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THE 2006 EDITION

This is the Revised and Updated edition of the manual.

The original manual was written by Philip Heatley in 1998 with extensive input from dairy farmers, dairy company personel, councils and rural professionals under the umbrella of the Dairying and the Environment Committee.

Revisions were undertaken by Helen Ritchie and coordinated by Fonterra under a project funded by New Zealand dairy farmers through Dairy InSight.

PURPOSE

The purpose of this manual is to provide guidelines to dairy farmers and their advisors for the practical, effective, and safe management of farm practices that may affect the environment. It is intended to promote voluntary uptake of best management practices.

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- Northland Regional Council
- Auckland Regional Council
- Environment Waikato
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Apart from the above organisations, important contributors to the original manual included:

- Livestock Improvement Advisory
- Mike O'Connor – AgResearch
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- Chris Tanner – NIWA
- Frank Muldowny

Contributors to the revised and updated version included Chris Tanner, Rupert Craggs and Lucy McKergow of NIWA.

HOW TO USE THIS MANUAL

A 'Glossary of Terms' follows this introduction to the manual. A separate, comprehensive 'Table of Contents' can be found at the front of each chapter.

Chapter 1, **'Sustainable Dairying'** gives an overview of different interests and roles in the promotion of sustainable dairying.

Chapter 2, **'Soil and Pasture Management'** gives a practical guide to help dairy farmers protect the soils on which they farm and maintain healthy pastures.

Chapter 3, **'Nutrient Management'** looks at how to optimise production while minimising losses of nutrients from the farm system.

Chapter 4, **'Waterways, Natural Features and Plantings'** describes principles and practices for making the most of waterways and natural areas on the farm.

Chapter 5, **'Irrigation, Energy and Emission Efficiencies'** focuses on how dairy farmers can save money and reduce environmental pressure by efficient use of water, energy and other resources.

Chapter 6, **'Structures, Earthworks and Races'** looks at how good design and maintenance can help minimise the impacts of farm infrastructure while enabling smooth farming operation and animal comfort.

Chapter 7, **'Chemicals and Farm Waste'** is a practical guide to help dairy farmers avoid causing soil, water and air pollution from agrichemicals and farm wastes.

All information has been compiled using current research data and following lengthy consultation with farmers, contractors, consultants, researchers, Local Authorities and Dairy Industry groups. The data presented in these sections are typical values for typical situations.

As all recommendations are addressed in regional or general terms, there is a need for local interpretation. That is, the application of these guidelines may be varied depending on 'on-site' conditions, practicability, economy, and regional regulatory controls.

The recommendations within this manual should be used in conjunction with local knowledge sourced from Dairy Industry, Local Authorities and advisors.

GLOSSARY OF TERMS

Aerobic bacteria
Bacteria that require free oxygen for growth. They are involved in farm dairy effluent treatment within the aerobic pond.

Aerobic conditions
Conditions where oxygen is freely available either in air or as dissolved oxygen within the effluent.

Aerobic pond
The second pond in an effluent pond treatment system. Effluent entering the aerobic pond from the anaerobic pond is converted into carbon dioxide, water, and new bacterial and algae cells in the 'presence of oxygen' - 'aerobically'.

Agrichemicals / Chemicals
Whether inorganic or organic, man-made or naturally occurring, modified or in their original state - used to control plant growth, to control disease-causing micro-organisms, or to control insects and other pests (e.g. herbicides, fungicides, insecticides and pesticides). Includes animal remedies but excludes fertilisers.

Algae
Primitive plants, usually aquatic, and capable of photosynthesis.

Ambient air quality
The background air quality of a region or area as distinct from the air quality downwind of a polluting source.

Ammonia-N
Nitrogen occurring in the form of ammonia (i.e. NH_3).

Ammonium-N
Nitrogen occurring in the form of ammonium (i.e. NH_4^+).

Anaerobic bacteria
Bacteria that do not require free oxygen for growth. They are involved in effluent treatment within the anaerobic pond.

