LADEDA PLOTTING HANDBOOK

R.D. WILLIAMS

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PREFACE

LADEDA is a computer program for retrieving information on land-dependent data, where the data consist of a description and boundary for each of many non-overlapping map units (homogeneous parcels of land). It was developed to handle the NWASCO New Zealand Land Resource Inventory which was compiled between 1973 and 1979. Both the program development and the data compilation were performed by scientists of the Land Resources Group, Water and Soil Division, MWD. The inventory was digitised, under the direction of P R van Berkel, between 1977 and 1981. Initially the boundary of each map unit was stored as a complete polygon with its description. During 1981 these boundaries were converted into line segments, each being the common line between two adjacent map units, using a program written by R Christian. In 1980 the initial LADEDA program was written by A M Moffat. Since 1981 the development of the LADEDA program has been continued by R D Williams.

Any enquiries regarding access to the Inventory data described in this publication should be directed to:

Director of Water and Soil Conservatic
Ministry of Works and Development
P O Box 12-041
WELLINGTON

ATTENTION Land Resources Liaison Unit

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INTRODUCTION

This handbook details procedures for producing computer drawn maps (plots) using the New Zealand Land Resource Inventory (NZLRI) data and the computer program LADEDA (an acronym of LAnd DEpendent DAta). It gives examples of the type of plots that can be prepared and the instructions to LADEDA (commands) used to create them. Readers are assumed to have some knowledge of the NZLRI worksheets and are referred to "Our Land Resources" (MWD 1979) for further information. This program is available for use at the Vogel Computer Centre of the Ministry of Works and Development.

The PLOT command and its options are introduced and a series of examples are given. These explain how the plotting algorithm works, how the options are used, and also show the range of plots available. The LADEDA commands that were used to generate each plot are given, with approximate execution times.

For convenient presentation some plots are reproduced at a reduced scale. For the same reason, some enquiry regions are quite small (eg, smaller than half a worksheet). The land resource data was compiled for reconnaissance planning at national, regional and district levels; it is not suitable for detailed planning enquiries for small areas.

This handbook is a supplement to the primary user's manual, the "LADEDA Reference Manual". An up-to-date version of the "LADEDA Reference Manual" is kept on the IBM computer and should be consulted by LADEDA users for any new improvements to the program.

THE LADEDA PLOT COMMAND

The function of the PLOT command is to produce a plot of a map for a field or a combination of fields. A field is either part of the descriptive data recorded on the worksheets, or is a set of user-defined rules using other fields. If the field values for two adjacent map units are the same then the common line between them, known as a segment, is not plotted. The field value (one or more characters) is plotted at the approximate centre of the largest map unit incorporated. If the plot contains any coastline, the appropriate coastal segments are plotted.

The result of the PLOT command is to produce an "intermediate plot file" consisting of the vectors (lines) and characters to be plotted. At the end of the LADEDA session this dataset is used as input to the TSO PLOT or LDDPLOT commands which generate the plot on one of the plotting devices.

The available devices are:

CALCOMP: A pen plotter with maximum dimensions of 140 x 70 cm.

VERSATEC: An electrostatic plotter with maximum dimensions of 500 x 20 cm.

TEKTRONIX: A graphic VDU screen for immediate display of the plot.

The "LADEDA Reference Manual" and the "TSO Command Manual" should be consulted for the creation and use of plot datasets.

The syntax for the PLOT command is as follows:

PLOT mapname fieldname_1 < fieldname_2 ... > < options >

where < > means that what is inside the brackets is optional.

... means that whatever precedes the dots can be repeated.

mapname is the name of a map that the user has created.

fieldname is the name of a field; either one of the descriptive fields or a user defined field. A number of fields may be plotted.

options follow the last fieldname and any number of options may appear in any order. Each option has a default value. The options are discussed in the next section.

OPTIONS OF THE PLOT COMMAND

SELECT condition

This causes only those map units which satisfy the condition to be used in the plot.

A condition is a test that evaluates to either true or false and is applied to each map unit (eg, slope less than 'C').

Default - to select all map units.

TITLE string_1 < string_2 ... >

This puts a title at the top of each frame of the plot.

The title is automatically centred and is made by concatenating the strings together. The maximum string length is 20 characters, the total maximum length for the title is 40 characters.

Default - "LADEDA PLOT"

BOUNDARY boundary name_1 < boundary name_2 ... >

This plots one or more arbitrary boundaries, eg, counties, catchments, user-defined boundaries, etc.

Only that part of the boundary inside the bounding rectangle of the map is plotted. Each boundary has its name plotted next to it for each frame that it appears on. When necessary boundaries are plotted as starred lines to distinguish them from map unit boundaries.

Default - do not plot any boundaries.

FRAMESIZE width height

This defines the size of the frame in tenths of a millimetre (tm).

A frame is a single page or section of the plot. If the map size is less than the frame size then the frame is reduced to exactly fit the map. Otherwise the plot is sectioned into two or more frames, with the first frame being for the north-west corner of the map. The frame size must always be smaller than the maximum dimensions of the plotting device and allowance should be made for an extra 250 tm in width and 500 tm in height for titles, grid values and other related text.

Default - if the scale is not equal to 1:250000

6494 4330 (worksheet size)

if the scale is 1:250000

6584 4389 (1:250000 map size)

BLOCKED

This forces the frame to remain at the specified or default frame size and not be reduced to the map size.

This is to avoid plotting small, difficult to handle, strips.

Default - not BLOCKED.

ALIGNED

This shifts the position of the frames relative to the map.

The north-west corner of the first frame is aligned with the north-west corner of the worksheet that it is on. Other frames will also be aligned if the frame size equals the worksheet size.

This is useful in producing plots that can be directly overlayed onto mile-to-the-inch base maps (worksheets or NZMS1 topographical maps).

Default - not ALIGNED.

CHARSIZE height

This changes the default height for characters plotted on the map (not titles, etc.)

The height is specified in tenths of a millimetre, with lower case letters plotted as small upper case letters (at 70% of the upper case height).

Default - (varies with scale)

scale $\leq$ 1:50000 : 25 tm

1:50000 $<$ scale $\leq$ 1:63360 : 20 tm

1:63360 $<$ scale $\leq$ 1:125000 : 15 tm

scale $>$ 1:125000 : 10 tm

VECTOR length

This alters the default value for the minimum length of the vectors plotted (in tm).

To avoid creating large "intermediate plot files" not all vectors are plotted. The vectors that make up map unit segments and arbitrary boundaries are aggregated until the combined length exceeds the minimum value (usually 0.5 mm). This is regardless of scale, but at smaller scales aggregation is greater. By increasing the minimum vector length the user can reduce the number of vectors plotted, and by decreasing the minimum (down to 0.0 mm) the detail of the plot can be increased.

Default - 5 tm.

SCALE number

This defines the scale at which the plot will be produced, ie, 1 : number.

The scale can range from 1:50000 to 1:10000000. If scale 0 is specified, the scale is calculated so that the map exactly fits the frame and thus no sectioning is required. This option could be used if an unstable paper base map had shrunk or stretched to a slightly different scale and it was intended to overlay a plot on the base map.

Default - 63360 (ie, mile-to-the-inch).

GRID spacing_1 < spacing_2 number_1 number_2 >

This defines the spacing of the grid lines on the plot in yards on the National Yard Grid.

The four numbers are the east spacing, the north spacing, the east origin and the north origin. The grid is infinite and is aligned on the origin, eg, to obtain the N.I. work-sheet grid use 45000 30000 120000 100000. If only one number is specified then the origin is assumed to be (0,0) and the north spacing is the same as the east spacing. If a grid is not required then GRID 0 should be specified.

Default - (varies with scale)

scale < 1:250000 : 10000 yards

1:250000 ⩽ scale < 1:1000000 : 50000 yards

scale ⩾ 1:1000000 : 250000 yards

MARGIN width

This increases the size of the map in all four directions by the specified width (in yards).

This is accomplished by temporarily enlarging the bounding rectangle of the map. This will clarify information around the edge of the map when the map has been produced by the exact overlay.

Default - 0 (ie, no margin).

NOMUBS

This causes the map unit boundaries not to be used.

The field value is still plotted at the centroid of every map unit in the map. This is useful for producing scatter plots at small scales.

Default - use map unit boundaries.

NODESCRIPTION

This causes the field values (ie, the description) not to be plotted, but they are still used for removing segments.

This is useful at small scales if only selected map units with the same field value are plotted, making the field values redundant.

Default - plot the field values.

BLANK

This causes embedded blanks within the field values not to be removed.

Default - compress the field values to remove blanks.

EXAMPLE PLOTS

SECTION 1 : BASIC PLOTS SHOWING SEGMENT REMOVAL

This sequence of five plots shows how the basic plotting algorithm functions. The first plot delineates all map units and subsequent plots show the effect of plotting less detailed fields. This causes more and more segments and field values to be removed since adjacent similar map units are merged. The last two plots are at a scale of 1:250000.

The five plots also increase in complexity, as further PLOT options are introduced. The first three plots are of the Mosgiel locality (Otago) and the last two show a larger region including Mosgiel.

PLOT 1.1 ALL MAP UNITS

PLOT 1.2 COMMON SEGMENTS REMOVED

PLOT 1.3 FURTHER SEGMENTS REMOVED

PLOT 1.4 DUNEDIN AREA AT A SMALLER SCALE

PLOT 1.5 BROAD GROUPING OF NORMAL UNITS

PLOT 1.1 All map units

Plot 1.1 shows all map unit boundaries for the enquiry region. Each map unit has two values. The first value is a unique map unit identification number which can be plotted by using the field NUMBER. This ensures that every segment is plotted. The area in the bottom right-hand corner is sea, and is not considered to be a map unit. The second value is the dominant land use capability (LUC) unit, LAND(1,4). (Note the lower case letters and removal of embedded blanks). No land use capability unit is recorded for non-normal units. The two non-normal units have been underlined: 35584 is the town of Mosgiel and 35598 is a river estuary.

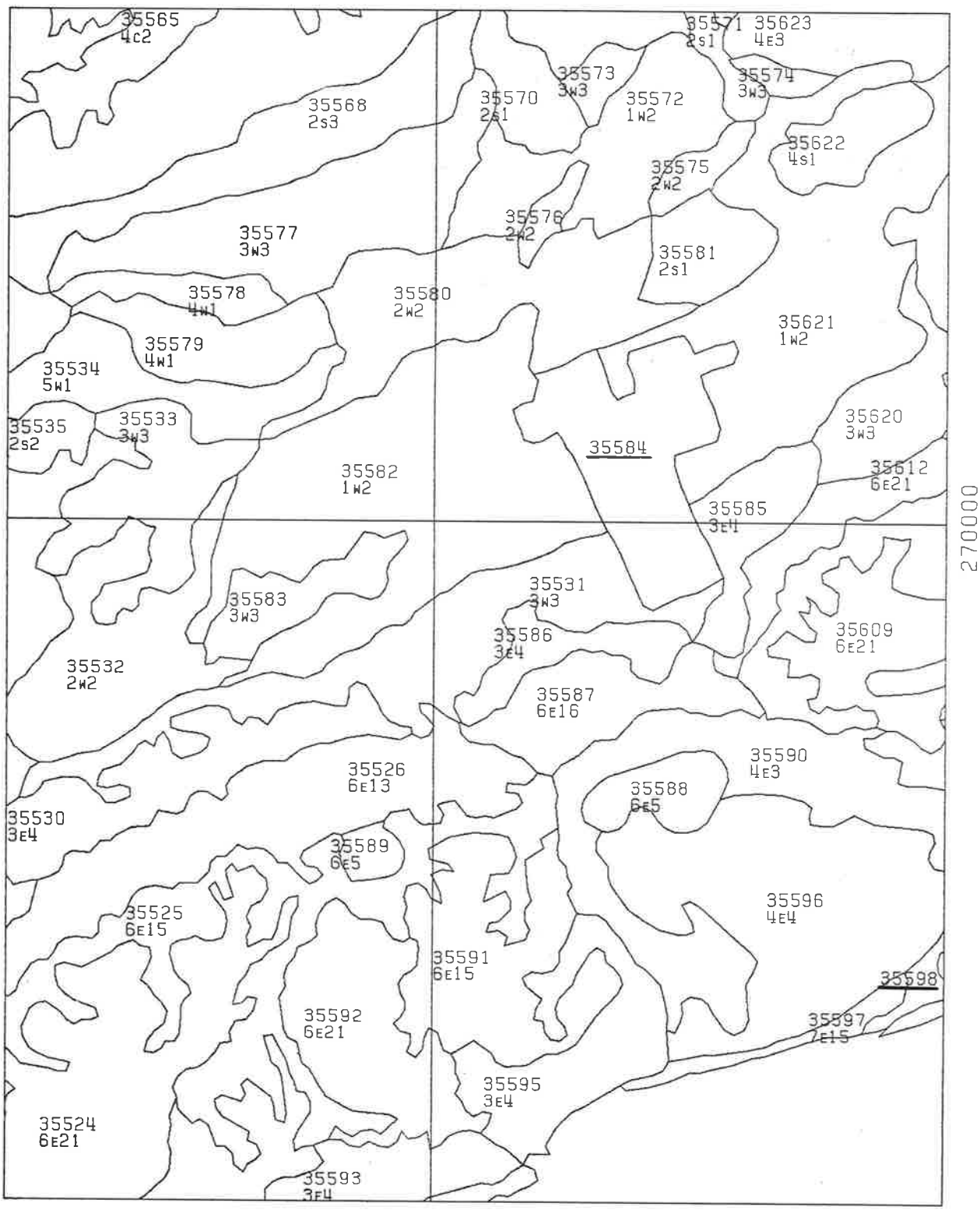
This map was created by defining as an arbitrary boundary a rectangular box which was overlayed onto the South Island. Since the coarse overlay was used there are some partial units at the edge of the plot that were not included in the map (overlaying will be discussed in section 2). The PLOT command let all the options take on their default values, with the exception of TITLE.

```
define boundary mosbox box                                    0.1 sec
395 2o2 4o6 27o

overlay coarsely south mosgiel mosbox                         7.6 sec

plot mosgiel number land(1,4)                                 2.1 sec
title 'all map units' end
```

