ENVIROARM LTD

Group of Companies

RESTORATION PLAN FOR WOODCOTE WOOD QUARRY LANDFILL SITE

REF: EL/WWL/RP/1.00/2023

Carried out for: **NRS Woodcote Aggregates Ltd**

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WOODCOTE WOOD QUARRY LANDFILL SITE

RESTORATION PLAN

CONTENTS

DEFINITION OF TERMS

Aftercare	- The maintenance work needed to ensure that a restored landfill site does not produce environmental problems
Afteruse	- The use to which the landfill site is put following its restoration
Restoration	- Completion of the landfill site to allow planned afteruse
Soil	- The medium in which plants live and grow and from which through their roots they obtain water and nutrients
Subsoil	- The less well-structured and less biologically active layer below top soil which acts as a reserve of nutrients and water for plant growth
Topsoil	-The biologically active surface layer of soil which provides a medium for cultivation of plants
the Agency	- the Environment Agency
Works	- the permanent works as shown on the contract drawings

PARTIES AND RESPONSIBILITIES

There parties involved in the development works outlined in this document, and these are:

The Employer (NRS Woodcote Aggregates Ltd)
This is the person or company for whom the works are constructed. The Employer is the Permit Holder for the Site. The Employer will manage design of the works and to implement and administer the contractor its construction. He will be responsible for all contractual matters relating to the Works and may vary the design of the works during construction according to the conditions encountered

The Contractor (NRS Woodcote Aggregates Ltd)
The Contractor is responsible for constructing the works in accordance with the specification.

The Designer (Enviroarm Limited)
This is the person or Company appointed by the Employer to undertake the design of the Works.

The Testing Laboratory
The laboratory appointed by the Employer to perform any on or off site testing required under the Specification and the CQA Plan are listed below and up to date UKAS Accreditation certificates will be presented as part of the Validation Report. The appointed laboratory will be UKAS approved for each individual test. The CQA Engineer/PM shall be responsible for liaison with the approved laboratory with regard to the timing of the testing.

Review Period and Additional Requirements
This Restoration Plan is subject to periodic review and will be revised subject to any legislation changes or changes in Technical Guidance.

1.0 INTRODUCTION

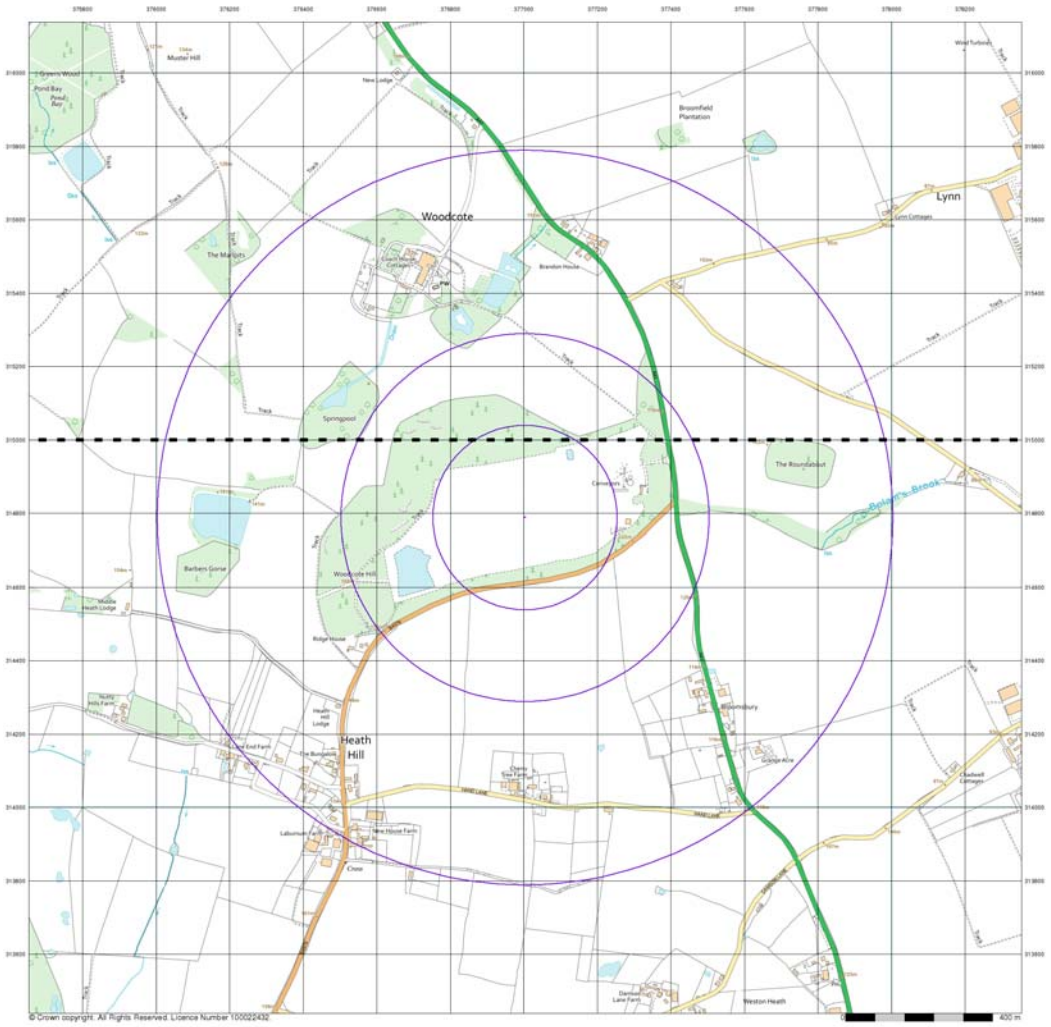
1.1 Site Location and Works Description

Site Location

1.1.1 The site is off the A41 in Weston Heath, Sheriffhales, Shropshire, 5km south of Newport town centre and 4.2km north of the A5. The centre of the site is at National Grid reference SJ 77036 14780 and the site entrance is SJ 77388 14944 see Figure 1 and Drawing ESID 1.

The Site comprises 22.4 hectares of agricultural land, which includes a woodland area. The site is a quarry.

Figure 1: Location Plan



Works Description

1.1.3 This Restoration Plan has been prepared by Enviroarm Ltd on behalf of NRS Woodcote Aggregates Ltd. The plan addresses the requirements for the placement of the restoration soils, quantities, waste types and

waste acceptance criteria for the Woodcote Wood Quarry landfill site under the Environmental Permit Application for the site.

1.2 Supervision

1.2.1 Waste acceptance will be dealt with by the Technically Competent Manager for the site who will ensure compliance with the conditions set out in the Restoration Plan, using the on-site stockpiled soils and soils remaining to be stripped.

1.2.2 The Contractor is required to have full-time supervision on site whilst any soiling activities are being undertaken above the engineered cap. Third party Construction Quality Assurance (CQA) personnel will also be present onsite full time to verify the Works are constructed in accordance with the Restoration Plan.

1.2.3 The CQA Engineer or other delegated CQA supervisor will compile a daily log sheet of site activities. These log sheets will be kept on site during the Contract and will be incorporated into the CQA Validation Report upon completion of the Works.

1.3 Surveying

1.3.1 On-site station information will be provided to the Contractor prior to the commencement of work. The Contractor will be expected to liaise with the Employer's land surveyor in regard to all setting out and construction level control.

1.3.2 During the Works an independent surveyor will undertake several as-built detailed surveys, on a 10m x 10m grid, and an on-site survey of test location points will also be carried out by the appointed consultants as well as a check of the independent surveyors survey checking at least 10% of the points, and these results will be presented in an excel format to compare the eastings, northings and ordnance datum points. The as-built surveys to be undertaken are as follows:

- Pre and post placement of the soil restoration layers, including cross-sections;
- Post placement of the restoration soils, including cross sections.

1.3.3 The results of all surveys shall be forwarded to the CQA Consultant not later than five working days after the respective survey was completed. The results shall be in digital DXF format together with a hard copy.

1.3.4 The level drawings and the as-built drawing will be issued with a copy of the CQA Validation Report.

1.4 Validation Report

1.4.1 Upon completion of the works a CQA Restoration Validation Report will be prepared by the CQA Consultant and forwarded to the Agency. The report will form a permanent record on the actual construction of the Works in relation to the requirements of the Restoration Plan. The report will summarise the works undertaken, the materials and construction methods employed, the physical sampling and testing and any other observations the CQA Consultant regards as pertinent to demonstrate that the Works have been undertaken in accordance with this Restoration Plan.

2.0 SOIL IMPORTATION

2.1 General Description

2.1.1 Soil originally placed in earth mounds will be used site for the purpose of restoration above the deposited waste.

2.1.2 The soils to be used for restoration will be fit for purpose, both chemically and physically. The minimum depth of the restoration soil will be 300mm of reworked sub soils or top soils except in tree planting areas where the soil profile will be 1 metre thick in compliance with The Landfill Directive, annex 1 paragraph 3.3 and Forestry Commission Guidance on Planting Woodlands on Landfill Sites.

2.2 Inert Waste Importation and Volumes

2.2.1 The site will use currently stockpiled soils and fields not currently stripped. In the event of a shortfall the soils will be sourced duirect from the treatment area delivered as PAS100/BS Top Soil.

2.3 Waste Types

2.3.1 The approved wastes for restoration are summarized in Table 1 below. Typically landfill permits state :

Wastes shall only be accepted for restoration where:
(a) they are listed in schedule xxx, and

(b) they are accepted in accordance with a restoration plan approved in writing by the Environment Agency.

Table 1: Permitted inert wastes for restoration

17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones other than those mentioned in 17 05 03
20	**MUNICIPAL WASTES, (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 02	**garden and park wastes (including cemetery waste)**
20 02 02	soil and stones

2.4 Waste Acceptance Criteria for Inert Soils for use in Restoration

The material to be imported to the landfill for restoration from the treatment facility will be inert for the sub soil horizon and topsoils can be imported for the final 300mm layer which will have an organic matter greater than 3% and more typically 5-7% so as to comply with the BS 3882:2015. The site restoration permitted wastes are defined as;

a. Inert Wastes and;
b. In accordance with the Landfill Directive and Environmental Permitting (England and Wales) Regulations 2010;
c. Tax Qualifying Exempt Materials.

3.0 SOIL RESTORATION PROFILE

3.1 Soil Placement

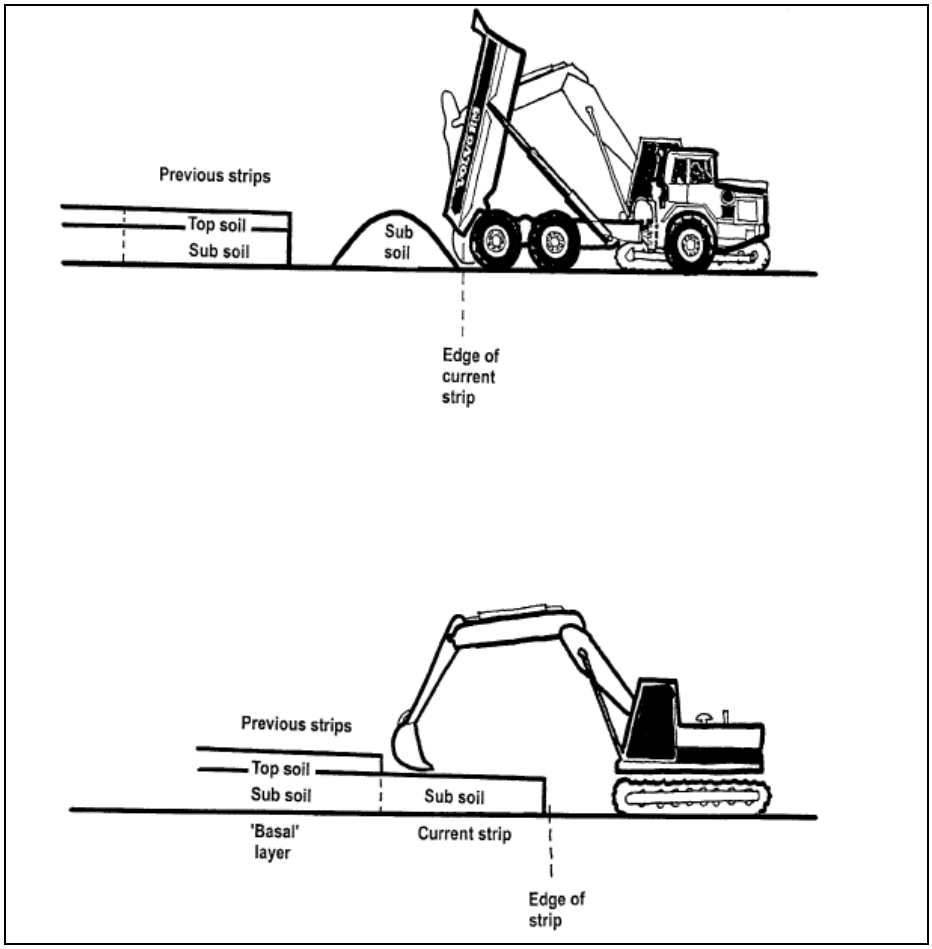
3.1.1 The soils are to be replaced in the correct sequence:-

- Sub-soil - 700mm thickness (upper section of landfill)
- Top soil - 300mm thickness (which will have an organic content greater than 3%)

3.1.2 The soils will be spread out using a hydraulic excavator with dump trucks delivering the soils and tipping them in front of the excavator therefore reducing compaction or delivered directly in HGV tippers and spread using a track type dozer.

3.1.3 Guidance on soil spreading using dump trucks, dozers and excavators is set out in Sheet 4, of the Good Practice Guide for Handling Soils prepared by MAFF. Any compaction caused will be alleviated by sub-soiling and guidance is to be found in Sheets 16 and 17, including removal of stones. The soils spreading will be carried out in accordance with the phasing of the site set out in the Environmental Setting and Installation design for the site. The soil spreading technique is presented at Figure 2 for reference.

Figure 2: Replacement of soils from soil storage mounds



3.1.4 Ripping will be undertaken at 45° to the contours to assist field drainage. Sub-soiling will be carried out when the soil is dry or moist to the full depth of working.

3.1.5 Any large stones (>100mm diameter in the topsoil, or 200mm diameter in the sub-soil) brought up by the sub-soil ripping or present in the restored soil will be removed, as per Sheets 16 and 17.

3.1.6 Stones collected will be used for any field drains.

3.1.7 The soil will then be cultivated. Mole board ploughs are not to be used due to potential invert topsoil. Discs may be used.

3.1.8 Feed bed preparation will be completed using chain harrows.

3.1.9 Soil testing (pH, N, P, K, conductivity) will be undertaken;

- Organic fertilizer - used to increase soil fertility;

3.1.10 The detailed application will be dependent upon soil analysis obtained from the approved soils testing laboratory.

3.2 Grass

3.2.1 The site restoration is based upon grass fields with specific tree plant areas with hedgerows breaking up the grassland open space as shown on Drawing OA991-D10. The summary aftercare provisions are:

- Grazing of the grass after year two, allowing the timothy, fescue and clover to develop;
- Damaged areas should be reseeded in late August/early September and grazing cattle removed for the winter period.

3.3 Hedgerows

3.3.1 The fences and hedges are to mark the field boundary. The hedgerows will be protected with post and wire fence.

3.3.2 The hedgerows are now fully self-sustaining and no further maintenance is to be carried out so as not to disturb any wildlife that currently exists in this habitat as previously identified in the ecological survey.