Anaerobic conditions
Conditions where oxygen is not freely available either in air or as dissolved oxygen within the effluent.

Anaerobic pond
The first pond in an effluent pond treatment system. Effluent is initially piped to the anaerobic pond from the farm dairy sump. In the anaerobic pond, the effluent begins breaking down in the 'absence of oxygen' - 'anaerobically'. Anaerobic bacteria are involved in these processes.

Annual plan
The annual Local Authority publication that sets out the objectives of the Council, the activities that it proposes to carry out and the cost. The draft is available for public comment.

Approved
Approved by a competent body to a recognised Dairy Industry standard. Consult your milk quality officer about approved substances or equipment.

Aquifer
A layer of rock or soil that is able to hold or transmit water.

Batter
A slope immediately above or below a track, road, pond, ditch or other excavation.

Best management practice
Land use practices or a combination of practices that are both practical and effective in minimising environmental effects.

Biodegradability
The ability to be decomposed by biophysical processes.

Biodiversity
The variability among living organisms from all sources (i.e. air, terrestrial, water). Includes diversity within species, between species, and of ecosystems.

Biological control
The introduction and establishment of the natural enemies that will prey on, or adversely affect, a pest.

BOD
Biochemical Oxygen Demand. Expresses organic content in terms of the amount of oxygen required by bacteria to break it down. It is used to show the risk of causing pollution from organic wastes.

BOD_5
BOD measured in a five-day bottle test at 20°C. It may express biochemical oxygen uptake in terms of quantity (i.e. BOD_5 g), concentration (i.e. BOD_5 g/m3) or loading rate (i.e. BOD_5 g/m^3/day).

Boundary control
A management programme required of an occupier around property boundaries to prevent a pest spreading to new areas or neighbouring properties.

Ca
Calcium.

Catchment
A watershed area defined by the ridges of the terrain and where surface water runs towards a storage area or waterway.

CEC
Cation Exchange Capacity. A quantitative measure of a soil's ability to hold exchangeable cations. It indicates the quantity of negative charge present per unit mass of soil.

Clean
Visibly free from dirt, manure, milk residues and other objectionable matter.

Clean-fill
Materials such as clay, soil, rock, concrete, brick or demolition products that are free of combustible or organic materials. They are, therefore, not subject to biological or chemical breakdown.

Clean-fill landfill
A landfill used solely for the purpose of clean-fill.

Coliforms
A group of bacteria used as an indicator of the total concentration of bacteria in an effluent sample.

Commercial operator
An operator trading for hire or reward. Does not include an employee, owner, occupier or manager.

Commercial user (of pesticides)
Any person applying pesticide on their own property or their employer's property in the course of normal business activities.

Conditions
In terms of regional plans and resource consents, includes terms, standards, restrictions and prohibitions.

Consultation
Involves putting forward a proposal that is not yet finally decided upon, listening to the reactions of other parties, considering their responses and then deciding what action should be taken.

Contaminant
Any substance that changes, or is likely to change, the physical, chemical or biological condition of water, air or land into which it is discharged (i.e. gas, liquid, solid, micro-organism, energy or heat).

Controlled activity
An activity that complies with conditions specified in the regional plan, is assessed according to matters the Regional Council has reserved control over, and is allowed only if a resource consent is obtained.

Denitrification
A biological process carried out by specialist bacteria, where nitrate (i.e. NO_3^-) is converted to nitric oxide (i.e. NO) or nitrous oxide (i.e. N_2O) or nitrogen gas (i.e. N_2). Anaerobic conditions, with a supply of free carbon, are required for denitrification.

Deoxygenation
The removal of dissolved oxygen from water.

Direct discharge
Any discharge to water via a pipe or similar conduit, or via a discrete flow path over land, such as channels, tracks or natural stormwater flow paths.

Discharging
Includes 'emitting', 'depositing', or 'allowing to escape' any contaminant into the environment.

