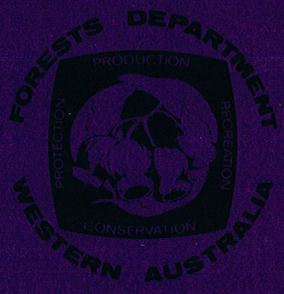
JARRAH 81

Guidelines for planning and control of logging and silvicultural operations in the Northern Jarrah Forest, west of Quarantine



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J A R R A H 81

Guidelines for planning and control of logging and silvicultural operations in the Northern Jarrah Forest, West of Quarantine.

NORTHERN REGIONAL GROUP (COMO)

JUNE 1981

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PART 1 : INTRODUCTION

1.1 General

Hardwood timber production operations in the northern jarrah forest must:

(i) conform with provisions of the General Working Plan;

(ii) be in accordance with the land use plan;

(iii) satisfy dieback hygiene rules; and

(iv) result in maintenance or improvement of the health and vigour of the forest.

Knowledge about forest ecology and techniques of management are continuously expanding, particularly in the areas of jarrah dieback disease and of disease management.

Current information allows cautious optimism for the long term protection of the forest, particularly if latest developments are scrupulously applied.

The logging techniques outlined in these guidelines were developed at Dwellingup for the Logging Trials Within Quarantine which commenced in 1980. They have been developed jointly by the Forests Department and the timber industry.

The objective now is to demonstrate how these techniques can be extended to other northern jarrah forest timber operations.

These guidelines are not regarded as "the last word". Nor is it expected that they can be universally applied. They are, however, the latest state of the art, based on the best information to hand at the moment.

So long as the principles are understood and are applied, then each D.F.O. can make his own refinements and include local variation as required.

1.2 Basic Principles

Basic principles are:

(i) Logging operations can only be considered for areas where timber production is compatible with the primary land use - see L.U.M.P.

(ii) Every operation must be evaluated from the standpoints of best hygiene option, or least impact of hygiene failure - see the "Dieback Hygiene Guide" - Appendex 1 to these notes.

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(iii) There are no universal prescriptions. Each stand must be treated on its merits, with the best treatment determined after study of land use priority, dieback status, stand structure, site and silvicultural options.

(iv) Other than for research purposes, silvicultural treatment must be based on the availability of markets for unwanted trees - ie. thinning to waste and cull felling will not be done at the moment.

(v) Cutting and regeneration plans must be integrated with regional fire protection plans and mining plans.

1.3 Scope

These guidelines are initially only for application within the northern jarrah forest, for areas west of quarantine - ie. areas currently designated Water Production or Recreation MPA.

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PART 2 : SUMMARY OF LATEST INFORMATION ON PHYTOPHTHORA CINNAMOMI

2.1 Source

These notes are derived from the paper "Seasonal Variation in Phytophthora Cinnamomi Soil Population Levels in Freely Drained Upland Jarrah Sites" by Shea, Gillen and Leppard in Protection Ecology (2) 1980.

2.2 Biology

2.2.1 Effective control measures can only be developed if the biological interactions of the host, pathogen and environment are fully understood.

2.2.2 The fungus is only found in the soil matrix in upland free draining sites at times when environmental conditions are suitable for sporulation. Suitable conditions exist when soil temperatures are above 15°C (and preferably about 20°C) and soil moisture contents are high. At other times of the year (summer and winter) soil population of Phythothora cinnamomi are very low or non-existent.

The pathogen persists through the summer (dry) and winter (cold) periods within the roots of infected or tolerant plant species.

2.2.3 The coincidence of warm soil and high soil moisture contents are generally achieved for reasonable periods in spring each year (1-6 weeks) This extended period of suitable conditions for sporulation allows rapid build-up of fungal populations detectable in the soil. The large build-up occurs because environmental conditions are favourable for long enough to allow growth of fungal hypae into the adjacent soil from roots of infected plants and to pass through several asexual (sporanzia/zoospore) reproduction cycles. Trials suggest that in suitable conditions soil population levels rise from nil to high numbers in 10-14 days. These new colonies of fungal material are available for colonisation of susceptible root material.

Spread of zoospores in surface or subsurface water flow and therefore, the amount and direction of spread is related to rainfall events occurring at the time, slope and any modification to landform which affects water movement.

2.2.4 The fungus dies out in the soil matrix as soil moisture is depleted in late spring and summer. During this period the pathogen exists in the mycelial (vegetative) form within host roots, particularly Banksia grandis.

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2.2.5 In autumn the environmental conditions and timing is less predictable, but in normal years the coincidence of warm soil temperatures and high soil moisture contents (brought about by opening rains) occur for limited periods of time only. Soil temperatures generally drop rapidly after opening (southerly) rains and there is not enough time for a series of asexual reproduction cycles to allow high build-up of pathogen populations in the soil matrix. In these instances the fungus occurs only at low levels in the soil and hence over winter mainly within host tissue in the vegetative form, awaiting spring conditions to stimulate emergence and sporangia production.

However, if the autumn weather pattern produces a sequence of rainfall events and warm soil temperatures persist then the pathogen may build up to high levels in the soil. Where this occurs the fungus may persist after winter in high levels in (dormant) vegetative form in both the soil matrix and in infected host tissue.

2.2.6 In upland freely drained jarrah sites the pathogen exhibits an ephemeral (seasonal) nature which has important implications for disease control measures. The situation can be summarised as follows:

SEASONAL VARIATION IN P.C. LEVELS - FREE DRAINED UPLAND SITES

Source and Form of *Phytophthora cinnamomi*	PATHOGENIC POPULATION LEVELS				
	Summer (Hot/ Dry)	Autumn (Moist/ Cold)	Autumn (Moist/ Warm)	Winter (Moist/ Cold)	Spring (Moist/Warm)
MYCELIAL GROWTH IN ROOTS OF SUSCEPTIBLE & TOLERANT HOSTS	LOW	LOW	HIGH	LOW-HIGH*	HIGH
MYCELIUM FREE GROWING IN THE SOIL MATRIX	NIL/LOW	LOW	HIGH	LOW-HIGH*	HIGH
SPORANGIA FORMATION & ZOOSPORE RELEASE IN SOIL MATRIX	NIL/LOW	LOW	HIGH	NIL/LOW	HIGH

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* "High" if autumn was warm and moist and allowed rapid build-up of fungal populations, otherwise population levels "low".

2.2.7 In lowland or moisture gaining sites conditions are favourable most of the summer for continued sporangia formation and free growth in the soil matrix. Therefore, we must highlight in our thinking the marked difference between free draining upland and moisture gaining (lowland) sites.

2.2.8 In upland situations "chlamydospores" do not play a significant role. The so called chlamydospores of Phytophthora cinnamomi are their walled vesicals which cannot persist in harsh conditions. (c.f the thick walled structures which are called chlamydospores in other fungal species).

2.3 Disease Control Implications

2.3.1 Disease is spread by movement of infected root material, clods of soil containing mycelium or zoospores, or by zoospores moving freely in a water medium.

Because of the variable levels of the pathogen in soil particularly and in roots throughout the year there will be varying degrees or levels of risk associated with management activities in the forest. Hygiene prescriptions will need to reflect this.

2.3.2 The potential to spread disease by transporting infected root material is relatively high all year. In spring and autumn there is likely to be higher levels of innoculum in these roots than at other times of the year.

2.3.3 The transport of soil (+ roots) in spring (particularly) and autumn presents a risk of moving high amounts of innoculum and gives a greater chance or risk of starting new infections. This will also be a problem in any winter which follows an autumn which allowed rapid build-up of pathogen populations.

2.3.4 The unpredictability of autumn weather and the continued persistence of myceleum in the soil over winter in favourable seasons is an added complication which has significant planning implications. For example a late start to a summer stockpiling operation might be ineffective if the conditions turn out to be ideal for rapid fungal build-up.

2.3.5 At all times of the year infected lowland and moisture gaining sites are likely to contain high soil population levels of the pathogen.

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2.3.6 Favourable conditions for rapid soil build-up can be caused by unseasonable weather (eg. extended summer rains).

2.3.7 These considerations continue to support the case for allowing those industries and activities which have the potential for soil movement, to operate in disease-free upland jarrah sites only during dry soil periods.

Even in this instance disease spread is possible through transport of root material, or from traversing lowland or moisture gaining sites. Maximum use of hygiene techniques must, therefore, continue.

Of all the seasons for operation, in normal years spring presents the greatest risk of disease spread.

2.3.8 The seasonal nature of Phytophthora cinnamomi suggests that it is having difficulty surviving on freely drained upland sites (which make up 60-85% of the jarrah forest).

Forest management should, therefore, aim to manupulate the forest character where possible to favour the host species and disfavour the pathogen.

2.3.9 This can be done by reduction in levels of Banksia grandis and by stimulation of legume understorey.

Two avenues appear to be available to achieve this end - mechanical methods or use of fire.

PART 3 : THE LOGGING OPERATION

This section comprises:

3.1 Planning

3.1.1 Primary Checklist

All cutting proposals must conform with the requirements of :

(i) The G.W.P.

(ii) L.U.M.P.

(iii) The 3 Year Logging Plan approved by Regional Leading Planning;

(iv) Annual Cutting Sections (F.D. 49B) approved by Conservator.

3.1.2 Classification

Classify the area to be cut.

Use 1:25 000 Topographic Plans with contour print as base maps, where available. (Check with H.O. Mapping Branch) If not available, use 1:50 000 plans and superimpose contour information from best available source.

(i) Identify Land Use Priority Area Boundaries and nominate influence zones.

(ii) Show forest blocks.