3.4 Footpaths

The current Public Footpath route allows for permanent diversions of footpaths and includes a new disabled footpath allowing access to the lower balancer pond used for fishing and shown on Drawing OA991-D8. The disabled footpaths are constructed using C32/40 concrete. The remaining footpaths will consist of recycled stone produced at the inert treatment facility on site.

4.0 AFTERCARE SCHEME

4.1 General

4.1.1 The outline strategy for Woodcote Wood Quarry Landfill is set out below;

4.1.2 The proposed cropping pattern is to be grass for the five-year aftercare period. The grassland will merge with surrounding tree and hedgerow plant areas.

4.1.3. The intention is to sow a species rich wildflower grassland mix. Depending upon ground conditions, the land may be grazed with sheep after the grass has become well established, after year two.

4.1.4. The cultivations carried out for the initial grass establishment will be prepared in such a way so as not to cause over-cultivation.

4.1.5. Soil samples will be taken to ensure correct nutrient balance. Should any nutrient deficiency be recorded then an application of farmyard manure would be used.

4.2 Year One

4.2.1 Spring sow grass, apply organic manure as top dressing of nitrogen if required.

4.2.2 Clearance of volunteer weeds, using an approved herbicide. The specific herbicide will be dependent upon weed type and half-life degradation values.

4.3 Year Two

4.3.1 Clearance of volunteer weeds using herbicide with short half-life degradation values.

4.3.2 Grass mow and crop in August.

4.4 Year Three, Four and Five

4.4.1 Continue with management of weeds as per 1 and 2 in Year Two.

4.4.2 Check for and repair any minor settlement.

References

1. Environment Agency Briefing Note The use of waste ibn restoration at landfills

2. Ministry of Fisheries and Food: Good Practice Guides for Soil.

3. Ministry of Fisheries and Food: The Soil Code Revised

4. Environment Agency How to comply with your Environmental Permit

DRAWING

Legend

Permit Boundary

Client: **NRS Woodcote Aggregates Limited**

Project: **Woodcote Wood Quarry Landfill**

Title: Restoration

CAD Ref:	Version:	Drawn by:	Scale:	Date:
EL/WQL/1	1	ARM	Plan 1:2500@A3	February 2023

ENVIROARM LIMITED

Drawing: **ESSD 5**

APPENDIX A:
CQA Forms

SITE INSTRUCTION

TO:	Site:	Loc No:
You are instructed to undertake the following work: **We confirm the following verbal instruction:**		
Accepted by: **Of:**	**Originator:** **ENVIROARM LIMITED**	

DAILY SITE RECORD

Site:	Date of Visit:	Time on Site:	Time Off Site:
Personnel/Staff:	Site Conditions/Weather: Rain off: Yes/No	Equipment:	
Operations Inspected:	Action:		
Comments on Workmanship:			
Instructions/Information Issued or Required:			
Progress Report *(use additional sheets if necessary)*			

Signature: _____

APPENDIX B:

Waste Acceptance Criteria

WOODCOTE WOOD LANDFILL AND WASTE TRANSFER STATION

WASTE ACCEPTANCE PROCEDURE

CONTENTS

APPENDICES

1.0 Introduction

1.1 Report Context

NRS Woodcote Aggregates Ltd has instructed Enviroarm Limited to prepare a Waste Acceptance Procedure (WAP) as part of an Environmental Permit (EP) application for Woodcote Wood Quarry Landfill in Woodcote, Sherriffhales, Shropshire under the Environmental Permitting (England and Wales) Regulations 2016.

The purpose of the WAP is to ensure that the site only accepts waste that is:

- Suitable for the activity;
- Is allowed by the EP; and
- Is appropriately considered by the environmental risk assessment. The WAP will also assist with:
- Ensuring the activities do not cause pollution;
- Assist in the waste sourcing decision making process; and
- Prevent the receipt of non-permitted wastes.

This WAP is divided into the following sections for ease of use:

- Section A: Landfill WAP; and
- Section B: Waste Recycling Plant WAP.

SECTION A: Landfill Waste Acceptance Procedure

2.0 Landfill Waste Acceptance Procedure Overview

This WAP has been prepared with reference to the following guidance for waste acceptance at landfills:

- DEFRA: Environmental Permitting: Environmental Permitting Core Guidance, March 2008;
- Environment Agency (EA) (2008) Environmental Permitting Regulatory Guidance Series No. LFD1. Understanding the Landfill Directive for Environmental Permitting; and

2.1.1 Landfill Directive

The Landfill Directive places controls on all landfill site's accepting waste. These controls also include the requirements for WAP and waste acceptance criteria (WAC), that were previously agreed by the Council of the European Union[1].

Before a type of waste can be accepted at a landfill site, the landfill operator must be satisfied that the waste meets their permit conditions, the WAP's and WAC. If a waste producer decides to deposit at a landfill, they must also follow these procedures, or the operator can refuse to accept the waste.

2.1.2 Woodcote Wood Quarry Landfill Classification

The site will accept non-hazardous waste into a fully lined and engineered landfill site, split into the following types of waste;

- Inert waste;

As defined in the Landfill Directive, there are numerical WAC limits for landfills accepting inert waste. Therefore, this document provides details on the WAP for waste accepted, rather than criteria and limits.

The list of wastes for acceptance at the landfill are included as Appendix 02-1 of this WAP.

1 Detailed in Council Decision 2003/33/EC.

3.0 Landfill Waste Acceptance Procedure

3.1 Level 1: Basic Characterisation

Level 1 basic characterisation of wastes constitutes a thorough determination, according to standardised analysis and behaviour testing methods, of the short and long term leaching behaviour and or characteristic properties of waste.

As a minimum, the following information about the characteristics of each waste stream will be obtained prior to receiving the waste at the site:

a) The full address where the waste was produced;

b) The identity of the producer;

c) All the reasonably identifiable previous uses of the producer site (where the waste is excavation waste);

d) The process giving rise to the waste;

e) The physical appearance of the waste including colour, texture and smell;

f) Its European Waste Catalogue (EWC) code;

g) Where a weighbridge isn't used, a metric conversion factor for volume (cubic metres) to weight (tonnes) for each waste stream; and

h) The quantity of waste to be imported.

Basic characterisation will focus on identifying key variables, of which there are two types:

- Those parameters which dictate that a waste will always be directed to a particular class of landfill; and
- Those parameters which vary in a waste stream such that the waste is sometimes suitable for one class of landfill, and sometimes another.

Basic characterisation will normally be required where:

- Wastes need to be analysed for a limited number of key variables, which may vary close to the landfill class limit values or the presence/absence of which affect the class of landfill; and
- A complete determination of composition and leaching is required, particularly if the waste is either a one-off, is from a very variable process, or has not undergone basic characterisation before.

In the event that there is suspicion of contamination, the waste will be tested.

3.2 Level 2: Compliance Testing

Level 2 compliance testing of waste is required for waste that is 'regularly arising'. Periodic checks on the waste will be carried out to ensure that the properties originally accepted on site have not changed.

Level 2 compliance testing constitutes periodical testing by standardised analysis and behaviour testing methods to determine whether the waste complies with the results of the basic characterisation, the acceptance criteria for the landfill class and the installation specific conditions of the permit. This test will focus on key variables and behaviour identified by basic characterisation and will be carried out at least once a year for each waste stream.

The relevant parameters to be checked will be determined from the results of the basic characterisation. The parameters, and reasons for their selection, will be documented, and the results of the tests will be maintained at the installation.

The requirements for Level 1 and Level 2 testing will depend upon the type of waste. For wastes that are regularly generated in the same process, where the input materials, and the process are well defined, and changes to the process are notified to the landfill operator, initial analyses may show that there is little variability in the waste, and there may be no further requirement for characterisation testing. Further deliveries may then only be subject to compliance testing. For wastes that are not regularly generated in the same process and installation, each batch may require the basic characterisation testing and consequently no compliance testing is needed.

3.3 Level 3: On-site Verification

Level 3 on-site verification of waste is to ensure each delivery of waste is the expected waste and that it has not been contaminated in storage or transport to the site.

A visual inspection to satisfy the Level 3 on-site verification requirements will be carried out on all waste deposited at the site. Preliminary verification, including checking of the paperwork, and a visual inspection if possible, will take place before vehicles carrying the waste can proceed to the disposal area.

The visual inspection will have two purposes:

- To confirm that the waste is permitted for disposal at the site; and
- To confirm the waste is as described in the accompanying documentation.

3.4 Weighbridge Procedure

3.4.1 Weighbridge

The weighbridge is located near to the entrance of the site and on route from the site entrance to the landfilling area. All customers' vehicles will be weighed either before and after discharging their load, if the tare weight of the vehicle is not known, or before discharge if the tare weight is known.

3.4.2 Computerised Measurement System

The weighbridge measurement equipment will be linked to a digital display unit inside the weighbridge office, from which the weighbridge operator can read the gross weight of vehicles.

The waste recording process will be carried out by the weighbridge operator on a computerised system comprising a keyboard, disk drive unit, visual display monitor, and ticket printer. The system will be linked for communication with the master computer. Records will be held in NRS's administrative department and kept at an appropriate location. Manual copies will also be retained in case of breakdown.

3.4.3 Vehicle Details

If a new vehicle uses the site, its details including registration number, tare weight and vehicle type will be entered into the computer to complete the transaction. Vehicles to be used by the customer for some time will be set up on the computer system to allow the vehicle and

contract details to show automatically when the weighbridge enters the vehicle registration.

3.4.4 Waste Identification/Verification

The weighbridge operator will identify the type of waste from the following information:

- Duty of Care transfer note; or
- Verbal confirmation from the driver.

Where possible, the weighbridge operator will undertake a preliminary visual examination of the waste.

3.4.5 Waste Quantity

The waste quantity will be determined from the measurement of the gross weight of the vehicle (determined prior to waste deposit) minus the tare weight (determined following discharge). For suitable vehicles the tare weight will be stored to enable the computer to automatically calculate the net weight of the load.

3.4.6 Ticket Issue

The transaction will be regarded as complete when the weighbridge operator obtains the driver's signature on the weighbridge ticket.

In case of temporary computer failure, manual tickets will also be available at the weighbridge, for manually recording waste receipts.

3.4.7 Duty of Care Waste Transfer Notes (WTN)

The Environmental Protection (Duty of Care) Regulations 1991 (as amended) impose requirements to complete transfer notes recording details of waste transfers, and to keep the transfer notes and make copies available to the EA on request. The Regulations place these responsibilities on the person who provides and the person who receives the waste.

Although the layout and information contained on WTNs can vary widely, the following items must be stated on or attached to the transfer note:

Description of Waste

The description of the waste must include some or all the following:

- EWC code;
- The type of premise or business from which the waste comes;
- The name of the substance or substances;
- The process, which produced the substance;
- A chemical and physical analysis; and
- Any special problems.

Quantity of Waste

The amount in weight or volume, and how it is packaged.

Current Holder of the Waste

The current holder of the waste must be one of the following:

- Producer of the waste-name and full address;

- A waste Collection Authority-Authority's name;
- A registered waste carrier-registration number and issuing authority; and
- Exempt from registration-state reason.

Details of the Transfer

The details of the transfer must include all of the following, and will be filled in by the manager or weighbridge operator:

- Full address of landfill site;
- Date and time of transfer (between dates may be shown for multiple loads); and
- Signature and full name in block capitals of current holder and person receiving waste, and the name of the company they represent.

The weighbridge operator will check that any transfer notes arriving at the weighbridge are filled out correctly. Transfer notes can either relate to a one-off transaction or can be long term 'season tickets' which can remain valid for up to a year. The Site Manager or a delegated representative will check the status of long-term season tickets regularly, and customers advised of any pending renewal requirements. The results of such audits, together with action taken shall be recorded in the site log.

3.5 Quarantine and Rejection Procedures

The objectives of the quarantine and rejection procedures are to ensure that all non-conforming waste is removed from site and that the waste producer and carrier are informed so that appropriate action can be taken to prevent recurrence.

3.5.1 Non-Conforming Waste

Wastes that are identified at the weighbridge as non-conforming will be held in the waste reception area (within the waste transfer building) for inspection. If the inspection confirms that the waste is non-conforming, the waste carrier and/or producer, and internal company line management, will be informed. The vehicle will be invited to remain on site until an agreed course of action has been determined between all relevant parties.

3.5.2 Waste Authorisation

The weighbridge operator will consult the Site Manager (or Deputy) where the waste does not conform to the information stored on the computer.

The Site Manager will determine if the waste is acceptable for disposal under the terms of the permit, and whether all necessary pre-treatment and characterisation testing has been satisfied. If there is any doubt, the waste will not be accepted, and the weighbridge operator will advise the driver accordingly. Alternatively, if the Site Manager agrees to accept the waste, the weighbridge operator will arrange for the load to be observed during discharge at the tipping area.

3.5.3 Waste Rejection at the Weighbridge

Incoming waste will be rejected at the weighbridge for a number of reasons including:

- Incomplete or unsatisfactory documentation;
- Physical appearance not fitting description on transfer note;

- Burst sacks or inadequately contained load;
- Presence of free liquid in the waste above the prescribed limits;
- Waste not adequately pre-conditioned; and
- Adverse weather conditions at tipping face.

The Site Manager (or Deputy) will be informed of any waste that is rejected at the weighbridge due to inaccurate documentation. They will then communicate with the customer, advising that the load has been rejected and the reasons why. The details will be entered on the waste rejection form.

If the site is unable to accept certain waste streams due to adverse weather conditions, customers will be notified by telephone or e-mail giving the period of closure, providing as much notice as possible.

3.5.4 Rejection at the Operational Area

A final visual inspection during placement of all loads will be carried out by a site operator, who will identify non- conforming within a waste deposit.

If non-conforming material is identified, the following action will be taken:

- The Site Manager (or Deputy) will be informed immediately by radio or telephone;
- Other waste and vehicles will be directed to another location on the working area, to ensure the suspect waste remains exposed;
- The Site Manager (or Deputy) will examine the WTN and any other documentation which provides details on the process or premises that produced the waste, to enable an appropriate assessment to be undertaken on inspection;
- The Site Manager (or Deputy) will inspect the non-conforming waste taking all necessary safety precautions;
- If the Site Manager (or Deputy) is satisfied that the description of the waste was appropriate, that there has been no contravention of the permit, or breach of contract, they will authorise the continuation of disposal; and
- The details of the incident will be recorded in the site log.

If the Site Manager (or Deputy) is not satisfied that the material conforms to the above requirements, the following action will be taken:

- The driver of the vehicle will be alerted, and the waste will be reloaded onto the vehicle where possible. The vehicle will then be redirected to the site entrance, issued with relevant paperwork and asked to leave the site;
- If the vehicle has left the operational area, the competent person will attempt to intercept the vehicle before leaving the site so that the waste can be re loaded, and relevant paperwork issued;
- If the vehicle has left the site before the presence of unauthorised waste is identified, the waste will be isolated or moved to a temporary ‘quarantine’ storage area;
- The waste carrier will then be contacted and asked to remove the waste from site. If the carrier is unable to remove the waste, it will be consigned to an alternative suitably authorised facility by a registered waste carrier. A duty of care WTN will be completed for all such transactions. In the event it is necessary to sample such waste to identify a suitable treatment facility, the necessary sampling will be carried out. The waste will be

stored in the quarantine area until a suitable alternative facility has been identified; and

- A skip will be maintained close to the operational area. This skip will be used for the storage of isolated contaminants identified within loads of waste which would not warrant rejection of the load. These minor inclusions will be removed from the load and placed in the skip prior to off-site removal.