ALL MAP UNITS



SCALE 1: 63360 MAP MOSGIEL 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 1 2 3 4 5 6

MILES 0 1 2 3 4

FIELDS PLOTTED : NUMBER LAND

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 395000 262000

PLOT 1.2 Common segments removed

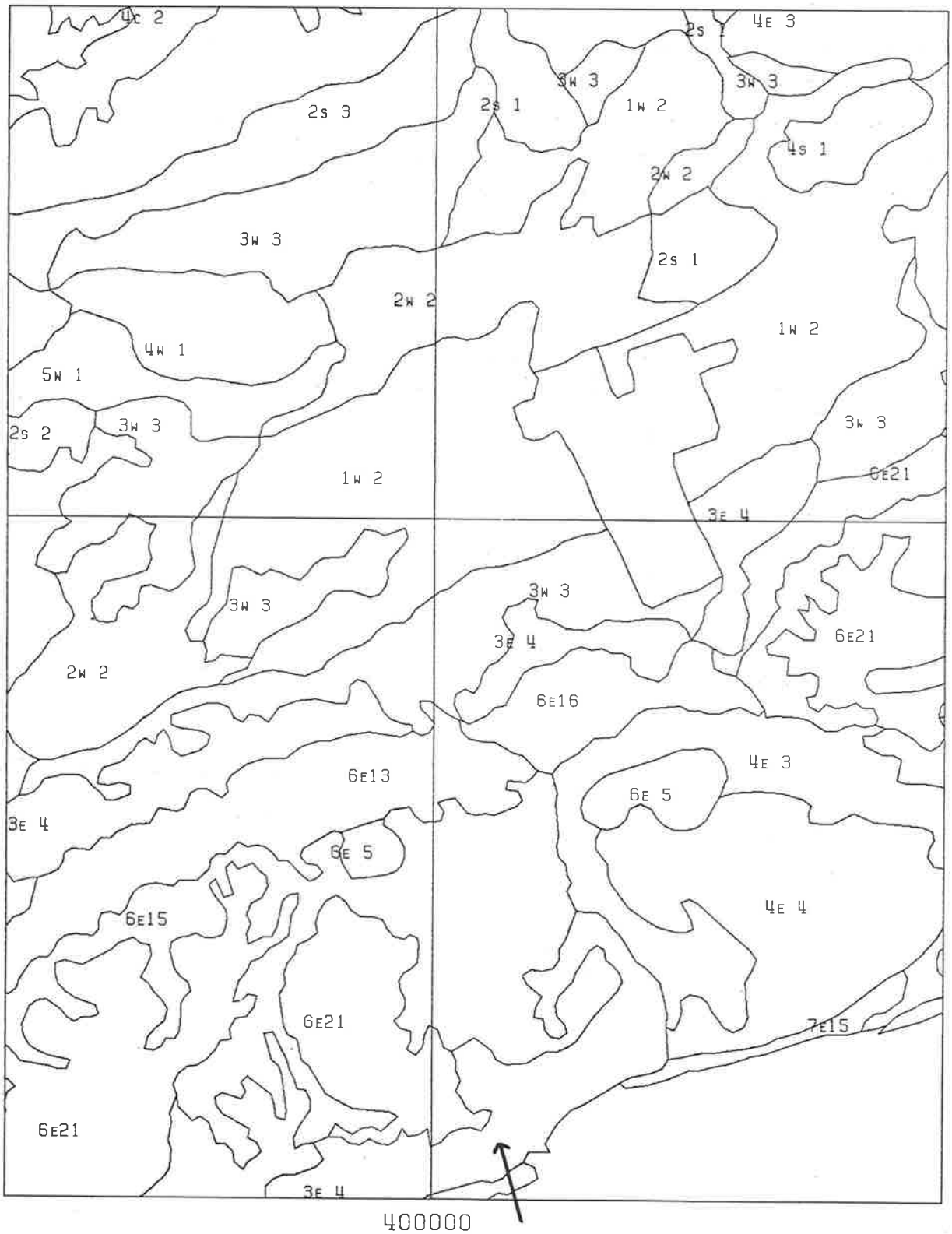
Plot 1.2 shows removal of segments when the field values of adjacent map units are the same. For example, the segment between map units 35593 and 35595 in Plot 1.1 (both 3e4) has been removed, as indicated by the arrow. The field value has only been plotted in the map unit of larger area for the removed segment.

The map is the same as that used for Plot 1.1, but only the LAND(1,4) field is plotted. The only option used is BLANK which suppresses the automatic removal of embedded blanks.

```
plot maxgier land(1,4)
title 'common segments' ' removed' blank end
```

2.1 sec

COMMON SEGMENTS REMOVED



SCALE 1: 63360 MAP MOSGIEL 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 1 2 3 4 5 6

MILES 0 1 2 3 4

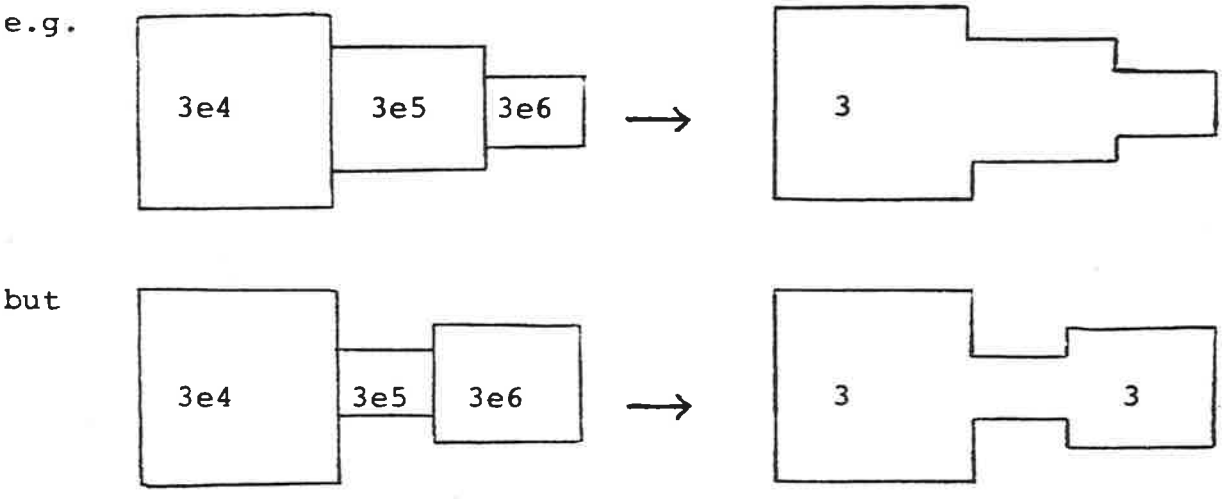
FIELDS PLOTTED : LAND

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 395000 262000

PLOT 1.3 Further segments removed

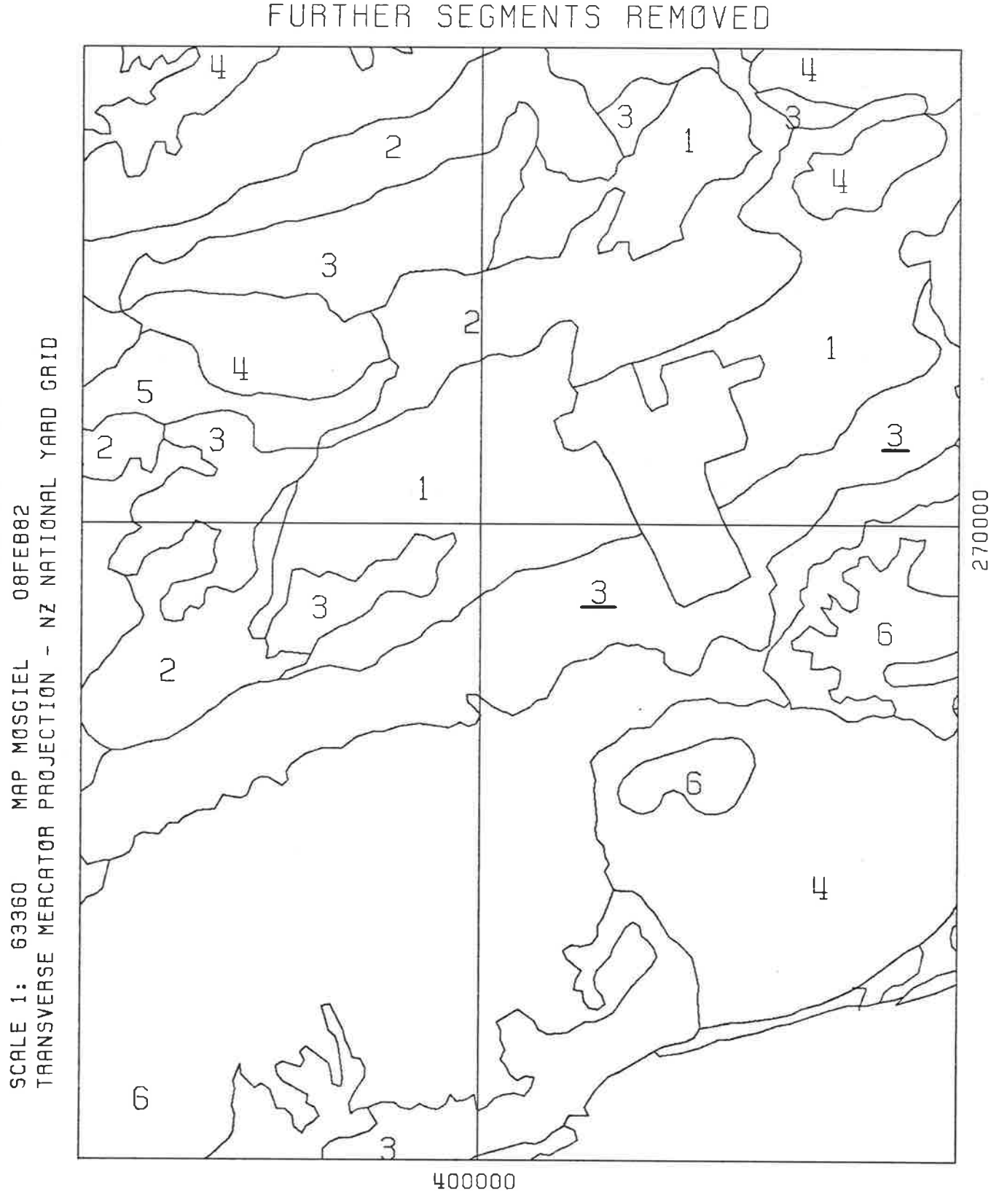
In Plot 1.3 further segments are removed by plotting only the first character of the land field, ie, LAND(1,1) (which is the LUC class). Notice that the narrow strip of class 3 land, stretching across the middle of the plot, has the field value 3 (underlined) plotted in two places. This is because of the algorithm for removing field values. The rule is to remove the field value from the map unit of smaller area whenever a segment is removed.