(iii) From latest Dieback maps updated by road traverses, ground survey and any other relevant information, delineate dieback categories, as follows:

Show dieback categories:

Dieback-free protectable : no colour

Dieback : red

Suspect and downslope of suspect : blue

Dieback-free but downslope of dieback : yellow

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In the definition of the categories, Downslope of dieback and Downslope of Suspect, use this guide:

Slope 1 - 15° : include an angle of 30°
Slope 16° + : include an angle of 20°

(iv) If dieback category cannot be determined, and the class "suspect" is not appropriate, apply the class "uninterpretable" - but only as a last resort. Seek specialist advice.

(v) Sub-divide blocks into coupes. Each coupe is a single dieback category, namely:

Dieback
Dieback-free protectable
Dieback-free downslope of dieback
Suspect and Downslope of Suspect

or parts of a single category.

Where areas of Dieback-free forest are sub-divided into coupes, try to make each coupe a microcatchment by using natural drainage and contour patterns.

Field check coupe boundaries.

3.1.3 Resource Data

Use most up-to-date inventory data to determine the volume on each coupe.

3.1.4 Integration of Harvest for all Produce

It is desirable to arrange one harvest for all products so as to avoid repeated returns to the area.

Therefore, try to arrange an integrated logging for sawlogs, poles, residues, peelers, etc.

3.1.5 Allocation of Coupes

Allocate coupes to season, cutting priority and the stockpile target.

Basic priority is to utilise dieback forest before dieback-free downslope of dieback, before dieback-free protectable. Wherever possible, avoid logging suspect forest until suspicions are or are not confirmed.

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Dieback can be logged when soils are moist (provided machines do not bog or cause unacceptable soil damage). Dieback-free forest should not be logged when soil is moist (especially in spring) unless absolute hygiene can be guaranteed.

Definition of "moist" in this context is still to be developed, - check with Research.

3.1.6 Road System

Design basic access system and mark on plan. Observe these guidelines:

(i) Use as few roads as possible;

(ii) Avoid new roading, unless required to relocate parts of existing roads for access to dieback-free forest;

(iii) Roads to be as low in the profile as possible;

(iv) Define unwanted roads for closure:

(v) Avoid crossing dieback categories;

(vi) Work through the "Dieback Hygiene Guide" to cross-check decisions taken.

It is accepted that conflicts will frequently arise in this area. In this case point (iii) should take priority.

3.1.7 Presentation of Plan

(i) Tabulate volumes by coupes by season and by year, to ensure allocations balance permissible intakes;

(ii) Nominate stockpile levels and deadlines;

(iii) Prepare coupe sheets for tree-markers and industry reps. - standard base coupe sheets will be produced by I & P on request.

3.2 Roading

3.2.1 Demarcate the planned roading system on the ground on foot. Ensure the dieback risk category is demarcated where boundary crosses a road to be used. Ensure any road required for access within a coupe remains in the single dieback category. In-coupe haul roads which pass through dieback into dieback-free forest may be used if surface-stabilised but this will always be subject to daily monitoring during wet weather. Road usage may need to be suspended if surface slush develops or if dieback

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pick-up is considered likely. Alternatively, it may be necessary to install a washdown at the entry to dieback-free zones.

3.2.2 Construct roads only in dry soil conditions.

(i) Control vehicle cleanliness by blowing down or washing down;

(ii) Road-working machinery to be washed down when travelling from dieback forest into dieback-free forest at designated clean points;

(iii) Clean down point to be on boundary of dieback on downslope of roadside, draining from road to diseased forest;

(iv) Clean down point to be signposted and to have hard surface for machine to stand on, eg. reject sleepers or belting, surface to be kept clean.

Contractor to supply own cleaning equipment and specified fungicide. Spray clean points with fungicide.

3.2.3 Road Specifications

Construct roads according to expected soil conditions at the time the road will be used and according to amount of expected use.

(i) For Road to be used only during Dry Soil Conditions

Specifications for these roads will be minimal, eg. 5m road clearing with 4m road surface, shallow side drains, culverts only in areas where surface run-off is defined, eg. creek beds. Gravel not necessary unless road crosses dieback-free forest and there is a risk of dieback transport.

(ii) For Roads to be used during Wet or Moist Warm Soil Conditions (Winter/Spring/Autumn)

If the road crosses or enters dieback-free forest, specifications will allow for rapid drainage and stabilised road surface.

eg. 6m road clearing with 4m road surface but drained on both sides of road.

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For access into dieback-free forest, stabilisation is required on steep slopes, tight corners and dieback areas. Gravel surface is required and culverts every 200 m where slopes exceed 1:15.

Road stabilisation requires:

- Construction of 10-15cm thick layer of gravel on well-drained, crowned road.
- Application of sterile water to road surface.
- Use of loaded gravel trucks and/or vibrator to compact moist road surface.

3.2.4 Road Works

(i) Clear and form - Road line to be pegged. Minimize width of clearing on roads used for short periods. Roads planned for heavy use to have allowances for corners to be straightened.

To avoid later hygiene difficulties, complete "profile falling" (or "side falling" of trees leaning over the road during the construction phase.

Debris from cleared areas to be stacked in natural gaps on edge of road.

(ii) Gravelling to be carried out during dry soil conditions. Use gravel from dieback-free pits whenever possible. Infected gravel only for roads passing through dieback forest. Use pits within the coupe whenever possible (in situ gravel), to avoid carting gravel across dieback boundaries.

Wherever possible gravel should be sieved at the pit to remove root material and treated with fungicide during spreading.

(iii) Select landing sites - see later under "Split-phase Logging".

(iv) Maintenance grading to be concentrated during dry soil conditions.

(v) The main objective of grading is to shape the road profile and to clean table drains to improve drainage off and away from road surface.

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(vi) Culverts. Install pipes by dozer or backhoe. If moist soil accumulates on machinery during culvert installation, machine must be washed down before leaving culvert.

(vii) Cross check all prescriptions in the Dieback Hygiene Manual.

(viii) Where roads are constructed (or maintenance graded) near or across steams, special precautions are needed to prevent erosion and siltation. Use bitumen mulch, silt traps and sumps or rocked walls within table drains.

(ix) If sections of unwanted roads ("billabongs") remain after re-alignments or new construction, these should be ripped up (when dry) and allowed to regenerate naturally.

3.3 Logging

3.3.1 General

According to what there is on the ground, logging may take place in areas which are classified as:

* Dieback forest
* Forest downslope of Dieback
* Suspect forest
* Dieback-free forest

Depending on how an area is classified, both hygiene and silviculture will vary.

Silviculture is covered in Part 4.

Hygiene variations are summarized as follows:

Coupe	Status of Plant on Entry to Coupe	Logging System	Status of Plant on Exit From Coupe
Dieback-free protectable	Must be clean	Split Phase	Need not be clean
Dieback-free Downslope of Dieback	Must be clean	Split Phase	Must be clean
Suspect and below Suspect	Must be clean	Split Phase	Must be clean
Dieback	Need not be clean	Conventional	Must be clean it exit route traverses dieback-free forest.

The Dieback Hygiene Guide (see Appendix I) must be used to cross-check each decision taken for each area.

3.3.2 Vehicle and Machinery Cleanliness

Where cleanliness is prescribed on entry to or exit from a coupe, or sub-coupe, this applies to all plant and vehicles.

Washdown must be at the point of entry, if there is any risk of dieback pick-up en route to the forest.

If log roads deteriorate, or free water lies on the road so that there is a risk of soil pick-up and transport, haulage through dieback-free forest must cease, or a washdown at each entry to dieback-free forest must be done.

3.3.3 The Mill Landing

Hygiene at the mill landing is crucial as it is the focal point for all logging operations.

The mill landing must be designed to prevent infected vehicles and trucks travelling back to the forest.

Basic design principles are:

* prevent contact between log trucks and mill landing equipment
* trucks to travel only on a soil-free hard deck
* a washdown unit to be incorporated with landing exit, if other design criteria cannot be satisfied.

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Similar principles must be applied to other town or settlement depots (eg. F.D. compound, workshop) from which infected vehicles could move out into the forest.

3.3.4 Conventional Logging System

Conventional logging is used in dieback forest. This means no special effort is required to separate the snigging, roading and hauling phase; sub-coupes are not required.

But:

Coupe boundaries must be carefully marked and no plant or equipment may cross out into dieback-free forest unless it is cleaned. Every effort should be made to minimise the number of vehicles moving in and out of the dieback coupes.

3.3.5 Split Phase Logging in Coupes Other Than Dieback

3.3.5.1 General

Logging operations in (i) dieback-free protectable, (ii) downslope of dieback and (iii) suspect forest, will be based on the split phase system.

The aim is to prevent Phytophthora on log trucks and loaders being spread up into the coupe by snigging machines. Potential infections are kept to the valleys.

The snigging phase for each landing must be completed before loading and hauling commence. Split phase logging and fewer, larger landings require excellent planning and control of the falling sequence and snigging pattern.

3.3.5.2 The Bush Landing

Each bush landing will service a nominated area, called a sub-coupe.

The siting of each landing within the sub-coupe is to be decided by the tree-marker in liaison with the company bush boss. Landings must be as low in the profile as possible. Use existing gaps.

Clear the landing before snigging commences. Landing area to be minimal but sufficient to store the volume of all timber to be removed from the sub-coupe.

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A six metre uncleared strip is left between the haul road and the edge of landing to act as a buffer.

Remove overhanging and potentially dangerous trees.

Debris is to be neatly stacked on the edge of the landing away from crop trees or regrowth.

3.3.5.3 The Shunt

When landing construction is completed a shunt road to the haul road will be installed leaving a physical barrier (eg. log) at the landing entrance. The Shunt is for parking of all outside vehicles until snigging of the sub-coupe is completed. No machine or vehicle may travel from the haul road onto the landing until snigging on the sub-coupe is complete. This is the vital key of the split phase operation.

3.3.5.4 Falling

The company bush boss will demarcate major snig tracks through the sub-coupe, ensuring point of entry into landing is designed to prevent water run-off onto landing (see diagram).

