Water voles in the Middle Level: a three-year study of water vole populations at Curf Fen and Ransonmoor, Cambridgeshire.

A Report for the Middle Level Commissioners

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The Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire & Peterborough

Summary

This report presents the results of a three year study (2003-2005) of water vole *Arvicola terrestris* populations in the Middle Level catchment area, Cambridgeshire. The need for the project was triggered by the findings of Hillier and Baker; their surveys in 2000 and 2001 found relatively high levels of water vole activity in ditches managed by the Middle Level Commissioners (MLC). The realisation that the area might be a national stronghold for voles, prompted the commission of this more detailed follow up survey, which would also examine the impacts of ditch management on vole populations.

This study investigated vole distribution in two discrete areas of the fens, Curf Fen and Ransonmoor. Both sites are within the jurisdiction of the Middle Level Commisssioners. The survey covered 27km of ditches at Curf Fen and 47km at Ransonmoor. Work was undertaken using a combination of canoe and foot survey. April was found to be the optimum month for survey. The survey looked for field signs and live sightings, the location of such records was recorded using GPS. The results were then entered into a GIS database to produce the distribution maps given in this report.

The spring 2005 survey achieved a 100% coverage of all main and side drains at both sites, and therefore provides a comprehensive picture of vole activity in these areas. The results show that both sites have high occupancy rates along the larger drains that are maintained by the Internal Drainage Boards (IDBs); at Curf Fen 64% of these ditches had vole activity, and an exceptionally high 93% at Ransonmoor. Both sites are therefore important strongholds for water voles in Cambridgeshire.

A combination of factors: higher water levels, greater drain linkage, and a less intensive ditch management regime, are all thought to play an important role in the extremely high occupancy rates discovered at Ransonmoor. It is believed an adoption of a similar less intensive management regime at Curf Fen would also benefit the water vole population at that site.

Activity levels in the side ditches (not maintained by the IDBs) are considerably lower with 39% occupancy at Curf Fen, and 30% at Ransonmoor; the generally low water level in these side ditches is thought to be the main limiting factor for voles.

The study results indicate that current methods employed for de-silting maintenance work have a minimal impact on vole activity. However, results show that bank re-profiling (side-trimming) can bring about the complete loss of voles in worked ditch sections. Further investigation of this impact on vole populations is strongly recommended; the recent bank re-profiling work undertaken in the autumn/winter of 2005 provides the ideal opportunity for a highly focused follow up survey in 2006 of these specific ditches.

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INTRODUCTION

1.0 Introduction

The water vole, *Arvicola terrestris* (Linnaeus 1758), was formerly common along the banks of rivers, streams, canals, ditches, dykes, lakes and ponds throughout mainland Britain. However over the last 15 years or so, the water vole has undergone one of the most catastrophic declines of a species ever known in the UK. The fact is that they are now one of Britain's most threatened native animals (Strachan 1997).

It is thought likely that the reasons for this decline commenced several decades ago but it was really only in the late 1980s that a significant reduction in population was described, following crucial survey work carried out by the Vincent Wildlife Trust. By the mid-1990s this had led to the establishment of various studies investigating the prime suspected causes, namely habitat loss and American mink, *Mustela vison*. Indications from recent survey work suggest that there are now only one fifth of the sites occupied by water voles that were occupied during 1989-90. This means the species is now limited to approximately just 3,000 colonies across the whole of Britain. To put this figure into perspective, it is estimated that there would have been well over a million colonies at the start of the twentieth century (Strachan 1997).

What has caused this huge decline in numbers? Changes in both land-use and riparian habitat management have resulted in habitat loss and degradation, causing fragmentation and isolation of water vole populations. This has led to an increased vulnerability to predation, especially by American mink, which have, coincidentally, been spreading and consolidating their range throughout Britain.

1.1 Water vole status in Cambridgeshire

The water vole is one of the priority species identified in the Cambridgeshire and Peterborough Biodiversity Action Plan (BAP). In many parts of Cambridgeshire numbers have reduced similarly to the national trend. Both the national and local water vole BAPs identify the need to locate and protect remaining viable breeding populations of water vole.

In 2000, a sample survey (Hillier 2000) was undertaken to look at the occurrence of water vole along the rivers and main drains managed by the Middle Level Commissioners (MLC), in order to inform the Commissioners' operational and project activities. This survey recorded positive signs of water vole at 22% of the locations sampled. Some of these were isolated locations, while others were concentrations of positive sites.

In 2001 a more detailed survey (Hillier & Baker 2001) of smaller drains identified from the 2000 survey was undertaken and showed an occupancy of 80%, suggesting fen drains could be a national stronghold for water vole.

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1.2 Project aims and objectives

Concerns exist over the impact of ditch maintenance regimes on water vole populations. The Middle Level Commissioners (MLC) are concerned that national guidelines on ditch management for water vole may be in conflict with their statutory drainage duties on ditch systems that have extremely shallow gradients. They therefore wish to reconcile any potential conflict.

As a result, this three-year project (2003-2005) was initiated to examine the relationship between water voles and ditch management. Two discrete areas within the Middle Level were selected for the project, Curf Fen and Ransonmoor. Figures 1.2A and 1.2B (on pages 3 and 4) illustrate the two study areas, and show the main ditches that are maintained by Curf IDB and Ransonmoor DDC respectively. The sites have different ditch management regimes. Ransonmoor has a maintenance regime that the MLC consider to be more sympathetic to the needs of water vole as described by conservation best practice whilst Curf Fen has a more intensive management regime. At Ransonmoor flail mowing is carried out in advance of both machine cleansing and side trimming works; mowing is confined to the bank-side from which the machine is working to afford better visibility. At Curf Fen the maintenance regime includes the flail mowing of most bank sides every year.

The project aims:

- To gather baseline survey data, that will provide an accurate picture of current water vole activity and distribution patterns at both sites. This information will assist the planning of future ditch maintenance work, and enable future survey work to detect changes in vole populations over time.
- To compare and contrast the impacts of two different management regimes on water vole populations.

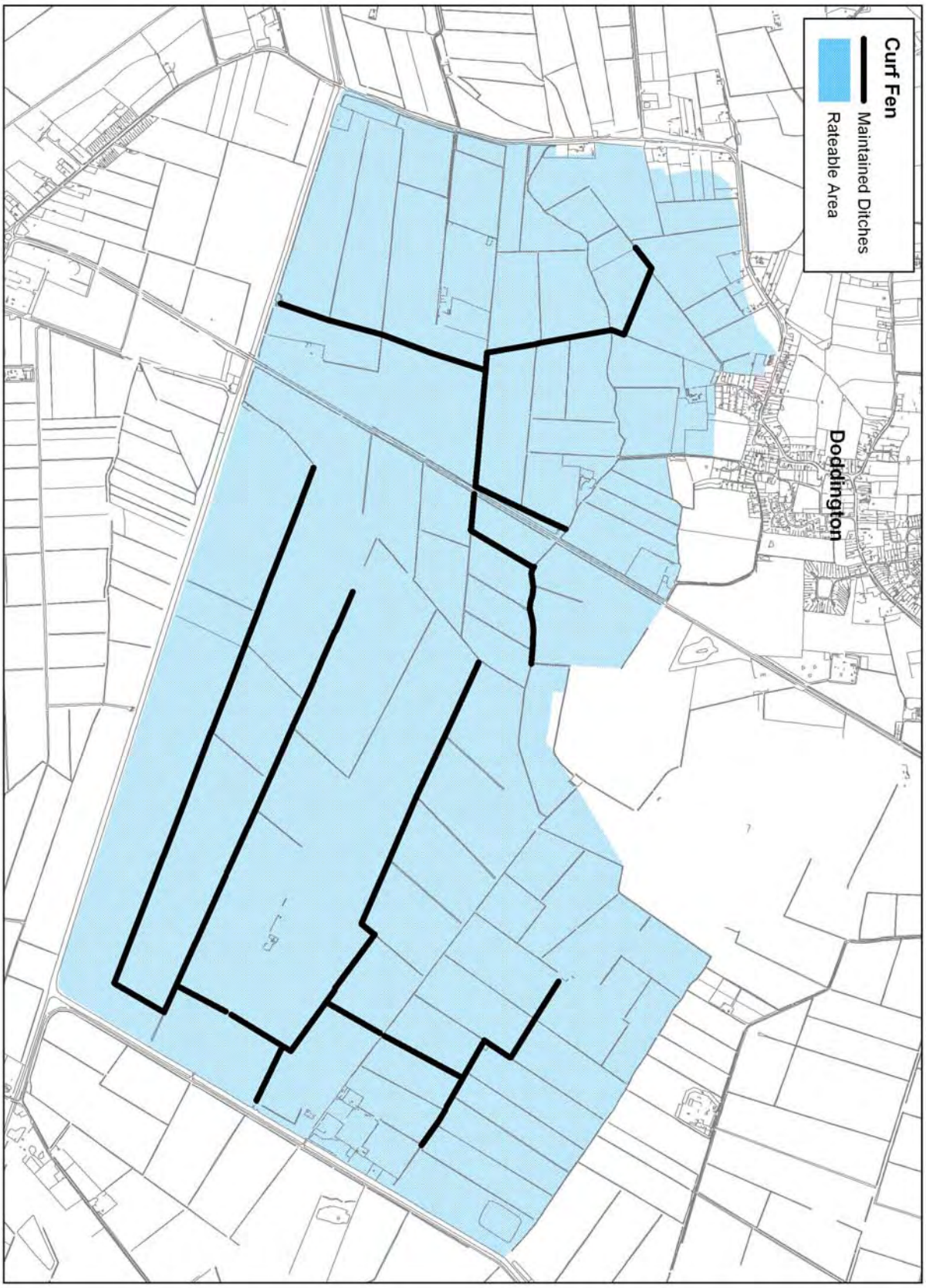

Figure 1.2A, Curf Fen survey area, illustrating ditches maintained by Curf IDB (Internal Drainage Board)

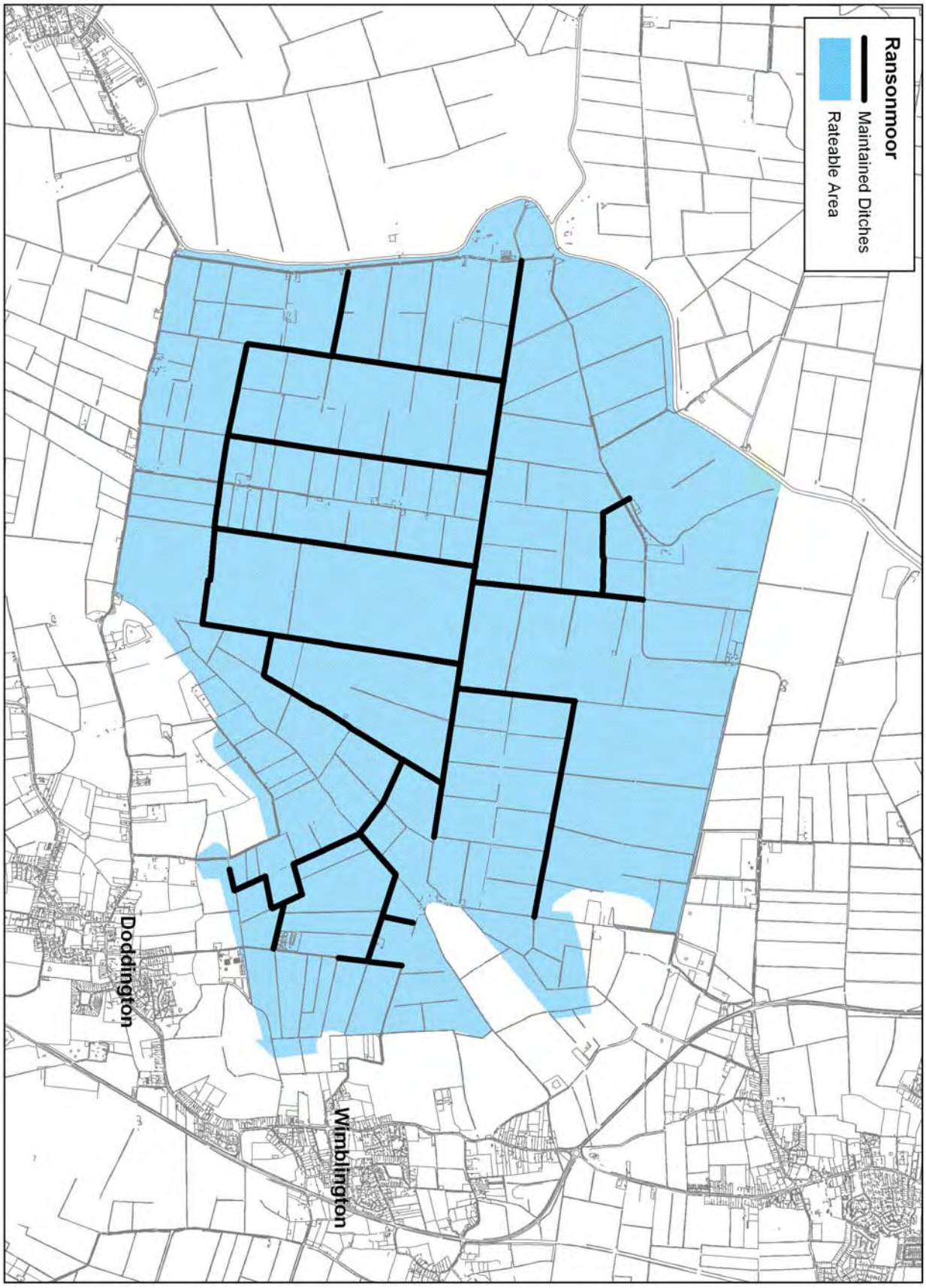

Figure 1.2B, Ransonmoor survey area, illustrating ditches maintained by Ransonmoor DDC (District Drainage Commissioners).