3.5.5 Non-Conforming Waste Record

For all non-conforming waste, an incident report will be raised which will be cross referenced in the site log. This will include the following details:

- Date and time;
- Producer details;
- Carrier details;
- Duty of Care transfer note reference number;
- Description of waste;
- Volume of waste;
- EWC code;
- Non-conforming waste;
- Samples taken;
- Details of communication with NRW (time, name of officer); and
- Actions agreed and taken.

SECTION B: Waste Transfer Station (WTS) Waste Acceptance Procedure

4.0 Recycling Facility Waste Acceptance Procedure Overview

This WAP has been prepared with reference to the EA's 'Guidance for the Recovery and Disposal of Non-Hazardous Waste (Sector Guidance Note IPPC S5.06).

4.1.1 Cornets End Quarry Waste Transfer Station

The Recycling Facility will be operated as to [produce stone for recycling and sub soils for inert landfill. Type materials that are inert or are non- hazardous. The proposed activities comprise the storage and physical/manual treatment of waste by sorting, separation, screening, blending, into different components for recovery and disposal, (no more than 50 tonnes per day) or recovery.

5.0 Recycling Facility Waste Acceptance Procedure

5.1 Pre-Acceptance Procedures

5.1.1 Sampling of Waste from Suppliers

Sampling of waste will not be routinely undertaken to validate the waste type against the description on the WTN, due to the nature of the waste accepted on site.

However, the Site Manager will, on occasion (no less than once a quarter) request a spot sample from the waste producer to validate the waste type against the description on the WTN.

For waste, a sample will be requested from the waste producer coming to the Woodcote Wood Recycling Facility.

The spot samples will be analysed and validated against the WTN description. If the spot sample does not conform to the WTN the Site Manager will review the contract in place and agree measures with the waste producer to correctly describe the waste types.

5.2 Waste Transfer Note

All waste arriving on site will be accompanied by a WTN. Where multiple loads arrive under contract one note may cover all deliveries.

Waste will be described in the WTN with reference to the EWC Codes with the appropriate code number. A copy of the list of wastes that can be accepted on site can be found in the waste list included in Appendix 02-1 of this WAP.

The Site Manager and site operatives will be trained to identify a correctly completed WTN. They will also be trained to complete all sections of a WTN fully and accurately.
The Site Manager or a site operative will check that the WTN includes signed confirmations that the waste hierarchy has been applied correctly under the Environmental Permitting (England and Wales) Regulations 2016 (as amended). The waste hierarchy illustrates the most and least favoured options of disposal (1 being the most favoured);

1. Prevention;
2. Minimisation;
3. Reuse;
4. Recycling;
5. Recovery/energy recovery; and
6. Disposal.

All WTN's will be kept for no less than 3 months. All WTN's will be held electronically on site.

5.3 Means of Measurement

The quantity of waste accepted and despatched from the site will be measured via the weighbridge or calculated by recording the volume of waste entering the site and the application of standard conversion factor as appropriate.

All wastes entering the site will be recorded upon arrival and the waste and recyclable components removed from site for disposal, for further recovery or reuse, will also be recorded on exit.

5.4 Waste Acceptance Procedure

The following steps will be followed on a daily basis. The Site Manager and all site operatives will be trained to understand and implement the following waste acceptance procedures:

1. On arrival at the site's weighbridge, vehicles will supply the site office with the relevant paperwork (WTN and any sampling schedules/results) for initial checks. Any discrepancies will be resolved before the waste is officially accepted on site. The Site Manager will be directly responsible for ensuring that no non-conforming waste is accepted for processing on the site.
2. Checks on storage capacity will take place throughout the day to ensure that suitable space is available for all incoming wastes. The checks on capacity will be made by site operatives and will be visual only.
3. The load will be weighed and recorded on the WTN and weighbridge ticket. One copy will be held on site and the other given to the driver of the vehicle.
4. A visual load inspection will take place. This will be carried out before the waste is unloaded in the waste transfer building and will be undertaken by the weighbridge operative, to ensure consistency with the WTN.
5. If the load is rejected, the WTN will be completed with the reason for rejection, and the vehicle directed off site.
6. If it is not possible to inspect the waste prior to unloading, the waste will be inspected immediately after off-loading in the waste reception area, within the waste transfer building.
7. If after the off-loading of waste it is shown to be non-compliant, the load will be reloaded onto a vehicle or directed to the designated quarantine area immediately.
8. If after visual inspection the load is deemed to be compliant, the vehicle will then be directed to the waste reception building, where the waste will be unloaded or tipped in the relevant waste reception area.

5.5 Non-Compliant Waste

All pre-acceptance checks will be carried out before any waste is accepted on site as detailed in Section 5.1. These checks shall significantly minimise the likelihood of non-conforming waste arriving on site.

If waste is found to be non-conforming the following procedure will be followed and must be organised by either the Site Manager or the Technically Competent Manager on site:

5.5.1 Waste Found to be Non-Compliant at the Weighbridge

Any waste found to be non-compliant at the weighbridge will be handled as follows:

1. The load will be rejected, the vehicle will not be allowed to enter the site; and
2. All rejection of loads will be recorded within the site log.

5.5.2 Waste Rejected after Deposition within the Waste Reception Area

Any waste found to be non-compliant following deposition within the waste reception area will be handled as follows:

1. Reloaded on to the delivery vehicle; or
2. Removed to a designated quarantine area as appropriate.

If it is possible to determine the origin of the waste, the Site Manager will arrange for the waste to be collected by the origin customer and they will arrange onward disposal or treatment.

If it is not possible to determine the origin of the waste, the Site Manager will arrange for onward disposal or treatment.

5.5.3 Non-Compliant Waste Record

The WTN will be completed and will be cross referenced in the site log. This will include the following details:

- Date and time;
- Producer details;
- Carrier details;
- WTN reference number;
- Description of waste;
- Volume of waste;
- EWC code;
- Non-conforming waste; and
- Actions agreed and taken.

TABLE 1: WOODCOTE WOOD QUARRY LANDFILL.
INERT WASTE LIST FOR LANDFILL

01	**WASTES RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS**
01 01	**wastes from mineral excavation**
01 01 01	wastes from mineral metalliferous excavation
01 01 02	wastes from mineral non-metalliferous excavation
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07
01 04 09	waste sand and clays
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 07	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones other than those mentioned in 17 05 03
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 09	minerals (for example sand, stones)
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 02	**garden and park wastes (including cemetery waste)**
20 02 02	soil and stones

TABLE 2: WOODCOTE WOOD QUARRY LANDFILL.
INERT WASTE LIST FOR MATERIAL RECYCLING FACILITY

01	**WASTES RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS**
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07
01 04 09	waste sand and clays
10	**WASTE FROM THERMAL PROCESSING**
10 12	**waste from manufacture of ceramic goods, bricks tiles and construction products**
10 12 08	waste ceramics, bricks, tiles and construction products (after thermal processing)
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 07	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 06	dredging spoil other than those mentioned in 17 05 05
17 05 08	track ballast other than those mentioned in 17 05 07
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 08	**waste from waste water treatment plants not otherwise specified**
19 08 99	Stone filter media only (if cleaned to remove sewage contamination)

TABLE 1: WOODCOTE WOOD QUARRY LANDFILL.
INERT WASTE LIST FOR MATERIAL RECYCLING FACILITY

19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 05	glass (excluding residual fines from mechanical treatment of mixed waste at transfer stations)
19 12 09	minerals (for example sand, stones)
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 02	**garden and park wastes (including cemetery waste)**
20 02 02	soil and stones

APPENDIX C:

MAFF Good Practice Guides for Soils

MAFF Ministry of Agriculture Fisheries and Food

GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 2:

Building Soil Storage Mounds with Excavators and Dump Trucks

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

This document should be cited as MAFF (2000), Good Practice Guide for Handling Soils (version 04/00). FRCA, Cambridge.

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*(DETR, A Better Quality of Life, May 1999, paragraphs 6.66 and 8.50)

**MPG7 (November 1996, paragraph 3).

Acknowledgements

The Guide was written and prepared by Dr R N Humphries of Humphries Rowell Associates, Charnwood House, Loughborough, LE11 3NP, UK. The art work was by R Shenton of H J Banks & Co.

April 2000

MAFF Ministry of Agriculture Fisheries and Food

SHEET 2 BUILDING SOIL STORAGE MOUNDS WITH EXCAVATORS & DUMP TRUCKS

The purpose of this Guidance Sheet is to provide a model method for best practice where excavators and dump trucks are to be used to build soil storage mounds. This Guidance Sheet comprises 5 pages of text, 2 figures and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This soil handling method uses back-acting excavators to build the storage mound in combination with dump trucks (articulated or rigid bodied) to transport the soil.

The soil handling method can affect the agricultural quality of the restoration through severe soil deformation (compression and smearing). This is primarily caused through trafficking, the effects of which increases with increasing soil wetness.

The advantage of this model method, if correctly carried out, is that it should minimise severe deformation of the soil as trafficking is minimised. However, compaction due to trafficking will be unavoidable in mounds where the height of the mound exceeds the effective reach of the excavator boom and the trucks have to travel on mounded soil. Such compaction will need treatment during the excavation operation (see Sheets 3 and 18).

The key operational points to minimise the degree and extent of severe soil compaction (and for the effective treatment of compaction) are as follows:

(i) To minimise compaction:

- strip in advance the soil to basal layer along haul routes and the operational footprint of the storage mound.
- dump trucks are only to stand and travel on the basal layer (unless raising the next level in multi-tier mounds).
- the machines are to only work when ground or soil surface conditions enable their maximum operating efficiency.
- single-tier mounds are preferred to multi-tier mounds as it avoids the need for trafficking on the soil being stored.
- raise the soil using only the excavator and maximise the mound height before trucks allowed to access upper surface.
- in the raising of multi-tier mounds, trafficking is to be confined to the upper surface of the lower tier. [This layer will require decompaction on excavation of the mound. Sheets 3 & 18]

(ii) To minimise the wetting of soils:

- site soil mounds in dry locations and protect from run-off from adjacent areas. Drain if a wet location.

- raise the soil mound to maximum height progressively along the axis of the mound, and shape the mound as it is being built to shed water and whenever stripping is suspended.

- measures are required to protect the face of the soil layer from ponding of water and maintain the basal layer in a condition capable of supporting dump trucks.

The Storage Operation

2.1 The mounds should be sited on dry ground, not in hollows and should not disrupt local surface drainage. Where necessary mounds should be protected from run-off/ponding by a cut-off ditch which is linked to appropriate water discharge facilities. Where the storage mound is in a hollow due to the removal of surface soils, measures should be undertaken to ensure that water is not able to pond within the storage area.

2.2 All machines must be in a safe and efficient working condition at all times. The machines are to only work when ground conditions enable their maximum operating efficiency. The operation is to be suspended before traction becomes a problem or the integrity of the basal layer and haul routes fails; haul routes must be maintained.

2.3 The operation should follow a detailed soil stripping/storage plan showing soil units to be stripped and stored, haul routes and the phasing of vehicle movements. The soil units should be defined within the site with information to distinguish types and layers, with information about ranges of thickness. Detailed daily records should be kept of operations undertaken, and site and soil conditions.

2.4 Remove topsoil and subsoil to basal layer from the haul routes, footprint of the storage mound and any other operating area in advance; adopting the practices outlined in Sheet 1. These soils should be stored in their respective mounds.

2.5 The dump trucks must only travel within the haul route and operational areas. The trucks should enter the storage area, reverse and back-tip the soil load starting at the furthest point of the mound from the point of access. The back-acting excavator pulls up the soil into a mound of the required dimensions. The excavator operates by standing on the mound (Figure 2.1). The excavator bucket can be used to shape and firm the sides as the mound is progressively formed to promote the shedding of rain; particularly at the end of each day, but also on the onset of rain during the day. This should include any exposed incomplete surfaces.

2.6 The process is repeated with the tipping of soil against the forming mound, and without wheels traversing onto previously tipped material. The operation continues progressively along the main axis of the mound.

2.7 Without the trucks rising onto the soil mound, the maximum possible height is related to the boom reach of the excavator (typically 3-4m).

2.8 To raise the mound higher, the trucks will have to travel on the upper surface of the mounded soils. In this case the mound should be raised to its maximum height (Figure 2.2). A ramp will have to be provided for the trucks to rise onto the surface of the first tier, which should be capable of trafficking without difficulty. The next tier would be formed repeating the process described above. If further tiers are required, the process would be repeated.

2.9 Any exposed edges/surfaces should be shaped using the excavator bucket on the onset of rain during the day. All surfaces should be shaped to shed water

at the end of the day. The final outer surface should be progressively shaped using the excavator bucket to promote the shedding of rain.

2.10 Work should stop in wet conditions with measures undertaken to prevent ponding at the base of the mound and on the basal layer. At the start of each day ensure there is no ponding on the basal layers and operating areas.

Operational Variations

2.11 If front loading machines are to be used to excavate multi-tier mounds (Sheet 3), then the compacted inter-tier layer must be sequentially decompacted at the building stage by the method described in Sheet 18.

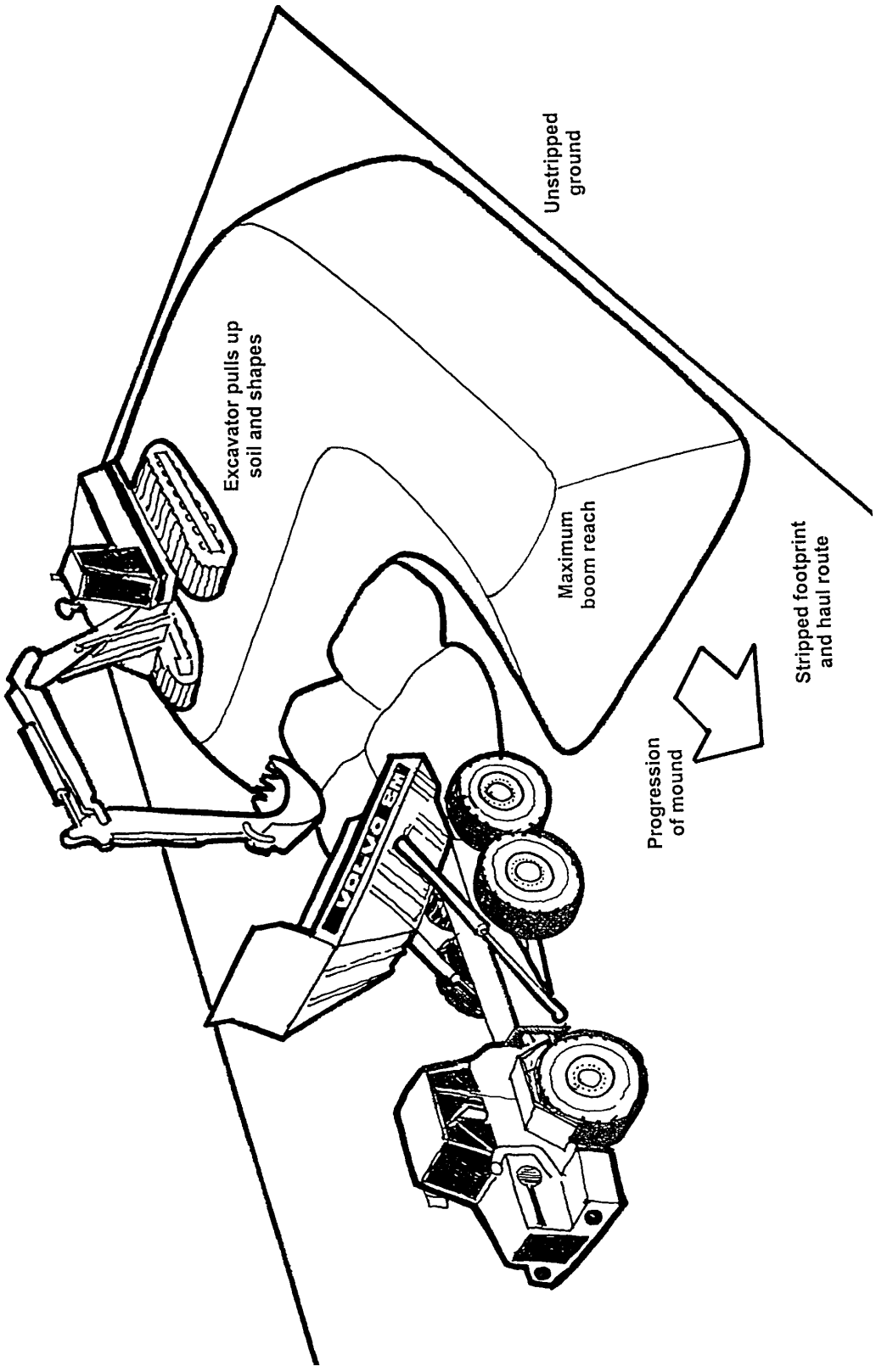

Figure 2.1 Soil storage mound construction with excavators and dump trucks: Single tier mound