The proper sequence of falling within sub-coupe is:

(i) major snig tracks to a depth that includes over-hanging trees

(ii) back third of the block

(iii) front of the block.

All marked trees must be felled and fully utilised but no tree should be felled into a designated crop tree.

3.3.5.5 Snigging

(i) Once within a coupe, the movements of the snigging machine must be strictly controlled. Machinery must work systematically from one sub-coupe to the next, starting on a new sub-coupe only after the previous one is completed. Sub-coupes at "the back" of the coupe will be worked first. When the

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tree-marker is satisfied that all operations in the sub-coupe are completed, the machine must be cleaned down before moving to the next sub-coupe. Clean down at the sub-coupe boundary, just above the 6 metre strip, or at the log road if this was crossed or traversed during travel to the next sub-coupe.

(ii) Skidders will construct major snig tracks and then remove logs along snig tracks as directed by the company bush supervisor. Logs will be pulled progressively from the rear to the front of the sub-coupe.

(iii) Avoid damage to future crop trees and dieback resistant eucalypts and make use of snig tracks and natural gaps in the forest. Tops will be snigged back from crop trees as directed by the tree-marker.

(iv) Approval of the tree-marker is required before machinery may move to a new sub-coupe, following a joint inspection with bush boss of the recently cut over sub-coupe, to check utilisation, hygiene and erosion control. Use the check list in Appendix II.

(v) Logs on landings may be sorted and heaped, but may not be loaded and hauled until all operations associated with snigging and erosion control are completed.

3.3.5.6 Erosion Control

The need for erosion control must be checked in all coupes, irrespective of dieback status. Where required, it must be undertaken before snigging machines leave the sub-coupe. This work includes cutting the snig tracks diagonally with the blade at intervals as follows:

Grade	Lateritic Gravels (Average Erosion Class)	All Other Soils Extreme Erosion Class)
0- 1°	Nil	200 metres
2- 5°	200 metres	100 metres
5-10°	100 metres	50 metres
10-15°	60 metres	30 metres
15°	30 metres	15 metres

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Where possible, cut-offs are to be located so that they discharge into logging debris or dense vegetation. Cut-offs will be at least 150 mm deep and must have an adequate outlet to prevent water ponding. Erosion control measures are required on all snig tracks where the mineral earth is exposed and slope exceeds 2^{o}.

3.3.6 Load and Haul

In the split phase logging system, this operation commences with the opening of the shunt to the landing by the loader. Loading may only commence with snigging in the sub-coupe is completed.

The loader may not leave the log landing and haul road, except to snig and load logs from trees retained for safety reasons while the haul road and landing is being used (ie. trees on immediate edges of landings and haul roads) or trees pushed over in the roading operation.

Aim to maximise the size of log trucks, so as to minimise trips carted.

Restrict the speed of trucks to lessen road damage. This especially applies to empty trucks.

3.3.7 Landing Rehabilitation

Following loading, the loader will push log and clearing debris into the centre of the landing and ensure drainage lines are open. Where landings are severely compacted, contour ripping may be necessary to allow regeneration.

(NOTE: In areas other than dieback, ripping must be postponed to dry soil conditions, as directed by the tree-marker).

Programmes for ripping and replanting of landings and snig tracks must be on the basis of assessment of need and approval from the D.F.O.

3.4 Permit Control

The tree-marker has "frontline" responsibility for all permit control. This must be completed before snigging machines depart and hauling commences for each landing where the split phase system is operating.

The aim of permit control is to ensure that environmental standards are maintained and that forest produce is not wasted.

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3.4.1 Log Utilisation Standards

(i) Minimum dimension log (jarrah)

log length	2.1 m and straight
Crown D.O.B.	250 mm

(ii) All crown logs to be utilised.

(iii) Bend in logs is acceptable to 20 mm in 1m.

(iv) Shattered logs are acceptable if less than 50% of the log in the one place has been affected.

(v) Stump height at the bottom of the scarf not to exceed 45 cm unless for reasons of butt defect or safety.

(vi) Minimum acceptable log should be considered down to 50% defect-free face occurring at the same place at both ends after an average amount of heartwood has been boxed out.

(vii) Minimum wind to be 1 in 4.

(viii) Long butting and dressing of logs must not exceed the minimum log specification.

3.4.2 Environmental Standards

(i) Check for damage to crop trees including dieback resistant trees and advance re-growth.

(ii) Check for soil compaction in coupe and landing and see that erosion control is correctly completed.

3.4.3 General

(i) Permit control to be carried out daily for major mills.

(ii) Mill landing inspections to be carried out fortnightly or more frequently during log stockpiling.

(iii) Safety Precautions - to be designated by the D.F.O. for all activities on the permit.

(iv) Logging will not proceed until log utilisation is complete and damage to residual stand and soil is minimised.

(v) Logging will not proceed if hygiene is being compromised unnecessarily.

(vi) Tree-markers to work to a permit control check list. (See Appendix II) Wherever possible problems must be sorted out on the spot.

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3.5 Log Stockpiling

3.5.1 The aim of stockpiling is to maintain log supplies to a mill without causing irreversible damage to the forest at times when damage is most likely to occur.

Damage can be defined as:

* Possibly Reversible - soil disturbance or compaction

* Likely to be Irreversible - introduction and/or intensification of dieback disease.

Damage to the forest is most likely during wet or moist soil conditions and most critical when Phytophthora is sporulating.

3.5.2 Summer stockpiling in the Northern Jarrah Forest is defined as the assembling of logs into dumps in specific locations during dry soil conditions, in order to avoid moist soil logging.

3.5.3 The aim is to obviate the need for logging in dieback-free forest during moist/wet soil conditions.

Dieback affected forest can be operated all year provided access is suitable, the fungus is not transported to dieback-free forest elsewhere and severe soil damage does not result.

3.5.4 It is most desirable to carry out stockpiling in dry soil conditions during summer.

Dumps are to be either at mill landing or adjacent to haul roads which have no access problems during wet soil conditions.

Plan to commence stockpiling in early January and complete by the end of April at the very latest. Logs should be milled in the same sequence that they were stockpiled. The early logs must be milled before end-checking or bardee damage becomes significant. Cutting in the mill will then not deplete logs stockpiled at a time when degredation is much slower.

Water may be used through a sprinkler system during parts of the day to slow down end checking and bardees.

It is the responsibility of Industry personnel to ensure most economical and efficient stockpile management.

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PART 4 : SILVICULTURAL PRACTICE

4.1 Aims

The aim of this section is to provide guidelines for the preparation of cutting and regeneration prescriptions for stands programmed for logging in the NJF.

Because there are many variables involved, there is no uniform prescription. Treatment will vary according to land use priority, stand health and structure and site quality.

However, there is a uniform aim: to maintain or improve the health and productivity of the forest. This aim is to be achieved by:

(i) The selection (or establishment) and protection of future crop trees, followed by

(ii) Cultural practices which strengthen the capacity of the forest to tolerate existing or possible future dieback infection.

4.2 Planning

Part 3 of this handbook dealt with the measures to be adopted in the planning and conduct of a logging operation so that the risk of dieback spread is minimised. We now look at the silvicultural practises to be followed.

Completed logging plans will show the annual cutting section sub-divided into Forest Blocks and coupes (eg. Clinton 7) each coupe being a separate dieback category, ie.

- Dieback-free protectable
- Dieback-free Downslope of Dieback
- Suspect and below suspect
- Dieback

This sub-division is necessary to enable dieback hygiene to be prescribed. To enable the silvicutlrual system to be prescribed a further classification is needed. Categories are:-

(i) Land Use Priority

Areas of the NJF west of Quarantine where logging will occur will be either Recretation, Water Production MPA or a designated Influence Zone.

(ii) Dieback Status

From the silvicultural standpoint (as opposed to the hygiene one) only two dieback classes are recognised:

(a) Jarrah Overstorey Affected - where the jarrah overstorey has suffered widespread mortality;and

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(b) Other Stands, including Dieback forest where only the understorey is affected.

Note: dieback status may change in that the disease may intensify with time in some areas. But as we are not able to predict future impact infallibly for all sites at present, lightly infected stands and stands downslope of dieback will be given the silvicultural benefit of the doubt.

(iii) Forest Structure

Depending on past events, stands in the western NJF fall roughly into two categories:

(a) Densely stocked even-aged pole stands; and

(b) Other stands normally comprising mixtures of size and age classes.

(iv) Site Quality

Site quality varies widely but needs to be taken into account when the replanting of graveyard dieback sites is being considered. In this context:

(a) Average to good sites should produce a new timber crop without difficulty (ie. sites are reasonably fertile, well drained and with deep soil).

(b) Poor sites are unlikely to produce a new forest without difficulty. These are poorly drained, infertile, rocky areas.

To determine whether such sites have "average to good" or "poor" timber production potential, carry out field inspection and consult the Havel classification.

The above classifications into broad categories of land use, dieback status, stand structure and site quality is complex at first glance.

To simplify the preparation and implementation of prescriptions stands will be inspected, classified and encoded before cutting commences.