BACKGROUND

2.0 Background information on water voles

2.1 Water vole ecology

Biology

The water vole, *Arvicola terrestris* (Linnaeus 1758), is a rodent of the subfamily Arvicolinae, along with all other voles, lemmings and muskrats. Currently two species are recognised. These are the northern water vole *A. terrestris* (Britain and throughout Europe to Russia) and the southern water vole *A. sapidus* found in southwest Europe (Wilson & Reeder 1993).

The water vole is the largest of the British voles weighing between 200-350g, with males normally slightly larger than females (Corbet & Harris 1991). It is typically vole-like with a rounded body, blunt muzzle and short round ears almost hidden in the thick fur of its head and nape. Its fur is variable in colour, although most southern England populations are typically reddish, medium to dark brown colour. A black colour form may occur in any population, but are more common at the higher latitudes of Scotland (Woodroffe 1996).

Water voles are often mistaken for brown rats (*Rattus norvegicus*) which frequently inhabit waterside habitats and are also excellent swimmers. However brown rats are generally larger, weighing up to 500g (Corbet & Harris 1991) and have pointed muzzle, larger eyes and more obvious ears. The water vole's tail is a little longer than about half the body length and is covered with fur, while the rat has a longer naked tail.

Lifestyle

Water voles are herbivorous, feeding mainly on the lush aerial stems and leaves of waterside plants, especially the fringing reeds, sedges and tall herbs. From the remains found at feeding stations, a nation-wide survey by Strachan & Jeffries (1993) was able to identify a surprisingly large list of 227 plant species eaten by the water vole in Britain. The researchers found that the most favoured plants were common reed, reed canary grass, sedges, sweet grasses and bur-reeds. The same survey found that the best sites show a highly layered bank-side vegetation with tall grasses and stands of willowherb, loosestrife, meadowsweet or nettles, often fringed with thick stands of rushes, sedges or reed.

Each vole utilises a series of burrows. These include residential burrows, comprising many entrances, inter-connecting tunnels, food storage and nest chambers, as well as bolt holes consisting of short tunnels ending in a single chamber. Nest chambers occur at various levels in the steepest part of the bank and the nest consists of shredded grass. Occasionally water voles will weave a nest into the bases of sedges and reeds as a large ball of vegetation (Laville 1989).

Water voles live in colonies, but string themselves out along a watercourse through a series of contiguous territories (Stoddart 1970). These are established by the breeding females, and frequent interactions between individuals determine social status. Depending on overall population density, season and habitat quality, the length of territory ranges from 30-150m for females and from 60-300m for males. The larger sizes occur when the population density is low and the habitat is poor.

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Dispersal is one of the least known aspects of water vole biology, but the evidence so far, is that their dispersal capacity is low (Strachan 1998). One of the largest recorded dispersal distances was noted between two watersheds, covering a distance of 2.8km (Stoddart 1970). This suggests that water voles might be very vulnerable to factors which cause population fragmentation.

Population studies along the linear waterways of Britain have shown that the numbers of individuals trapped within a 100m stretch of riparian habitat varied with habitat type and season (Strachan 1998). Estimates ranged from 2.4/100m (West Lancashire dyke system) through 3.3/100m (North Yorkshire Moors) to 6.1/100m (Bure marshes, Norfolk) and 14.0/100m (Wildfowl and Wetland Trust, Slimbridge).

The water vole breeding season lasts from March to October. During the breeding season, home ranges are marked by discrete latrine sites. These consist of flattened piles of droppings topped with fresh ones. Territory holders scent-mark at these latrines by stroking their hind-feet across lateral scent glands on the flanks and then drumming them on the latrine (Stoddart 1971).

Exceptionally, water voles may survive three winters. Over-winter mortality may be very high among some colonies, with the loss of up to 70% of the individuals especially among the dispersing juveniles. Although water voles do not hibernate they do spend long periods within their nest chambers (often cohabiting with other members of the colony) and there may be very little sign of above ground activity (Stoddart 1971).

Survival strategies

In Britain the water vole has had to contend with a wide range of traditional predators for many millennia, including fox, otter, stoat, weasel, rat, owl, heron, raptors and large fish. More recently the arrival of the feral American mink has been implicated in the water vole decline (Woodroffe 1996).

As a prey species the water vole has evolved a number of anti-predator survival strategies which include hiding or escaping to safety, high population recruitment, and high recolonisation potential. The first option is to sit still and avoid being seen. This works with animals that hunt by sight (e.g. birds of prey, owls and herons), but does not work with predators that hunt by smell. The next option is to escape to the burrow system, especially "bolt" holes. This works with all predators except those slim enough to follow them underground, such as stoats and weasels. The final option is to dive into the water, Water voles purposefully splash dive into the water with a noisy "plop" that acts as a warning signal to other voles. The vole then kicks up a cloud of sediment to act as a screen to confuse predators. However this strategy has been observed to be an ineffective defence against mink (Woodroffe *et al*. 1989).

As in many prey species, water voles show r-selected characters i.e. small body size, early reproduction, quick growth and large numbers of young. So although short lived, they have between 2-5 litters a years and each litter is between 2-6 young. Young born before July may breed in the same year although most do not reach sexual maturity until after the first winter (Strachan 1997).

Finally, water voles have high recolonisation potential. Among a local population there is a natural dispersal of juveniles together with an emigration of adults defeated in territorial disputes, including some pregnant females. In this way, predation losses at some sites may be quickly replaced by immigration (Strachan 1998).

Habitat preferences

Water voles appear to show relatively high site specificity in choice of sites. This may be tied to the suitability of the banks for burrowing, suitable refuge areas above winter flood levels and a year round availability of feeding material (Strachan & Jeffries 1993).

In Britain, the best water vole populations can be found where the conditions favour a slow-flowing watercourse, less than 3m wide, around 1m in depth, and with limited fluctuations in water levels (Strachan 1997).

Water voles are found where the riverbank is predominantly earth (as opposed to gravel or rocks) with either steps or a steep incline into which the voles can burrow and create nest chambers above the water table. Water voles may occupy inundated marshland adjacent to watercourses, provided there are nesting opportunities among tall tussocks of sedges, rushes and grasses. Backwaters, side streams, permanent ditches and dykes and ox-bow lakes are important refuges for water voles; they may even prefer them to the main river channel (Strachan, 1997).

Above ground the water vole's activity is largely confined to runs in dense vegetation within 2m of the water's edge. The amount of bank side and emergent vegetation cover is very important. The best sites offer a continuous swathe of tall and luxuriant riparian plants that provide at least 60% ground cover Sites excessively shaded by shrubs or trees are less favoured (Strachan & Jeffries 1993).

2.2 Reasons for decline of the water vole

Various hypotheses, none of them exclusive, have been proposed to explain the nationwide decline in the water vole. The factors potentially contributing to the water vole's decline include the degradation or fragmentation of habitat, isolation of water vole colonies, changes in the fluctuation of water levels, pollution and the impact of predators. Each is a problem in its own right but together the effects may be catastrophic to the survival of the water voles. Each of these factors will now be briefly examined in turn.

Habitat degradation

Factors implicated in the degradation of habitat include heavy grazing pressure by domestic livestock, river engineering and bank side maintenance works and bank reinforcement. Inappropriate management of banks leads to loss of suitable habitat for water voles. Water voles need relatively stable water levels, earth banks for burrowing and good levels of vegetation for food and cover.

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Habitat fragmentation

Habitat fragmentation, resulting in small segments of suitable habitats being separated by greater distances, is a common difficulty encountered with species conservation. Clearly some level of fragmentation, loss of suitable bank side vegetation will disrupt the population dynamics of water voles. However, with the limited information known about dispersal distances and their mating systems it is hard to predict the consequences of particular patterns of habitat fragmentation. What is certain though, is that the more isolated a colony becomes, the less likely it will survive in the long-term (Strachan & Jeffries 1993).

Water level fluctuations

Fluctuations in water level is another detrimental factor to the water vole. Water voles need water, as a means of escaping predators and also as a quick way of patrolling their territories. A sudden change to low water level therefore impacts on a water vole population considerably. Equally dangerous to water voles is the risk of flooding either through prolonged heavy rainfall, or the sudden release of extra water to a watercourse. As water levels rise, the voles seek refuge in air pockets within their tunnel systems, but when the water brims to the bank or floods over it for several days the voles are forced away to unfamiliar habitat (Strachan 1997).

Pollution

Contaminants of the freshwater and riparian environment include organo-chorine insecticides and their metabolites, alkyl-phenols, polychorinated bi-phenyls, heavy metals and farm waste pollution. Their effects on water voles remain largely unknown and may have had a direct effect in the past. However improved environmental legislation, monitoring and enforcement of discharge consents, together with pollution prevention advice and the diminished use of many of these contaminants have led to improved water quality throughout Britain in recent years (Environment Agency 1997).

Predation

Although they have many predators, water voles are particularly vulnerable to the American mink once it has colonised a waterway. The regular foraging of a nursing female mink is likely to locate all local water vole colonies and most individuals. However, where the riparian habitat provides dense cover for water voles (such as expansive wetlands of inter-connecting waterways and ponds or among reedbeds), the impact of mink predation appears to be lessened (Strachan *et al*. 1998).

Persecution

Water voles are often mistaken for rats. This can result in unneeded pest control impacting on water voles. Unlike rats, water voles are vegetarian and are confined to the water and adjacent banks.

2.3 Protection of the species

The massive decline of water voles in recent decades has led to its inclusion in the UK Biodiversity Action Plan short list of priority species. This outlines two key objectives for the species, firstly to maintain the current distribution and abundance of the species in the UK. Secondly to ensure that there are water voles present throughout their 1970's range by the year 2010. (WVSG 1997)

The water vole has also received limited legal protection since 16th April 1998, through its inclusion on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) in respect of Section 9 (4) only. This section of the Act protects the water vole's places of shelter or protection, but does not protect the voles themselves. Legal protection makes it an offence to intentionally:

- Damage or destroy or obstruct access to any structure or place which water voles use for shelter and protection.
- Disturb water voles while they are using such a place.

(DoE 1998)

The legislation is currently under review and it has been proposed that the protection given to water voles under the Act is upgraded to give the animals themselves full legal protection. It is anticipated this proposed change will be approved by the government in the near future.

As a protected species, the water vole is covered by the requirements of the Department of Environment's Planning Policy Guidance on Nature Conservation (PPG9). This states that the presence of protected species is a material consideration when considering a planning application and suggests that planning authorities should consider attaching appropriate planning conditions to secure the protection of the species. Planning authorities should therefore, take appropriate steps to check for the presence of protected species and ensure that water vole habitats are protected through the planning process (Strachan 1998).

3.0 METHOD

The methodology used for survey work broadly followed that set out in the Water Vole Conservation Handbook (Strachan, 1998). This includes searching for latrines, grazed lawns, runs, burrows and feeding remains in addition to recording any sightings of individuals. However, the established methodology requires alternate 500m stretches to be surveyed for every one kilometre covered; this method is better suited for linear river stretches, as opposed to the complex networks of ditches that are typical of the modern fenland landscape.

For this reason it was decided more appropriate to instead survey whole ditches, rather than following a rigid set distance. For recording purposes ditches were divided into sections, a new section beginning whenever an intersection between ditches occurred; typically sections were in the region of 250m length. The ditch sections selected for survey at both Curf Fen and Ransonmoor are illustrated in Figures 3.0A and 3.0B on pages 12 and 13 respectively. At both sites all IDB maintained ditches were selected for survey, together with an extensive number of the smaller side ditches. The total number of ditch sections together with total length of ditches in the survey project are presented in Table 3.0A below.

Table 3.0A, summary of ditch section numbers and lengths surveyed at both sites.

	CURF FEN		**RANSONMOOR**	
	Number of ditch sections	Length (km)	Number of ditch sections	Length (km)
IDB maintained ditches	57	12.49	83	21.86
Side ditches	46	14.74	96	25.24
TOTAL	**103**	**27.23**	**179**	**47.10**

The established national survey methodology requires only one bank to be surveyed on any one particular channel. However, because of varying management regimes for different banks, both banks were surveyed in this study. IDB maintained ditches, where sufficiently deep water was present, were surveyed by canoe. This was found to be an extremely efficient method; more rapid than foot survey, and being at water level made it considerably easier to spot water vole signs. The smaller side ditches which generally had much lower water levels, were mainly surveyed by foot. For these ditches surveyors worked in pairs, walking on opposite banks; this enabled surveyors to act as “spotters” for their partner. With the more steep sided ditches, it is incredibly difficult to see vole signs on the bank one is working on. Working in pairs enables the detection of many field signs that would otherwise be missed. There is also the added bonus of reducing health and safety risks.

Based on the 2005 survey which managed a 100% coverage of the project ditches, 6 field days are required to cover Curf Fen, three of these days in the canoe; the larger Ransonmoor requires 9 field days (4 of which in canoe). These figures are based on two

experienced surveyors working together per day. The periods of survey for each year of the project are listed in Table 3.0B below:

Table 3.0B, periods of survey for each year of the project.

	2003	2004	2005
Curf	May/June	May/Oct	April
Ransonmoor	Oct/Nov	June/July	April/May

April was found to be the optimum month for survey work within such a fen environment. In this month the voles are fully active and vegetation is still short enough to enable efficient survey. Surveying later in the year is made increasingly difficult by tall vegetation, especially new Common Reed growth and Nettles; such vegetation slows survey work, and makes it more difficult to spot vole activity.