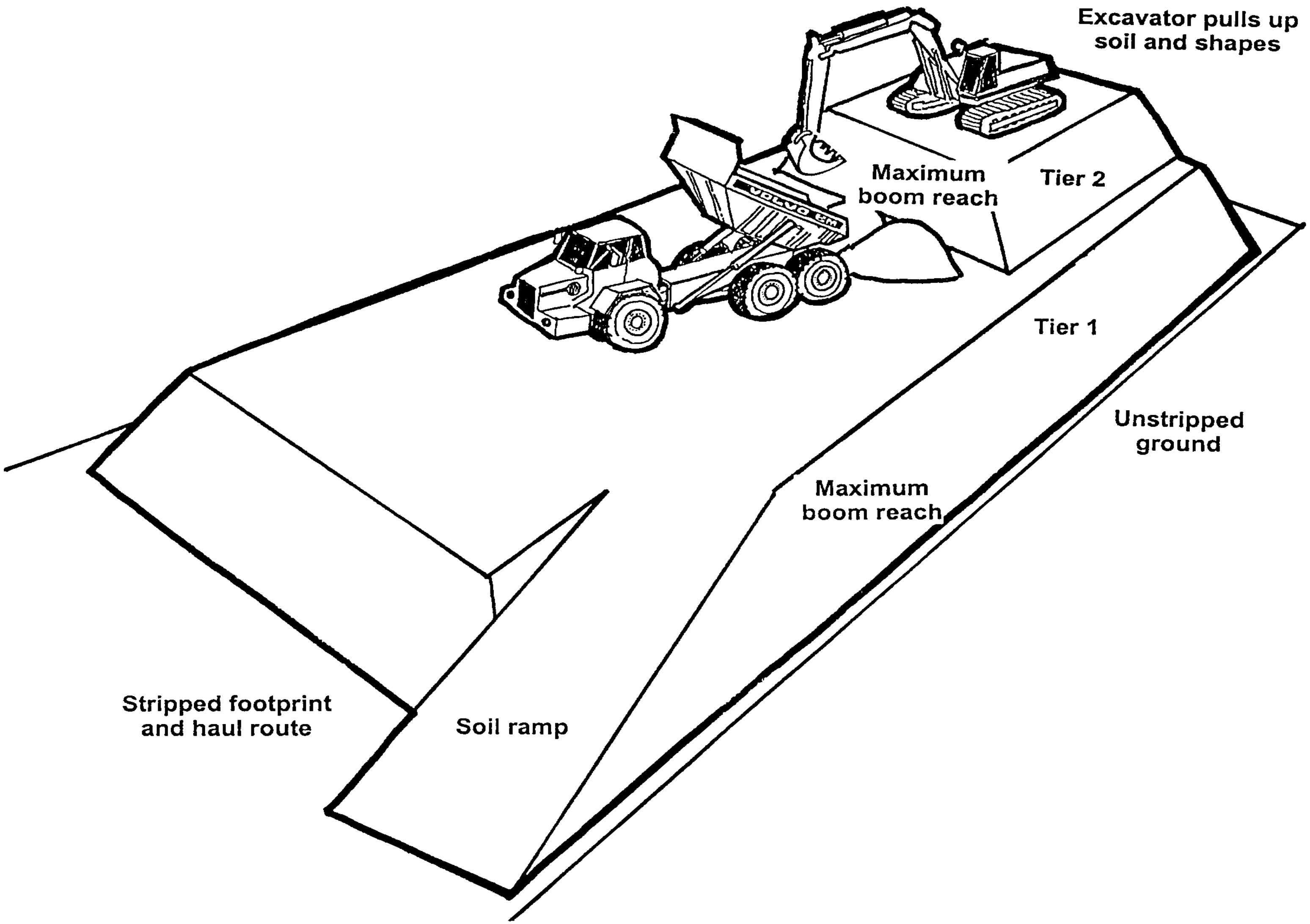

Figure 2.2 Soil storage mound construction with excavators and dump trucks: Multi-tier mound

MAFF Ministry of Agriculture Fisheries and Food

GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 3:

Excavation of Soil Storage Mounds with Excavators and Dump Trucks

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

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**MPG7 (November 1996, paragraph 3).

Acknowledgements

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SHEET 3 EXCAVATION OF SOIL STORAGE MOUNDS WITH EXCAVATORS & DUMP TRUCKS

The purpose of this Guidance Sheet is to provide a model method for best practice where excavators and dump trucks are used to excavate soil storage mounds. This Guidance Sheet comprises 4 pages of text, 3 figures and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This soil handling method uses back-acting excavators to load the soil in to dump trucks (articulated or rigid bodied) for transport to the replacement areas.

The soil handling method can affect the agricultural quality of the restoration through severe soil deformation (compression and smearing). This is primarily caused through trafficking, the effects of which increases with increasing soil wetness.

The advantage of this model method, if correctly carried out, is that it should avoid severe deformation of the soil as trafficking is minimised. However, where the soil has been stored in multi-tier mounds there will be a need for decompaction treatment during the excavation operation (see below and Sheet 18).

The key operational points to ensure avoidance of severe soil deformation are as follows:

(i) To minimise compaction:

- the dump trucks must only operate on the 'basal'/non-soil layer, and their wheels must not on any circumstances run on to the soil in store.
- the excavator should only operate on the soil mound.
- the machines are to only work when ground conditions enable their maximum operating efficiency.
- when excavating the multi-tier mounds, excavate tier by tier starting with the uppermost, trafficking is to be confined to the upper surface of the next tier.
- if compaction has been caused then measures are required to treat it before it is loaded into the trucks (see below and Sheet 18).

(ii) To minimise soil wetness and rewetting:

- the mound should be shaped to shed water before rainfall occurs and whenever replacement is suspended.
- measures are required to protect the face of the soil layer from ponding of water and maintain the basal layer in a condition capable of supporting dump trucks.

The Excavation Operation

3.1 The dump trucks are to travel only on haul routes and in operational area, and both must be maintained. In the case of single tier mounds they must only operate on the basal layer. Detailed daily records should be kept of operations undertaken, and site and soil conditions.

3.2 The trucks should enter the storage area and draw alongside the active excavation face. If back-acting excavators are used, they will need to stand on top of the mound to load trucks (Figure 3.1). The mound is to be dug to the base before moving progressively back along its axis.

3.3 With multi-tier mounds, the soil should be excavated tier by tier starting with the uppermost tier. This will necessitate the running of the trucks on the stored soil. Excavation should be in the same height of tiers as originally built so that the same surfaces are used for trafficking to minimise further compaction (Figure 3.2). Having removed an upper tier the trafficked layer must be decompacted. This can be achieved by progressively digging the surface as described on Sheet 18 in advance of loading the next layer. It is essential that the digging is effective and this needs to be systematically tested before soil is loaded. The process is repeated for each soil tier.

3.4 Any exposed edges/surfaces should be shaped on the onset of rain during the day. All surfaces should be shaped to shed water at the end of each day.

3.5 Work should stop in wet conditions with measures undertaken to prevent ponding at the base of the mound and on the basal layer. At the start of each day ensure there is no ponding on the basal layer and operating areas.

Operational Variations

3.6 Front loading machines may be used to excavate single tier soil mounds provided that they only operate on the basal layer with the dump trucks (Figure 3.3).

3.7 Front loading machines are only to be used for multi-tier mounds if the compacted inter-tier layer has been decompacted at the building stage.

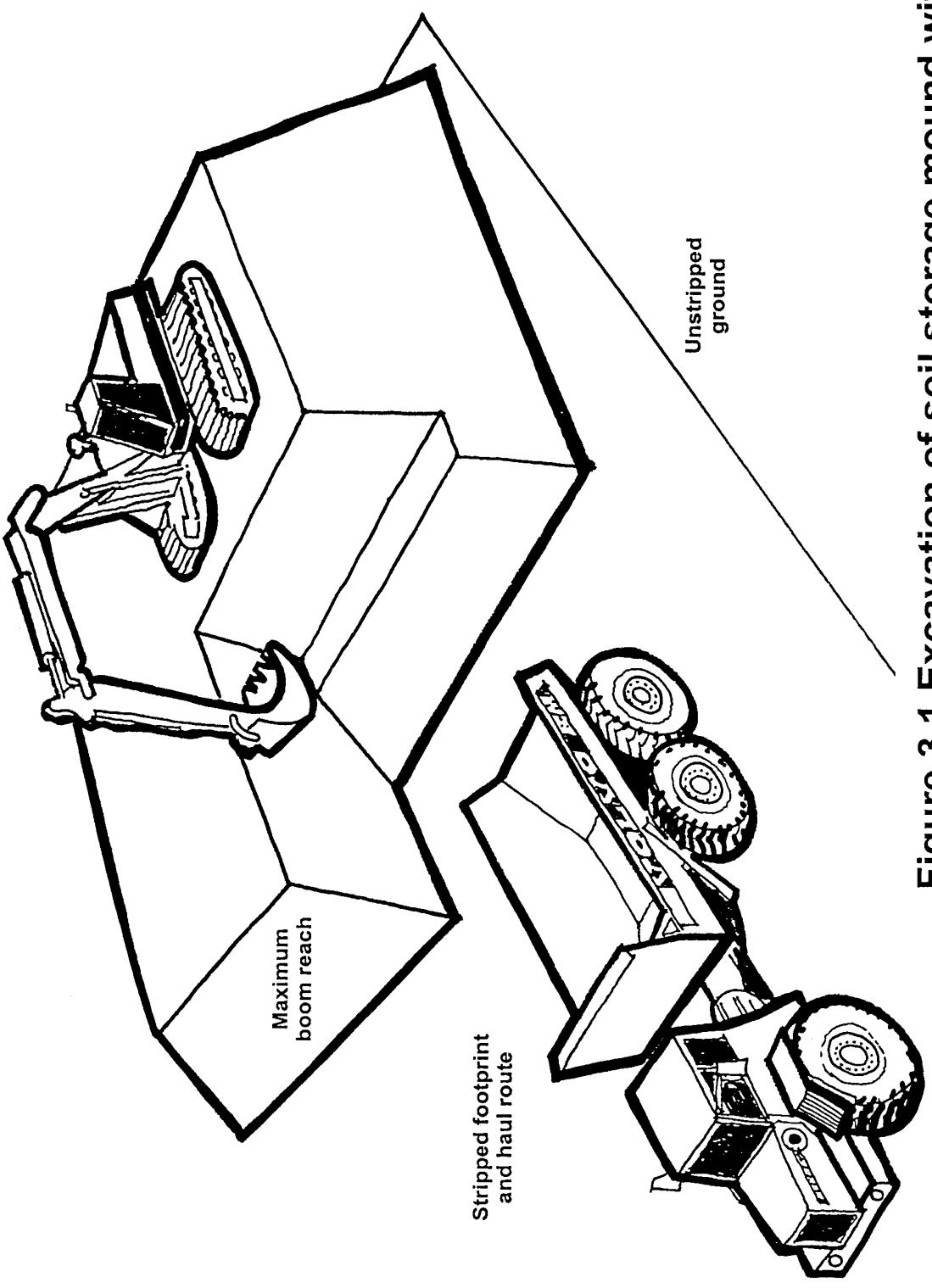

Figure 3.1 Excavation of soil storage mound with excavators and dump trucks: Single tier mound

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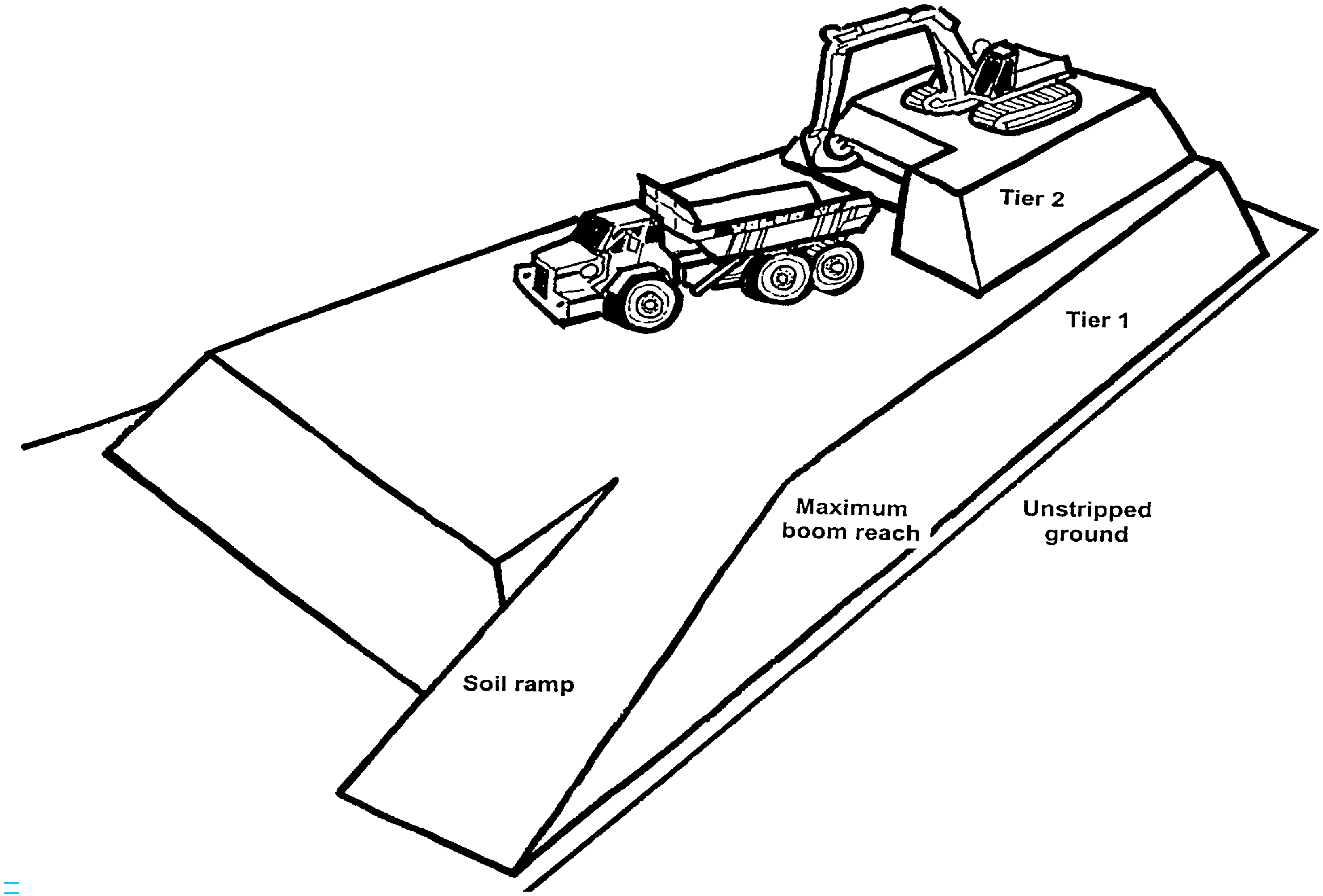