The only option used in this plot is the CHARSIZE option. The default value of 20 tm (ie, 2 mm) has been doubled to 40 tm (ie, 4 mm).

```
plot mosgiel land(1,1)
charsize 40
title 'further segments' ' removed' end
```

2.0 sec


FURTHER SEGMENTS REMOVED
SCALE 1: 63360 MAP MOSGIEL 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID
270000
400000
KM. 0 1 2 3 4 5 6
MILES 0 1 2 3 4
FIELDS PLOTTED : LAND
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 1 ACROSS 1 DOWN. ORIGIN 395000 262000

PLOT 1.4 Dunedin area at a smaller scale

By using a smaller scale of 1:250000, Plot 1.4 shows a larger area surrounding Mosgiel. The same field, LAND(1,1), has been used as for Plot 1.3. The effect of the algorithm for removing field values is more noticeable in this plot, particularly for the widespread areas of class 6 land. Since the map is larger than the specified frame size the plot has been sectioned into two parts. Field value characters that are cut by the sectioning line are repeated on both frames so that the two frames can be pasted together.

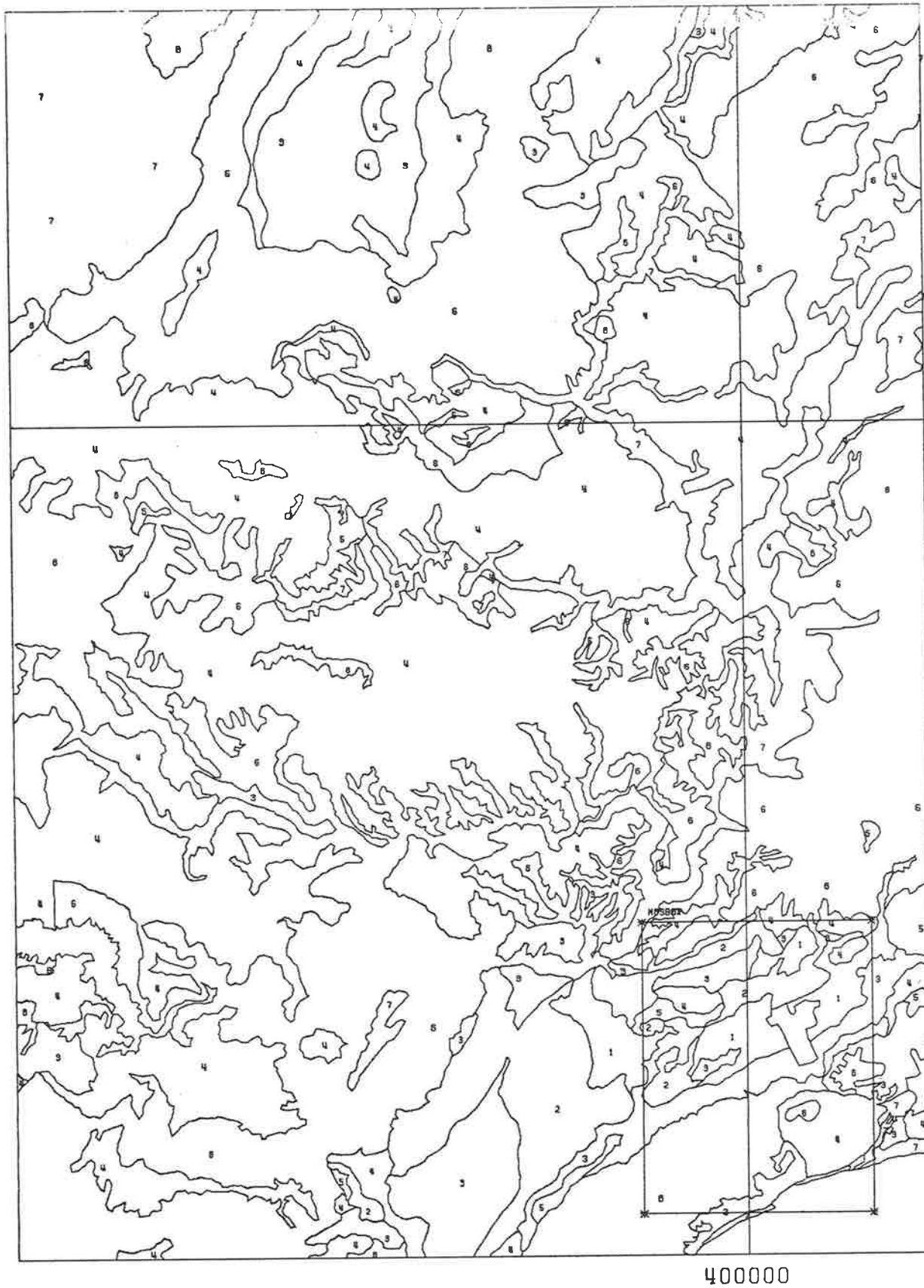
The map was created by defining a boundary as a box (worksheets - S154, S155, S163, S164) and overlaying this onto the South Island. The SCALE option was used to change the scale and the BOUNDARY option was used to plot the original enquiry region of Mosgiel. The use of the FRAMESIZE option ensured that each frame would fit on an A4 page.

```
define boundary dunbox box
365 260 445 320                                    0.1 sec

overlay coarsely south dunedin dunbox              7.7 sec

plot dunedin land(i,i)
scale 250000                                       7.1 sec
boundary mosbox
framesize 1600 2200
title 'dunedin area at a ' 'smaller scale' end
```

DUNEDIN AREA AT A SMALLER SCALE



SCALE 1: 250000 MAP DUNEDIN 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 5 10 15 20 25

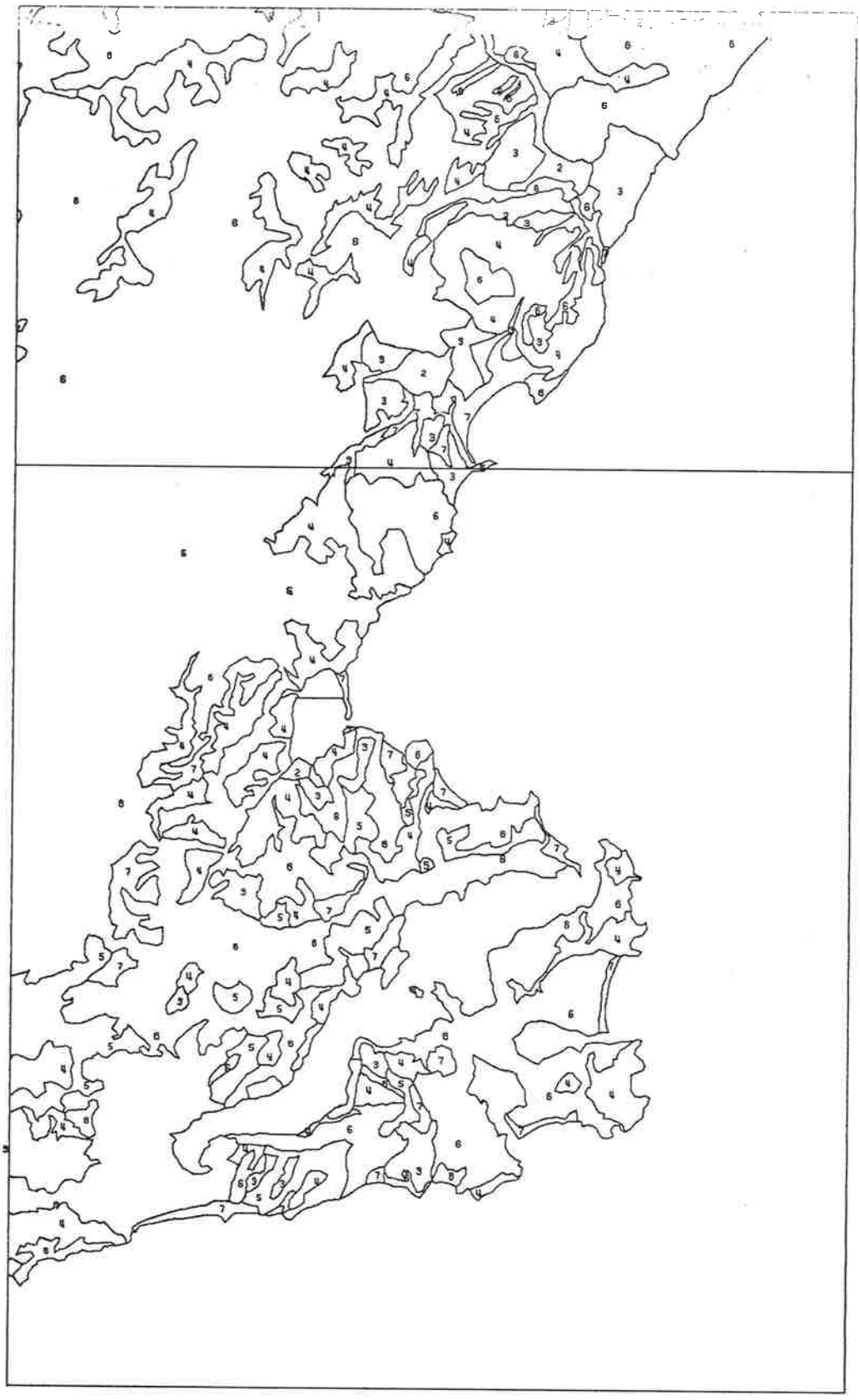
MILES 0 5 10 15

FIELDS PLOTTED : LAND

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 365000 260000

DUNEDIN AREA AT A SMALLER SCALE



SCALE 1: 250000 MAP DUNEDIN 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 5 10 15 20 25

MILES 0 5 10 15

FIELDS PLOTTED : LAND

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 2 ACROSS 1 DOWN. ORIGIN 408744 260000

PLOT 1.5 Broad grouping of normal units

Plot 1.5 demonstrates how field values can be grouped to produce a less detailed plot. Class 1 to 4 land has been grouped as A for arable and class 5 to 8 land as N for non-arable. Non-normal units (eg, towns, etc.) have not been included in the plot, but all coastal segments have been automatically plotted to ensure a continuous coastline. The minimum vector length has been doubled which has resulted in the lines looking less smooth.

The new grouped land field was set up by defining a "virtual" field using LAND(1,1). The map is the same as that used for Plot 1.4, but the GRID option has been used to change the default value, the SELECT option used to remove non-normal units, and the VECTOR option used to alter the minimum vector length.

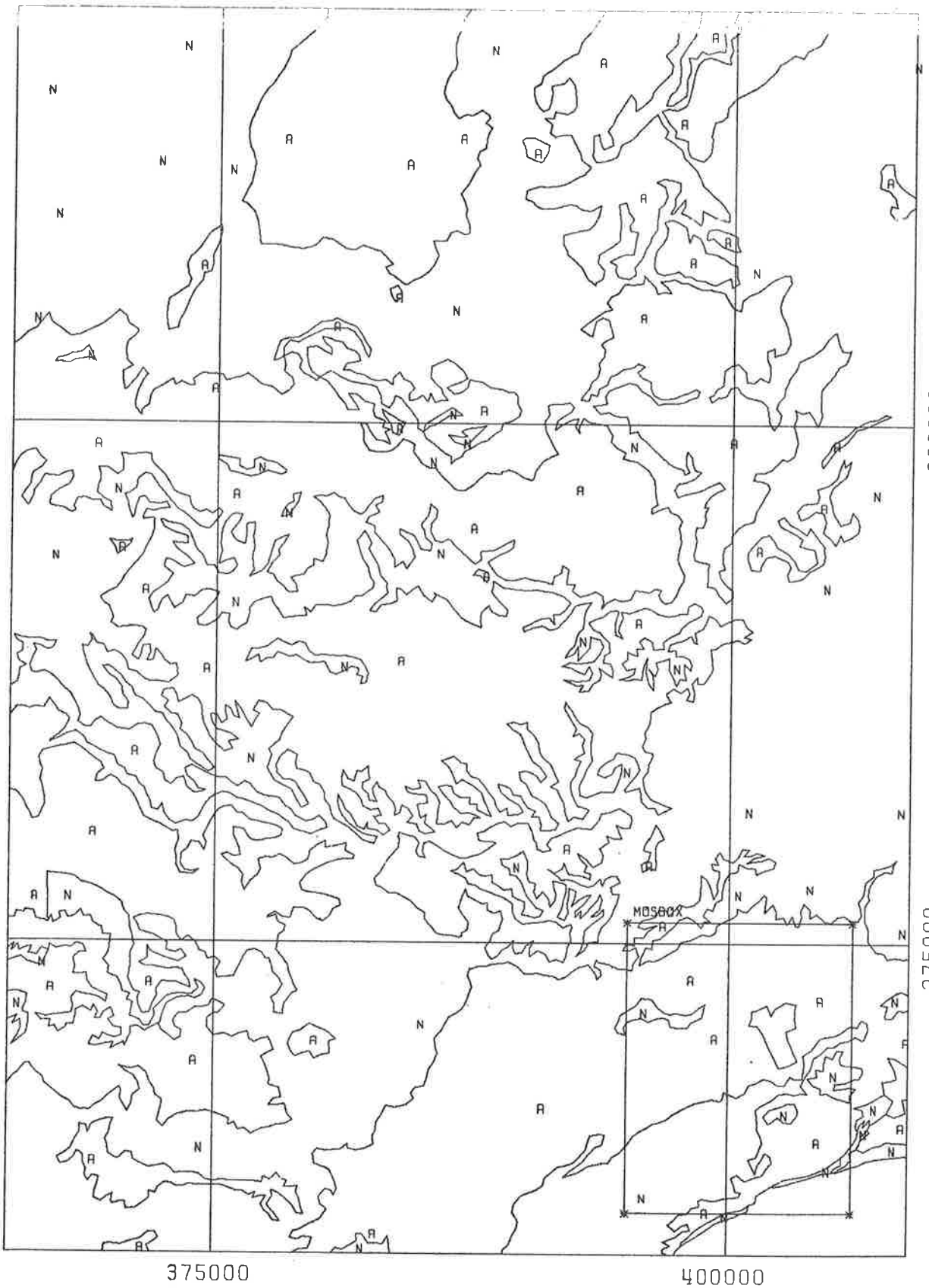
```
define field landgp virtual
land(i,i) ge '1' and land(i,i) le '4' 'A'
land(i,i) ge '5' and land(i,i) le '8' 'N'
else ' '
```