Experience gained from the first two years of survey, lead to a number of refinements being made to the 2005 survey method; this enabled more information to be gathered during field survey to assist data analysis. In 2005, a handheld GPS unit was used to record very accurate locations of water vole signs; these were then analysed within MapInfo GIS. ***Appendix 1*** shows the data recording form used for the 2005 survey. Information recorded during survey in addition to water vole activity included: channel width, water depth, bank height, bank slope, and detailed notes of the vegetation present on both banks of each ditch section. Any incidental mink, and rat signs were also recorded.

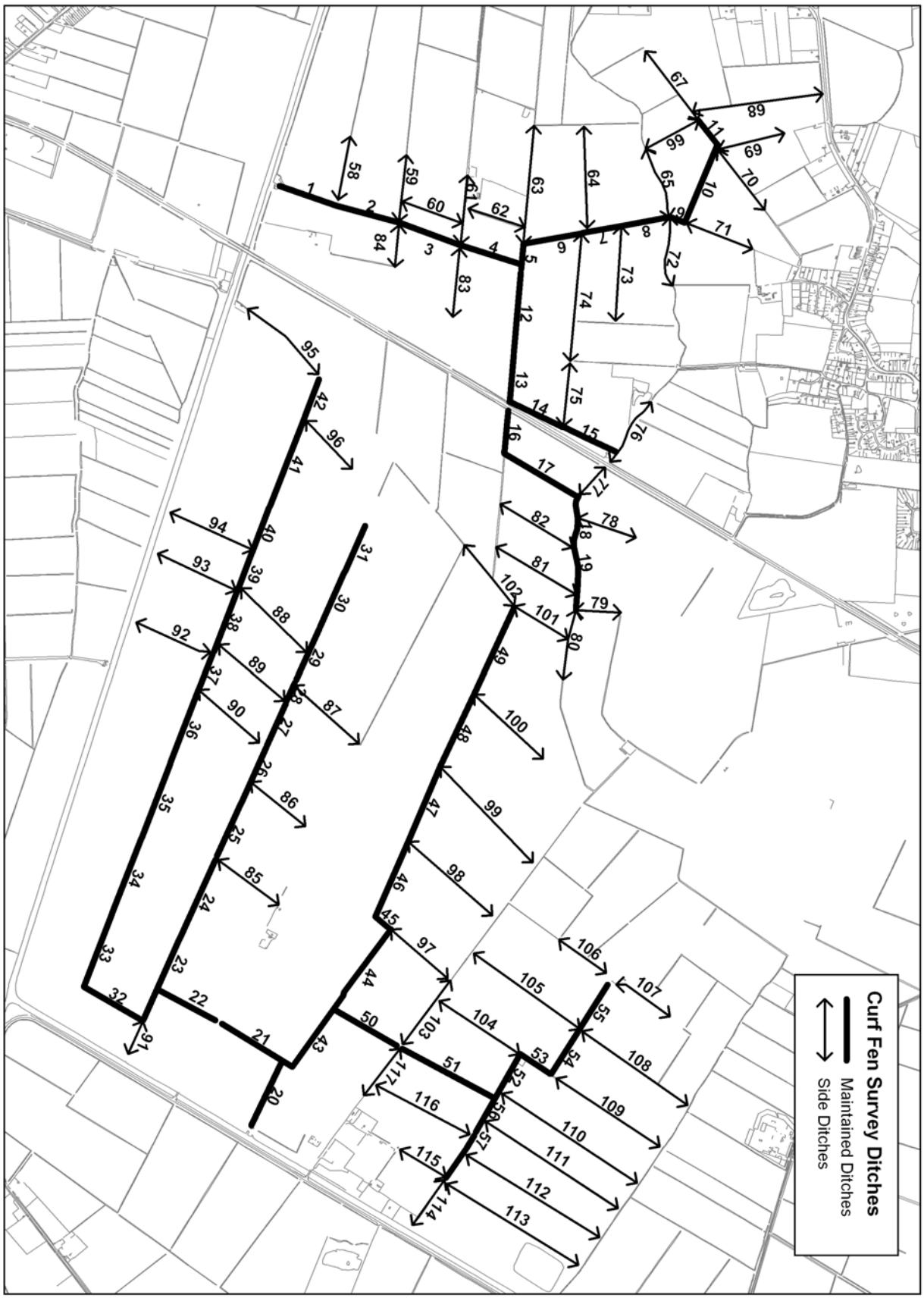


Figure 3.0A, Curf Fen – survey ditch sections

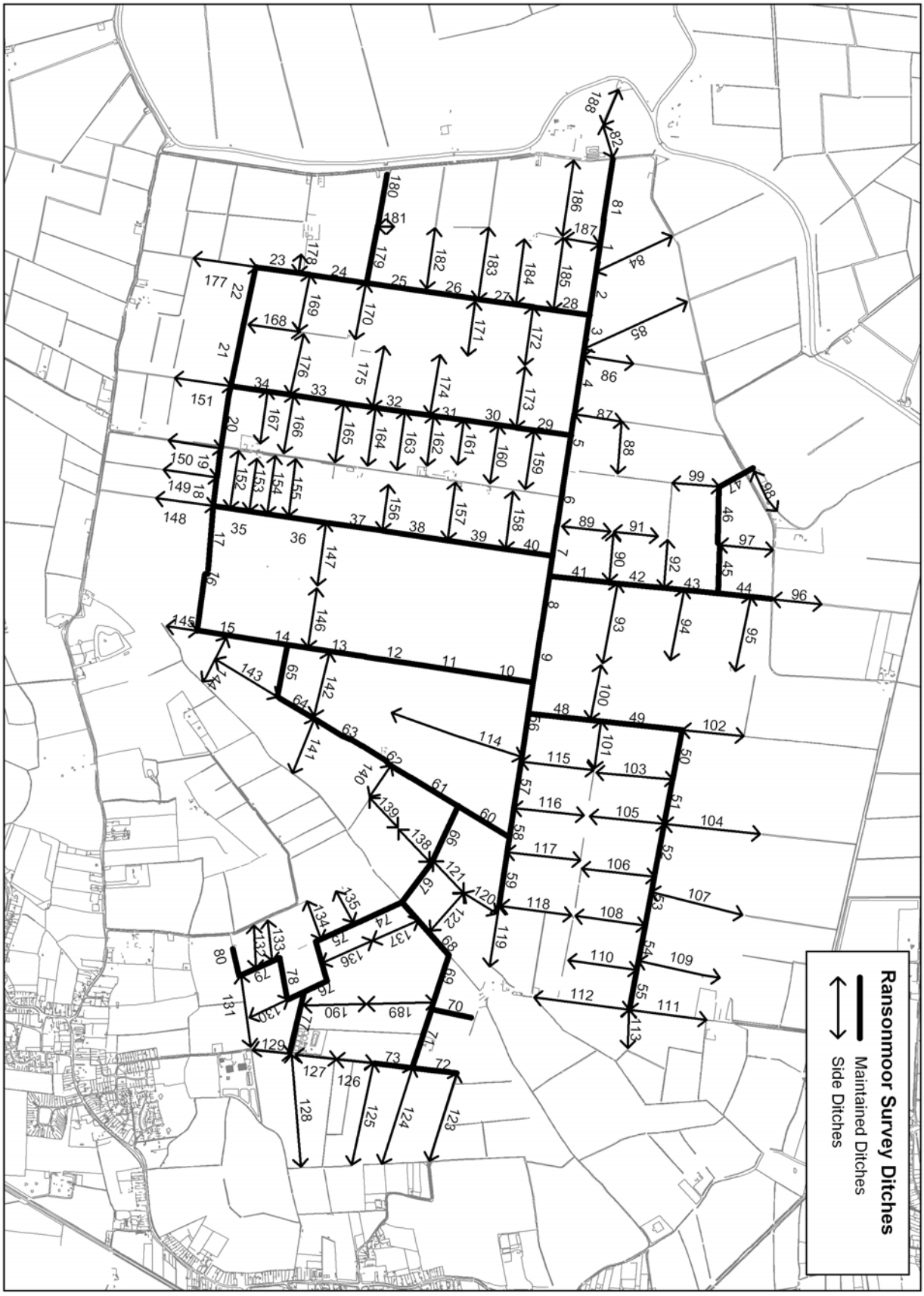


Figure 3.0B, Ransonmoor – survey ditch sections

4.0 RESULTS

Note, for the convenience of the MLC engineers the following summarised results have been presented using the MLC ditch numbering system for main drains at both Curf Fen and Ransonmoor. The original survey data was collected using a different numbering system, to allow the ditches to be divided into sections each approximately 250m in length.

Numerous maps have been produced to illustrate the survey results. For convenience these are presented together at the end of this chapter on pages 21 to 34.

4.1 CURF FEN - IDB maintained ditches

Table 4.1A below summarises the extent of survey of the IDB maintained ditches at Curf Fen for each of the three years of the study; in 2005 the survey achieved 100% coverage of the ditches thereby enabling an extremely accurate snapshot of current water vole activity in the area. The results discussion will therefore concentrate on 2005 activity; figures illustrating results for 2003 and 2004 are given in ***Appendices 2-3.***

Table 4.1A, summary of survey results for IDB maintained ditches

	2003	**2004**	**2005**
Number of ditches surveyed	22	41	57
% of ditches surveyed	38.6	71.9	100
Length (km) of ditches surveyed	4.54	9.39	12.49
% length of ditches surveyed	36.3	75.2	100
Number of ditches surveyed with vole activity	9	7	36
% of surveyed ditches with vole activity	40.9	17.1	63.2
Length (km) of surveyed ditches with vole activity	1.66	1.65	7.95
% length of surveyed ditches with vole activity	36.6	17.6	63.7

In 2005, water voles were found along almost 8 km of the IDB maintained ditches; this is approximately two-thirds (64%) of total ditch length. This is far greater than recorded in both 2003 and 2004 when voles were found along 37% and 18% of surveyed ditch length respectively. This increase is thought to be due to much improved methodology (e.g. better timing, greater use of canoe) and coverage achieved in 2005, rather than an actual change in vole numbers.

Figure 4.1A on page 21 illustrates the spring 2005 distribution of water voles along the IDB maintained ditches. An attempt has been made to grade the relative size of vole populations using latrine counts found along each ditch. Populations have been graded into the categories small, medium and large based on the following latrine count sizes:

Low	1 or 2 latrines
Medium	3 to 6 latrines
High	7+ latrines

It should be noted this is a very basic grading, and reflects only relative population numbers in Curf Fen and Ransonmoor. IDB maintained ditch stretches that are currently exceptional "hotspots" for voles are listed in Table 4.1B below which also provides the recorded evidence of activity. Figure 4.1B on page 22 illustrates stretches that are hotspots, both main and side ditches.

Table 4.1B, ditch stretches that are water vole "hotspots"

Ditch stretch (MLC numbering)	Number of latrines	Number of active holes	Feeding stations
21-22	35	18	1
33-36	28	many	4
40-41	34	16	0

Conversely, a number of ditch stretches on the site stand out for their distinct lack of water voles, even though neighbouring ditch sections have good vole activity. Four such sections are given in Table 4.1C below, together with likely reasons as to why voles are not using these particular ditches.

Table 4.1C, key stretches of the ditch system with no voles; likely reasons voles are not using these ditches.

Ditch stretch (MLC numbering)	Likely reason for water vole absence
2-4	Banks very shallow with very short vegetation. No emergent vegetation.
4-9	Shallow banks.
5-6 & beyond	Shallow water 0.05-0.1m deep. Dense algal growth.
17	Low water levels. Banks largely bare soil. Water choked with weeds.

Impact of ditch maintenance work on water vole populations

Figures 4.1C and 4.1D on pages 23 and 24, give an indication of how recent de-silting ("slubbing out") work has impacted on vole populations at Curf Fen. This was work carried out in the autumn/winter of 2004. Figure 4.1C shows vole activity in the summer prior to work commencing, and Figure 4.1D illustrates activity the summer following the work. The results show that the work has had little impact on vole activity; in 2005 the animals are present in relatively large numbers, along all ditch sections 31-37. No voles were recorded along section 30-31 either before or after the maintenance work; the banks along large parts of this section have been reinforced by either stone or plastic mesh, and as such offer very poor habitat potential for voles. It is therefore unsurprising that voles are absent along this stretch. Such "hard" engineering techniques should be avoided where possible in watercourses known to support or having the potential to support vole populations.

The three Figures (4.1E, 4.1F and 4.1G) on pages 25-27, illustrate a three year sequence in water vole activity patterns in the south-eastern part of the site, an area that underwent ditch maintenance work in 2003. The work comprised of side-trimming work along section 16-17, and just de-silting between sections 18-22.

Firstly, Figure 4.1E shows where water voles are present on these stretches in the summer of 2003 before maintenance work commences later in the winter. The second map, Figure 4.1F, shows the survey results of summer 2004 following the winter work. From this it can be seen that voles originally present between section 16-17 are no longer so, they appear to have moved eastwards to occupy ditch section 16-18. Voles that were present on section 20-21 are no longer present anywhere in that general area not even in the adjacent main drains. The third and final map in the sequence, Figure 4.1G, shows the 2005 survey results in this area; this shows that water voles have returned to the ditches that were worked in 2003.