Figure 3.2 Excavation of soil storage mound with excavators and dump trucks: Multi-tier mounds

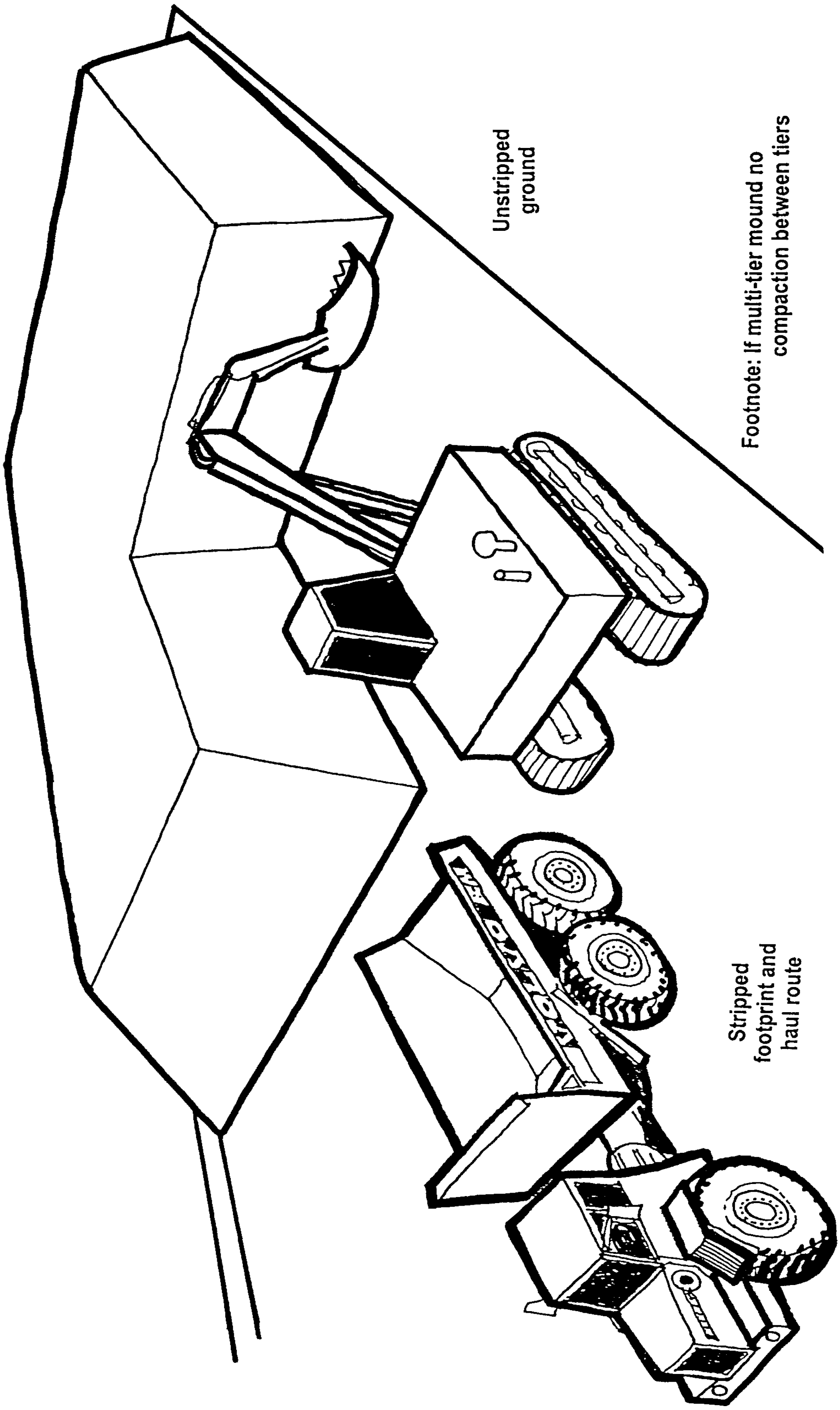

Figure 3.3 Excavation of soil storage mounds with front loading shovels and dump trucks: Single and multi-tier mounds

GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 4:

Soil Replacement with Excavators and Dump Trucks

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

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SHEET 4 SOIL REPLACEMENT WITH EXCAVATOR & DUMP TRUCK

The purpose of this Guidance Sheet is to provide a model method for best practice where soils are to be replaced by excavators and dump trucks. This Guidance Sheet comprises 7 pages of text, 4 figures and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This soil handling method uses back-acting excavators in combination with dump trucks (articulated or rigid bodied). An excavator is used to spread the soil tipped from dump trucks used for transportation to replacement areas.

The soil handling method can affect the agricultural quality of the restoration through severe soil deformation (compression and smearing). This is primarily caused through trafficking, the effects of which increases with increasing soil wetness.

The advantage of this model method, if correctly carried out, is that it should avoid severe deformation of the soil as trafficking is minimised. Consequently, there should normally be no need for decompaction treatment during the replacement operation, unless the soils are in a compacted state following stripping or storage. Where compaction occurs at replacement this will need treatment during the replacement process. Also where required, it will be necessary to integrate the removal of stones or damaging materials with the replacement process. Both decompaction and removal of materials are covered in separate Guidance Sheets (16-19).

The early installation of under drainage is strongly recommended. Where required this should either be undertaken sequentially during the replacement of the soils or in the early aftercare period. Until drains are installed it is recommended that the restored land is sown and managed as grassland.

The key operational points to ensure avoidance of severe soil deformation are as follows:

(i) To minimise compaction:

- the dump trucks must only operate on the 'basal'/non-soil layer, and their wheels must not on any circumstances run on to the soil layer(s).
- the excavator must only operate on the basal layer.
- the adoption of a bed/strip system avoids the need for the trucks and excavator to travel on the soil layers.
- the machines are to only work when ground conditions enable their maximum operating efficiency.
- if compaction has been caused, then measures are required to treat it (see Sheets 18 & 19).

(ii) To minimise soil wetness and rewetting:

- the bed/strip system provides a basis to regulate the exposure of lower soil layers to periods of rain and a means of maintaining soil moisture contents. The soil profile within the active strip should be completed to the topsoil layer before rainfall occurs and before replacement is suspended.

- measures are required to protect the face of the soil layer from ponding of water and maintain the basal layer in a condition capable of supporting dump trucks.

The Replacement Operation

4.1 The area to be restored is to be protected from in-flow of water, ponding etc. Wet sites must be drained in advance. Before the operation starts the basal layer should be to level and clean.

4.2 Prior to commencing operations a Meteorological Office forecast should be obtained which gives reasonable confidence of soil replacement proceeding without interruptions from rainfall events. If significant rainfall occurs during operations, the replacement must be suspended, and where the soil profile has been started it should be replaced to topsoil level. Replacement must not restart unless the weather forecast is expected to be dry for at least a full day.

4.3 All machines must be in a safe and efficient working condition at all times. The machines are to only work when ground conditions enable their maximum operating efficiency. The operation should only be carried out when the basal layer supports the machinery without ruts or is capable of repair/maintenance. The operation is to be suspended before traction becomes a problem or the integrity of the basal layer and haul routes fails.

4.4 The operation should follow a detailed replacement plan showing soil units to be replaced, haul routes and the phasing of vehicle movements. The soil units should be defined on the site with information to distinguish types and layers, and thickness. Detailed daily records should be kept of operations undertaken (including the removal of stones and other damaging materials, and the results of any assessment of the need for additional decompaction and effectiveness of decompaction work undertaken), and site and soil conditions.

4.5 The excavator and dump trucks are only to stand, work and travel on the basal/formation layer.

4.6 The soil layers above the base/formation layer are to be replaced in sequential strips with the subsoil layer(s) replaced first, followed by the topsoil layer; each layer being replaced to the specified thickness. The next strip is not to be started until the profile in the current strip is completed. This is often referred to as the 'bed or strip system'. The system involves the progressive sequential laying of the materials in strips across the area to be restored (Figure 4.1).

4.7 The initial strip width and axis is to be demarcated. Strip width is determined by excavator boom length less the stand-off to operate; typically about 5-8m. Effective boom length can also reduce with profile heights greater than 1m; at 1.5m the effective reach of the standard boom may result in only 2m wide strips. A wide bucket with a blade and not teeth should be used to spread the soil.

4.8 Reverse dump truck up to edge of the current strip and tip the lowest layer (subsoil) soil, without the wheels riding onto the strip (Figure 4.1). The dump truck should not drive away until all the soil is deposited within the strip without spillage over the basal layer; this may require assistance from the excavator to 'dig away' some of the tipped soil (Figure 4.2). The excavator is to spread the tipped soil to full thickness by digging, and the pushing and

pulling action of bucket. Each load of soil should be spread following tipping, before another is tipped. Should the spread soil comprise of large blocks (>300mm), normally these should be broken down by using the excavator bucket to 'slice' the blocks into smaller pieces (see Sheet 18) before the next load is spread. The process is repeated from left to right until the strip is completely covered with the required depth of the soil layer (Figure 4.3). Alternatively, decompaction by ripping should be undertaken once the strip is complete (see Sheet 19). Decompaction work must be completed before the next soil layer is placed.

4.9 Level boards and soil pits should be used to verify soil thickness in each strip and overall levels. Allowances (ie. a bulking factor) should be made for any settlement that may take place of the replaced loose soil.

4.10 Where stones are to be removed as part of the replacement process, normally the method described in Sheet 16 should be used once the strip is complete. An alternative method and one suited to removing potentially damaging materials (eg wire ropes) is described in Sheet 17. These operations must be completed before the next soil layer is placed.

4.11 On completion of the lowest (subsoil) layer, repeat the process spreading the next layer (subsoil/topsoil) (Figure 4.4). Tip the soil by reversing to the outer edge of strip/soil previously laid, but without the truck wheels riding onto the already placed layer. The soil is to be spread by the excavator to full thickness by digging, and the pushing and pulling action of bucket described above, and undertaking any necessary decompaction work and removal of stones if using Sheets 16 to 19. Repeat the process progressively (left to right) along the strip and undertake any removal of damaging materials or decompaction. Level boards should be used to verify soil thickness in strip and overall levels.

4.12 Where the profile is made up of further soil layers (subsoil/topsoil) the process outlined above should be repeated on completion of the strip.

4.13 On completion of topsoil layer the processes outlined above should be repeated for the next strips until the area to be restored is completed. Before the operation starts the basal layer should be to level and clean.

4.14 At the end of each day the current strip must be completed if rain is forecast. If during a day it is evident that a full strip cannot be completed, then only start part of a strip; this too must be completed.

4.15 At the end of each day, or during the day if interrupted by rain, make provisions to protect base of restored strip from ponding/runoff by sumps and grips, and also clean and level the basal layer. At the start of each day ensure there is no ponding in the current strip or operating areas, and the basal layer is to level with no ruts.

Operational Variations

4.16 When the replaced soil profiles reach about 0.6-1m in height it may not be possible to discharge the load from some dump trucks directly onto the previously placed layers because of the height of the dump truck body. The preferred solution is to tip the soil against the partially completed profile as heaps without the dump trucks rising onto or reversing into the placed material. The soil material is then lifted by the excavator onto the profile. It is considered preferable to accept some limited soil losses rather than to contaminate the topsoil with overburden. The loss of topsoil is minimised if the basal/ formation layer is kept to level and clean.

4.16 If the basal/formation layer is to be decompacted, before any soil material is placed, each strip is to be firstly decompacted before the subsoil layer is replaced using either methods described in Sheets 18 or 19. The basal layer must only be decompacted in the strip required for soil replacement, and must

only be prepared on the day of soil placement. During this process it may be necessary to use Sheets 16 or 17 for the removal of stones or damaging materials from the decompacted basal layer.