0.1 sec

```
plot dunedin landgp
scale 250000   grid 25000
boundary mosbox
select type eq 'n'
charsize 15 vector 10
framesize 1600 2200
title 'broad grouping of' ' normal units'
end
```

5.8 sec

BROAD GROUPING OF NORMAL UNITS



SCALE 1: 250000 MAP DUNEDIN 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 5 10 15 20 25

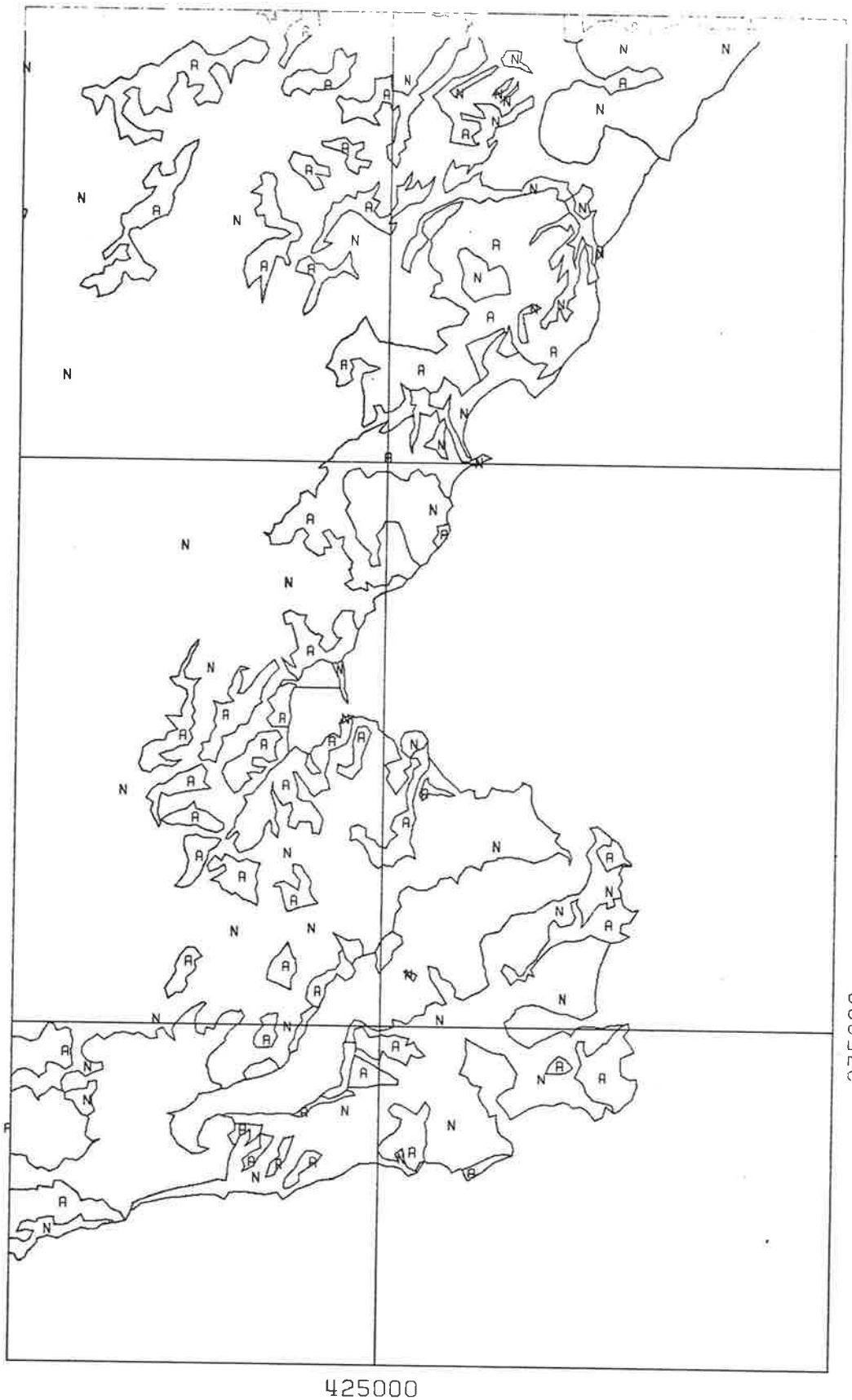
MILES 0 5 10 15

FIELDS PLOTTED : LANDGP

MINIMUM VECTOR LENGTH PLOTTED : 1.0 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 365000 260000

BROAD GROUPING OF NORMAL UNITS



SECTION 2 : OVERLAYING AN ARBITRARY BOUNDARY

In this section three examples are given to illustrate how arbitrary boundaries are overlayed onto the LRI data. There are two types of overlay, coarse and exact. The coarse overlay was developed first and does not rely on the map unit boundary data. The exact overlay is a more recent development, and is not yet fully operational.

The arbitrary boundary used for these examples is a circle, centred approximately on the town of Levin (map unit 45010), with a radius of 6 km (6562 yards). The area of the circle is:

$$\pi r^2 = 3.1416 \times 6^2$$
$$= 113.10 \text{ km}^2$$
$$= 11310 \text{ ha}$$

PLOT 2.1 COARSE OVERLAY EXAMPLE

PLOT 2.2 EXACT OVERLAY EXAMPLE

PLOT 2.3 EXACT OVERLAY WITH MARGIN

PLOT 2.1 Coarse overlay example

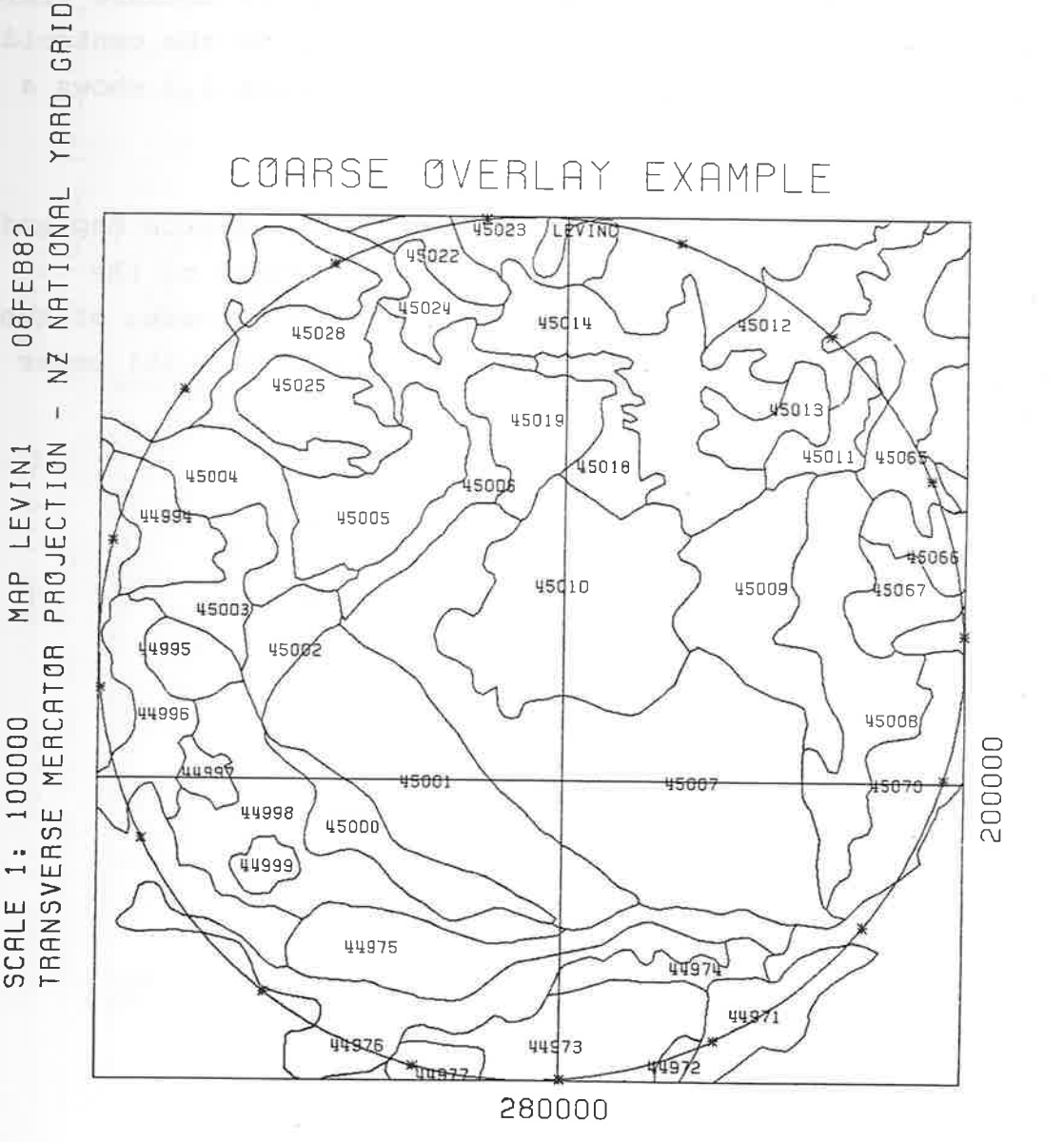
Plot 2.1 shows a plot of the Levin map at a scale of 1:100000 after using the coarse overlay. Map units are included in the map only if their recorded centroid lies within the arbitrary boundary. No area calculations are made and the proportion associated with each map unit is always recorded as 100%. Thus some areas inside the boundary are not in the map and other areas outside the boundary are in the map. Note - the whole of the map unit boundary within the bounding rectangle is always plotted, regardless of the proportion associated with the map unit.

The circle was created by the DEFINE BOUNDARY command and used as input to the OVERLAY COARSELY command. The processing time taken by the coarse overlay is proportional to the size of the source map (in this case NORTH). The PLOT command uses the field NUMBER to get every map unit plotted. The area of the coarsely overlayed map is 12116 ha, about 800 ha (+ 7%) over the true area. This is significant in tabular print-outs and correlations for small enquiry regions.

```
define boundary levinc factor 1 circle 277500 202000 e3e2      0.5 sec

overlay coarsely north levinf levinc                            9.0 sec

plot levinf number                                              2.0 sec
scale 100000
title 'coarse overlay' ' example'
boundary levinc
framesize 1600 2000 end
```


COARSE OVERLAY EXAMPLE
SCALE 1: 100000 MAP LEVIN1 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID
45023 LEVIN
45022
45024
45028
45014
45012
45025
45019
45013
45011
45065
45018
45004
45006
44994
45005
45066
45010
45009
45067
45003
44995
45002
45008
44996
44997
45001
45007
45070
200000
44998
45000
44999
44975
44974
44971
44976
44973
44977
44972
280000
KM. 0 2 4 6 8 10
MILES 0 2 4 6
FIELDS PLOTTED : NUMBER
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 1 ACROSS 1 DOWN. ORIGIN 272938 195438

PLOT 2.2 Exact overlay example

In Plot 2.2 the same circular boundary has been used as an exact overlay. The exact overlay computes the intersections between the arbitrary boundary and the map unit boundary data. These are used to trace around the map units crossed by the arbitrary boundary and thereby calculate the area inside the boundary. Thus the correct proportion values are stored for the map units on the new map. Everything inside the boundary is part of the map. This tends to produce a cluttered plot at the edges and field values may become removed from their map units, eg, map unit 45068 (see arrows). This is because field values are moved horizontally or vertically from the centroid to locate them inside the bounding rectangle. Plot 2.3 shows a solution to this problem.