4.2 CURF FEN – side ditches

Table 4.2A below summarises the extent of survey of side ditches at Curf Fen for each of the three project years; these are smaller ditches that intersect with the IDB maintained ditches. In 2005 the survey managed 100% coverage of these ditches far exceeding the 50% target that was set at the start of the project and achieved in 2003. Time constraints in 2004 meant that the side ditches were not explored; available time was instead focused on the maintained ditches.

Table 4.2A, summary of survey results for smaller side ditches

	2003	**2004**	**2005**
Number of ditches surveyed	23	0	46
% of ditches surveyed	50.0	0	100
Length (km) ditches surveyed	7.49	0	14.74
% length of ditches surveyed	50.8	0	100
Number of ditches surveyed with vole activity	5	0	15
% of surveyed ditches with vole activity	21.7	0	39.3
Length (km) surveyed ditches with vole activity	2.26	0	5.80
% length of surveyed ditches with vole activity	30.2	0	39.3

In 2005 water voles were found along almost 5.8 km of the side ditches, this is 39% of total ditch length. This is a modest increase in water vole presence compared to 2003 when 30% of surveyed ditch length had positive vole activity. Again, this increase is thought to be due to much improved methodology and coverage achieved in 2005, rather than an actual change in vole activity. Figure 4.2A on page 28 illustrates the spring 2005 distribution of water voles across all ditches (both IDB maintained and side ditches) at Curf Fen.

Table 4.2B below highlights three side drains with exceptional water vole activity, these “hotspots” are illustrated in Figure 4.1B (page 22).

Table 4.2B, "hotspots" for 2005 vole activity in side ditches (illustrated in Fig4.1B, page 22)

Map label	Ditch number (Wildlife Trust project numbering)	Latrine counts	Active holes	Feeding stations
A	70	25	0	1
B	99	11	20	1
C	105	9	13	2

The majority of side ditches (60.7% of total length in project), however, have no signs of vole activity. This is believed to be largely due to very low water levels, 39% of these vacant ditches are dry and a further 45% have less than 10cm water depth.

4.3 RANSONMOOR – DDC maintained ditches

Table 4.3A below summarises the extent of survey of the DDC maintained ditches at Ransonmoor for each of the three project years; in 2005 the survey achieved 100% coverage of the ditches thereby enabling an extremely accurate snapshot of current water vole activity in the area. As per Curf Fen the results discussion will therefore concentrate on 2005 activity; results for 2003 and 2004 are given in ***Appendices 4-5.***

Table 4.3A, summary of survey results for DDC maintained ditches

	2003	2004	2005
Number of ditches surveyed	29	54	83
% of ditches surveyed	35	65	100
Length (km) ditches surveyed	7.84	13.24	21.86
% length of ditches surveyed	35.9	60.6	100
Number of ditches surveyed with vole activity	24	37	75
% of surveyed ditches with vole activity	82.8	68.5	90.4
Length (km) surveyed ditches with vole activity	6.51	10.24	20.25
% length of surveyed ditches with vole activity	83.0	77.3	92.6

In 2005, water voles were found along approximately 20 km of the DDC maintained ditches; this is an impressive 93% of total ditch length. This is an increase in total ditch length with activity when compared with 2003 and 2004 results (83% and 77% respectively). This increase is likely to be due to the improved methodology (better timing, greater use of canoe) and coverage achieved in 2005, rather than an actual change in vole numbers.

Figure 4.3A on page 29, illustrates the spring 2005 distribution of water voles along the maintained ditches, graded by relative population size as per Curf Fen.

Table 4.3B below lists DDC maintained ditch stretches that are currently exceptional "hotspots" for voles. Figure 4.3B on page 30, shows these stretches together with a couple of side ditches that also had particularly high levels of activity when compared with other ditches on the site.

Table 4.3B, DDC maintained ditch stretches that are water vole "hotspots in 2005 (illustrated in Fig4.3B, page 30)

Map label	Ditch number (Wildlife Trust project numbering)	Latrine counts	Active holes	Feeding stations	Number of runs
A	36	16	1	0	0
B	66	12	0	0	0
C	74	9	2	2	4
D	77	10	0	0	0

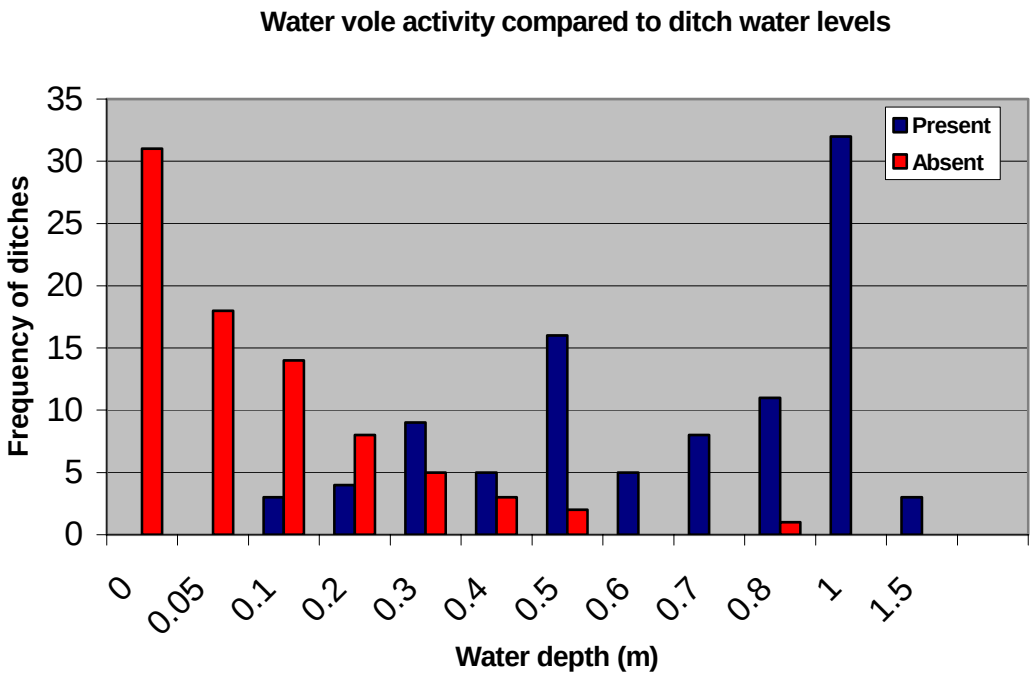
As observed at Curf Fen, there are a number of ditch stretches at Ransonmoor that stand out for their complete absence of water vole activity, despite adjacent ditch sections having voles present. Two such sections are given in Table 4.3C below, together with likely reasons as to why voles are not using these particular ditches.

Table 4.3C, key stretches of the ditch system with no voles; likely reasons voles are not using these ditches.

Ditch stretch (MLC numbering)	Likely reason for water vole absence
28-31	Very low water levels (0-5cm). Bank reinforcement work (wood piles and shuttering). No emergent vegetation
35-37	Low water levels. No emergent vegetation

The importance of having a reasonable depth of water for water voles cannot be over stated. The 2005 results showed a very strong positive correlation (Pearson's Product Moment Correlation Coefficient of r=0.78, where n=179, statistically significant at the 1% level) between water vole activity and water levels. Figure 4.3C below illustrates the relationship found between Ransonmoor ditch water levels (both main and side ditches) and the presence or absence of water voles. Ditches with a water level below 5cm have a complete absence of voles, at 10-20cm it is still extremely unlikely to find the animals present. It would appear a water depth of 30cm is the critical value, at this depth or above the voles will occupy the ditches if other habitat conditions are suitable.

Figure 4.3C, Water vole activity 2005 at Ransonmoor compared to water depths.



Impact of ditch maintenance work on water vole populations

Figures 4.3D and 4.3E on pages 31 and 32, give an indication of how recent de-silting ("slubbing out") work has impacted on vole populations at Ransonmoor. This was work carried out in the autumn/winter of 2004. Figure 4.3D shows vole activity in the summer prior to work commencing, and Figure 4.3E illustrates activity the summer following the work. The results show that the work has had little impact on vole activity; in 2005 the animals are still found in relatively large numbers, along all but one stretch of ditch (section 33-34); they have also colonised the northern half of section 24-25 where they were previously unrecorded.

Figure 4.3F on page 33, shows a similar pattern following work of the same year over on the western limit of the site. Survey data prior to the maintenance work is not available for this area. However, despite this it can be seen that water voles are present along both the sections (1-3 and 13-14) that underwent de-silting. The Figure also shows that vole activity is present along two thirds of ditch section 4-13 following side-trimming (bank re-profiling) work. The unavailability of vole data prior to work on this section means that it is not possible to say whether there has been a net loss in vole numbers following the work; however, it is encouraging that a good proportion of this ditch section continues to support voles the spring following the work.

4.4 RANSONMOOR – side ditches

Table 4.4A below summarises the extent of survey of side ditches at Ransonmoor for each of the three project years; these are smaller ditches that intersect with the DDC maintained ditches. In 2005 the survey managed 100% coverage of these ditches far exceeding the 50% target that was set at the start of the project. Time constraints in 2004 meant that few of the side ditches were explored; available time was instead focused on the DDC maintained ditches.

Table 4.4A, summary of survey results for smaller side drains

	2003	**2004**	**2005**
Number of ditches surveyed	33	8	96
% of ditches surveyed	34	8	100
Length (km) ditches surveyed	10.65	2.34	25.24
% length of side ditches surveyed	42.2	9.3	100
Number ditches surveyed with vole activity	10	4	22
% of surveyed ditches with vole activity	30.3	50.0	22.9
Length (km) surveyed ditches with vole activity	3.59	1.3	7.53
% length of surveyed ditches with vole activity	33.7	54.3	29.8

In 2005 water voles were found along 7.5 km of the side ditches, this is approximately 30% of total ditch length. A similar level of activity was found in 2003. The small number of side ditches surveyed in 2004 cannot be considered a representative sample of vole activity that year.

Figure 4.4A on page 34, illustrates the spring 2005 distribution of water voles across all ditches (both DDC maintained and side) at Ransonmoor. Table 4.4B below highlights two side drains with particularly good levels of water vole activity, these "hotspots" are illustrated in Figure 4.3B on page 30.

Table 4.4B, hotspots for 2005 vole activity in side ditches (illustrated in Fig4.3B, page 30).

Map label	**Ditch number (Wildlife Trust project numbering)**	**Latrine counts**	**Active holes**	**Feeding stations**
E	87	9	0	0
F	147	12	3	3

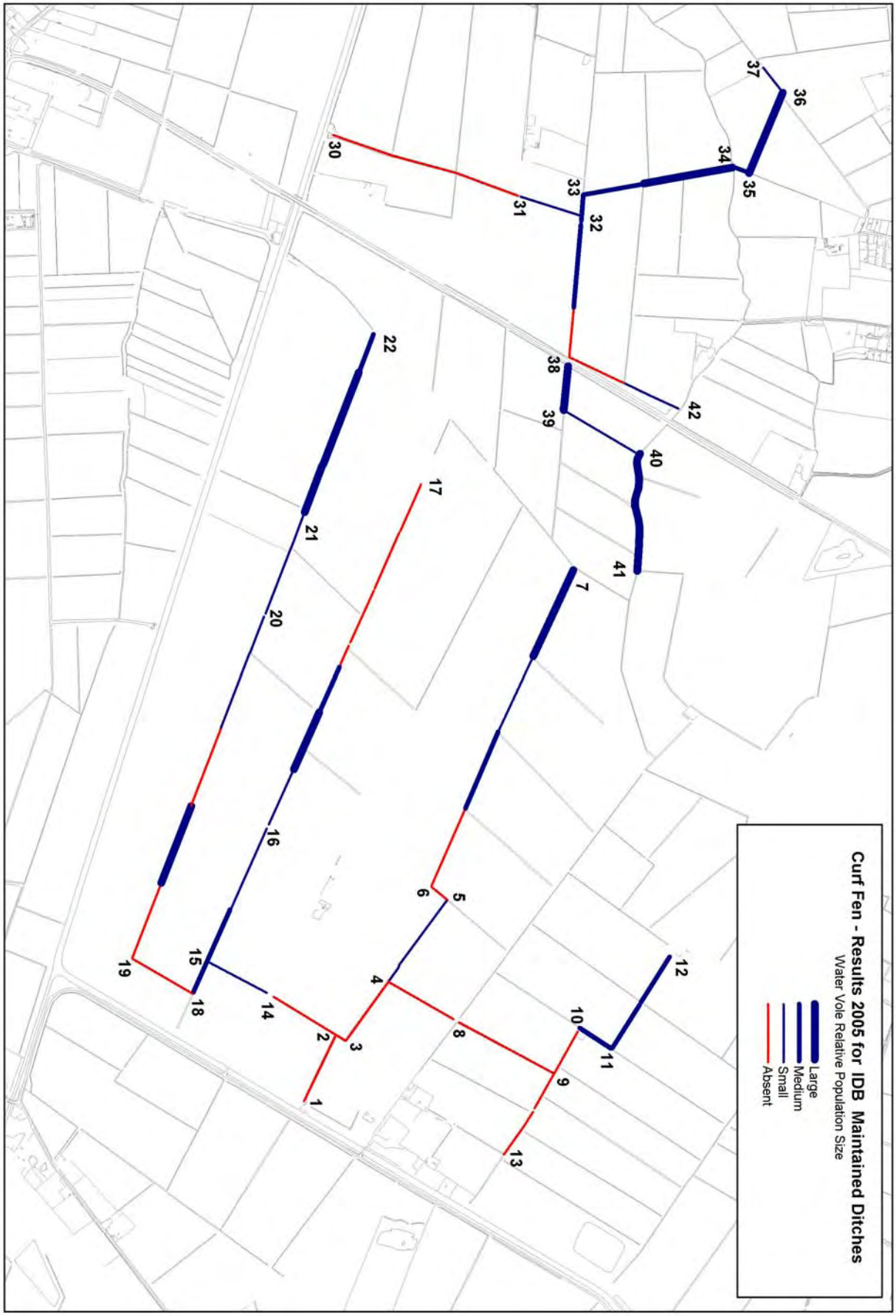


Figure 4.1A, Curf Fen Results 2005 – for ditches maintained by Curf IDB.