Discretionary activity
An activity that complies with conditions that may be specified in the regional or district plan, and requires a resource consent, which may or may not be granted by the Council.

Disease
A disease capable of transmission to humans (e.g. brucellosis, salmonella and tuberculosis).

Dissolved oxygen
The concentration of free oxygen dissolved in water, and usually expressed as g/m^3 or mg/l.

District
An area in relation to, and under the management of, the District Council.

District Plan
A plan prepared by the District Council for managing the use and protection of resources under its jurisdiction.

Domestic user (of pesticides)
Any person applying pesticide on their own property in a private or domestic capacity and who does not produce crops for sale or reward.

E. coli
Escherichia coli. The main coliform bacterium formed in the gut of warm-blooded animals.

Earthflow
The movement of soil and underlying materials that does not destroy the surface cover. Cracks are left as the earth 'flows' downhill.

Earthworks
The disturbance of land by excavation, cutting and filling, quarrying or mining, roading or tracking.

Economic instruments
A charge, levy or other financial incentive or disincentive.

Ecosystem
The interaction of collective plant, animal and micro-organism communities and their non-living environment.

Effluent
The liquid waste from a farming operation (farm dairy effluent, silage leachate).

Erosion
Any particulate or mass movement of soil, under the influence of wind, water or gravity.

Eutrophication
The enrichment of a waterway by N or P, causing algae and higher forms of plant life to grow too fast. This disturbs the balance of organisms in the waterway, usually because algae use up the dissolved oxygen which is needed by plants, fish and small animals.

Evaporation
The loss of water from a surface (e.g. soil) to the air, in the form of vapour. Usually expressed in millimetres in a given time period (e.g. mm/day).

Evapotranspiration
The combination of evaporation and transpiration (i.e. the combined loss of water from the soil and from plant surfaces to the air, in the form of vapour). Usually expressed in millimetres in a given time period (e.g. mm/day).

Existing landfill
A landfill that is currently accepting wastes for disposal.

Exotic plant
A plant that is not native to New Zealand.

Facultative bacteria
Bacteria that can grow both in the presence and in the absence of free oxygen.

Facultative pond
The correct term for what are commonly referred to as aerobic ponds. A facultative pond has both an aerobic upper layer and an anaerobic lower layer. Therefore, both aerobic and anaerobic processes are carried out in a facultative pond.

Faecal coliforms
Species of heat tolerant bacteria (usually E. coli) used as an indicator of the extent of bacterial contamination of a liquid effluent sample.

Farm dairy
Includes any milking area, milk receiving area, milk storage area, and yards used in connection with milking.

Field capacity
When the soil is fully wetted and more rain would cause water loss through drainage.

Fossil fuel
Petroleum based fuel/hydrocarbon based fuel (e.g. oil, diesel, coal, natural gas).

Freeboard
The vertical distance between the top of the embankment and the maximum effluent level of the storage facility.

Freshwater
Any water within the region except coastal water and geothermal water.

Groundwater
Subsurface water contributing to the water table, an aquifer or a confined aquifer.

Groundwater table
The plane that forms the upper surface of groundwater saturation.

Habitat
The place or type of site where an organism or population normally occurs.

Herbicide
Any substance used to destroy or control any form of plant life.

Holding pond
A pond storage facility usually used for the storage of effluent prior to land application.

Hydraulic loading
The volume of water applied to an area of land (mm).

Hydrological design
An irrigation design process that determines the volume of water to be applied and the interval between successive applications.

Indigenous
Produced by or naturally belonging to a particular region.

Infiltration rate
The rate at which water moves through the soil (mm/h).

Iwi
A tribe. Iwi have interests in the land and resources of a particular district.

Iwi authority
The authority that represents an iwi and is recognised by that iwi as having the authority to do so.

K
Potassium.

Kaitiaki
A guardian, steward.

Lactation days
The average number of milking days in an average year.

Land
Includes land covered by water and the air space above land.