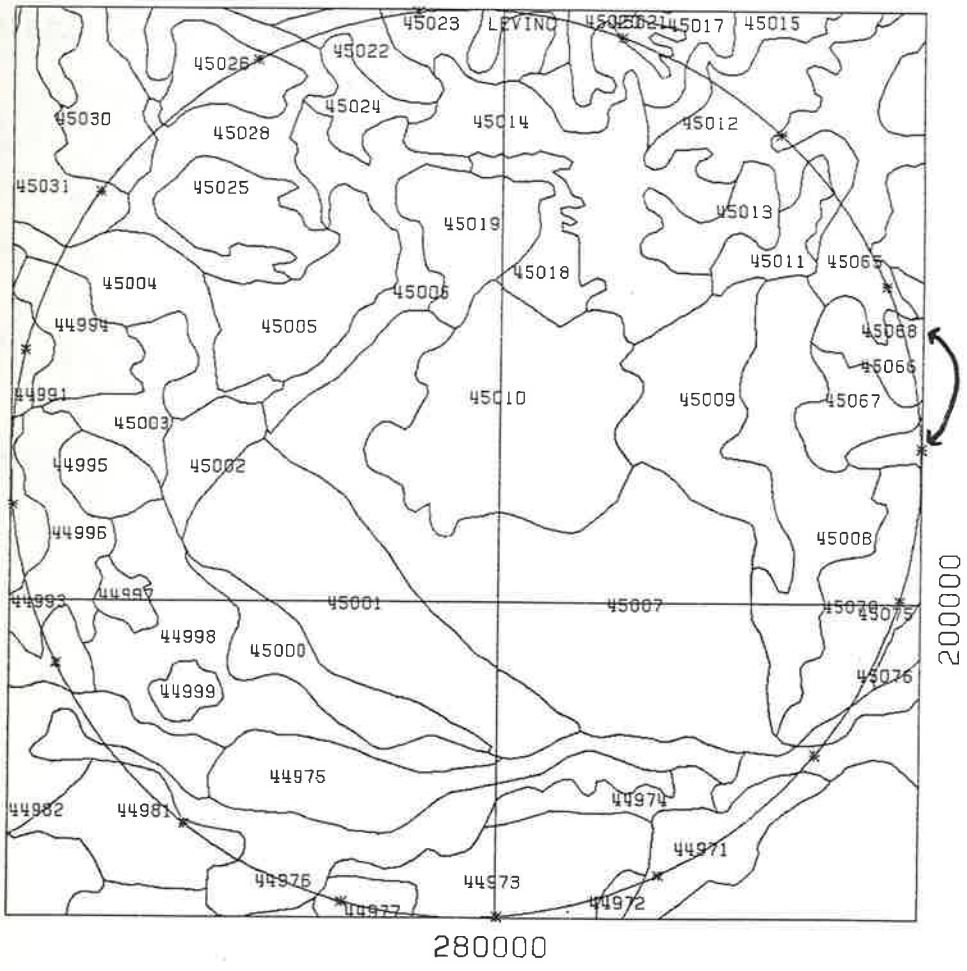
The OVERLAY EXACTLY command does not require a source map and its processing time is proportional to the length of the arbitrary boundary. By using the proportions the area of the exactly overlayed map is 11287 ha, only 23 ha (- 0.2%) under the calculated true area.

```
overlay exactly levinc levinc eng                    2.6 sec

plot levin2 number                                   2.0 sec
scale 100000
boundary levinc
title 'exact overlay - example'
framesize 1600 2000 eng
```

SCALE 1: 100000 MAP LEVIN2 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

EXACT OVERLAY EXAMPLE



KM. 0 2 4 6 8 10

MILES 0 2 4 6

FIELDS PLOTTED : NUMBER

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 272938 195438

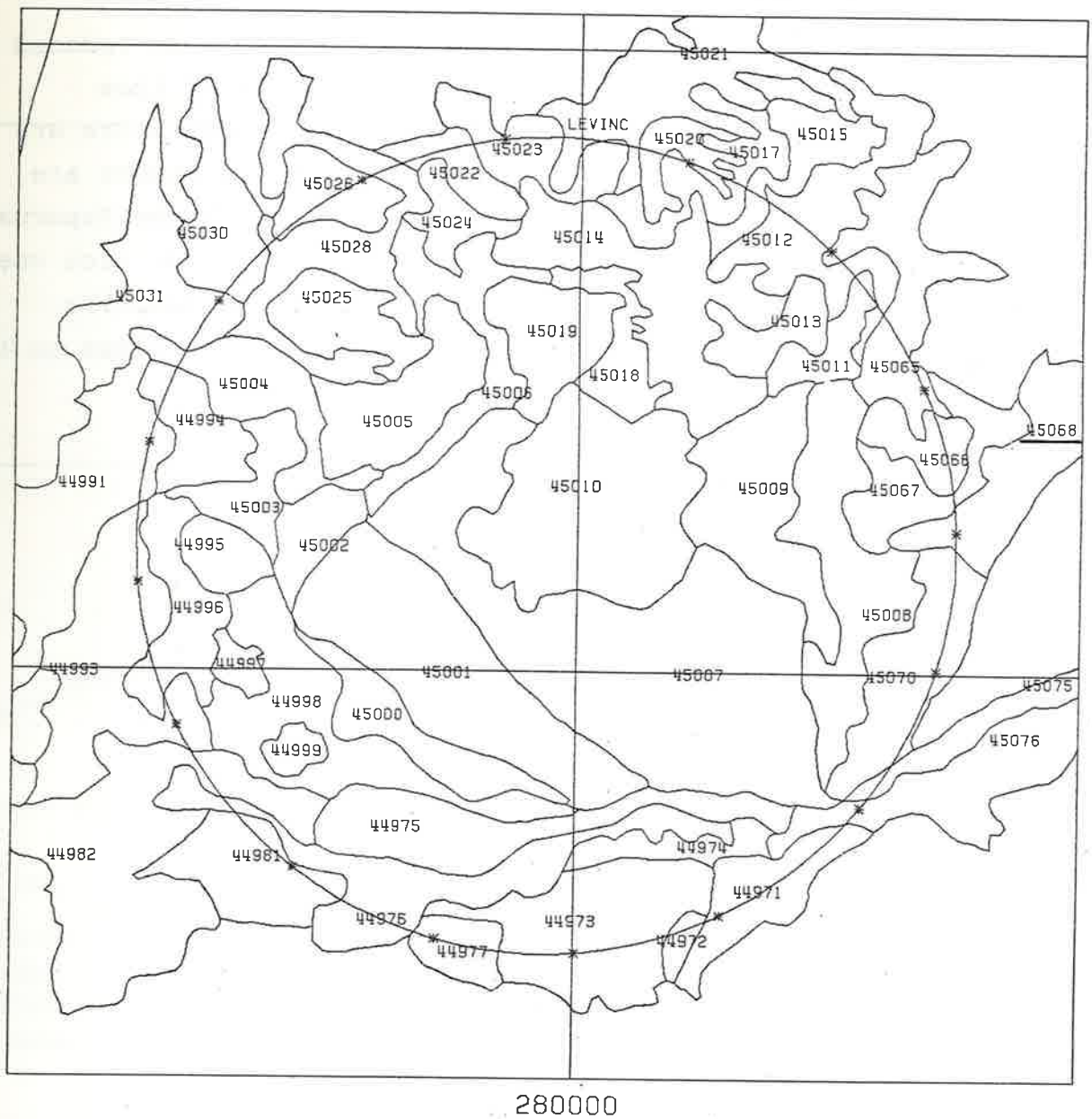
PLOT 2.3 Exact overlay with margin

Plot 2.3 shows an improvement to the exactly overlayed map. By specifying a margin, more space is available to record field values close to the arbitrary boundary. With a margin it is no longer necessary to move inward the field values of map units with their centroids outside the bounding rectangle. Thus it is clear which field value belongs to each map unit. It also shows the shape and size of map units near the edge of the plot which may aid interpretation.

The MARGIN option has been used to set the margin at 2000 yards (a 5000 yard margin should ensure that the complete boundary for each map unit intersected by the arbitrary boundary would be plotted). The MARGIN option effectively increases the bounding rectangle in all four directions. Note - the user is able to control which map units that are partially inside the arbitrary boundary are included in the map.

```
plot levin2 number
scale 100000                                    2.1 sec
boundary levinc
framesize 1000 2000
margin 2000
title 'exact overlay ' with margin
end
```

EXACT ØVERLAY WITH MARGIN



SECTION 3 : FRAME SIZE AND ORIENTATION

There are two options, BLOCKED and ALIGNED, which are helpful in producing plots that can be overlayed onto base maps. These are explained in the "Options of the PLOT command" section. Although valid at any scale they are particularly useful at 1:63360 for the NZMS1 maps on which the LRI worksheets are based. This series of five plots shows the use of these two options at a scale of 1:63360.

For the purpose of this handbook the plots have been reduced in size to fit on an A4 page. As a consequence of this reduction the LADEDA commands used to generate the plots are somewhat misleading so are not listed. Only the frames are shown to give their relative size and position to the Paparua County boundary (computer name PAPACOUN). The first plot uses the field WKSHEET (worksheet number) to show the relative positions of the worksheet edges (ie, the straight lines on the map).