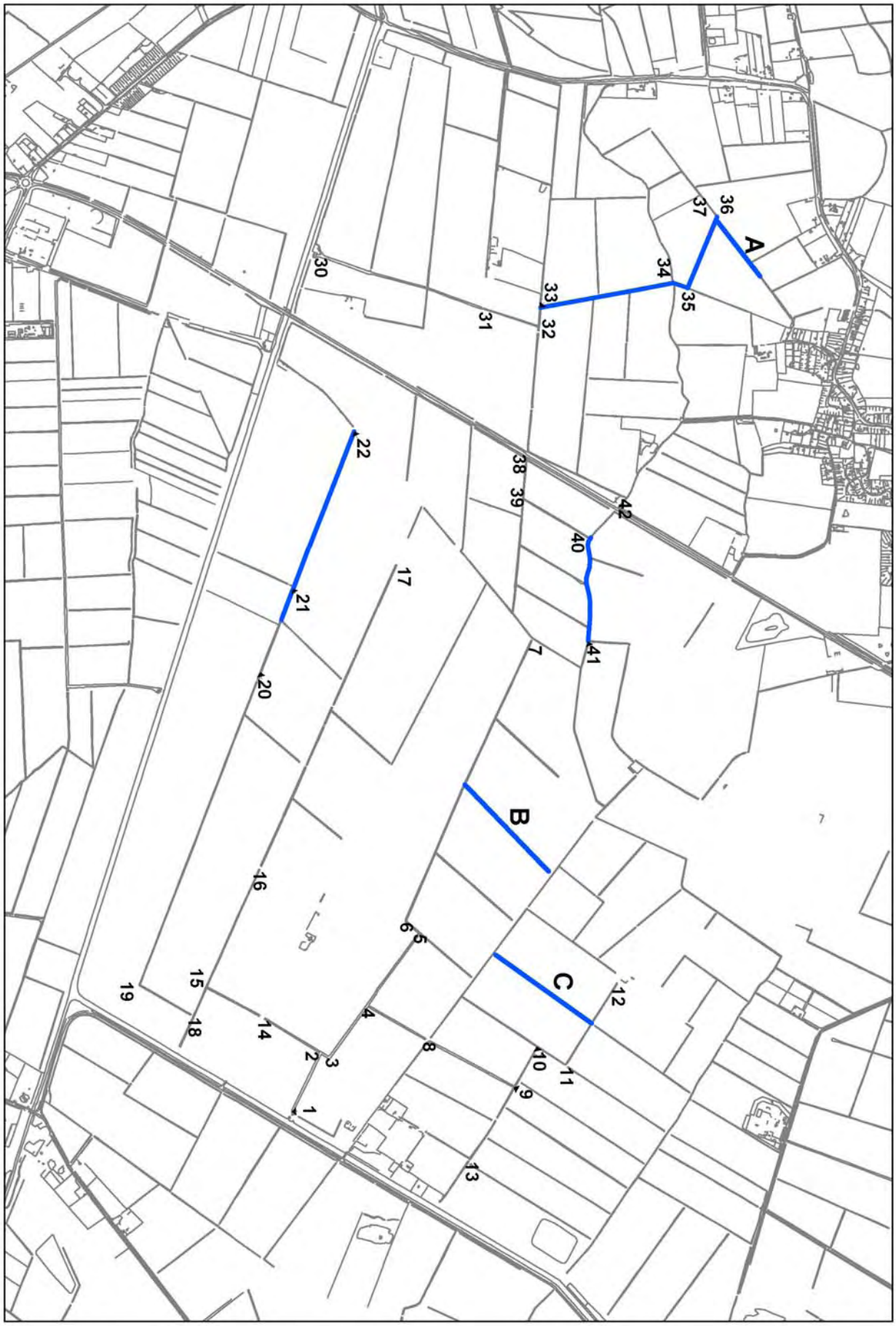


Figure 4.1B. Curf Fen "Hotspots" 2005 – ditches showing exceptional water vole activity

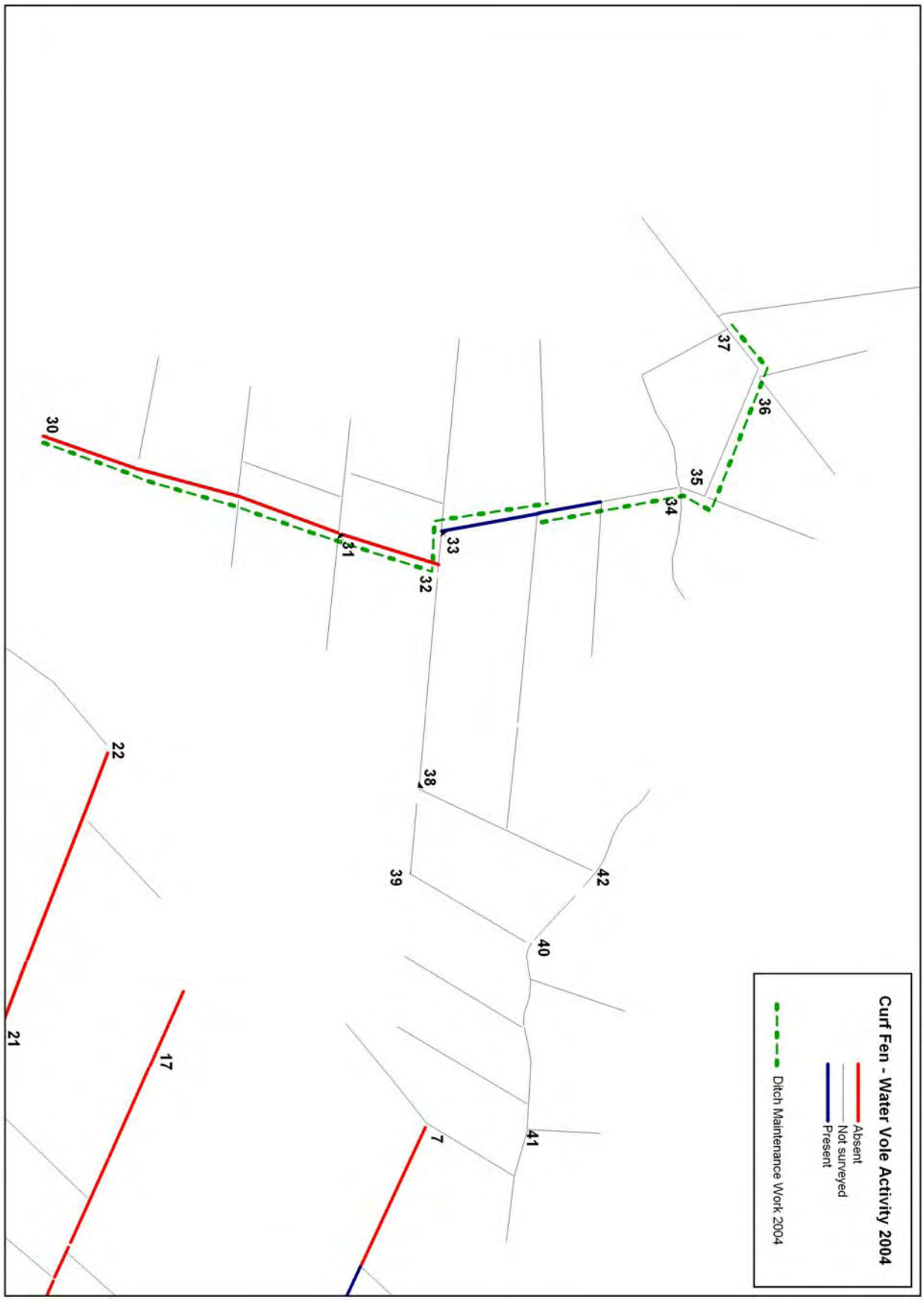


Figure 4.1C. Curf Fen - water vole distribution summer 2004 prior to planned de-silting work later in the year.

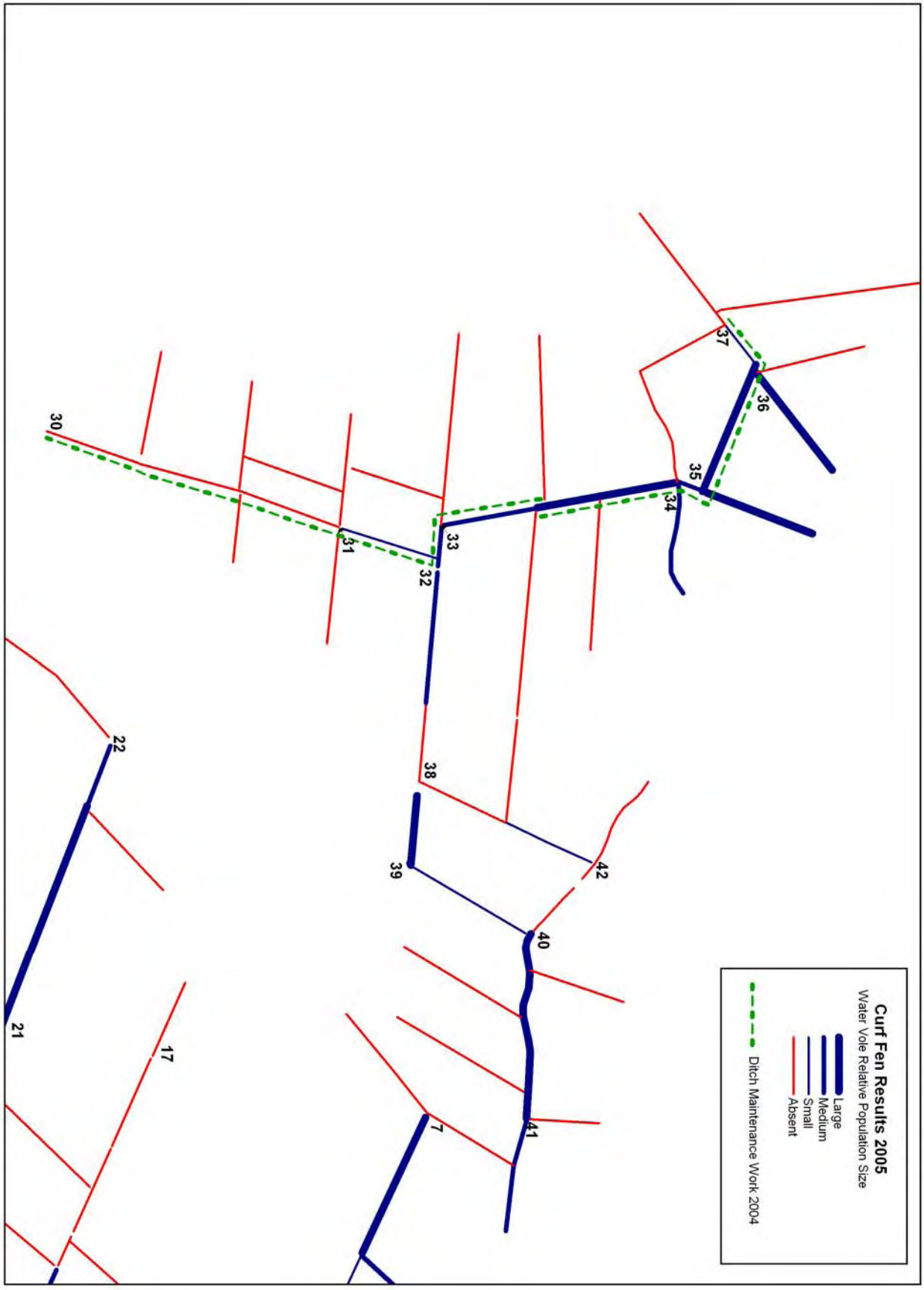


Figure 4.1D. Curf Fen - water vole distribution spring 2005 following winter de-silting work.