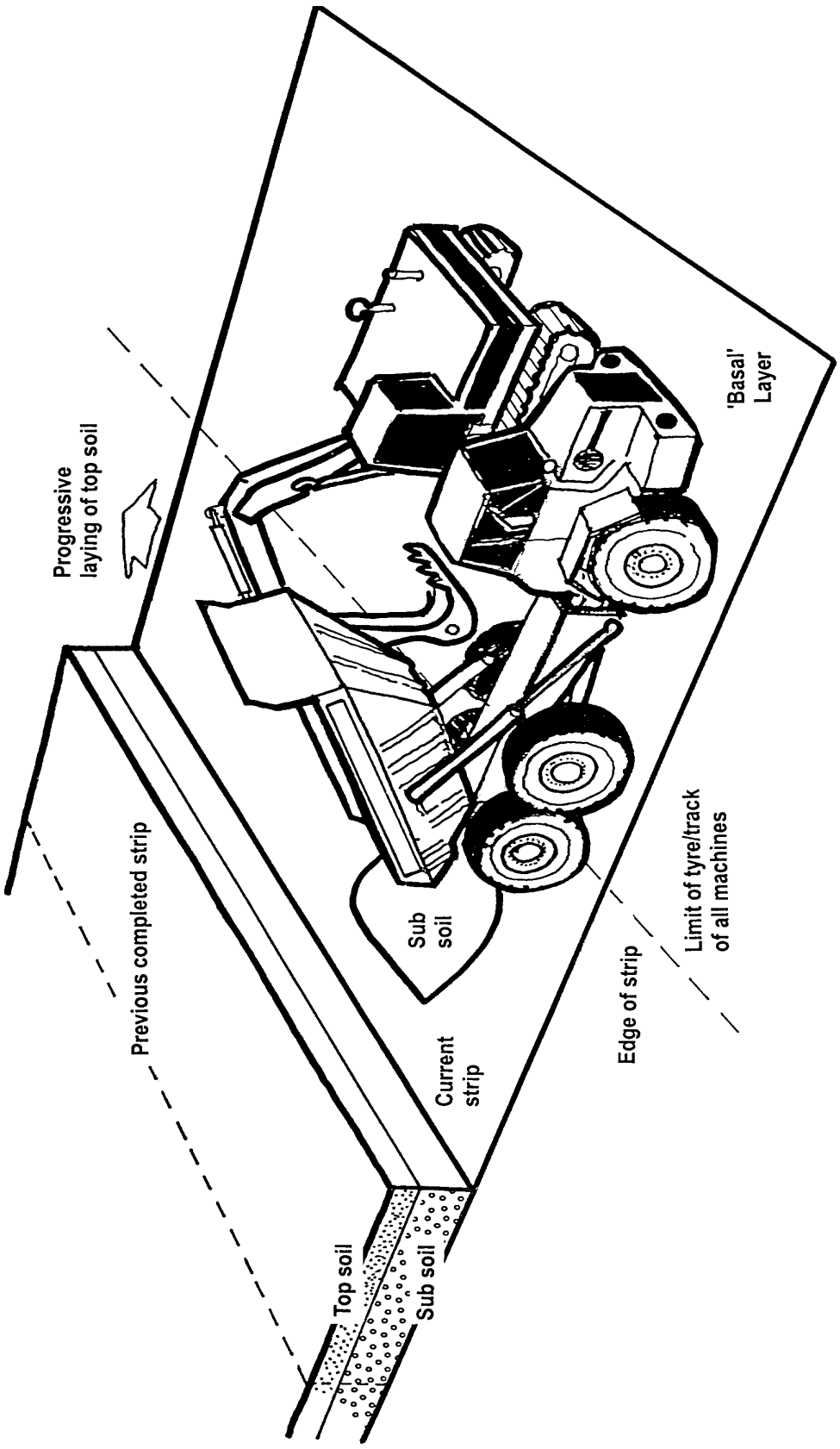
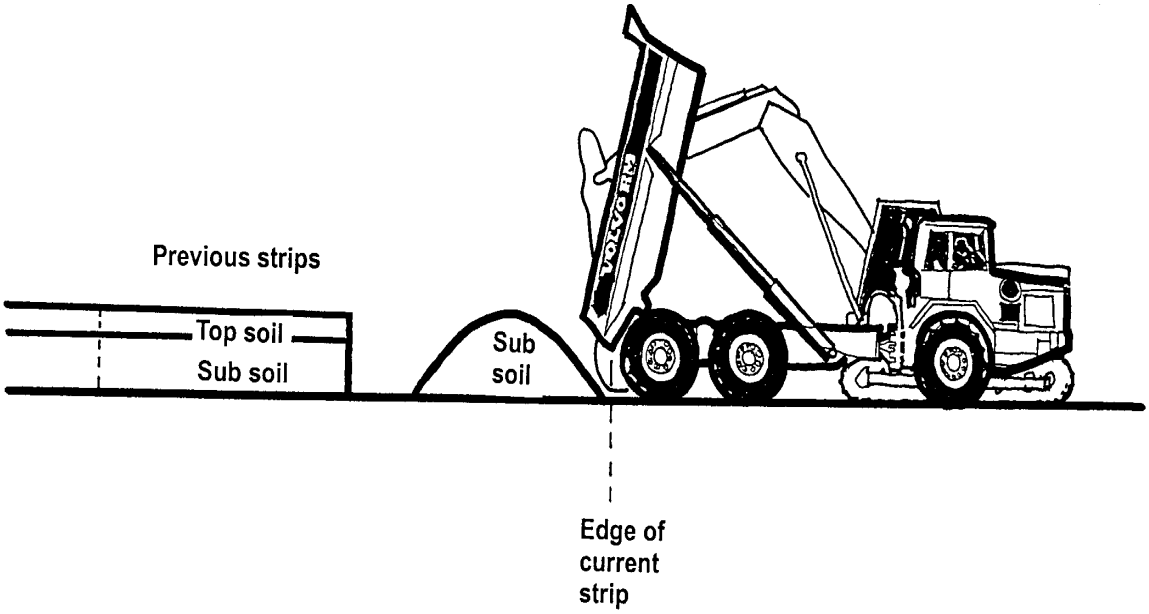


Figure 4.1 Soil replacement with excavators and dump trucks: Sub soil layer



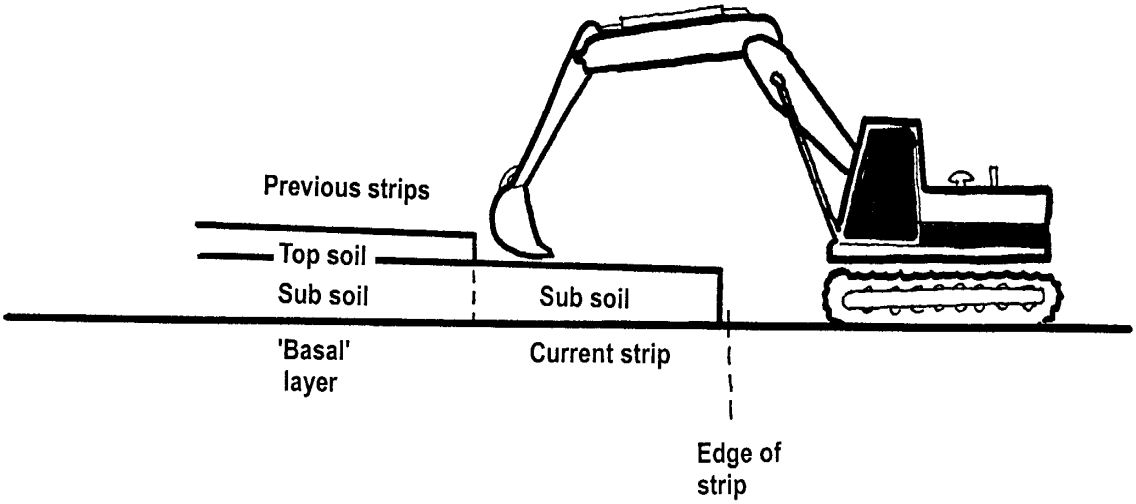


Figure 4.2 Soil replacement with excavators - dump trucks Sub soil layer

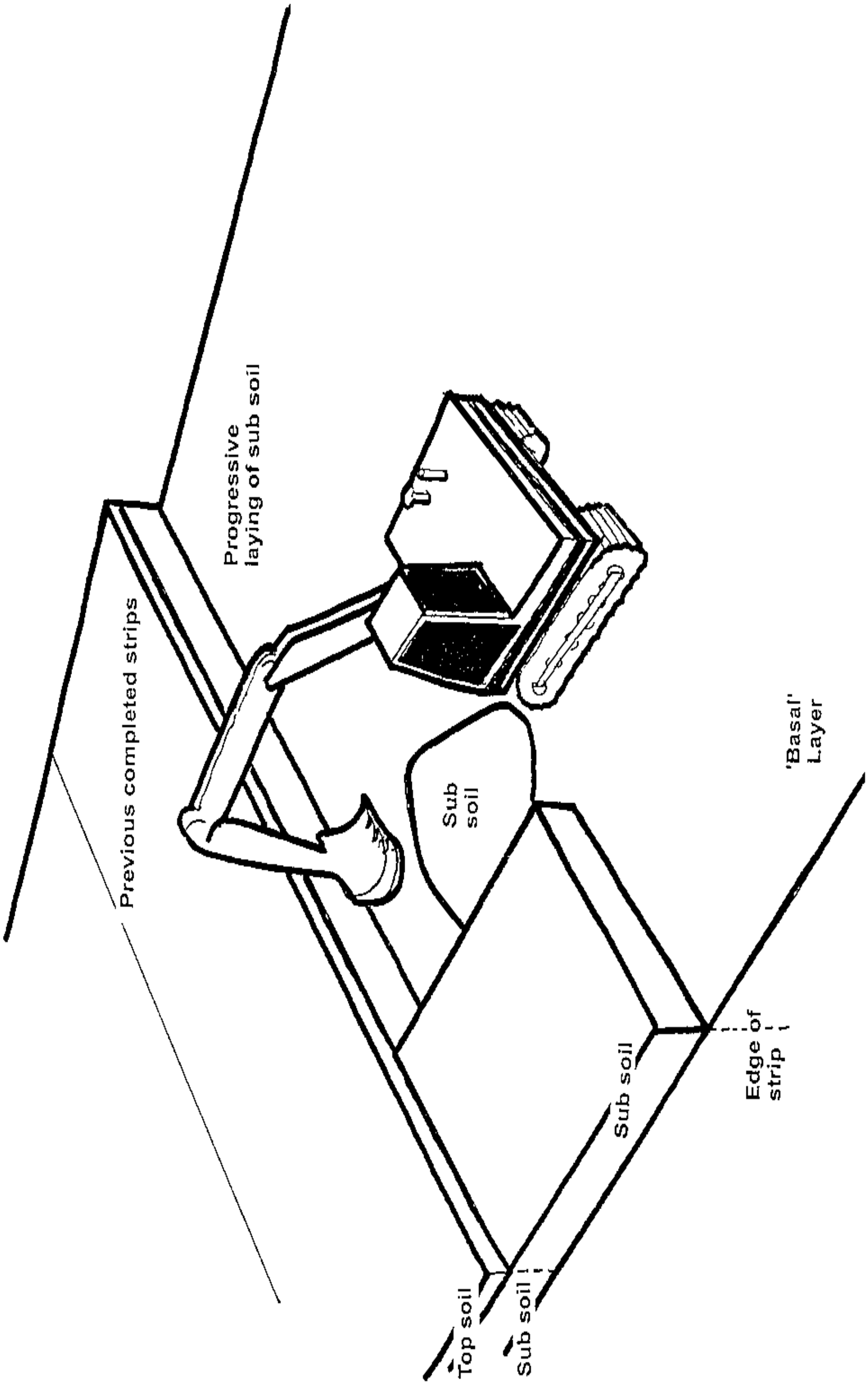
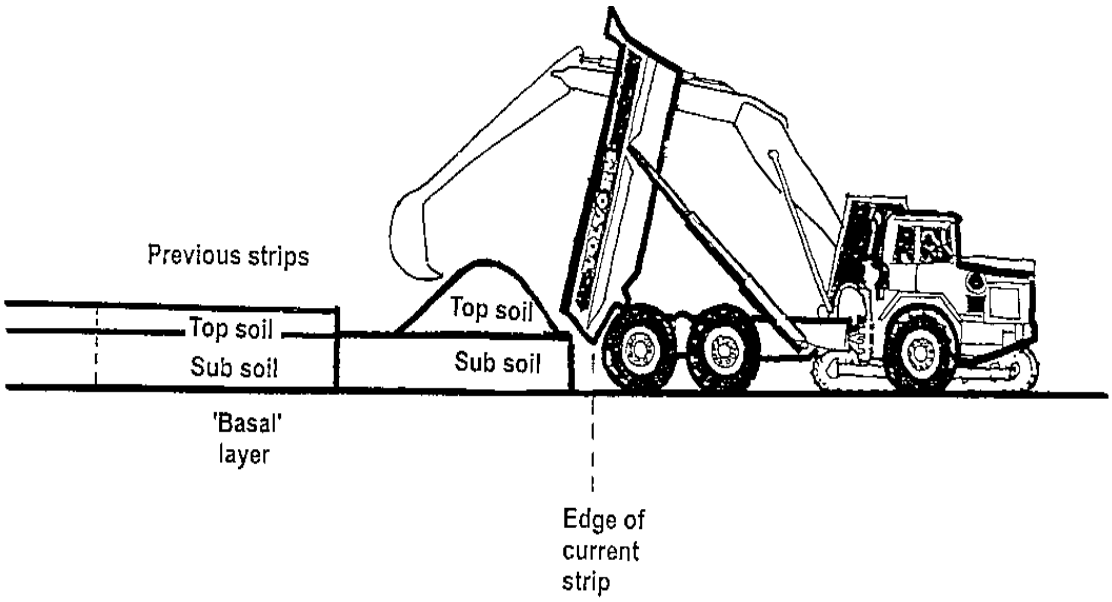


Figure 4.3 Soil replacement with excavators and dump trucks: Sub soil progressively laid



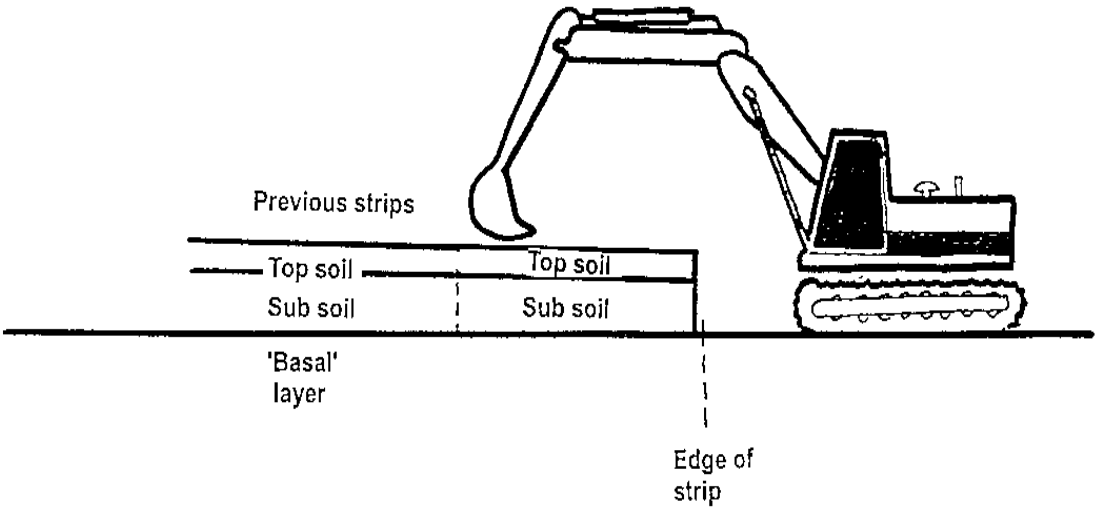


Figure 4.4 Soil replacement with excavators and dump trucks: Top soil layer

GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 16:

Release & Removal of Stones and Damaging Material from Excavator Replaced Soils

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

This document should be cited as MAFF (2000), Good Practice Guide for Handling Soils (version 04/00). FRCA, Cambridge.

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*(DETR, A Better Quality of Life, May 1999, paragraphs 6.66 and 8.50)

**MPG7 (November 1996, paragraph 3).

Acknowledgements

The Guide was written and prepared by Dr R N Humphries of Humphries Rowell Associates, Charnwood House, Loughborough, LE11 3NP, UK.

MAFF Ministry of Agriculture Fisheries and Food

SHEET 16 RELEASE & REMOVAL OF STONES AND DAMAGING MATERIAL FROM EXCAVATOR REPLACED SOILS

The purpose of this Guidance Sheet is to provide a model method for best practice where stones and/or potentially damaging materials are to be released from excavator replaced soils (see Sheet 4). This Guidance Sheet comprises 3 pages of text and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This soil handling method uses a back-acting excavator to remove stones and damaging materials (eg. wire rope, concrete blocks) from replaced layers of soil or treated basal layers.

The occurrence of stones and materials can affect the agricultural quality of the restoration, largely through interfering with cultivations.

The advantage of this method, if correctly carried out, is that it should avoid additional deformation of the soil (compaction) as trafficking is avoided.

The key operational points to ensure avoidance of severe soil deformation are as follows:

(i) To minimise compaction:

- the excavator must only operate on the basal layer.
- the operation should only be carried out when the soils are below their plastic limit.
- the excavator is only to work when ground conditions enable maximum operating efficiency.
- if compaction is caused, then measures are required to treat it (see Sheet 18).

(ii) To minimise soil wetness and re-wetting:

- see Sheet 4.

The Release & Removal Operation

16.1 The removal of large stones (>150mm) from shallow depths of replaced soils (<300mm) is possible using an excavator fitted with a Geith Stone Rake Bucket (R) or similar. This is a slatted bucket with 'teeth' (150mm apart and about 300mm long). The same equipment can be used for the basal/formation layer provided it has been decompacted first, either by an excavator with a standard bucket (see Sheet 18) or ripping with tines (see Sheet 19). Where the stones to be removed are less than 150mm, but greater than 20mm, a specialist stone picking machine should be used. The use of such equipment is generally

only applicable to the topsoil layer. The removal of these smaller stones should be part of the cultivation phase for cropping, and is outside the scope of this document.