PLOT 3.1 CHCH AREA SHOWING PAPARUA

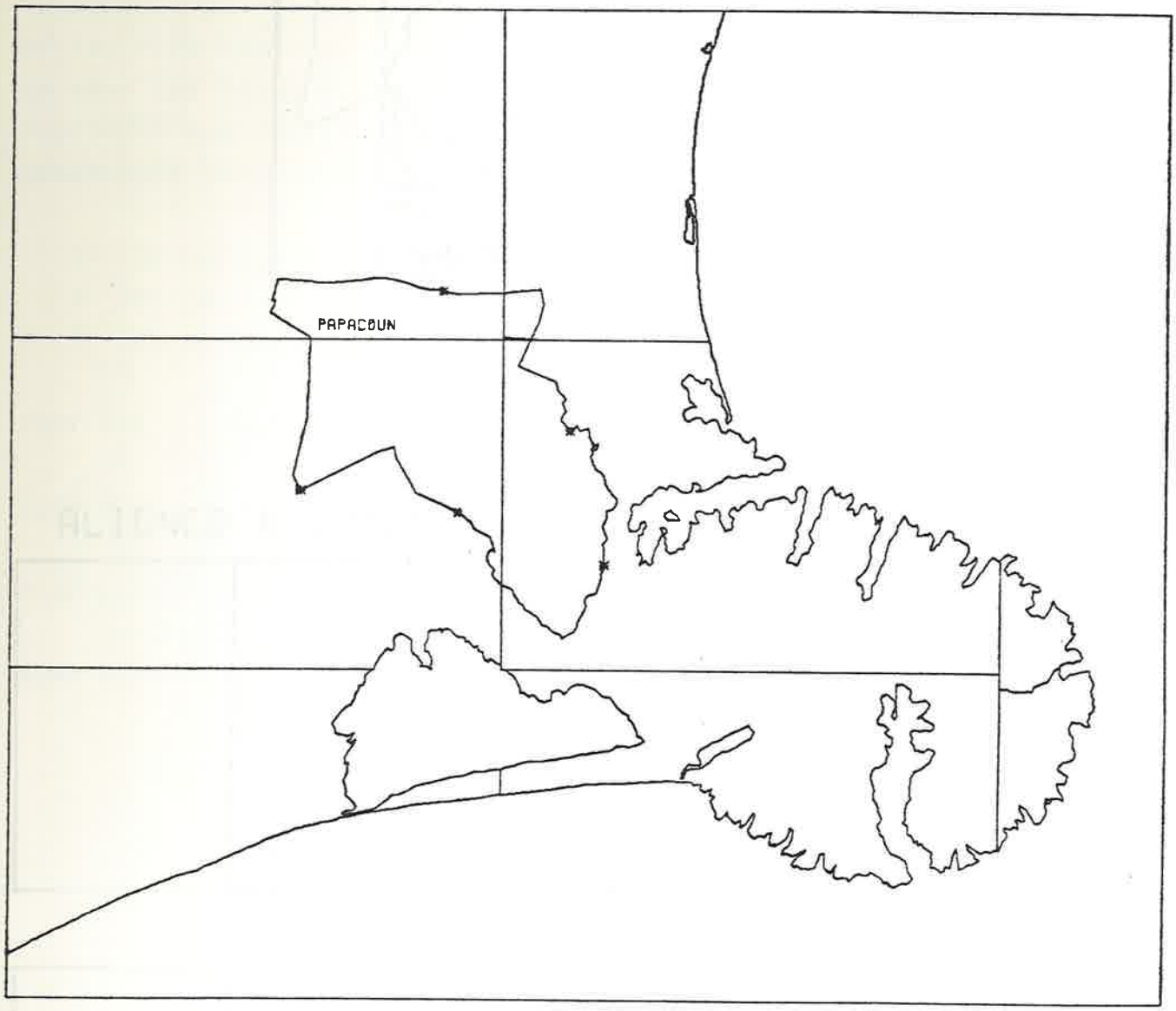
PLOT 3.2 BASIC PLOT

PLOT 3.3 BLOCKED PLOT

PLOT 3.4 ALIGNED PLOT

PLOT 3.5 ALIGNED AND BLOCKED

CHCH AREA SHOWING PAPARUA



KM. 0 10 20 30 40 50

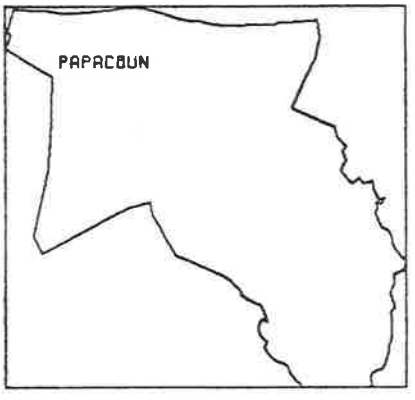
MILES 0 10 20 30

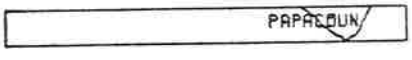
FIELDS PLOTTED : WKSHEET

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

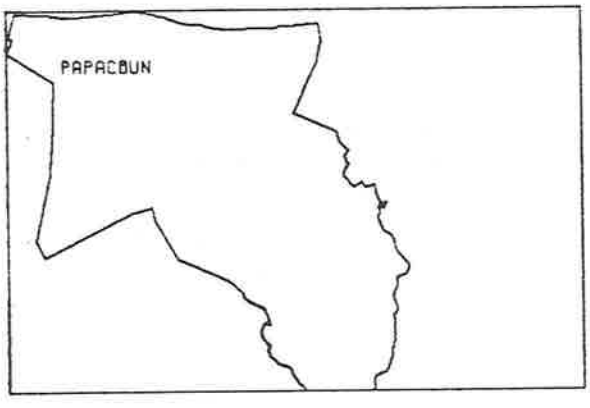
FRAME 1 ACROSS 1 DOWN. ORIGIN 545000 500000

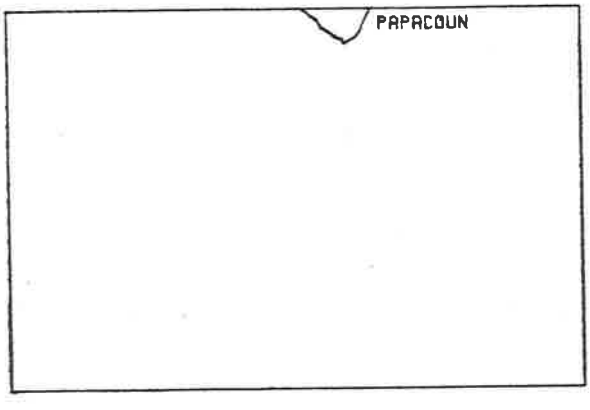
BASIC PLOT



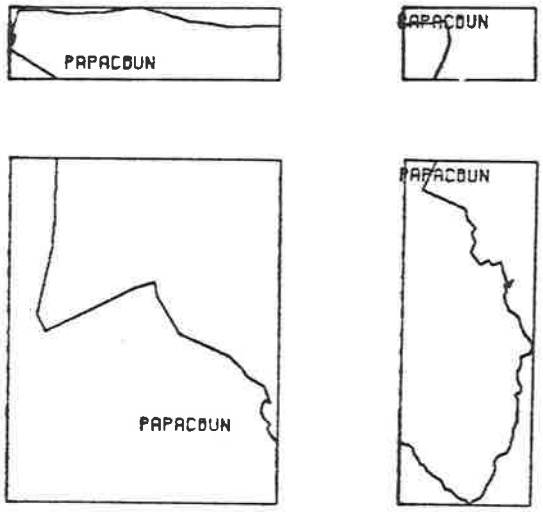


BLOCKED PLOT

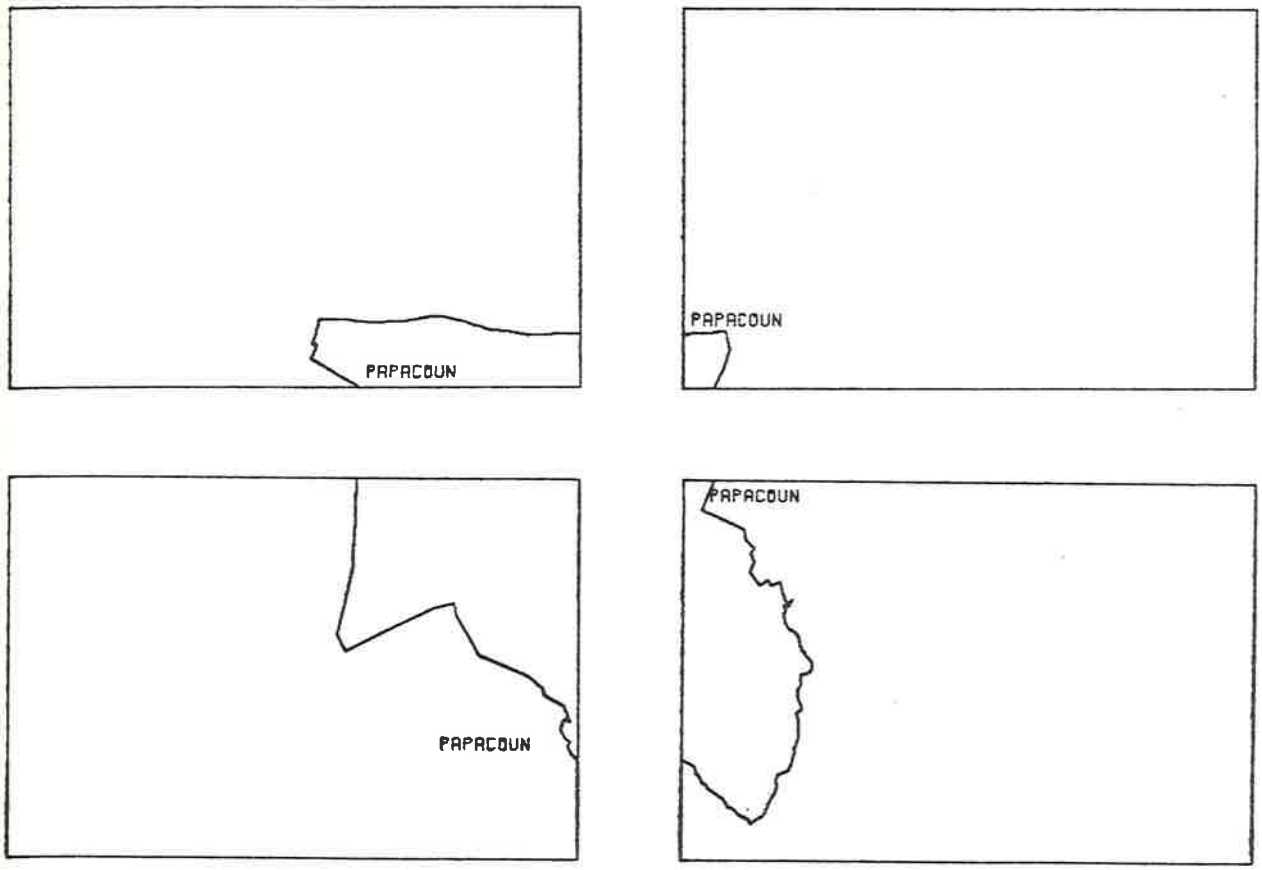




ALIGNED PLØT



ALIGNED & BLØCKED



SECTION 4 : SAMPLE OF USERS' PLOTS

This section presents four plots that have been generated by users working with LADEDA. It gives examples of the way LADEDA can be used as well as showing the remaining options of the PLOT command. When maps are plotted at small scales or when the field values are long, plots may become too cluttered and detailed. This section shows three ways of overcoming these problems:

1) To omit the map unit boundaries.
2) To omit the field value characters.
3) To select a subset of the map units.

PLOT 4.1 N.I. TUNNEL GULLY DISTRIBUTION

PLOT 4.2 TUNNEL GULLY BOUNDARIES

PLOT 4.3 NORTH CANTERBURY LAND STUDY

PLOT 4.4 WETLAND VEGETATION FOR S172

PLOT 4.1 N.I. tunnel gully distribution

Plot 4.1 shows the distribution of tunnel gully erosion in the North Island. A star has been plotted at the centre of each map unit for which tunnel gully erosion was recorded and the map unit boundaries have not been used. The areas where the concentration is greatest, North Auckland and Wairarapa, appear as dense black shapes, whereas small pockets of tunnel gully erosion, such as in Hawkes Bay, appear as individual stars. However, no adjustment is made for the map unit area, thus areas in which map units tend to be small will give the incorrect impression of a denser distribution.

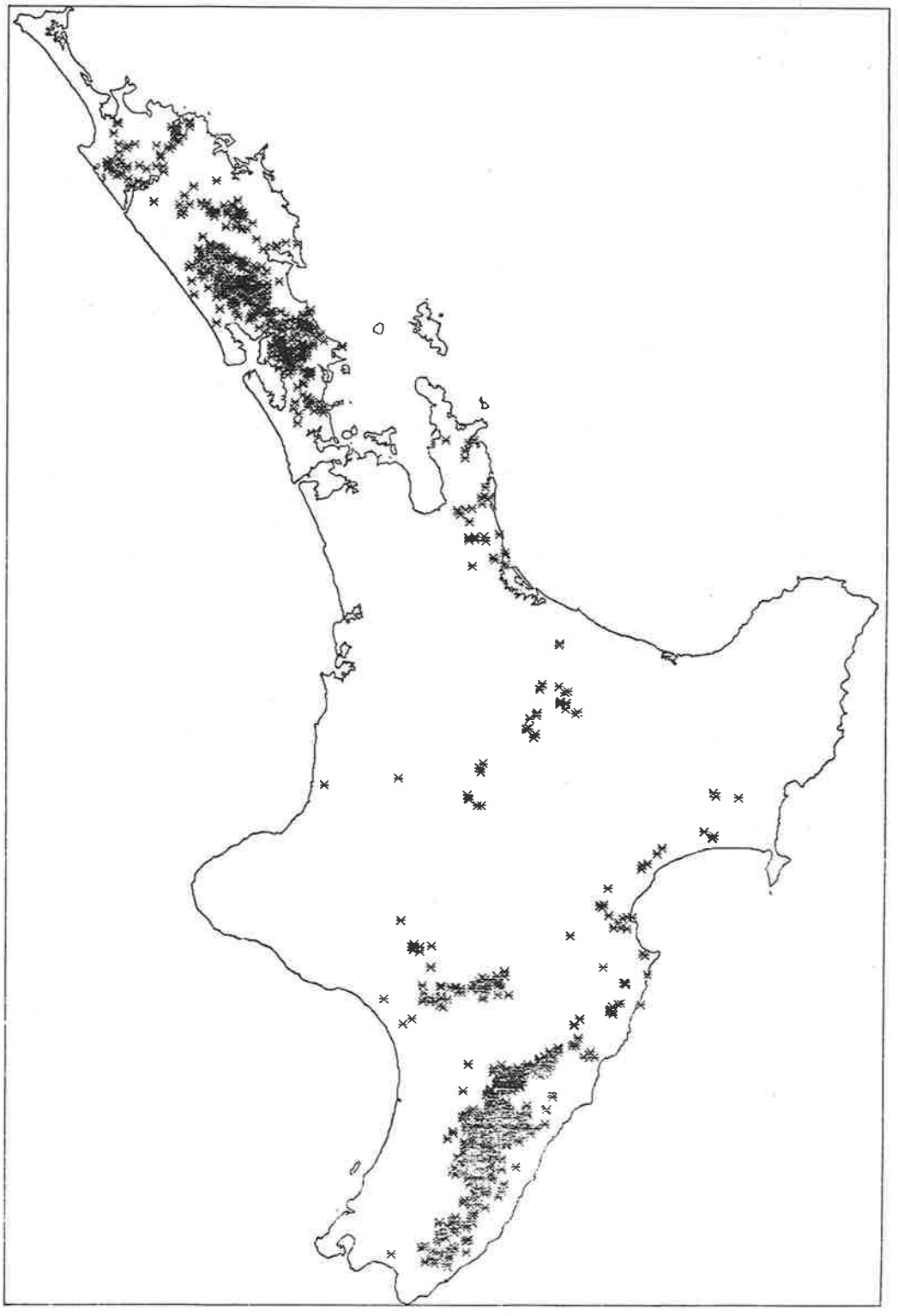
A user-defined "virtual" field, TGDIST, was created which has the value '*' whenever the field EROSION contains a T (the symbol used to represent tunnel gully erosion). The EXTRACT command was used to create a new map, NTGMAP, which contains only the map units with tunnel gully erosion recorded. The GRID 0 option means that no grid is plotted and the NOMUBS option means that NO Map Unit Boundaries are used or plotted.

```
define field tgdist virtual
erosion ct 'T' '*' else                                    0.1 sec

extract north ntgmap tgdist eq '*' end                     17.5 sec

plot ntgmap tgdist                                         5.3 sec
scale 4000000
grid 0
charsize 20
nomubs
framesize 1600 2100
title 'n.i. tunnel gully' ' distribution'
end
```