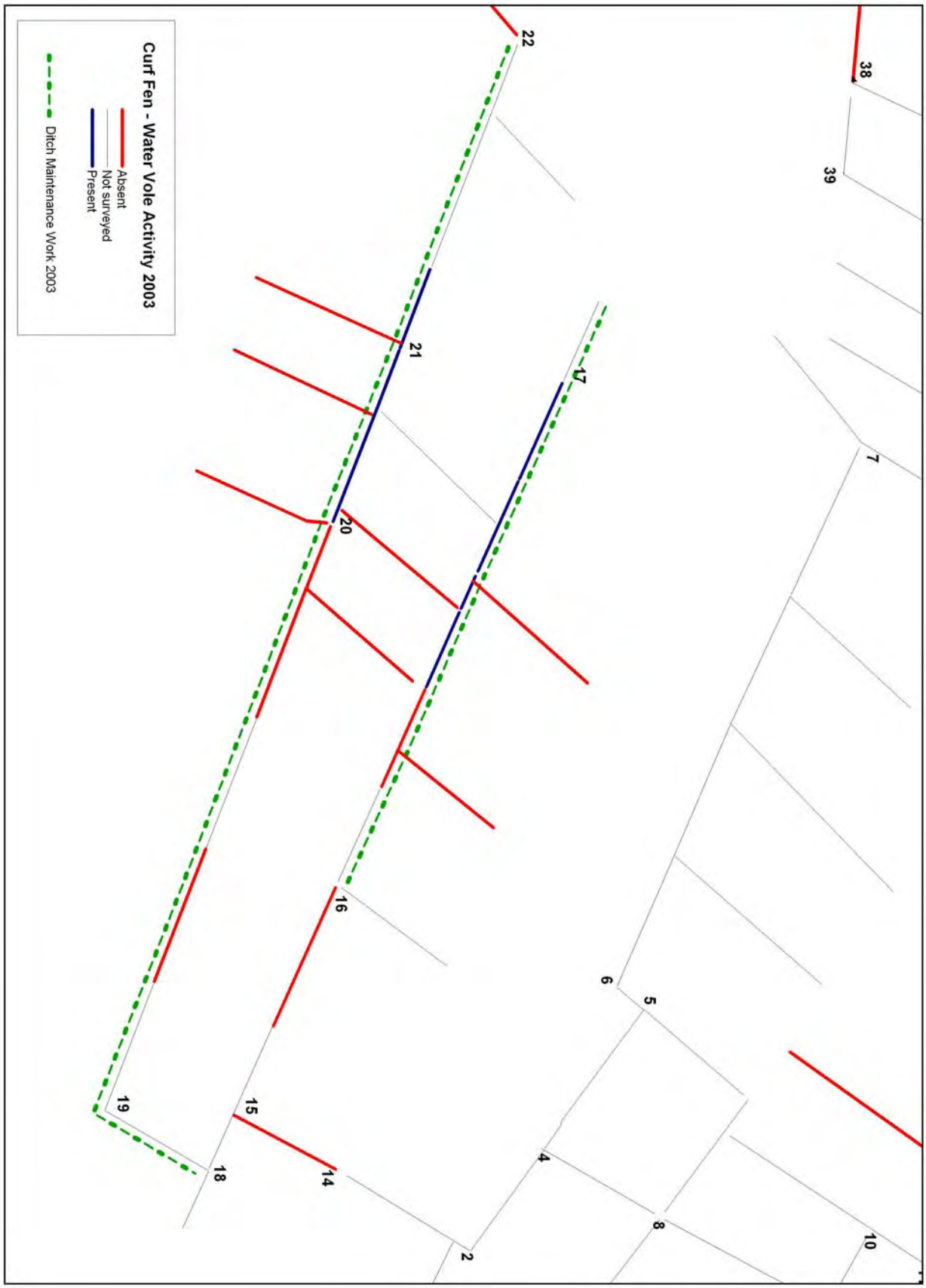


Figure 4.1E. Curf Fen - water vole distribution summer 2003, prior to winter ditch work (Section 16-17 side trimming, section 18-22 de-silting only.)

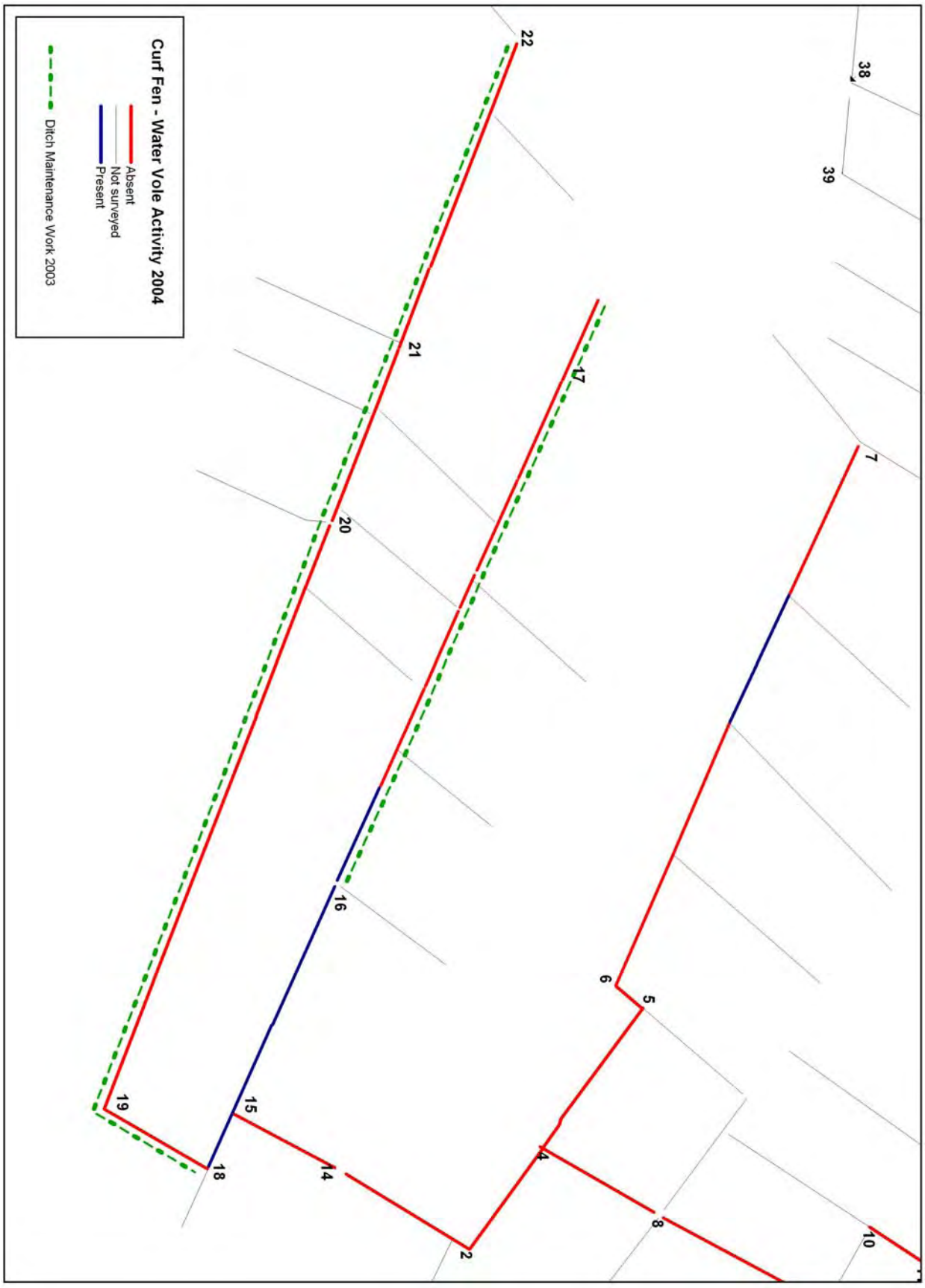


Figure 4.1E Curf Fen - water vole distribution summer 2004, following ditch work previous winter (Section 16-17 side trimming, section 18-22 de-silting only).

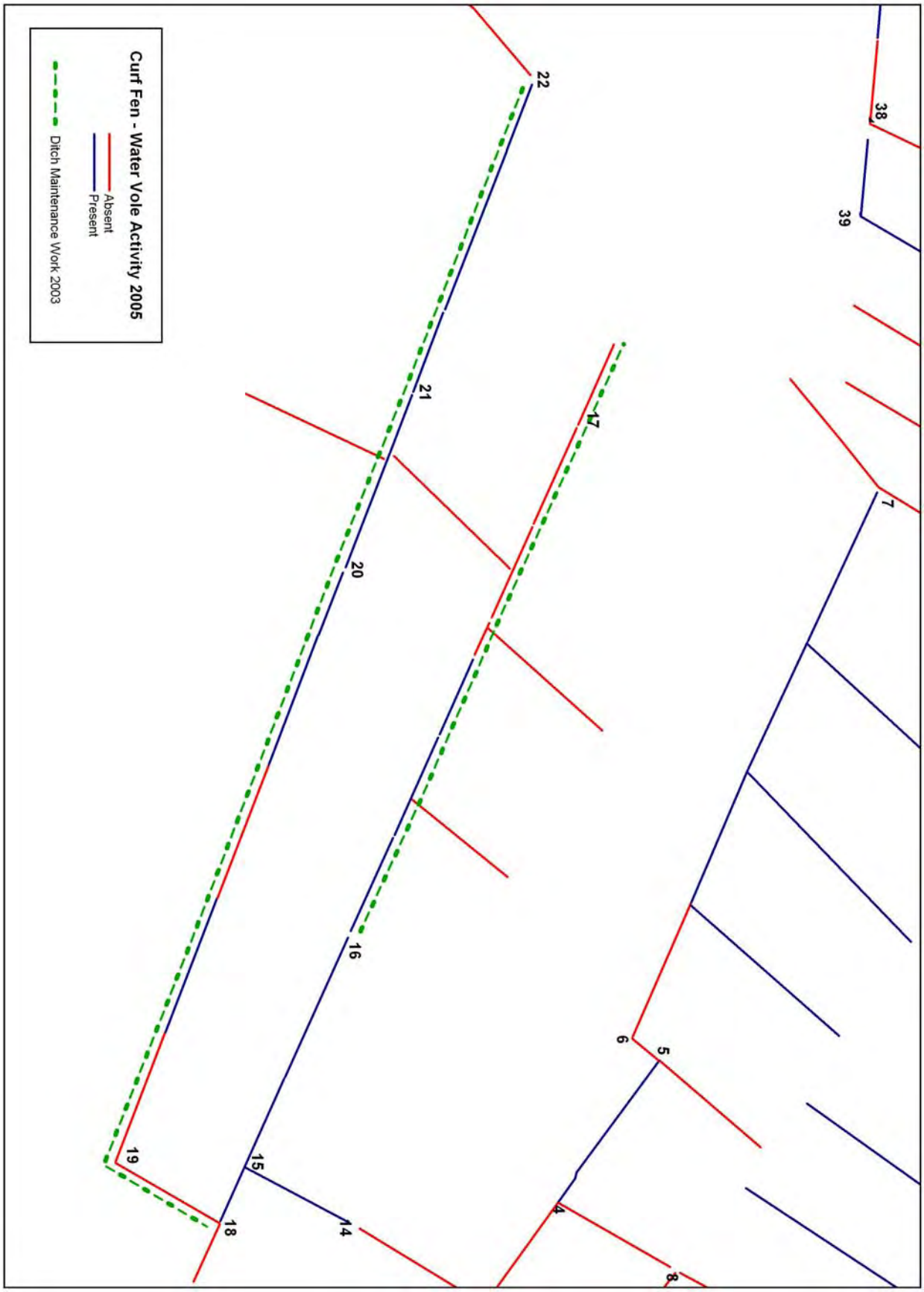


Figure 4.1G. Curf Fen - water vole distribution spring 2005, following ditch work winter 2003 (Section 16-17 side trimming, section 18-22 de-silting only).

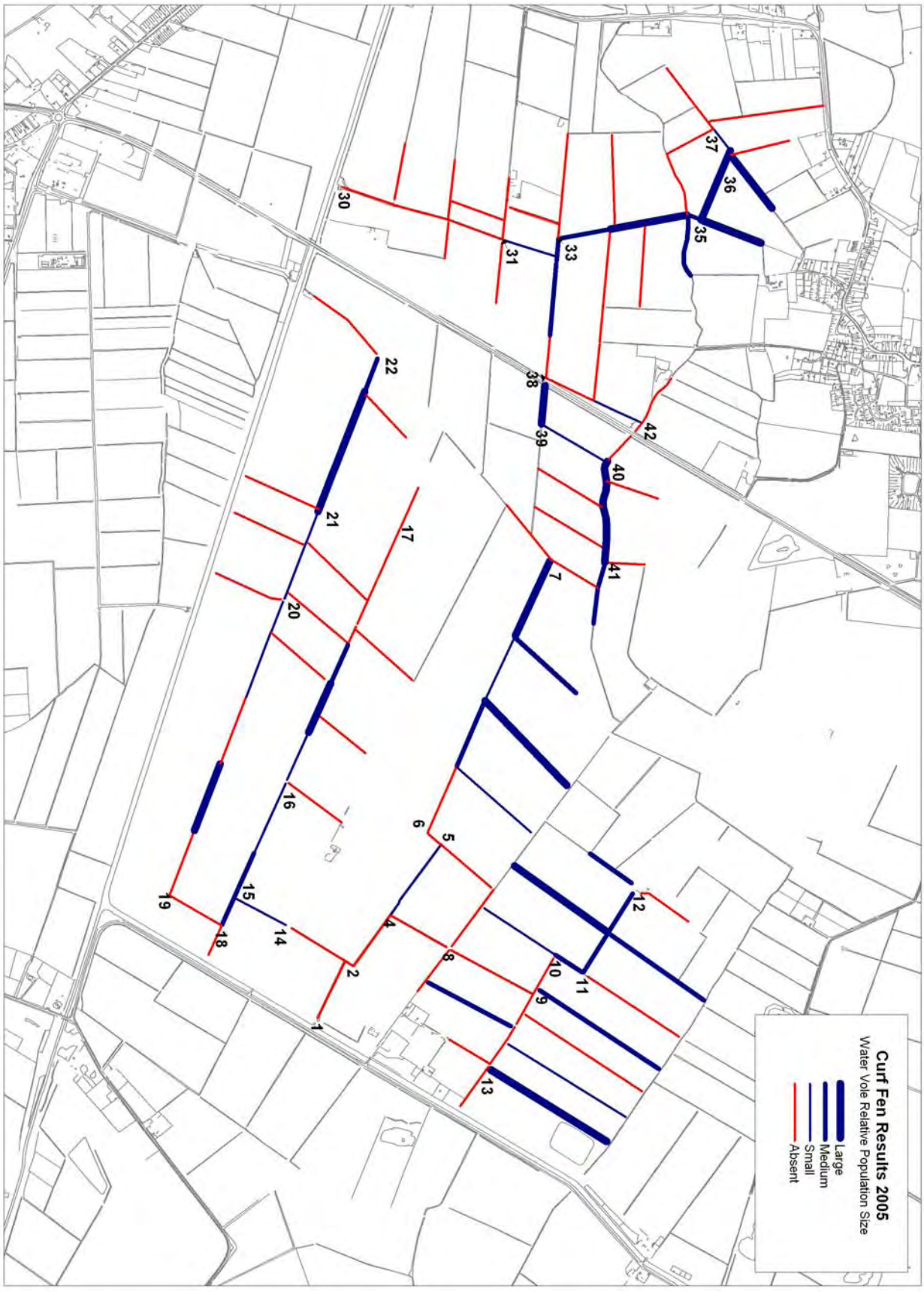


Figure 4.2A. Curf Fen - water vole distribution spring 2005 for all ditches (main and side)