Leachate
The liquid resulting from the decomposition of material (e.g. silage leachate, landfill leachate). May also be loosely termed effluent.

Leaching
The removal of soluble constituents (e.g. salts, fertiliser nutrients) from the soil by liquid moving downward through the soil profile.

Local Authority
A Regional Council or Territorial Authority (i.e. District Council or City Council).

Loess
Deposit of fine, light coloured, wind-blown dust.

Marae
The traditional meeting centre of the hapu.

Maximum application depth
The maximum amount of effluent that should be applied to pasture at one time (mm).

Maximum application rate
The maximum speed at which effluent should be applied to pasture (mm/h).

Mechanical aeration
Mechanically mixing air and effluent together, using air pumps, agitators or liquid sprayers, in order to raise the concentration of dissolved oxygen within the effluent.

Mg
Magnesium

Micro-organisms
Microscopic organisms, such as bacteria, viruses, algae and fungi, that can live in water, soil, air, animals and plants.

Mineralisation
The conversion of organic matter into a mineral substance

Minimum application interval
The minimum interval between successive effluent applications to pasture (days).

Mo
Molybdenum.

N
Nitrogen.

Nitrate
NO_3. The main nitrogen containing anion occurring in soil. It is very soluble and moves freely in water through the soil profile.

Nitrification
A biological process carried out by specialist bacteria where ammonium-N (i.e. NH_4^+) is converted to nitrate (i.e. NO_3^-). Aerobic conditions are required for nitrification, although the process can continue at low oxygen concentrations.

Non-complying activity
An activity that is not permitted by a rule in the regional plan or is not included in any other category. Applications for a resource consent can be made and are assessed on their individual merit.

Non-point source discharge
Involves diffuse discharges onto or into land, air, a waterway or the sea (e.g. runoff, fertiliser leachate).

Notification
Public notification of a resource consent, or any policy statement or plan, or changes to one.

Occupier
In relation to any place physically occupied by any person, means that person; in relation to any other place, means the owner of that place; in relation to any other place, includes any agent, employee, or other person acting or apparently acting in the general management or control of that place.

Organic matter
Substances of animal or plant origin.

P
Phosphorus.

Particulate
In the form of minute, separate particles.

Pathogenic micro-organisms
Micro-organisms (e.g. bacteria, viruses, cysts, eggs and larvae of parasites) considered to be harmful to animals, plants and humans.

Permeability
The property of a soil describing the ability to allow significant movement of water through it.

Permitted activity
An activity that is allowed by a regional plan without a resource consent if it complies in all respects with any conditions in that plan.

Pesticide
A chemical substance used to destroy, control or repel bacterial, animal or plant pests.

Pest management strategy
A strategy approved under Part V of the Biosecurity Act (1993), for the management or eradication of particular animal or plant pests.

pH
A way of expressing how acidic or alkaline a solution is. The pH is usually measured using a water extract. A pH of 7.0 is neutral, whereas lower values are said to be acidic, and higher values are alkaline.

Plan
A regional plan or a district plan.

Point source discharge
A discharge from a specific and identifiable outlet onto or into land, air, a waterway or the sea.

Polishing
Where secondary treated effluent undergoes a final treatment.

Pond system
A constructed ponding system composed of an anaerobic pond and an aerobic pond, designed for the holding and treatment of farm dairy effluent before discharge to a waterway or constructed wetland, or application to pastoral land.

Prohibited activity
An activity that is not allowed under any circumstances.

Quarrying
The open surface extraction of rock material from the ground, the stacking, storing, depositing or treatment of the excavated material, and the removal of debris tailings and waste materials.

Receiving water
Any water, as defined in the Resource Management Act (1991), that receives contaminants or water from point source or non-point source discharges.

Region
An area in relation to, and under the management of, the Regional Council.

Regional plan
A plan prepared by the Regional Council for managing the use and protection of natural and physical resources (i.e. geothermal, coastal, water, air and soil resources).