N.I. TUNNEL GULLY DISTRIBUTION



SCALE 1:4000000 MAP NTGMAP 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 50 100 150 200 250 300 350 400
MILES 0 50 100 150 200 250
FIELDS PLOTTED : TGDIST
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 1 ACROSS 1 DOWN. ORIGIN 10000 82000

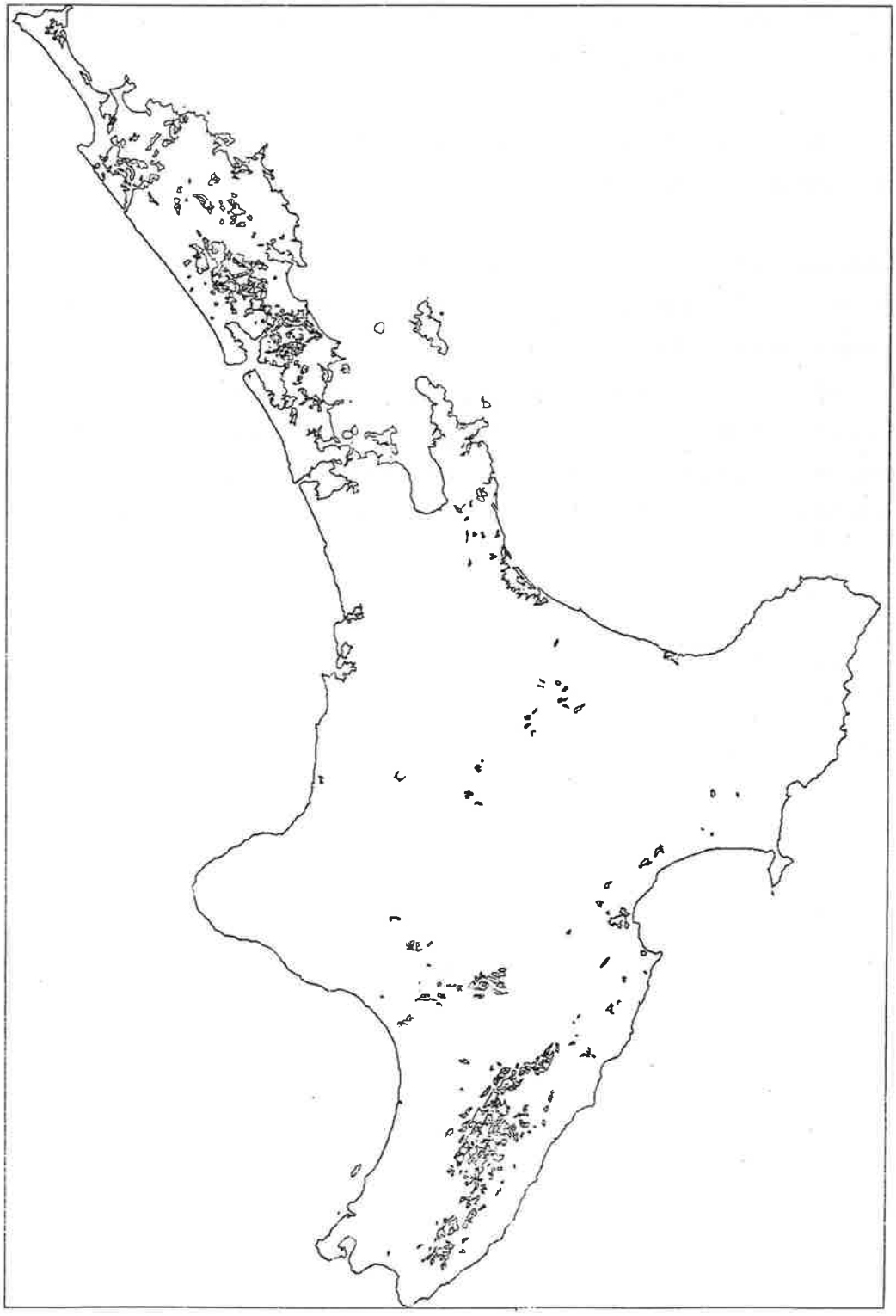
PLOT 4.2 Tunnel gully boundaries

Plot 4.2 shows the same tunnel gully distribution as Plot 4.1, but with the map unit boundaries plotted and the field values omitted. This approach is preferable as it shows the true distribution and size of the map units. Omitting the field value, which is redundant in single factor plots, helps to give a less cluttered plot. This method could be used for multi-factor plots (ie, many different field values) if a larger scale plot was also produced with both boundaries and field values. This could then be used to interpret (or colour in) the smaller scale plot.

In this command the NODESCRIPTION option was used to suppress the plotting of the field values. However, the field value is used to determine which segments are plotted. Notice that using the map unit boundaries required more execution time than the previous example.

```
plot ntgmap tgdist                                    8.2 sec
scale 4000000
grid 0
nodescription
framesize 1800 2100
title 'tunnel gully' ' boundaries'
end
```

TUNNEL GULLY BOUNDARIES



SCALE 1:4000000 MAP NTGMAP 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

KM. 0 50 100 150 200 250 300 350 400
MILES 0 50 100 150 200 250
FIELDS PLOTTED : TGDIST
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 1 ACROSS 1 DOWN. ORIGIN 10000 82000

PLOT 4.3 North Canterbury land study

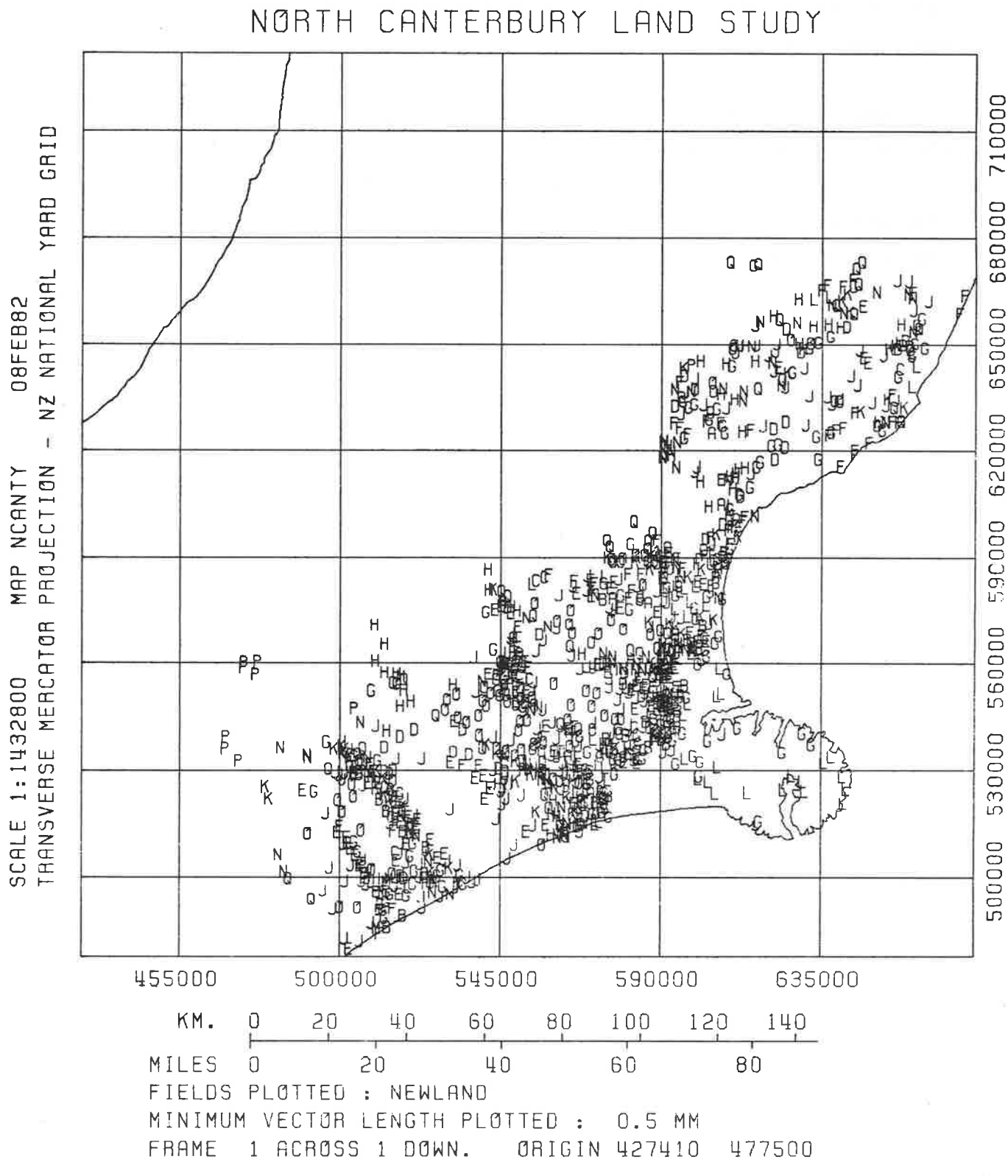
Plot 4.3 shows a variation on Plot 4.1 but for the MAF North Canterbury sub-region. The purpose of this plot is to show the distribution of certain LUC (land use capability) units and to identify the outliers. The field values (single letter codes) can be differentiated where the letters are sparse but not in areas where the letters are concentrated.

The map was created using the system boundary NCANMAFS. An "indexed" field was set up in which the LUC units being studied were represented by the letters A to Q, and all other LUC units by a blank. This new field was plotted using the SCALE 0 option. This causes the scale to be calculated by the computer so that the map will just fit inside the frame and not require sectioning. The full GRID option was used to obtain the work-sheet grid.

```
declare boundary ncanmafs system                    0.1 sec

overlay coarsely south ncanty ncanmafs
                                                    9.5 sec
define field newland indexed land(1,4)
'1c 1' 'A'                                         11.8 sec
'1w 1' 'B'
'2c 1' 'C'
'2e 1' 'D'
'2s 2' 'E'
'2s 3' 'F'
'2w 1' 'G'
'3e 5' 'H'
'3e11' 'I'
'3s 5' 'J'
'3s 9' 'K'
'3w 1' 'L'
'3w 2' 'M'
'4s 6' 'N'
'4s 7' 'O'
'6s 7' 'P'
'6s 8' 'Q'
else ' ' end

plot ncanty newland
scale 0                                             9.0 sec
grid 45000 30000 500000 500000
charsize 20
nomubs
framesize 1600 2200
title 'north canterbury' ' land study'
end
```


NORTH CANTERBURY LAND STUDY
SCALE 1:1432800 MAP NCANTY 08FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID
500000 530000 560000 590000 620000 650000 680000 710000
455000 500000 545000 590000 635000
KM. 0 20 40 60 80 100 120 140
MILES 0 20 40 60 80
FIELDS PLOTTED : NEWLAND
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 1 ACROSS 1 DOWN. ORIGIN 427410 477500

PLOT 4.4 Wetland vegetation for S172

Plot 4.4 shows the effect of plotting only selected (or extracted) map units with both map unit boundaries and field values. Wetland vegetation for worksheet S172 is plotted at a scale of 1:125000. The whole of the vegetation field (VEG) has been plotted. Notice the difference between upper and lower case letters and the way the field values are plotted across the frame edge so that the two frames can be pasted back together.