4.3 Classification and Encoding

Before logging commences in a coupe, a detailed field inspection must be carried out. This will provide data for classification and the assignment of a stand code, as set out overleaf:

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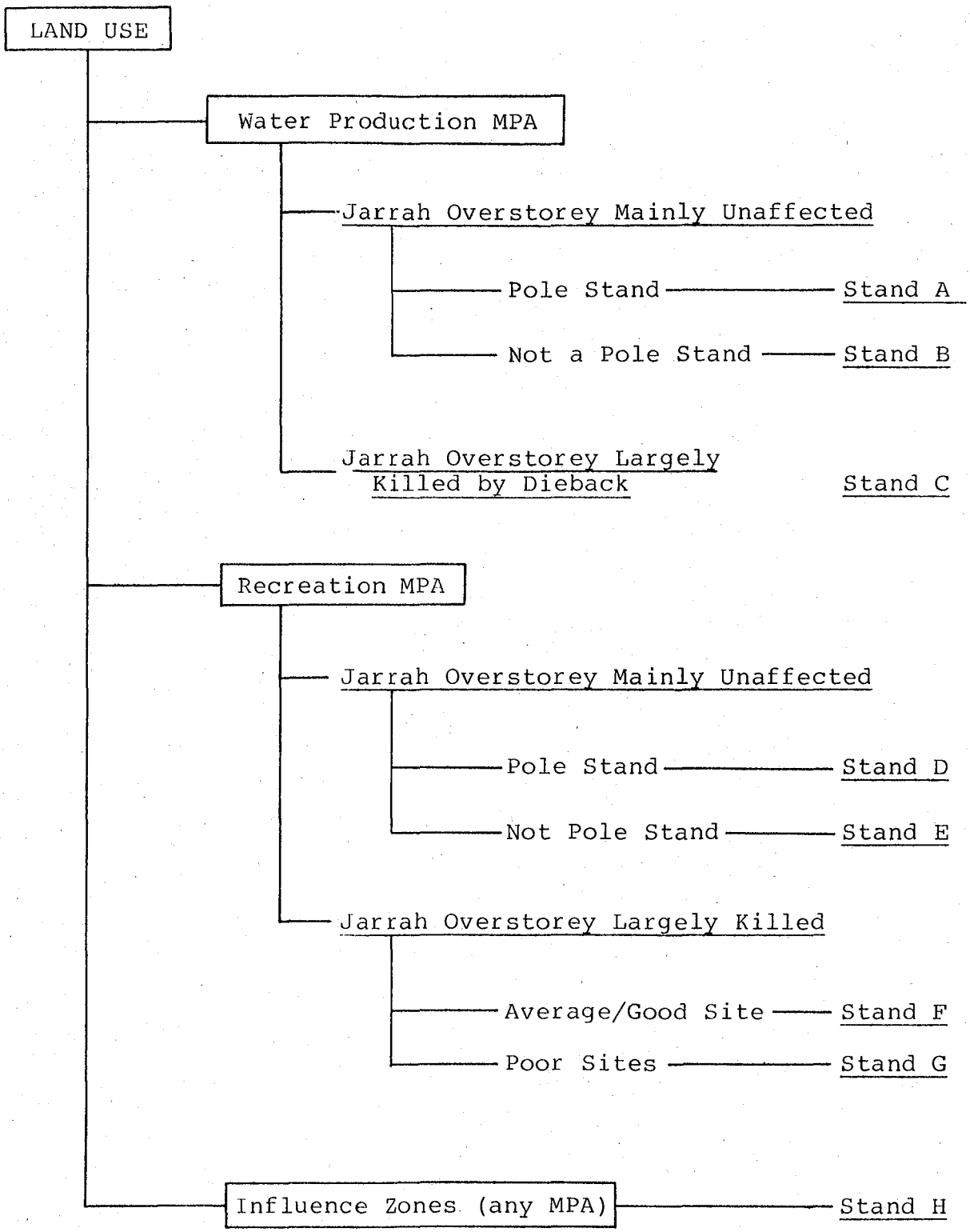

When classification is completed, coded stands will be marked clearly on each coupe sheet, to indicate where particular prescriptions will be applied.

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4.4 The Crop Tree

For the purposes of this prescription, the idealised crop tree is described as a tree which occurs in or above the general level of the canopy (ie. is a dominant or co-dominant), has a healthy crown and a straight, defect-free bole. It should have the capacity to grow vigorously for many years, ie. to be available in the future crop whether that be 5 or 50 years hence.

Size and age are not important, although very large mature trees will not normally be retained as crop trees.

High value products such as poles, piles and veneer logs will not normally be retained as crop trees, unless no alternative tree at the prescribed spacing and of the desired form and vigour is available for retention. If an alternative crop tree is not available, the pole, pile or veneer log would be retained.

Where no crop tree exists in the current stand, one must be established either by natural regeneration from seed trees, or by planting.

4.5 Prescriptions

4.5.1 Stand A

* Water Production MPA
* Jarrah overstorey still largely unaffected by dieback
* Pole Stand

(i) Select and mark crop trees for retention. Aim for 250 sph or approximately 6 m x 6 m between crop trees.

(ii) Jarrah is the preferred species, but if absent or deficient, retain marri, blackbutt, wandoo or bullich.

(iii) Harvest all marketable poles, logs and minor produce from trees not marked for retention. Crop trees must be protected from falling and snigging damage. Ensure erosion control and landing rehabilitation measures are carried out.

(iv) Scrubroll mature (over 6 years old) banksia. (Note need to conform with hygiene requirements).

(v) Carry out tops disposal on crop trees.

(vi) After one summer's drying, burn tops and banksia. Seek dry soil conditions, but low FDI.

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(vii) Close roads not wanted for future management, and rehabilitate where necessary.

Note: Need for Hygiene precautions during parts (iii) and (iv) of this prescription.

4.5.2 Stand B

* Water Production MPA
* Jarrah overstorey still largely unaffected by dieback
* Not an even aged pole stand

(i) Note presence and stockings of poles or advance growth. Where areas are understocked (ie. less than 500 sph of J or M), seed trees to be retained.

(ii) Seek and mark for retention and protection crop trees less than 60 cm dbh at a spacing of approximately 250 sph (6 m x 6 m spacing)

(iii) Harvest all trees over 60 cm dbh and all other marketable trees not marked for retention as crop trees, for poles, sawlogs and minor forest produce. Crop trees to be protected from falling and snigging damage. Erosion control measures to be carried out.

(iv) Carry out tops disposal on crop trees.

(v) Scrub roll mature banksia.

(vi) Burn tops and banksia in the autumn, under dry soil conditions.

(vii) Rehabilitate landings and close unwanted roads.

(viii) Protect from fire until regeneration is tough enough to withstand its effects.

4.5.3 Stand C

* Water Production MPA
* Extensive mortality in jarrah overstorey

(i) Mark for retention and fully protect all sound, healthy dieback tolerant species - eg. marri, blackbutt, bullich.

(ii) Salvage all marketable produce from trees not marked for retention.

(iii) Carry out tops disposal on retained trees.

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(iv) If finance available, stack debris into heaps at regular intervals to create ash-beds and push banksia.

(v) Burn in the autumn under dry soil conditions to promote natural regeneration.

(vi) Rehabilitate landings.

(vii) Protect from future burning until regeneration can withstand fire.

Note: Replanting not required in Water Production MPA.

4.5.4 Stand D

* Recreation MPA
* Even-aged pole stand
* Jarrah overstorey largely unaffected by dieback

Apply identical treatment to Stand A, but ensure Influence Zones are identified and excluded from Stand A treatment.

4.5.5 Stand E

* Recreation MPA
* Not an even aged pole stand
* Jarrah overstorey largely unaffected by dieback

(i) Mark for retention crop trees and/or see trees as in Stand B, but also retain the occasional large old tree (over 60 cm dbh) to add to the character and diversity of the forest produce.

(ii) Harvest trees not marked for retention, for poles, sawlogs and minor forest produce.

(iii) Carry out tops disposal and push banksia.

(iv) Burn in the autumn when soil is dry, but use low FDI to prevent scorching retained forest.

(v) Tidy up and rehabilitate landings and snig tracks.

(vi) Protect regeneration until no longer fire sensitive.

4.5.6 Stand F

* Recreation MPA
* Extensive mortality in jarrah overstorey
* Average to good site quality

(i) Apply as for Stand C (i) to (vi)

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(ii) In the winter after burning, plant with dieback tolerant timber producing trees. Use : E. wandoo, E. patens, E. resinifera. Plant on ashbeds at approximately 625 stems per hectare. Fertilise with 100 gms MAP per tree at time of planting.

(iii) Protect from fire until fire-resistance achieved.

4.5.7 Stand G

* Recreation MPA
* Extensive mortality in jarrah overstorey
* Poor site quality

(i) Apply as for Stand C (i) to (vi).

(ii) In the winter after burning, plant E. wandoo on selected sites (eg. ashbeds, stump holes, etc.) where a future tree might grow. An establishment of 50 - 100 trees per hectare will be acceptable.

(iii) Protect from fire until regeneration is no longer fire sensitive.

4.5.8 Influence Zones

These are areas designated by the planner which surround special natural or artificial features in the forest.

For example:
* Streams and rivers
* Roads, railway lines, SEC lines
* Private property, Settlements
* Tourist, recreation facilities, scenic drives, walk tracks, etc.

After designation, the local D.F.O. will prepare an appropriate prescription for each area, taking into account land use, dieback status, hygiene, aesthetics, conservation values and risks of visual or noise pollution or of undesirable effects on water supply.

In the preparation of these prescriptions, D.F.O.'s should refer to specialists in landscape management and guidelines produced by Extensions Branch.

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PART 5 : IMPLEMENTATION

5.1 Responsibility

Classification of the forest and implementation of both hygiene and silvicultural prescriptions are the responsibility of Senior Divisional staff who will direct treemarkers and Industry staff.

5.2 Procedure

The basic steps are :-

(i) Inspection of logging coupes

(ii) Classification and encoding stands within coupes

(iii) Marking coupe sheets

(iv) Treemarking to prescription

(v) Logging and Regeneration treatments

(vi) Return of coupe sheets so that work programme can be compared with work carried out

(vii) Update of protection and burning plans to ensure protection of regeneration.

The fine details of the HOC system have not yet been finalised, but will be included in this handbook when they are.