Regional policy statement
A statement that guides or directs the decision making in a region, so that the eventual course of action achieves the desired results.

Rill
A small channel shaped by the removal of topsoil by the flow of water over the land. Such channels can develop into gullies.

Riparian
The area directly beside and including a waterway or lake.

Rip-rap rock
A constructed loose rock foundation of a structure.

Road Controlling Authority
Transit New Zealand the City Council or District Council.

S
Sulphur.

Sacrifice area
An area of pasture where stock are contained during wet weather. The wet soil and pasture in this area is temporarily damaged (i.e. sacrificed) in order to retain the condition of other paddocks.

Sedge
Grass-like plant which grows in swampy areas or beside waterways or lakes.

Sediment
Solid material (e.g. silt and sand) carried in water or effluent and that will ultimately settle to the bottom of sumps, ponds, barrier ditches, constructed wetlands or waterways.

Sheet erosion
Erosion where thin layers of surface material are gradually removed more or less evenly from an extensive area of sloping land.

Slip
Rapid sliding or flowing of soil and subsoil, exposing a slip surface.

Sludge
Effluent exceeding 20% total solids. Sludge accumulates at the bottom of sumps, barrier ditches or ponds. Sludge will not flow and requires mechanical spreading equipment such as scrapers and front-end loaders.

Slump
Slipping of a very large mass of rock or unconsolidated material.

Slurry
Effluent with between 10 and 20% total solids. Such material can be conveyed by using vehicle spreaders but cannot be conveyed by gravity or pumps through piping systems.

Soil
Includes both topsoil and subsoil to a depth of at least 1 m.

Solid fuel
Non-petroleum based fuel (e.g. wood, dry manure).

Stormwater
Rain water that has drained from the farm dairy and collected in guttering/pipes, or has run off from the surrounding land.

Streamside management area
An area of varying width next to a waterway which contributes significantly to the natural functioning, quality and character of the riparian zone.

Submission
A written statement in support of, or in opposition to, a resource consent, policy statement or regional plan, or changes to them.

Subsoiling
Subsoiling lifts and shatters compacted layers in the soil. This then allows water to flow freely through the soil.

Subsurface drain
An underground pipe structure that collects excess soil water and discharges it into a surface drain or waterway.

Sump
A small effluent storage facility used to collect flushed effluent and store it for short periods, prior to land application or pond treatment.

Surface drain
An open drain. Any man-made waterway that has an outlet to water, or a natural waterway that has been channelised and regularly maintained.

Suspended solids
Effluent solids that are in suspension within the liquid effluent but are removable through filtering.

Sustainable dairying
Dairy farm practices that are economically viable, environmentally sound and socially acceptable.

Taonga
A treasured possession.

Tapu
Set apart, sacred or consecrated.

Territorial Authority
Any District Council or City Council as defined by the Local Government Act (1974).

Total solids
The sum of dissolved solids and undissolved solids in effluent or water.

Transpiration
The loss of water, from plant surfaces (e.g. leaves) to the air, in the form of vapour. Usually expressed in millimetres in a given time period (e.g. mm/day).

Urupa
A graveyard or burial site. Tapu by nature of being associated with death.

Volatilisation
Loss of ammonia gas (i.e. NH_3) to the atmosphere following its conversion from ammonium-N (i.e. NH_4^+). Volatilisation is pH and temperature dependent, increasing with increasing alkalinity and/or increasing temperature.

Waterway
Fresh or geothermal surface water in a river, lake, stream, pond or natural wetland.

Wetland
Permanently or intermittently wet areas, shallow water and land water margins which support a natural ecosystem of plants and animals that are adapted to wet conditions.

Wind-blow
Erosion by wind, whereby wind picks up soil particles and either blows them into the air (i.e. deflation), or blows them against exposed rock or soil (i.e. abrasion).

Yards
Those parts of the farm dairy used for holding livestock for milking, breeding or veterinary treatment.

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