16.2 The effective removal of materials (wire rope, drums, tree roots, concrete lintels, etc) damaging to aftercare operations (eg. cultivation, under-drainage installation) is generally not effective with the above bucket method. This operation is best undertaken using ripping equipment and practices described in Sheets 17 and 19.

16.3 An excavator with a Geith type of bucket 'combs/rakes' the surface to a depth of up to about 200-250mm of each soil layer when it has been replaced to level along the strip, and before the next layer is placed. The combing action is used to release and windrow the stones, and the bucket is used to load them into a dump truck for disposal or utilisation elsewhere.

16.4 The combing action serves to level the soil surface and can also break up soil clods. Where the soil is of a very fine texture (clayey) and has a relatively high moisture content, it can be difficult to break down soil clods and release the stones. In these circumstances the stone rake bucket can be ineffective in releasing and removing stones.

16.5 Where required, in conjunction with the excavator-dump truck combination, the above is to be integrated into the procedures listed in Sheet 4.

16.6 Stone removal from the topsoil layer can be delayed until the whole area has been restored. If this option is adopted the use of the bucket method is not appropriate, and a tine cultivation method should be used followed by removal of the stones by hand or machine. In this situation, a final deep ripping of the soil profile is likely to be required on completion (see Sheet 19).

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GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 18:

Soil Decompaction by Excavator Bucket

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

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*(DETR, A Better Quality of Life, May 1999, paragraphs 6.66 and 8.50)

**MPG7 (November 1996, paragraph 3).

Acknowledgements

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SHEET 18 SOIL DECOMPACTION BY EXCAVATOR BUCKET

The purpose of this Guidance Sheet is to provide a model method for best practice where an excavator bucket is used to decompact soils and basal/formation layers. Excavators are most likely to be used for this purpose where soils are replaced by either excavator and dump truck or bulldozer and dump truck combinations. This Guidance Sheet comprises 3 pages of text and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This decompaction method uses an excavator (back-acting type) with a bucket to dig the soil layers to relieve compaction and smearing.

The advantage of this model method, if correctly carried out, is that it should result in the complete lateral decompaction of the soil layer. However the method is limited to relatively shallow depths due to practicalities and bucket size. There is no advantage

of this method over the use of tines (Sheet 19) in respect of soil water content, the soil must be dry enough to shatter.

There are a number of key operational points:

- the excavator is only to stand on and work from the basal/formation layer.
- the moisture content of the soils should be at least 5% below their plastic limit, or greater than this if so advised.

The Decompaction Operation

18.1 The excavator is only to stand on and work from the basal/formation layer.

18.2 The bucket is to be of a type with teeth.

18.3 Where the soil layer to be decompacted is up to about 0.5m thick the following procedure can be adopted. The excavator is to decompact the specified layer by systematically digging along a working face from the back to the front of the strip, working in sections. The digging is to be a cutting action, with the bucket down to the full depth of the layer to be decompacted, and through a scooping motion the soil material is lifted and re-deposited. It is essential each successive bucket 'dig' overlaps with the former both to the back and side of the dig. Finally, the bucket edge can be used to lightly grade the finished surface.

18.4 Where the soil layer is deeper than the capability of the bucket (about 0.5m), a 'double-digging' approach is needed. The process is to systematically work its way along the strip, and the next layer of soil is not to be laid until this operation is complete. The method is particularly time consuming and the method described in 18.5 below is recommended.

18.5 The alternative for deep profiles to be decompacted by this method is to place the layer in several layers, each up to 0.5m in thickness, and to sequentially decompact each layer as described in 18.3 above. The next layer is to be placed on the decompacted strip, but only when the former layer has been laid and decompacted along the entire length of the strip. The process is repeated until the soil horizon is replaced to the required thickness and has been 'dug over'.

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GOOD PRACTICE GUIDE FOR HANDLING SOILS

Sheet 19:

Soil Decompaction by Bulldozer Drawn Tines

Issued by the Farming and Rural Conservation Agency, Cambridge

April 2000

v04/00

MAFF FOREWORD

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Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential**. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling "Good Practice" to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

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SHEET 19 SOIL DECOMPACTION BY BULLDOZER DRAWN TINES

The purpose of this Guidance Sheet is to provide a model method for best practice where tines are used to decompact soils and basal/formation layers. Tines are most likely to be used for this purpose where soils are replaced by either earth scrapers (towed and self-propelled types) or bulldozers and dump truck combinations. The tines should be drawn by tracked bulldozer and not by wheeled tractor or grader machines. This Guidance Sheet comprises 9 pages of text, 5 figures and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This decompaction method uses a tracked bulldozer to draw tines through the soil layers to relieve compaction and smearing. For this method of decompaction to be effective, there are a number of requirements to be met, in particular the

soil should be in a dry enough condition to be able to shatter and the use of effective equipment.

There are a number of key operational points to maximise the effectiveness of the decompaction treatment:

(i) To maximise decompaction:

- the moisture content of the soils should be at least 5% below their plastic limit, or greater than this if so advised.
- the ripping pattern must be overlapping passes and recompaction at depth must be treated in the ripping strategy.
- the tines should be sufficiently closely spaced to ensure that full lateral decompaction is achieved with overlapping passes.
- the use of winged straight tines is recommended.
- the tine length and width must be compatible with the proposed depth of decompaction, and allow for soil 'heave'.
- tine and wings must have wear plates and be in good operating condition. Worn and deformed tools must not be used.
- the towing unit must be capable of pulling the tine combination in an operationally efficient manner, without undue weaving and track slippage.

(ii) To minimise rewetting:

- ripping should not be undertaken if significant rainfall is forecast.
- where the soil profile is partly raised to ground level, the uppermost soil layer should be left in an unripped state. Where the subsoil layer has been ripped, but the topsoil not placed, it should be sealed by blading with a bulldozer. On resumption of operations, the upper and lower layers will required decompacting.

Ripping Strategies

Ripping to decompact soils is an integral part of the soil replacement procedures using towed or self-propelled earth scrapers or bulldozer-dump truck combinations. The primary aim of the ripping strategy is to ensure that there is no significant compaction within the soil profile which might impede root growth or drainage. There are two basic ripping strategies that can be used. These are; when the soil profile is ripped sequentially as the soil layers are built up, or when it is ripped only after the profile is complete. Each have their own limitations and the selection should be matched to the soil profile in question and the specification of the equipment to be used. It may not be possible to treat deep compaction, or even compaction at moderate depth, once the profile has been completed, hence it is essential that the correct strategy is adopted. In some circumstances it may be necessary to adopt a combination of both strategies to achieve satisfactory results.

(i) Sequential ripping of each layer before next is placed (Figure 19.1a):

- appropriate when profile/horizon thickness exceeds the effective depth of the tine or capacity of the towing unit being used; a number of sequential rips are required, each layer ripped before the next is placed.

- the depth of subsequent sequential ripping must relieve any recompaction of the lower layers following the placement of the new overlying layer or other surface operations.

- appropriate where stones and/or damaging materials are to be released and removed from sub-surface horizons.

- has to be carried out during the replacement operations.

- the final surface layer ripping can be delayed (as with (ii) deep ripping approach) until all strips complete and works finished.

(ii) Single deep ripping on completion of profile (Figure 19.1b):

- appropriate when profile thickness is equivalent to or less than the effective depth of tine and capabilities of towing unit.
- appropriate where stones and/or damaging materials are absent or need not be removed from sub-surface horizons.
- appropriate where artefacts or stones need only to be removed from surface topsoil layer, where a shallower surface cultivation would be carried out prior to final ripping.
- appropriate where sequential ripping has been undertaken and there is still recompaction at depth.
- final ripping can be delayed until all strips and final works complete, or later in aftercare period.

Equipment

19.1 Crawler-tracked tractor units of a minimum 300hp are required. [Expect 30hp/leg or shank on multiple tine beam cultivator to 750mm depth and 100hp/tine three leg or shank to 750mm depth.]

19.2 There are two types of ripping units: i) frame-mounted on tractor unit and usually hydraulic operated, and ii) mounted on towed trailers/tool carriers and either cable or hydraulic operated. Control mechanisms have to be matched between tractor unit and tool carriers.

19.3 There are two types of tines: straight leg and curved leg. The former is the most commonly used and is the principal tool for decompaction. Straight tines are to be used where there are obstructions or the soils/formation layer is excessively stony. Curved tines are typically used, in combination with straight tines, and set to operate at shallower depth for the purpose of reducing the 'drag' resistance of the following straight tines. Often the straight tine is operated in a raked mode (about 10 degrees backwards from the foot) rather than in an upright stance to promote decompaction by uplift and also to reduce drag.

19.4 Straight tines (leg) should have a wedge foot (Figure 19.2) at the base to reduce drag, aid penetration and assist with the upward displacement of the soil and shattering effect.

19.5 There are two forms of straight tines, those with and those without wings (Figure 19.2). Wings of 250-400mm total span (outer tip to outer tip) are welded either side of the tine leg or foot at angle 20-30 degrees. This is to promote upward displacement and lateral shatter, but also has the effect of significantly increasing drag. Straight tines without wings will require either more overlapping passes or closer spaced tines (the latter will increase drag).

19.6 There are two critical dimensions which determine the potential effectiveness of the tines, these are tine length (which determines the potential depth of decompaction) and tine thickness (which determines the potential amount of heave and therefore shatter and decompaction). The achievement of the potential of the ripping tools is dependent on the moisture content of the soil/formation material (it must be dry enough to shatter otherwise the soil material simply deform around the tool).

19.7 The length of the tine is the most common limiting dimension of the tool. The length of the tine from the heal of the foot to the base of the tool bar/carrier

less 200/250mm or 30%, whichever is the lesser, is the potential maximum effective ripping depth of the tine (Figure 19.3). The deduction allows for upward displacement of the soil as the tool is drawn through the profile. Without this allowance the soil heave will rise to or above the tool bar and increase drag and reduce the decompaction achieved (Figure 19.3). The most commonly used tines have maximum effective depths of about 500-700mm. Whilst longer tines can be provided these may cause problems with mobility of the tractor unit. One exception is the British Coal specification SIMBA MK IV Ripper with 1.2m carrier borne tines which has a potential effective depth of 900-1000mm.

19.8 The width of the tine (front to back) co-determines the potential effective ripping/ decompaction depth, with a ratio of 5 times the width of the tine (Figure 19.2). Typically the width of the tine is 300-400mm, giving a potential effective depth of 1500-2000mm and operationally is not usually a limiting factor. The thickness and width of the tine used is usually determined by other factors, the mechanical stresses imposed by the work undertaken (ie its strength) and the slot dimensions in the tool bar carrier.

19.9 The thickness of the tine (typically 40-80mm) contributes significantly to its strength but also to drag. The tine should have a welded wear plate on the leading edge to reduce wear, as should the leading edge of the attached wings (Figure 19.2).

19.10 The minimum number of tines must be two, each following the mid point of the tracks of the tractor unit (Figure 19.4). Generally, the most common configuration is three with a tine central to the tractor unit. The tines may be arranged in a straight line or as a triangle with the central tine leading to reduce drag. The tines may or may not have wings, often the central tine may be without wings to reduce drag. Three winged tines are the preferred

configuration. However, straight tines are more appropriate where there are significant artefacts/obstructions, and where soils are excessively stony.

19.11 Mixed combinations of curved tines leading straight tines (as a double beam configuration) are an alternative and can potentially achieve more effective lateral shatter.

Decompaction Operations

19.12 Ripping to decompact materials must only to be undertaken when the soils are dry enough to shatter and must be suspended before the soil become plastic. Ripping should only be undertaken in dry weather and is to be suspended when the tractor unit looses traction/weaves under normal operating conditions. If the soils are inherently wet consideration should be given to deep ripping later following the establishment of a crop to dry out the upper horizons; this may require several successive years of treatment to progressively decompact the profile.

19.13 The tines are to be drawn through the basal/formation or soil layer at the required depth according to the decompaction strategy and capability of the equipment and towing equipment. The tines are to be drawn at sufficient and constant speed, and at their optimum angle (rake) to achieve maximum heave with the least drag, and without track slippage or the tractor unit weaving.

19.14 The ripping is only to be undertaken both ways along one axis and at an orientation to promote down-slope drainage, but never cross-wise or across slope. Where ripping is in one direction, as down slope on steep gradients, the machinery is to travel back only on unripped ground.

19.15 The ripping must achieve the required depth in the first pass without the heave rising above the base of the tool bar (Figure 19.3), the tine is to enter to its full depth on the first pass and all subsequent passes. The area should not be ripped to a shallow depth first and then re-ripped to a greater depth. However, this may be unavoidable in the first pass in order to 'break' ground and reduce resistance to be able to achieve the required penetration. Headlands are to be ripped first to enable quick and full penetration; this is essential at the base of slopes. Ripping must extend into and out of sides of ditches.

19.16 Where the final profile thickness is equivalent to or less than the effective depth of the tine, the ripping operation can be undertaken after all the horizon(s) have been laid (Figure 19.1b), except where it is necessary for stones or artefacts to be removed.

19.17 Where the profile thickness exceeds the effective depth of the tine, the profile must be ripped in a sequence of successive layers. The ripping is to be undertaken sequentially following the placement of each layer and before the next layer can be laid. This usually takes place after the placement of each horizon (ie lower subsoil, upper subsoil and topsoil) (Figure 19.1a). If the proposed horizon thickness exceeds the effective depth of the ripper tine, then the soil horizon needs to be laid in sub-layers, with each of these being ripped before the next is laid.

19.18 In the ripping of successive replaced horizons/layers, allowance must be given to recompaction caused in the lower layers by the laying and spreading of the soil by scrapers or bulldozer. The allowance necessary depends on the soil type and moisture content. For scrapers, recompaction to 400mm should be allowed for in specifying the thickness of the next layer of soil to be placed and decompacted. A minimum of 300mm should be allowed for bulldozers with standard or narrow tracks. The recompacted soil layer must be

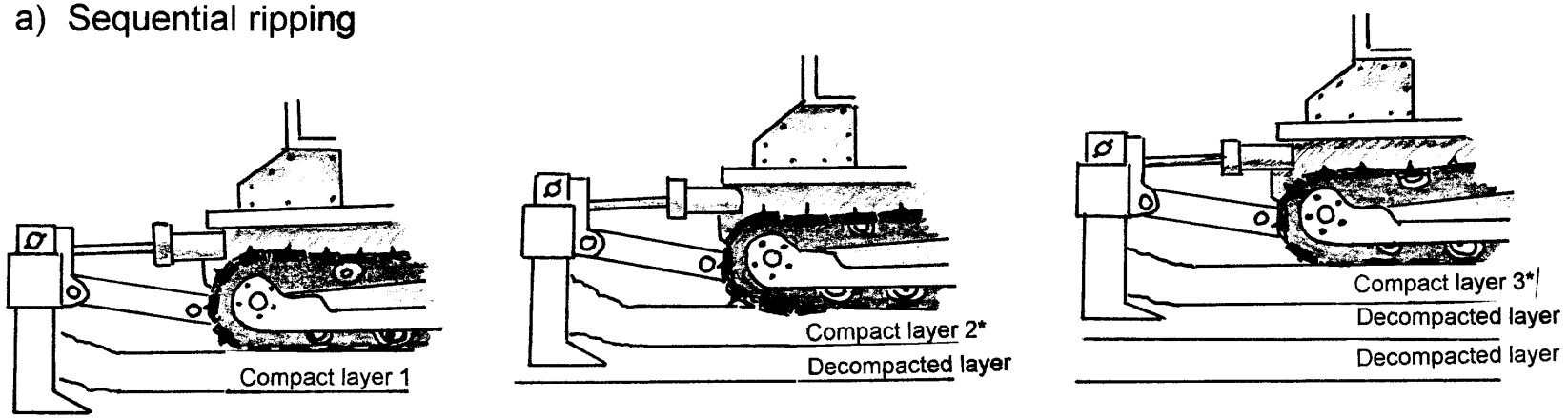
decompacted along with the thickness of the new layer laid. This requires the depth of decompaction of the next layer to include the thickness of the recompacted soil layers. The thickness of the new layer that can be laid over the recompacted layer(s) will be governed by the potential effective depth of the tine. Hence, after the laying and decompaction of the first soil layer, subsequent soil layers will have to be laid at shallower thickness (Figure 19.3).