5.3 Liaison with Industry

The best results will be achieved if both foresters and sawmillers are committed to the principles, the plan and its implementation. D.F.O., D/F and Permit Officer must confer with their Industry counterparts at every stage, sharing both the problems and their solutions. This liaison will both optimise chances of success and ensure continuity as personnel change.

APPENDIX 1

DIEBACK HYGIENE GUIDE

An aid for planning forest operations so that dieback spread is prevented or minimized

Comprises: Introduction
How to use the guide
Planning Routines A to I
Glossary of terms

Prepared by: R J Underwood
West Australian Forests Department

1980

INTRODUCTION

Jarrah dieback is a serious forest disease of south-western Western Australia. It is caused by the soil borne fungus *Phytophtyhora cinnamomi*. An effective means of controlling the disease is by the practice of "dieback hygiene". The aim of dieback hygiene is to prevent transport of the fungus from infected to dieback-free forest.

It is necessary to consider dieback hygiene when planning any forest operation in the southwest. Often difficult decisions must be made, and alternative courses of action evaluated.

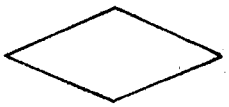
This guide has been designed to help foresters plan and conduct an hygienic forest operation. It will NOT provide him with the detailed job prescription; this will vary for almost every job and every site. Rather it concentrates on the principles involved, to be used as a guide and memory-jogger at the planning phase of every operation.

NOTE: For the sake of convenience, the guide uses logging as the base operation. For any other proposed activity (eg. road works, bauxite mining, fire control, recreation etc) substitute the appropriate word - for example, "pit" for "coupe"; "crusher" for "mill landing" etc.

TO USE THE GUIDE

Enter at Routine A and follow through to Routine I, as directed.

The symbol  denotes an action.

and  denotes a question.

Routine A deals with the different impact of the disease in the major forest types.

Routine B concerns operations planned in dieback-tolerant forests.

Routine C provides for the definition of dieback risk categories.

Routine D provides for dieback-free and protectable stands.

Routine E provides for stands non-protectable from infection.

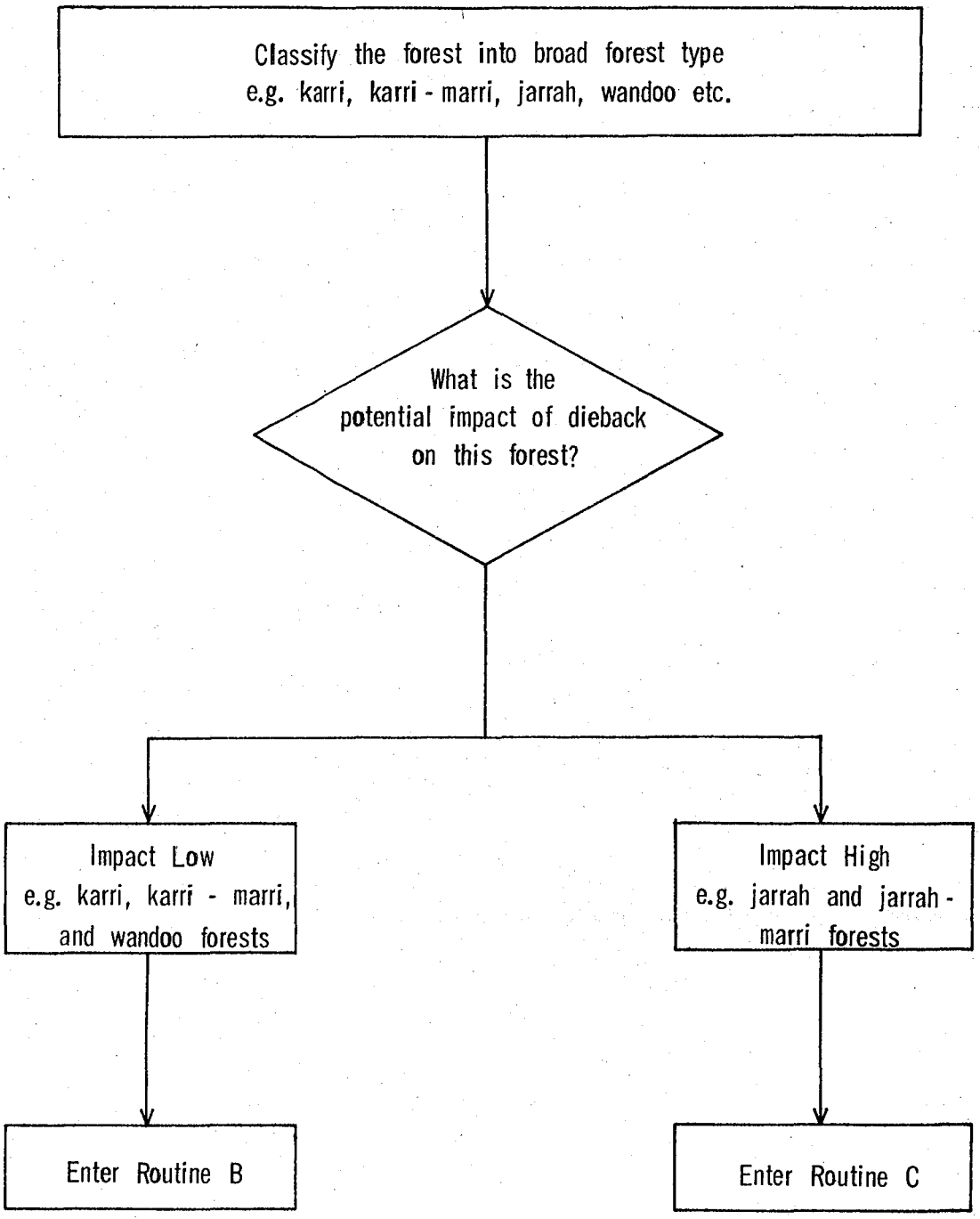
Routine F provides for dieback or suspect dieback stands.

Routine G concerns access planning.

Routine H is a hygiene failure test.

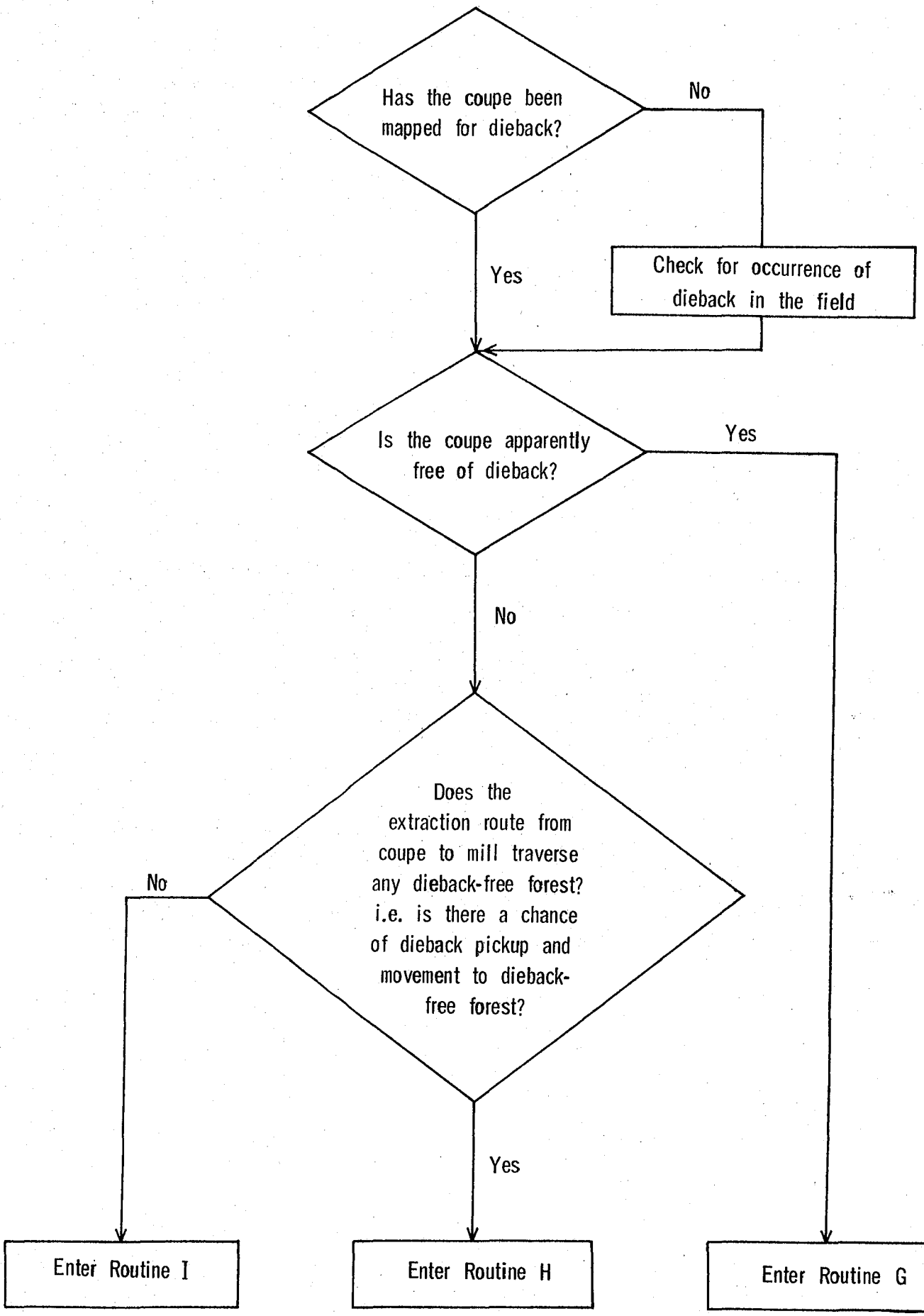
Routine I is a mechanism for prescription and control.