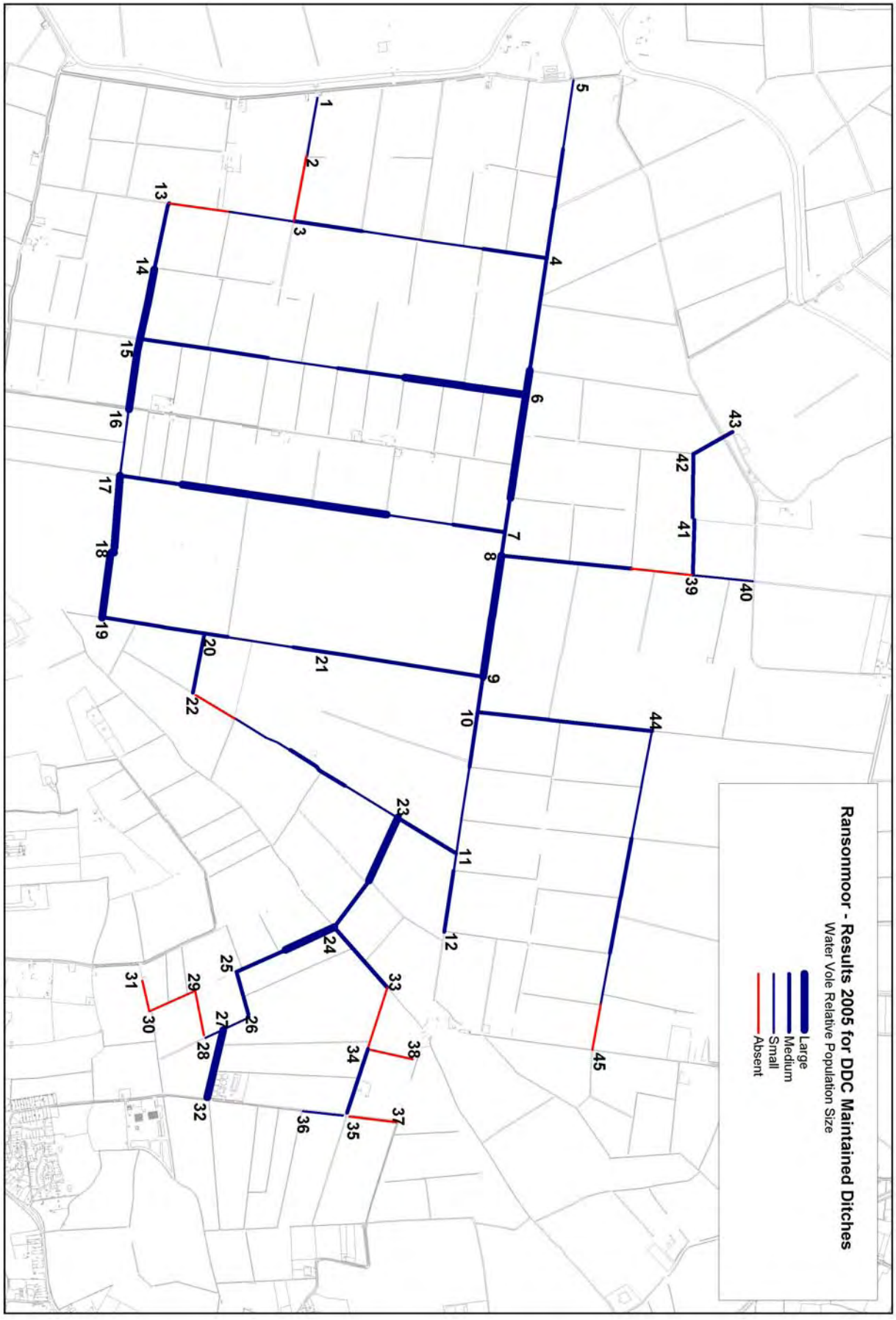


Figure 4.3A, Ransonmoor Results 2005 – for ditches maintained by Ransonmoor DDC.

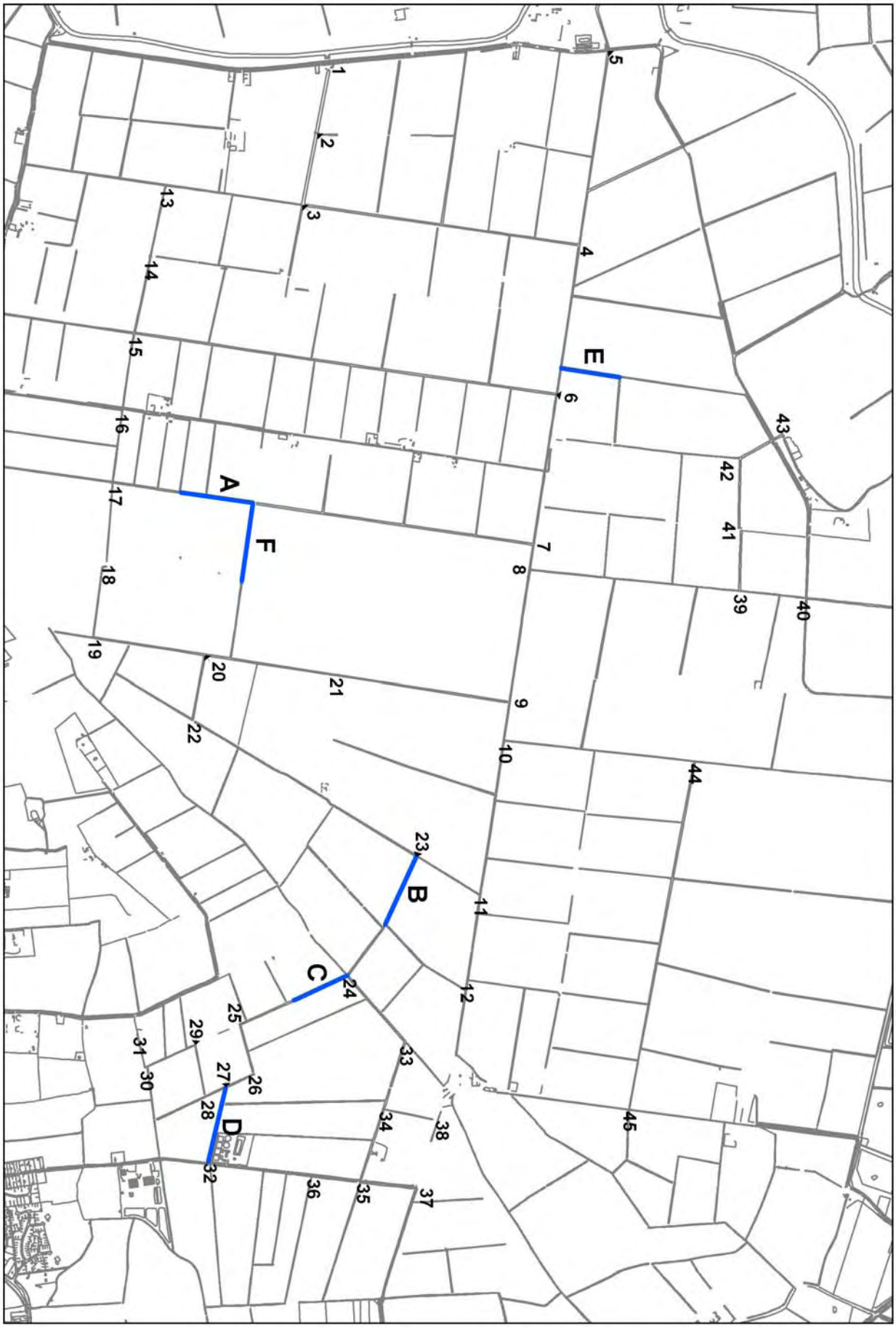


Figure 4.3B. Ransonmoor "Hotspots" 2005 – ditches showing exceptional water vole activity.

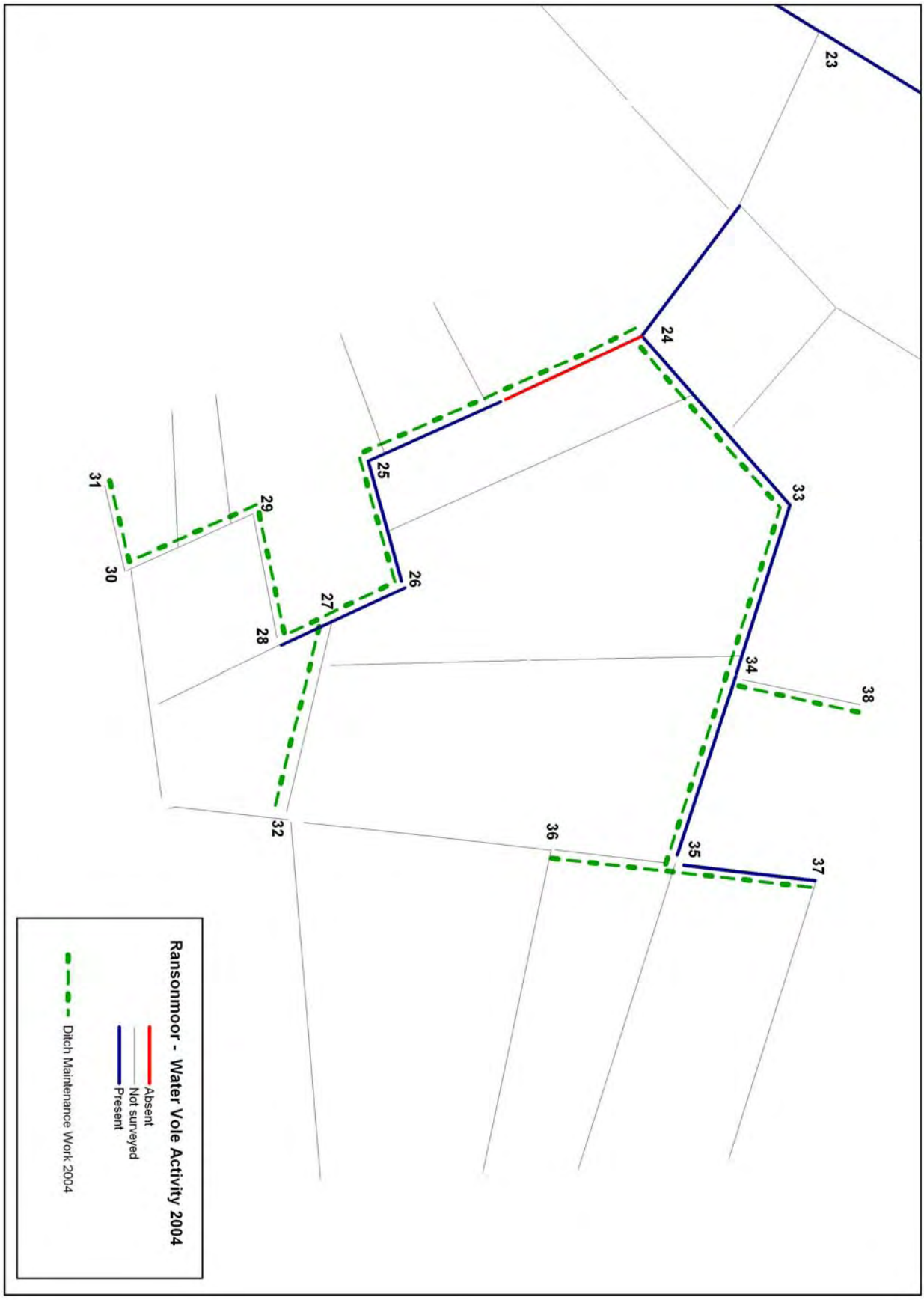


Figure 4.3D. Ransonmoor - water vole distribution summer 2004 prior to planned de-silting work later in the year.

