONS				
NO.	REVISION	BY	APPROVED	DATE

AS-BUILT
BY _____
CHECKED _____
DATE _____

PROJECT: *STANDARD SNOWMOBILE BRIDGE*

SHEET TITLE: *WHITE MOUNTAIN NATIONAL FOREST*

SCALE: *AS SHOWN*

SHEET *S-1* 1 OF 1

FILE NO. *92075S1.DWG*

PROJECT NO. *9 20 75*

APPENDIX C

Grooming Equipment Suppliers

* All Season Vehicles, Inc.
Marcell, MN
Distributed in New York by:
Mabie Bros., Inc.
8571 Kinderhook Road
Kirkville, NY 13082
Contact: Paul Mabie (315) 687-7891
Product: Track Truck trail grooming system (Class B groomer)

* Al's Snow & Track Equipment Repair
5400 River Ridge Drive N.W.
Brainerd, MN 56401
Contact: Al Bartlet (218) 828-4537
Products: groomer parts, new and used, groomer rebuilding, parts fabrication service.

* Armand Gauthier
Jericho Street
White River Junction, VT 05001
(802) 295-3585
Product: "Frenchie" custom drags (for Class C groomers)

* Bombardier Corp.
Ski-Doo/Sea-Doo Division
Valcourt, QC Canada
Distributed by: Ski-Doo dealers
Product: Alpine II twin track snowmobile and grooming drag (Class C groomer)

* Bombardier Corp.
Industrial Equipment Division
Granby, QC Canada
Contact: Wayne Overland, Product Manager
P.O. Box 3465
3909 Crescent View Avenue
Duluth, MN 55804
(218) 728-1640, FAX (218) 728-1635
Product: BR-160 grooming tractors (Class A groomer)

* Charles Vogel Enterprises
P. O. Box 279
St. Germain, WI 54558
Contact: Chuck or Mike (715) 479-4200
Product: Arrowhead trail grooming drags (for class A & B groomers)

* Collett Electronics Ltd.
90 Durand Road
Winnipeg, Manitoba R2J 3T2
Canada
Contact: Les Collett, Pres. (204) 663-7692, (800) 665-7888
Product: Groomer Warning Beacon (works with Collett 49 MHz helmet radios)

* Derby Equipment, Inc.
Route 5
Derby, VT 05829
Contact: Moe Provost (802) 766-2400
Product: Sur-Trac farm tractor conversion groomer (Class A groomer)

* Haines Commercial Equipment Co. Inc.
Pak Rak Industries Div.
Haines, OR 97833
Contact: Dick Camp (503) 856-3677
Products: Pak Rak drag (for Class C groomers)

* Les Equipments Industrial de Roberval Inc.
Roberval, QC Canada
Represented in New York by:
Schroon Lake Tractors, Inc.
Route 9
Schroon Lake, NY 12870
Contact: Gerry Dolly (518) 532-7144
Product: Gilbert Surfacer & drag (Class A groomer)

* Logan Manufacturing Company, Inc.
(Formerly Thiokol, DMC)
Logan, UT

New York State Office:
211 Edie Road - R D 6, Bay #4
Saratoga Springs, NY 12866
Contacts:
Dave Mahler, Regional Mgr. (518) 583-3190
Bruce Morrow, Sales Rep. (315) 682-7439
Products: LMC Beartrac 1800, 1500 & 1200 grooming tractors (Class A groomers) complete service & repairs, used tractors of all brands

* Marcel Grooming Equipment
P. O. Box 2729
New Liskeard, Ontario P0J 1P0
Canada
Contact: Marcel Hacquard (705) 647-5444
Products: Conversion kits for Massey-Ferguson farm tractors (Class A & B groomers)

* Town & Country Snowmobiles
P. O. Box 400
East Conway, NH 03813
Contact: John Marr (603) 939-2698
Product: Heavy Duty Pro and Lite Pro trail grooming drags (for Class C groomers)

* The Shop Industrial
112 Fielding Road
Lively, Ontario P3Y 1L5 Canada
Contact: Mike Heino (705) 682-1522, (800) 663-3724
Product: Mogul Master drag (for class A groomers)

* Tucker Sno-Cat Corp.
Medford, OR
Distributed in the northeast by:
Cook & Cook Enterprises
Newport, VT
New York Sales Representative:
Lynn Truesdell (315) 782-0139
HC-31, Box 116
Watertown, NY 13601
Products: Tucker Sno-Cat grooming tractors and drags (Class A and B groomers)

NOTE: This informational listing is provided for the convenience of the manual user only.

No recommendation or endorsement of any of these suppliers or their products is made or implied.

Trail grooming operators must exercise their own good judgement when choosing equipment.