ROUTINE A : DIEBACK IMPACT



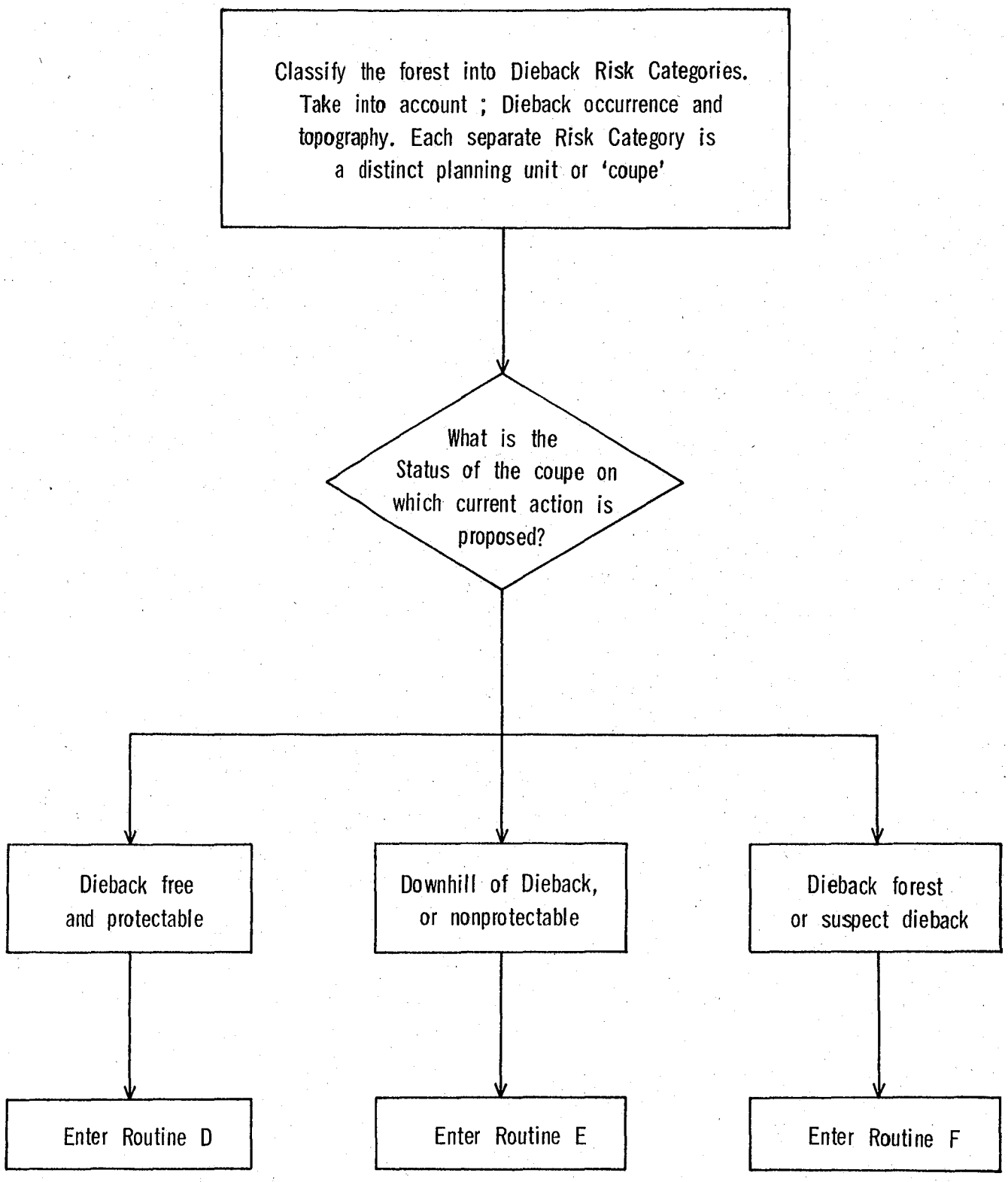
ROUTINE B : DIEBACK TOLERANT FORESTS

For an operation in dieback-tolerant forest :



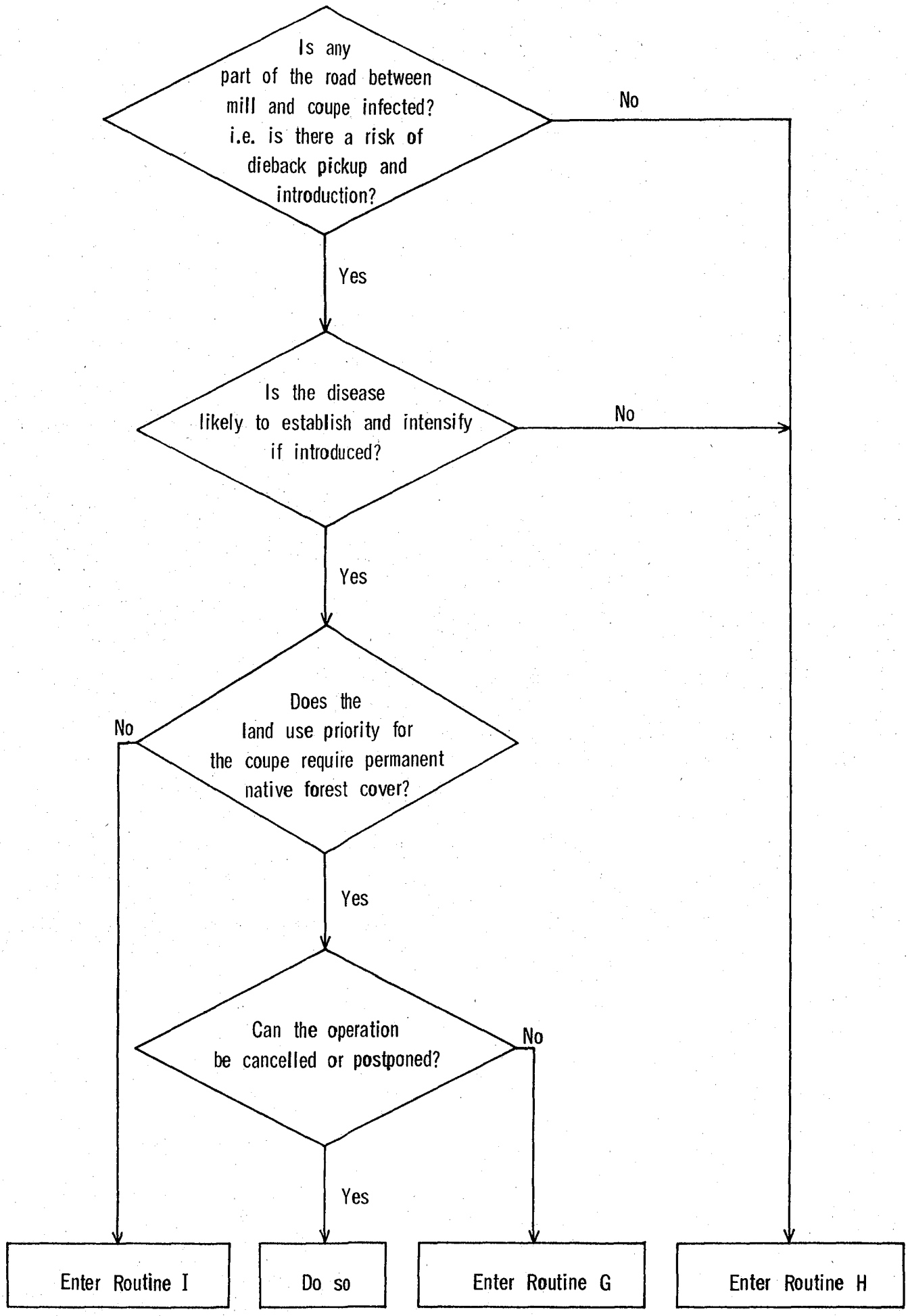
ROUTINE C : DIEBACK RISK CATEGORIES

For forest in which the impact of dieback could be high :



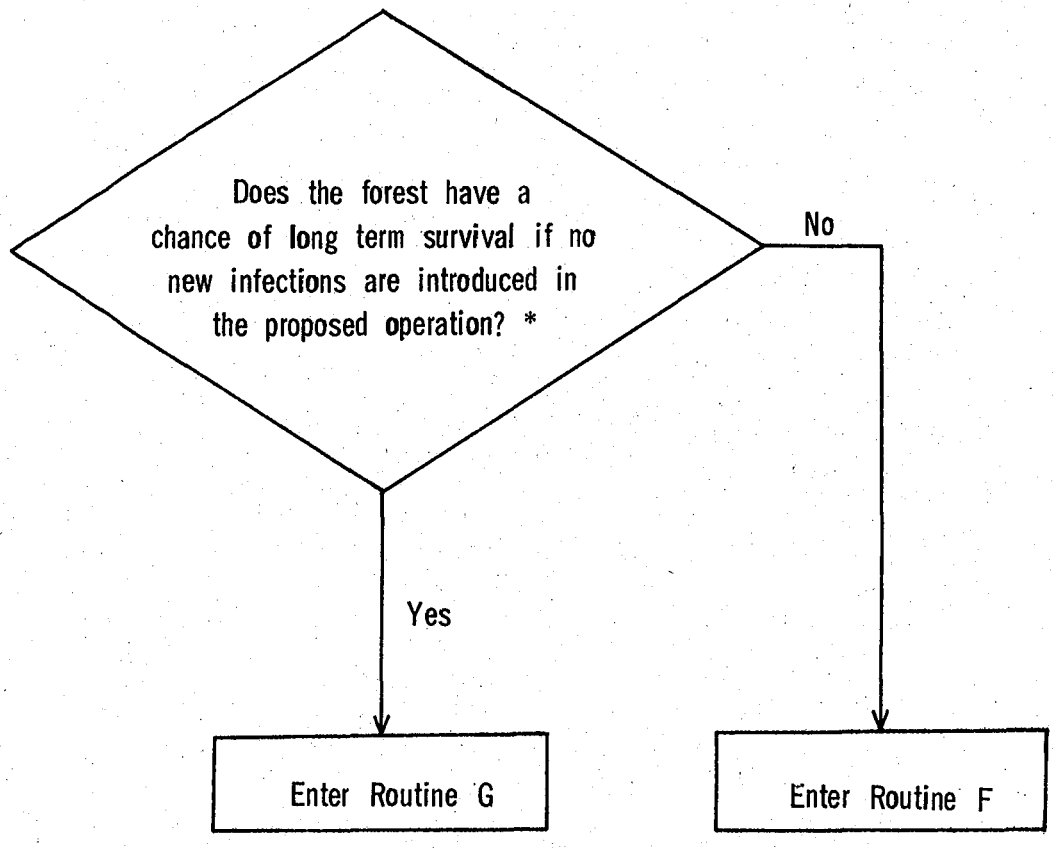
ROUTINE D : THE COUPE IS DIEBACK FREE AND PROTECTABLE

For forest apparently free of infection and upslope of any known infections :