19.19 The final decompaction of the topsoil layer should be to the full effective depth of the tine.

19.20 In carrying out the ripping operation, each successive pass is to overlap, with the tine on the ripped side bisecting the pass of the outer and central tine of the previous pass (Figure 19.4). Where full depth or lateral consistency of decompaction is not achieved, the overlap should be increased by further bi-section.

19.21 The degree and consistency of loosened soil must be checked as the ripping is taking place, especially across the junctions between strips (the latter may require inspection by pits). Routine qualitative assessment can be made with a 15mm diameter steel probe with blunt convex end. The probe is pressed in soils at 150mm intervals along a number of transects across the line of ripping, and the depth to penetration and feel of resistance recorded (Figure 19.5). Alternatively soil penetrometers may be used. Both methods should only be used in conjunction with a method of on-site 'calibration' of compactness; this is essential as soil water content and stoniness have a major influence on interpretation.

a) Sequential ripping



*ripping depth to include recompaction in lower layers

b) Final deep rip

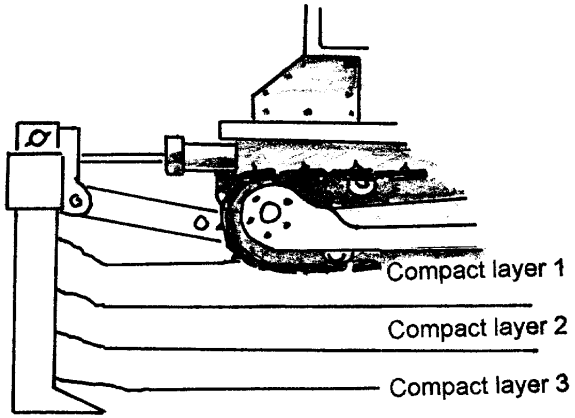


Figure 19.1 Decompaction by bulldozer drawn tines

MAFF Ministry of Agriculture Fisheries and Food

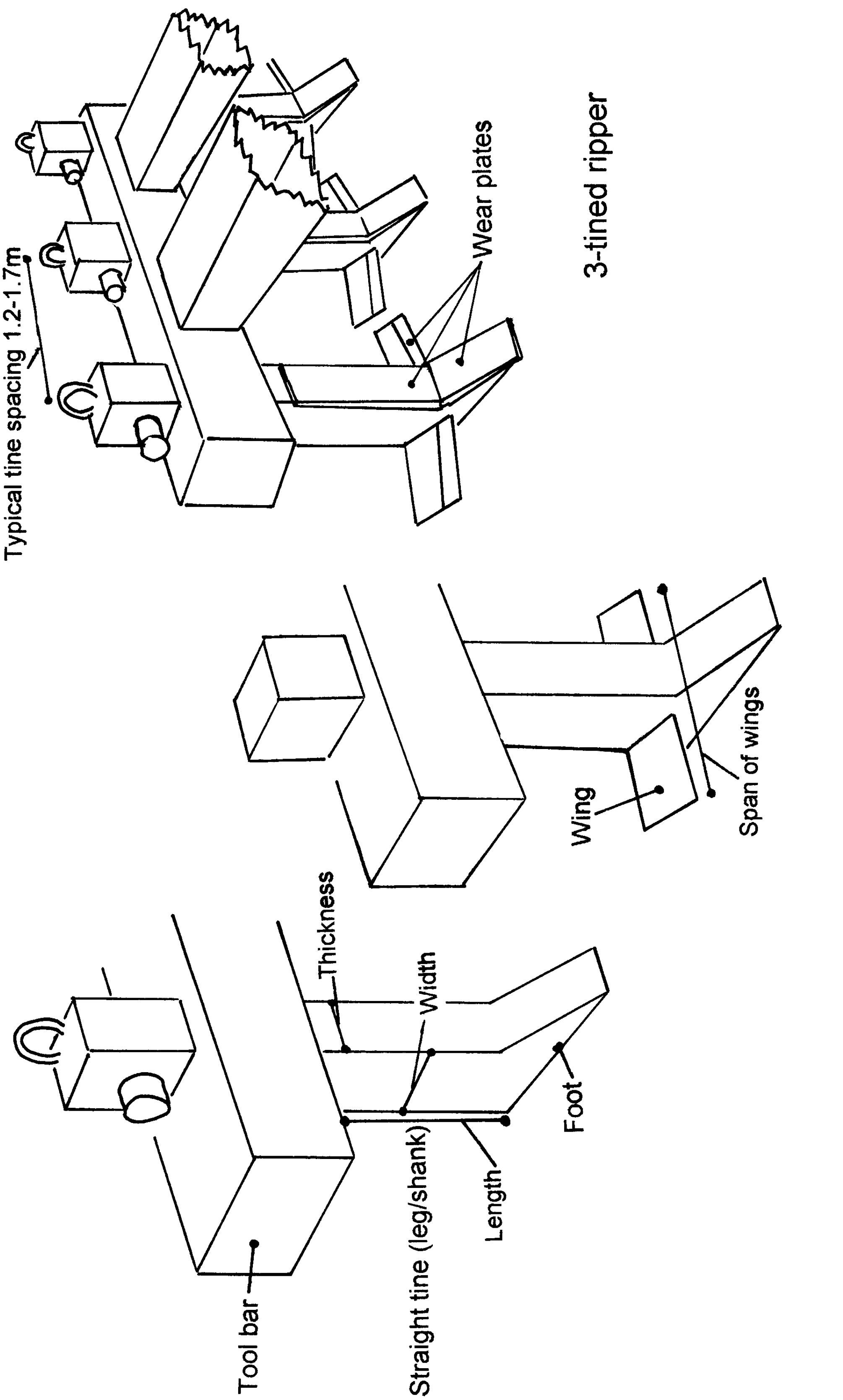
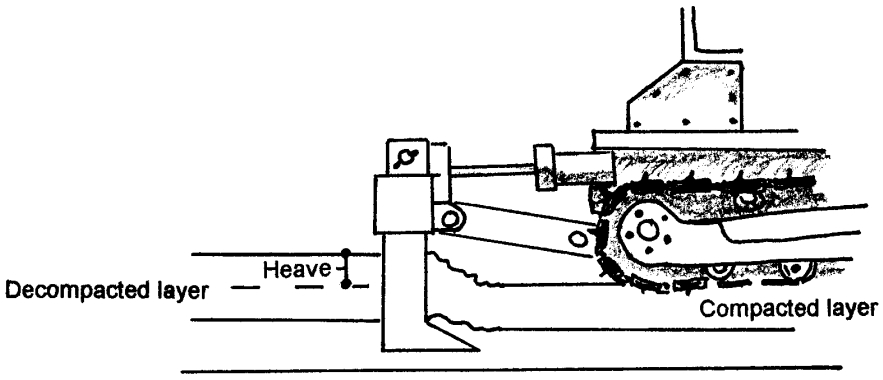
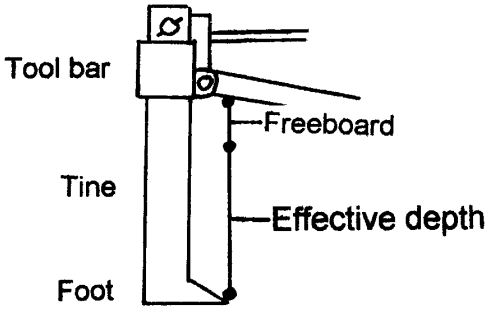


Figure 19.2 Features and critical dimensions of bulldozer drawn tines



Heave = freeboard required below tool bar



Calculation of effective depth of tine of 300mm width & 900mm in length below tool bar:

i) potential maximum depth of decompaction is 1500mm with tine of 300mm width and 900mm with tine of 900mm length

ii) potential effective operating depth for first soil layer is 900 - 200 (freeboard) = 700mm

iii) potential effective operating depth subsequent soil layer is 900 - (200 + 300 [eg depth of recompacted lower material]) = 400mm

Figure 19.3 Effective decompaction depth by tines

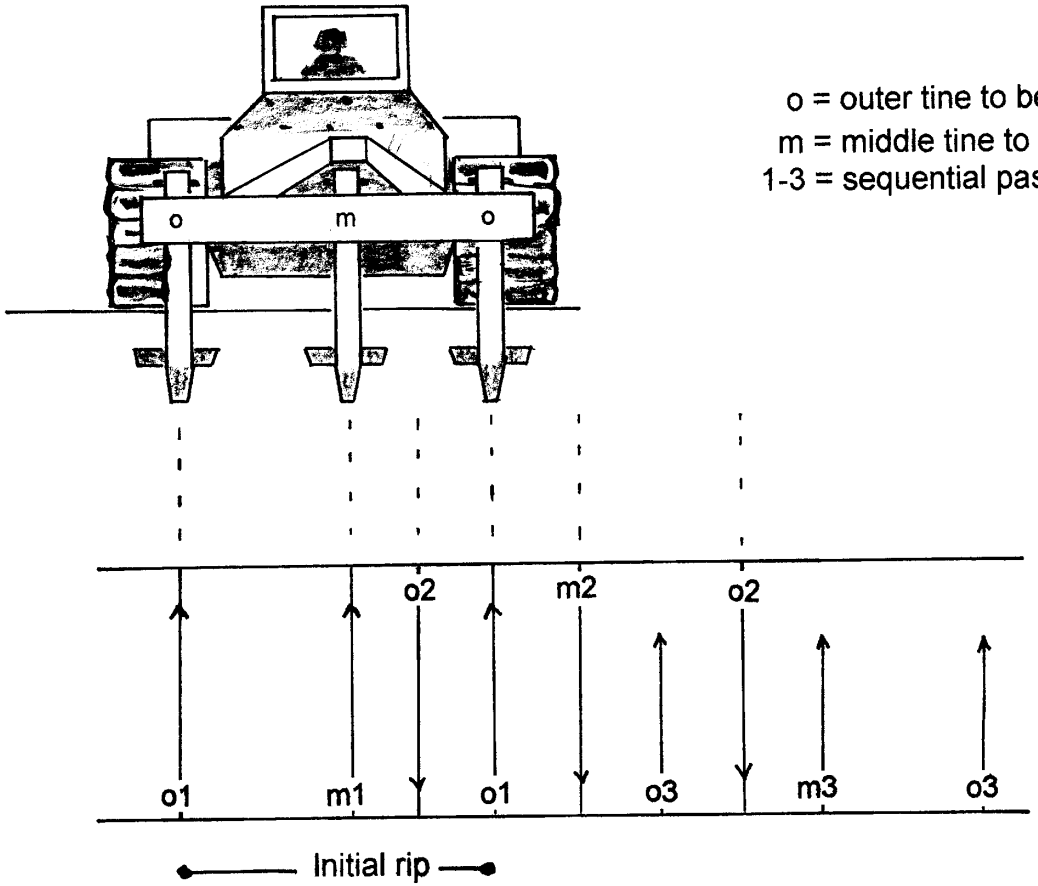


Figure 19.4 Decompaction by overlapping passes of bulldozer drawn tines

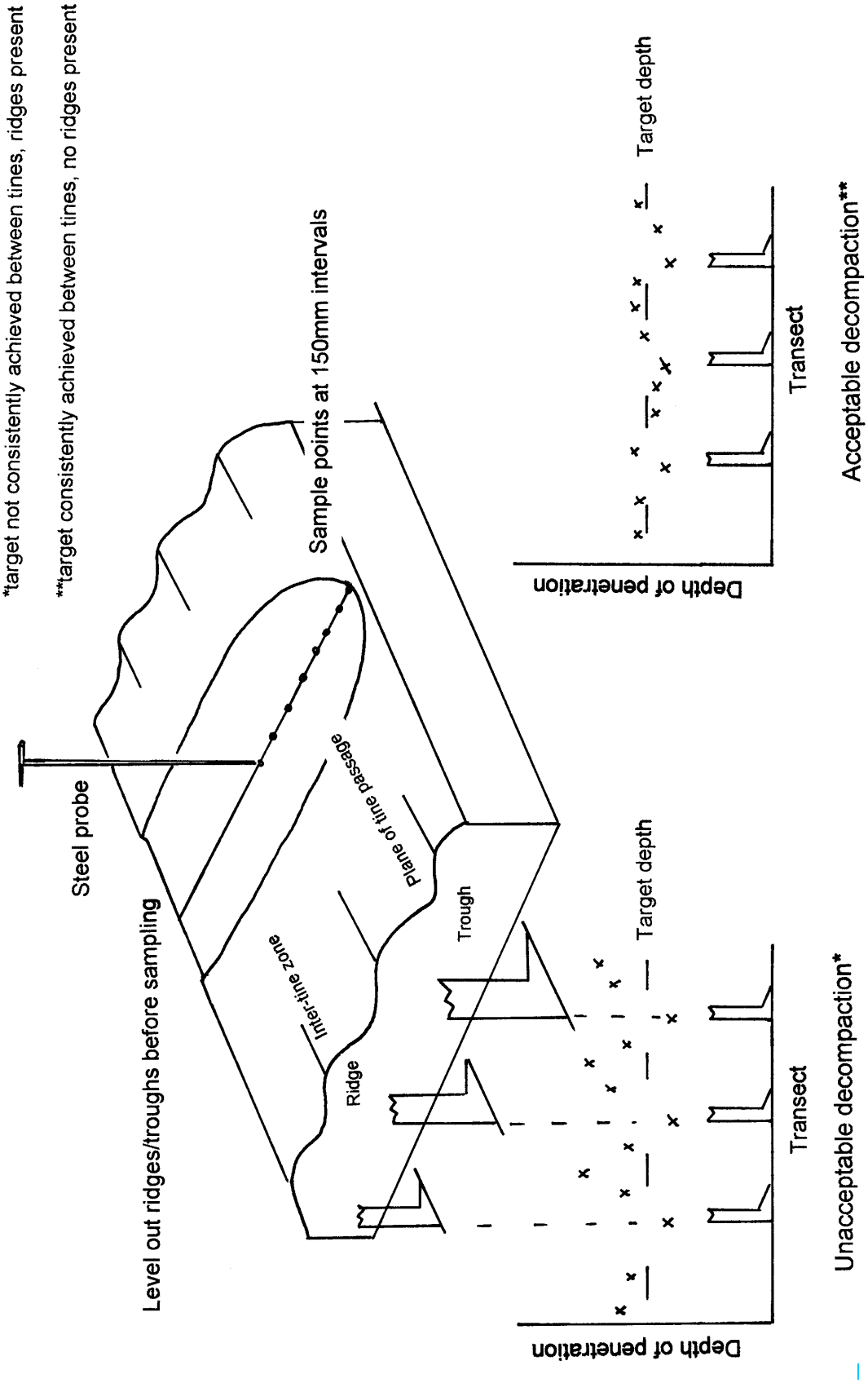


Figure 19.5 Assesment of decompaction achieved