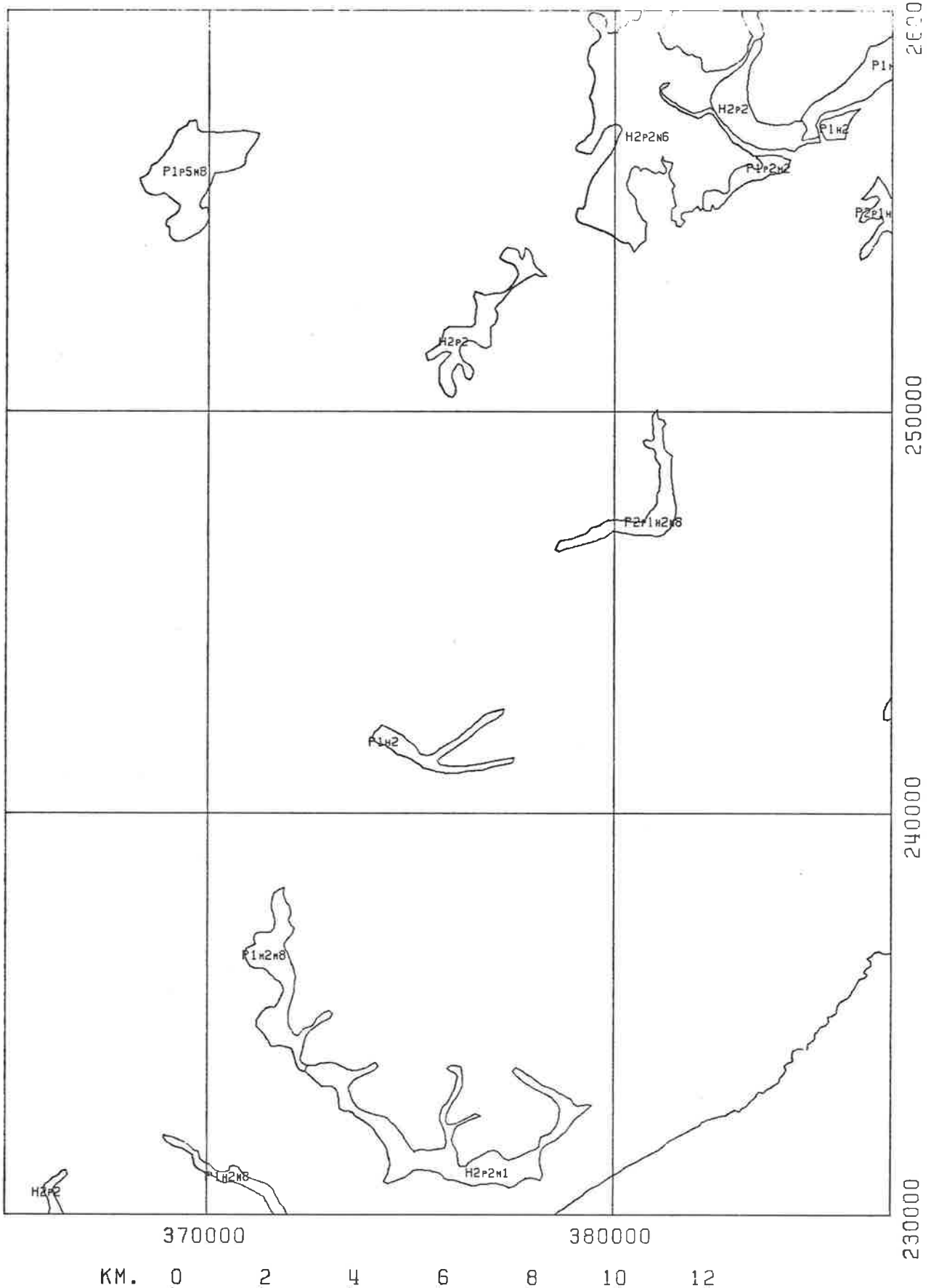
The map S172 was created by overlaying the worksheet boundary. The SELECT option was used to obtain the required map units that satisfied the given vegetation condition. The EXTRACT command has the same effect, but it creates a new permanent map of the extracted/selected map units.

```
define boundary s172b box
365 230 4rv 2e0                                    0.1 sec

overlay cosmely/ south s172 s172b                  8.3 sec

plot s172/ veg                                     2.1 sec
scale 125000
framesize 1e00 2200
select
capveg ct 'F 5' or
capveg ct 'H 1' or
capveg ct 'H 2' or
capveg ct 'H 5' or
capveg ct 'H 6'
title 'Wetland vegetation' 'for s172'
end
```

WETLAND VEGETATION FOR S172



SCALE 1: 125000 MAP S172 12FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID

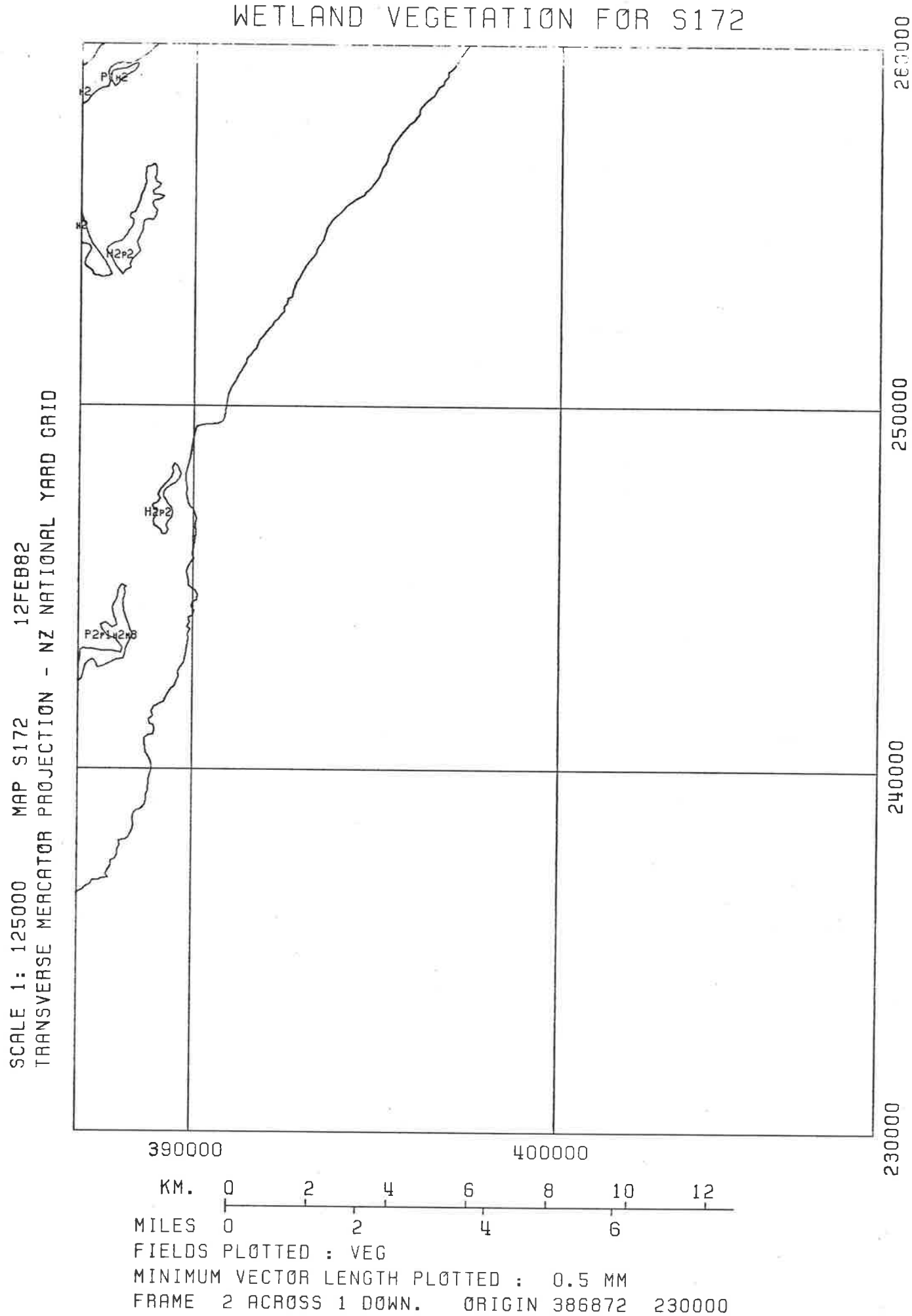
KM. 0 2 4 6 8 10 12

MILES 0 2 4 6

FIELDS PLOTTED : VEG

MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM

FRAME 1 ACROSS 1 DOWN. ORIGIN 365000 230000


WETLAND VEGETATION FOR S172
SCALE 1: 125000 MAP S172 12FEB82
TRANSVERSE MERCATOR PROJECTION - NZ NATIONAL YARD GRID
H2P2
P2H2
390000
400000
250000
240000
230000
KM. 0 2 4 6 8 10 12
MILES 0 2 4 6
FIELDS PLOTTED : VEG
MINIMUM VECTOR LENGTH PLOTTED : 0.5 MM
FRAME 2 ACROSS 1 DOWN. ORIGIN 386872 230000

GLOSSARY OF TERMS

arbitrary boundary — A closed polygon consisting of a sequence of vectors. The boundary can be a system boundary that has been digitized, eg, counties, catchments, pest boards, state forests, etc, or a user-defined boundary such as a circle or box. Arbitrary boundaries are used in overlaying and any arbitrary boundaries can be plotted within a map.

bounding rectangle — The minimum and maximum eastings and northings for the map. Nothing is plotted that lies outside the bounding rectangle.

centroid — The centre of the largest circle that could be drawn inside the map unit. This was judged manually when the map unit data was digitised.

coarse overlay — Map unit inclusion is determined by whether or not the recorded centroid of the map unit is inside the arbitrary boundary. The map unit boundary data is not used. The proportion is always recorded as 100%. Any map can be used as the source map.

condition — A test that is applied to each map unit to determine whether or not it is to be included. A simple condition is of the form - fieldname operator fieldvalue, where operator is a comparison such as equals, greater than, contains, etc. Complex conditions can be formed by connecting simple conditions with AND or OR.

exact overlay — The exact proportion of each map unit inside the arbitrary boundary is calculated, thus correct areas can be given for tabular printouts. The arbitrary boundary is always overlayed onto the whole island (NORTH or SOUTH).

extracted map — The result of processing a source map by the EXTRACT command. Map units are included in the new map if they satisfy a given condition. However, the bounding rectangle remains as that of the source map.

field — A field is a set of rules, identified by its fieldname, that are applied to the descriptive data to give a field value for each map unit. The field can be part of the descriptive data, eg, NUMBER, SLOPE, ROCK, etc.; a special field based on the descriptive data, eg, MAINROCK, MAPREF, etc.; or a user-defined set of rules using other fields, eg, "indexed" or "virtual" fields. A subfield can be obtained in the following way: fieldname (start, length), eg, LAND(1,4) is the first 4 characters of the LAND field.

field value — The value that a field takes for a particular map unit. The value is always a string of between 1 and 20 characters.

frame — A single page or section of the plot, the size being determined by the user. Each frame has its own grid values, titles, etc, and is given a position on the plot in the form (across, down).

"indexed" field	A user-defined field that is based on a single field. The definition consists of a number of string_a - string_b pairs, where string_a is a value that the base field could evaluate to, and string_b is the value that the indexed field will take on. The indexed field is evaluated for every map unit and stored at the time of definition. Thus an indexed field takes longer to define but is quicker in actual use than a virtual field.
map	A collection of map units and the proportions of each unit inside the map. Maps can be produced by extracting or overlaying; or by merging, subtracting or intersecting two other maps.
map size	This is determined by the bounding rectangle that the map lies completely within. The map size will determine the plot size.
map unit	A homogeneous parcel of land mapped on 5 factors at mile-to-the-inch (soil, slope, erosion, rock and vegetation). A 6th factor, land use capability assessment, is assigned to each map unit. Each map unit has a unique identification number in the South Island or North Island.
map unit boundary	The polygon that describes the shape of the map unit. The polygon consists of one or more segments.
non-normal	A map unit which is one of the following; estuary, ice-field, lake, quarry or mine, river, town or city. The 6 descriptive factors are not recorded.
normal map unit	A map unit for which the 6 descriptive factors are recorded.

overlayed map	The result of using the OVERLAY command - there are two versions: OVERLAY COARSELY and OVERLAY EXACTLY. Map units are included in the new map if they lie within the arbitrary boundary. The bounding rectangle of the map is that of the arbitrary boundary.
plot	The result of processing a map through the PLOT command. The plot will consist of one or more frames.
proportion	The percentage of a map unit that is considered to be part of the map. In tabular print-outs the area of the whole map unit is multiplied by the proportion to give the correct area. The coarse overlay always gives proportions of 100%.
segment	The common line between two adjacent map units (or a map unit and the sea). Each segment consists of one or more vectors placed head to tail.
vector	A straight line going from a start point to a finish point.
"virtual" field	A user-defined field that will return a value dependent on the value of other fields. The virtual field consists of a number of condition-string pairs, where the condition is some test applied to other fields, and the string is the value the virtual field will take if the condition is satisfied.