ROUTINE E : THE COUPE IS NONPROTECTABLE FROM INFECTION

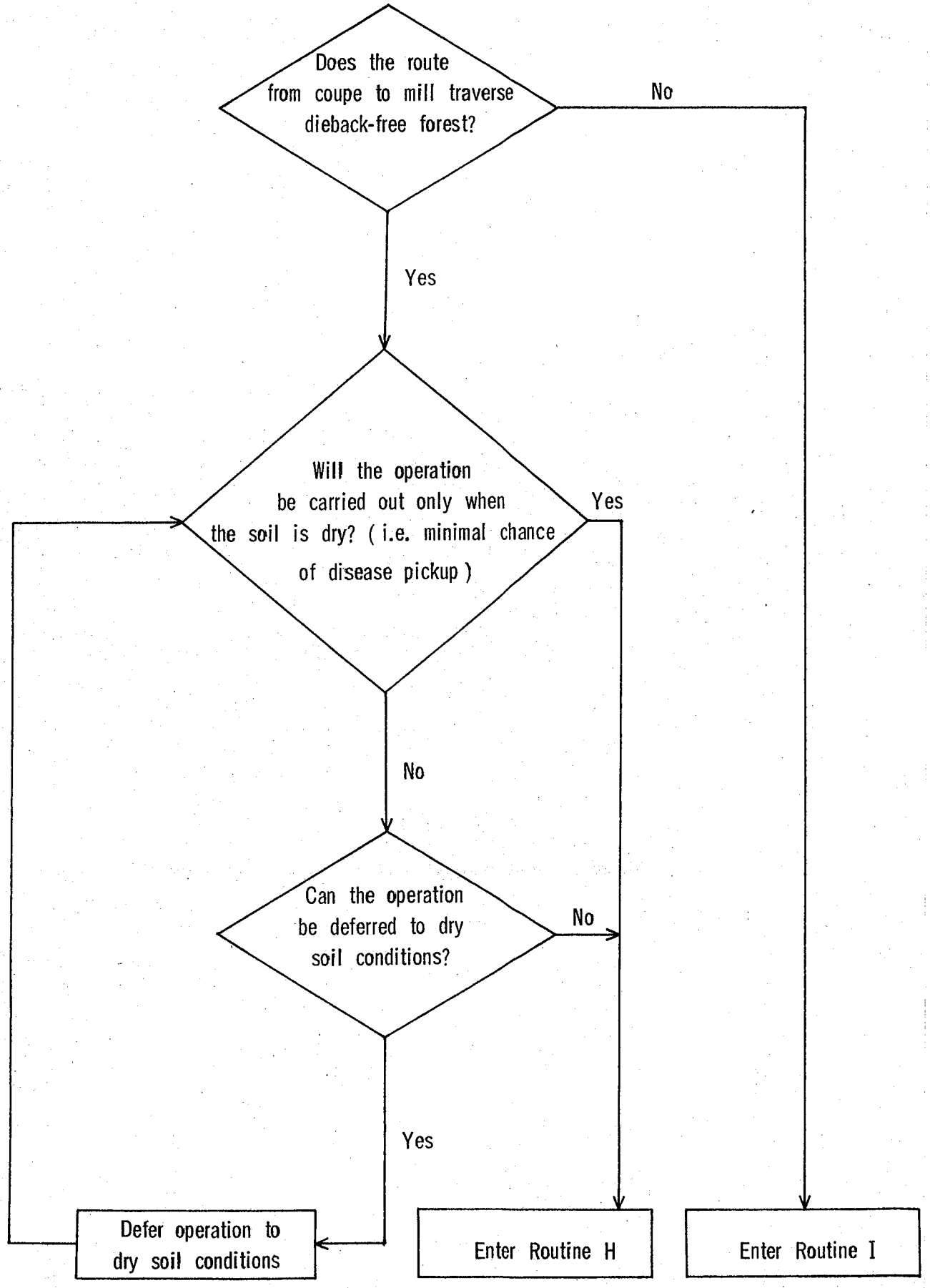
For forest which is downslope of an area already infected with dieback :



* This requires, with present knowledge, a value of judgement. If in doubt, check your assessment against that of experienced foresters and research scientists.

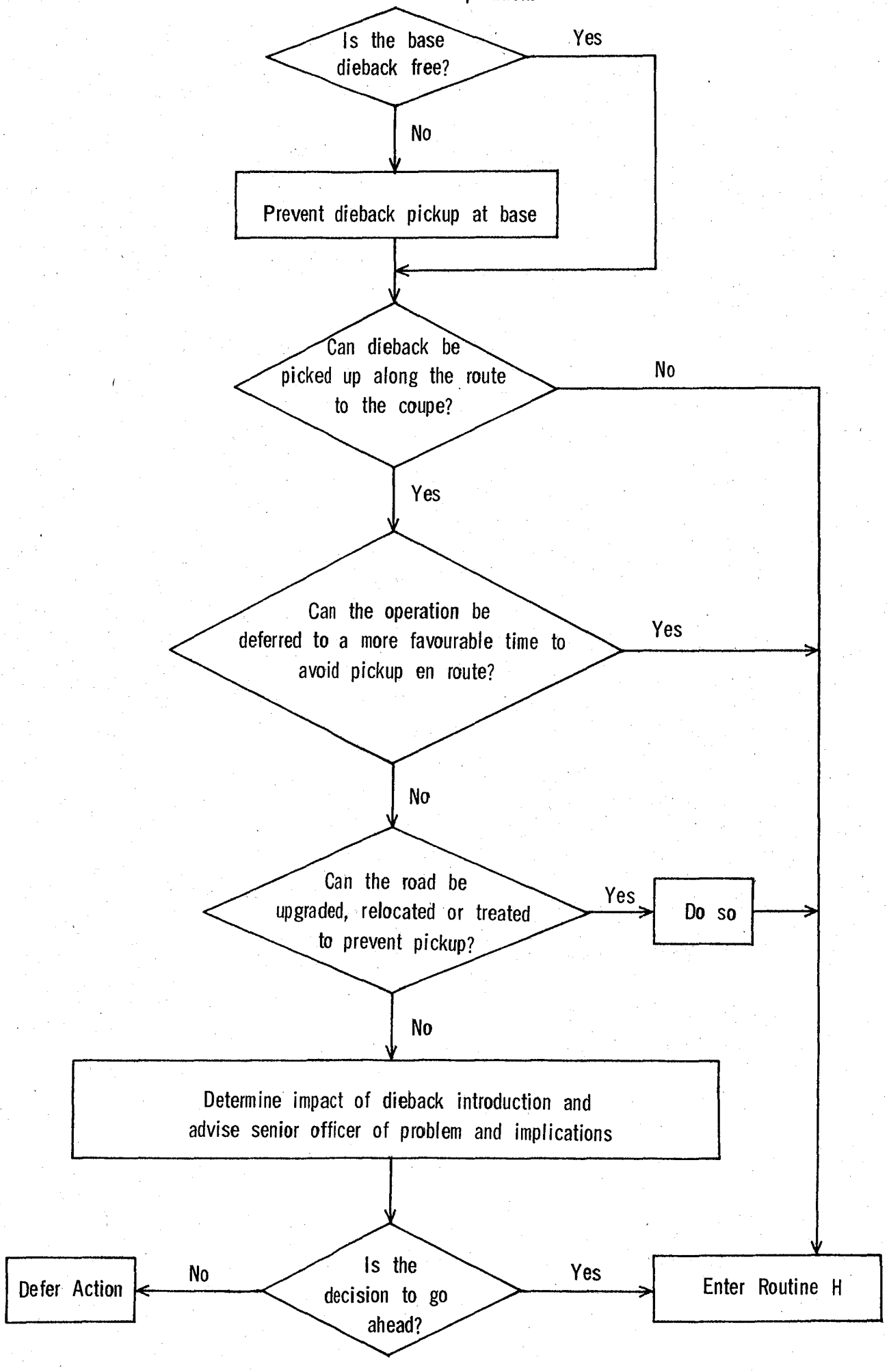
ROUTINE F : THE COUPE IS DIEBACK OR SUSPECT DIEBACK

If an operation is proposed in forest which is already infected, or suspected of being infected, the main risk is of disease pickup and transport to dieback-free forest elsewhere.



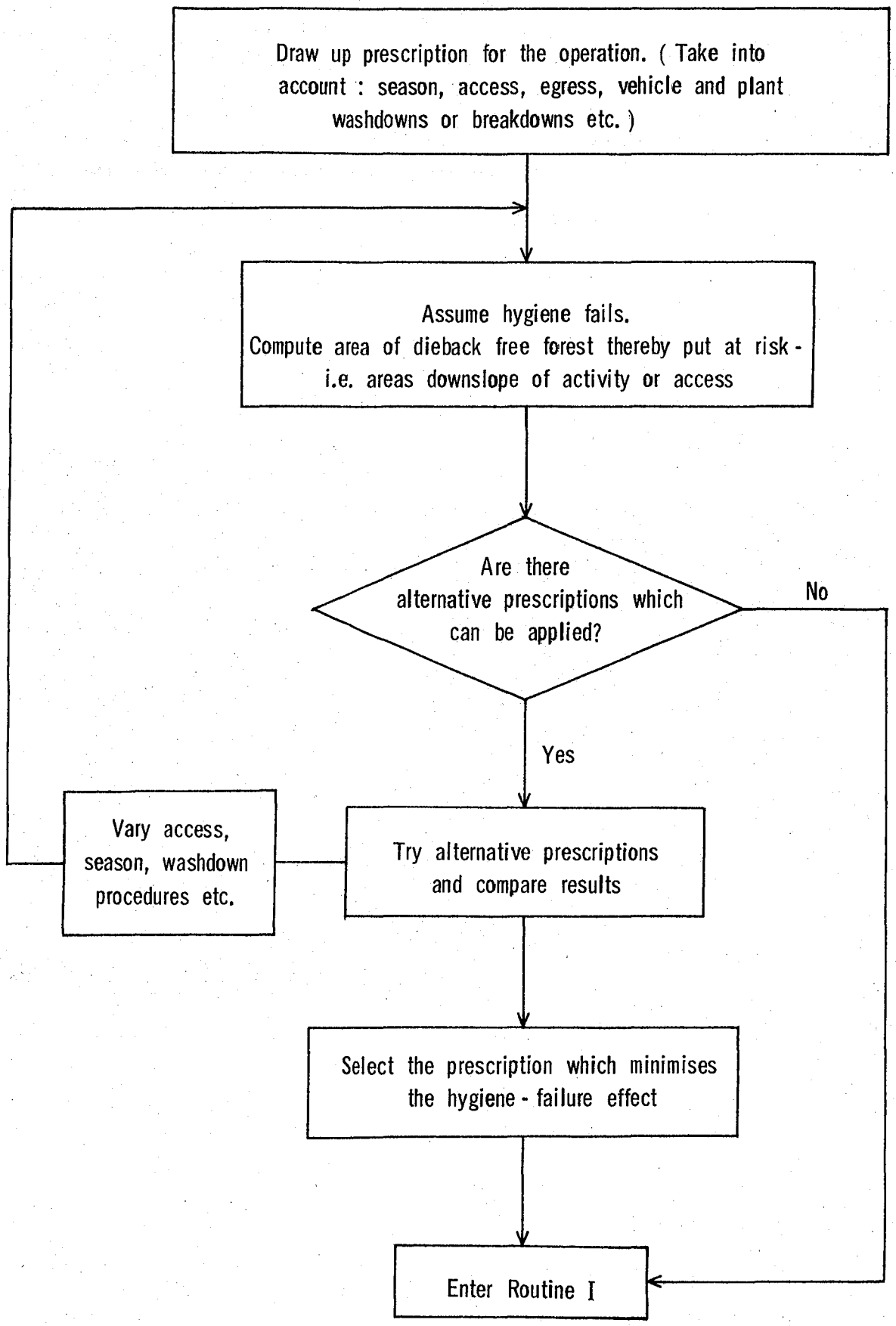
ROUTINE G : ACCESS

For any operation, dieback pickup can occur at the base (i.e. mill landing) or along the route to and from the forest operation.

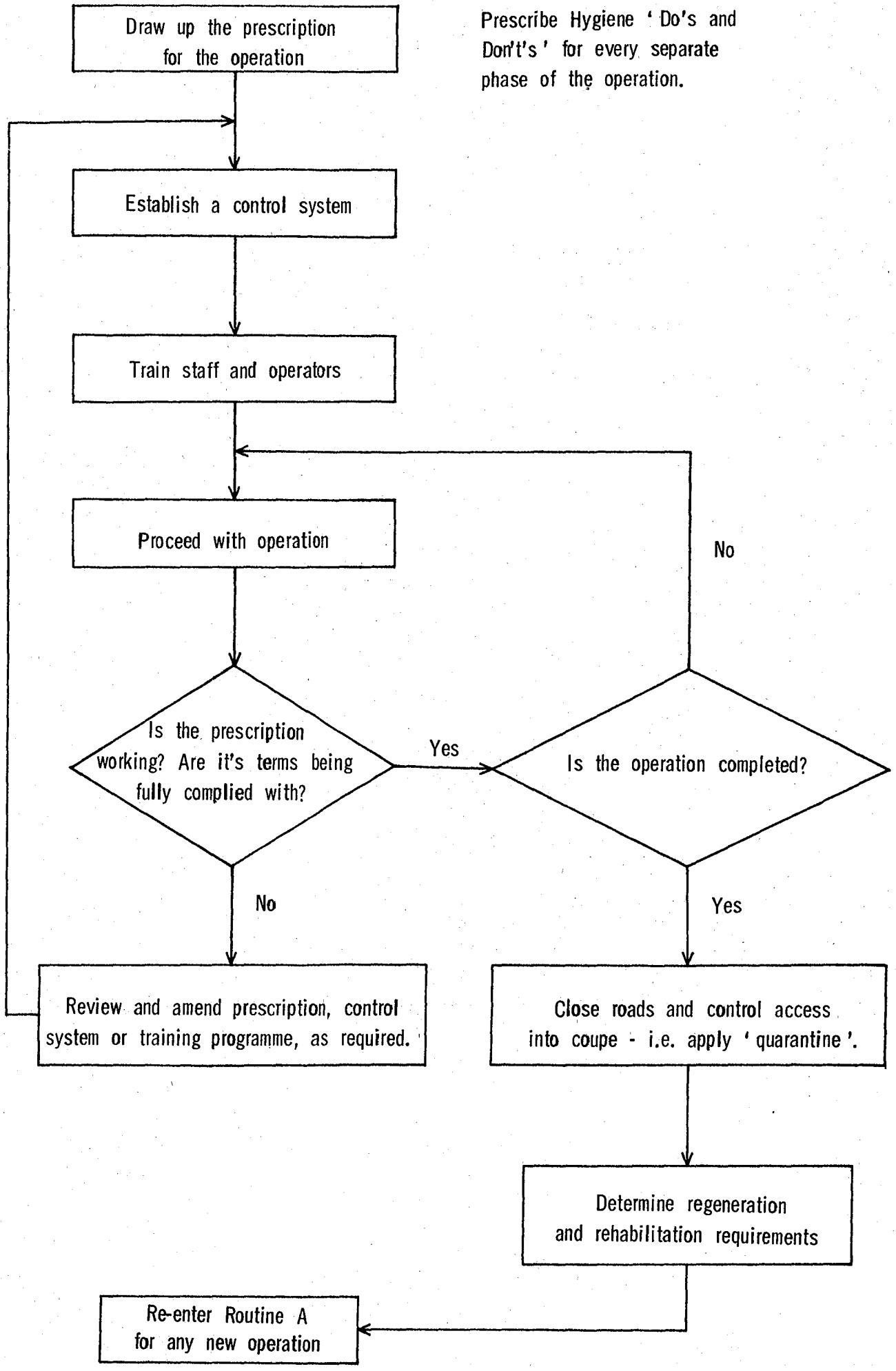


ROUTINE H : THE HYGIENE- FAILURE TEST

For any proposed operation it is necessary to examine the implications of possible hygiene failure.



ROUTINE I : THE OPERATION



GLOSSARY OF TERMS

DIEBACK:	The W.A. forest disease caused by *Phytophthora cinnamomi* ("*P.c.*").
DIEBACK FOREST:	Forest in which dieback symptoms are present.
DIEBACK SYMPTOMS:	Decline and death of indicator species in a particular pattern and/or location, suggesting the presence of dieback.
INDICATOR SPECIES:	Plants susceptible to dieback in the field.
SUSPECT DIEBACK:	Forest in which the evidence for dieback presence is inconclusive.
DIEBACK-FREE FOREST:	Forest apparently free of dieback.
DIEBACK TOLERANT FOREST:	Forest in which susceptible tree species do not die after infection with *P.c.*
PROTECTABLE FOREST:	Forest apparently dieback-free and uphill from existing dieback infections.
NON-PROTECTABLE FOREST:	Forest downhill from dieback infection.
DIEBACK IMPACT:	The effect of the disease on the forest plants and animals and/or the use to which the forest is to be put.

APPENDIX 2

LOGGING COUPE INSPECTION AND ACTION SHEET

1. Block/Coupe: .....
2. Sub-coupe: .....
3. Date Inspected: .....
4. Officer Inspecting: ..... in company with .....
5. Utilization
   Logs to be dressed: .....
   Logs to be snigged to landing: .....
   M.N.T. to be felled and logs prepared: .....
   Stump height: .....
   Long butts: .....
   Safety (T.I.R.) .....
   Fire Precautions: .....
   Other comments: .....
   .....
   .....
   .....
6. Erosion Control: Completed: [Yes] [No]
   Action required: .....
7. Landing: Debris stacked [Yes] [No]
   Drainage completed [Yes] [No]
   Action required: .....
8. Crop Trees: Preserved/Protected: [Yes] [No]
   Action required: .....
9. Dieback Hygiene Practices
   Hygiene failures are [Noted] [Not Noted]
   Action required: .....
   .....
10. Control:
    Copy of Action sheet passed to Bush Boss .....(his name)
    and action requirements listed above fully explained: [Yes] [No]
    Target date agreed for completion .....
    Bring/up date for field check .....

_____
(Signature of permit OIC)

Action Noted & Endorsed: _____
(District Forester)

Date: .....