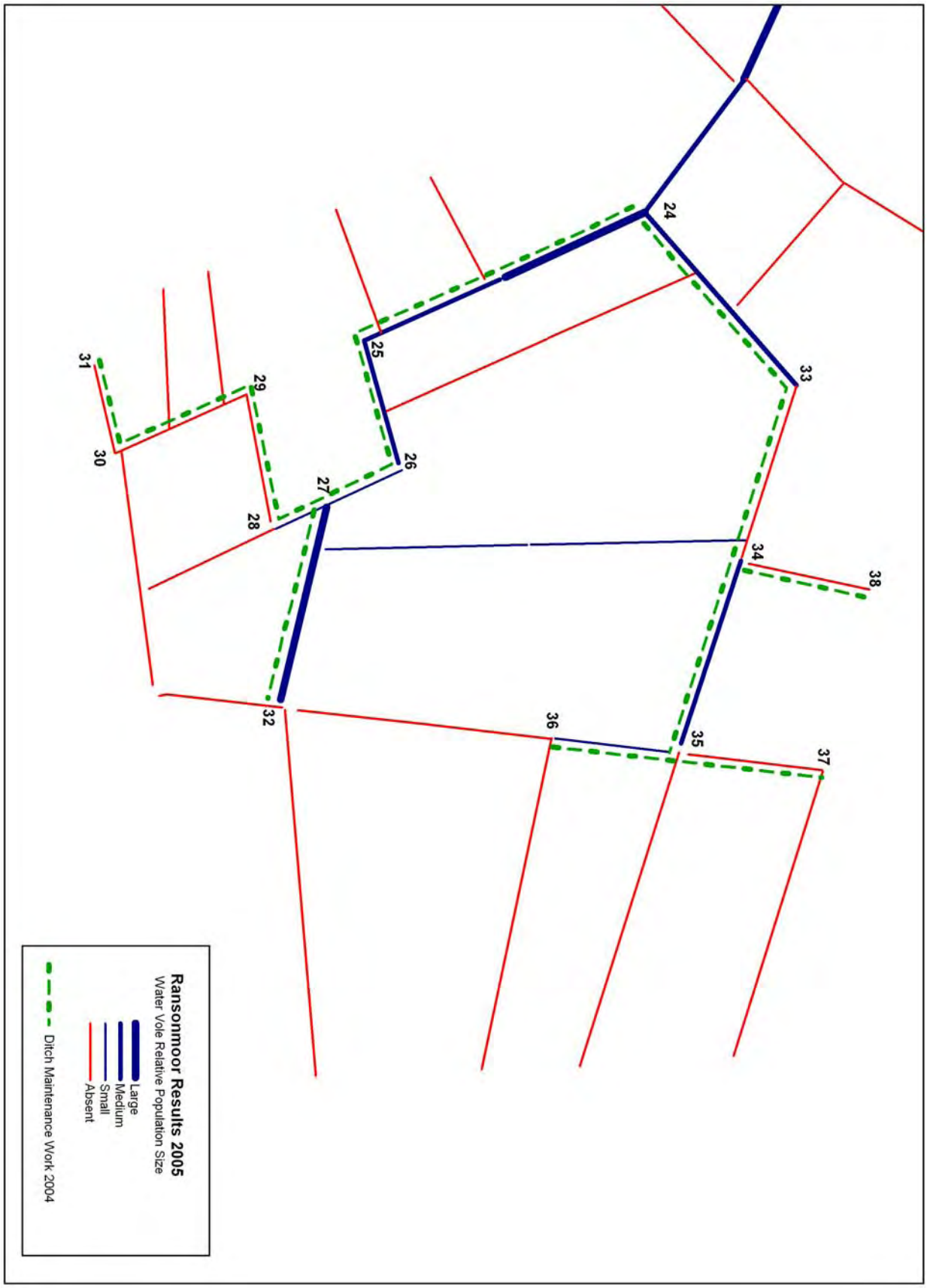


Figure 4.3E, Ransonmoor - water vole distribution spring 2005 following winter de-silting work.

Figure 4.3E. Ransonmoor - water vole distribution summer 2004, following winter ditch work (Section 4-13 side trimming, sections 1-3 & 13-14 de-silting only).

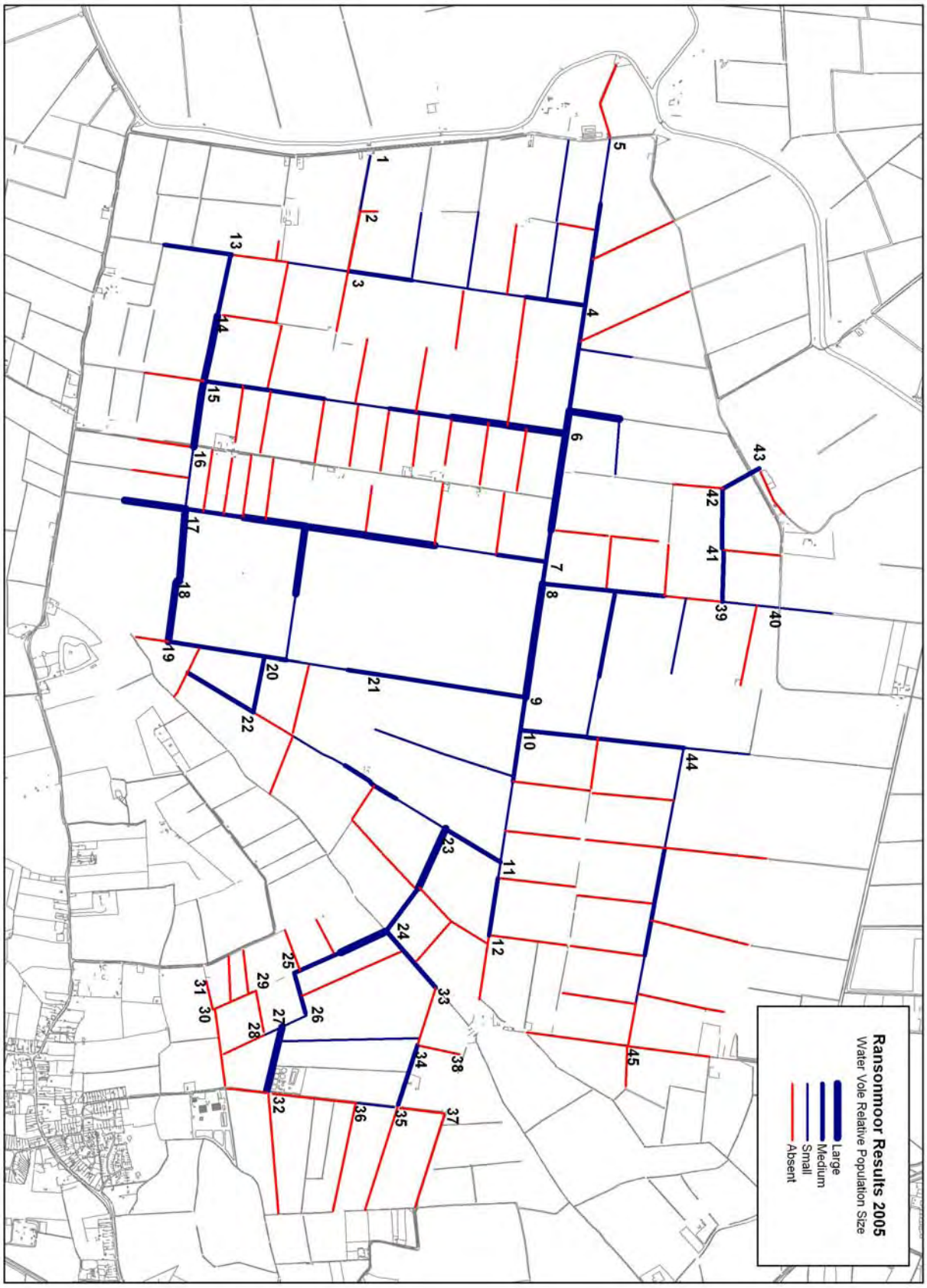


Figure 4.4A. Ransonmoor - water vole distribution spring 2005 for all ditches (main and side)

5.0 DISCUSSION

5.1 Summary of findings

The results from this three year study show that both Curf Fen and Ransonmoor have very impressive water vole occupancy levels across their ditch systems. The very detailed 2005 survey which managed to visit all ditches within the survey areas found that 64% of IDB maintained ditch length at Curf Fen had vole activity, and an exceptionally high 93% at Ransonmoor. No evidence of mink was found at either site.

The difference in occupancy rates between sites is thought to be due to the combined effect of a variety of factors including water levels, ditch linkage and management regimes. Ransonmoor benefits from having consistently higher water levels in its main drains when compared to Curf. Because of its site layout it also has better linkage between drains, allowing greater movement of vole populations between ditches; the ditch network at Curf also suffers from being bisected by the A141 Chatteris to March Road. The more sympathetic management regime employed at Ransonmoor is also thought to play an important role in making the site particularly suited for water voles.

Despite the healthy distribution of water voles at both sites (especially Ransonmoor), it should be noted that in any particular ditch section the water vole populations are small, and therefore still vulnerable to disturbance.

At both sites the smaller side ditches which are not maintained by the respective IDBs show far lower occupancy rates, 39% of ditch length at Curf and 30% at Ransonmoor; the considerably smaller amount of vole activity found in these side ditches, is believed to be largely attributable to the significantly lower water levels present.

The results indicate that when it comes to de-silting work, the current method employed (working just one side, over the winter, and placing removed material well away from the banks) has minimal impact on vole populations. Good levels of vole activity were observed along such ditches in the summer following the work.

However, the results also show that major re-profiling work of ditch banks can have a significant negative impact on vole populations. Further observations made during a field visit to Ransonmoor in February 2006 following recent re-profiling work (carried out between sections 7-17) further supports this finding. This was a stretch where high levels of vole activity were recorded in spring 2005 before the work. All vole habitat on the worked side had been entirely destroyed, and the ditch has been taken over by rats. The removal of all emergent vegetation, and continued low water levels has further made the ditch unattractive to voles. It will be interesting to discover how long it takes the voles to re-colonise this ditch, and at what point the rats disappear.

5.2 Recommendations for ditch management work

At both sites the good practice of limiting major maintenance work (i.e. de-silting, bank re-profiling) to one bank in any one year is certainly assisting wildlife conservation within these ditch networks. The less intensive management regime being carried out at Ransonmoor appears to be playing an important role in maintaining a strong water vole population across the site. A similar reduction in frequency of bank flail mowing and other ditch maintenance work is likely to be similarly beneficial for the vole populations at Curf Fen.

Whilst the study has demonstrated that de-silting operations are having minimal impact on vole populations, concern still remains over the impact of bank re-profiling (side-trimming work) on the animals. Unlike other operations this maintenance work completely destroys the voles burrow system and surrounding habitat. For this reason it is recommended the following suggestions be considered when planning such work.

- Firstly, is re-profiling a whole ditch section absolutely essential? Working long continuous lengths of ditch in one session (this might be up to 1-2km in length) leaves little opportunity for voles to move to adjacent undisturbed ditch habitat. Working shorter lengths of ditch at any one time, or leaving short sections where there is low slippage risk untouched, would give the animals a better chance of surviving within a worked section of ditch.

- It is strongly recommended that a water vole survey be carried out in advance of this particular type of maintenance work. The survey should note exact locations of water vole activity, with particular attention paid to the location of active burrows. The survey findings can then be used to guide the implementation of planned works. Should low levels of activity be discovered the engineers can commence works as planned in the knowledge that work will have a low impact on water vole populations. Should high levels of vole activity be recorded then the planned work needs to be reassessed. Is the work absolutely essential, could it wait a couple of years? Water vole populations can naturally rise and fall or even completely move to a new location. It is possible by waiting a year or two that work can be carried out when there is much less vole activity thereby minimising impacts. If waiting is not a viable option, then working around major points of activity must be considered. Active burrows are frequently in clusters, meaning the majority of a ditch length may have little or no activity. Therefore leaving short stretches of ditch where there is major vole activity untouched, would greatly minimise the negative impact on voles, whilst allowing maintenance work to continue as normal for the majority of the ditch length. Where bank re-profiling on such key vole stretches is unavoidable, advice should be sought from English Nature before commencing work.

With regard to maintenance work generally, there are other simple measures that would further enhance the ditch network both for water voles and other wildlife:

- Ditches would benefit from having some emergent vegetation left in the channel following de-silting operations, either a narrow fringe or the occasional small cluster of plants. Maintaining a small proportion of such vegetation is highly unlikely to impede drainage especially on wider drains, and will help stabilise banks in addition to increasing the conservation value.

- The creation of small berms during routine maintenance work would allow for the establishment of a thin strip of marginal vegetation which would protect the bank from erosion as well as being highly beneficial for water voles.

- Limiting flail mowing of ditch banks that need other maintenance work is preferable to routine annual cutting. Where more regular cutting is considered necessary then both voles and other wildlife would benefit from retaining an uncut strip of vegetation along the toe of the bank. A minimum of 15cm sward height should be left when banks are mown. Cutting vegetation shorter than this exposes the water voles to predation as well as removing their habitat and food supply.

- Bank reinforcement work: bank side engineering has considerable potential for destroying or damaging water vole habitat. "Soft" engineering techniques should preferably be used. The use of stones should be avoided whenever possible. When wooden shuttering is used to support banks, sufficient space should be left between some planks to allow voles to burrow into the banks.

5.3 Recommendations for future monitoring work

The 2005 results provide a comprehensive baseline dataset for both sites that will allow any future monitoring work to identify changes in water vole activity over time.

In the short-term it is recommended that further highly targeted monitoring be conducted at both sites. This should focus on examining only ditches that have had recent maintenance work carried out, or where there is planned work for the following winter. It is highly desirable to have survey results for these ditches both prior to, and after the work. Of particular interest are those ditches where bank sides are re-shaped. The collection of this data would further our understanding of how ditch maintenance work impacts on water vole populations over time. Such targeted monitoring would be quick to undertake. The next two field seasons are particularly important for gathering this information in-order to take full advantage of the 2005 results. It is recommended that such monitoring work is conducted in April, which has been demonstrated to be the optimal month for conducting such surveys, and will allow valid comparison with 2005 data.

With their widespread distribution of water voles, both sites should be considered regionally (and perhaps nationally) important for the species. As such, a full re-survey of all ditches at both sites is recommended in five years time in order to assess the health of the overall population over time.

ACKNOWLEDGEMENTS

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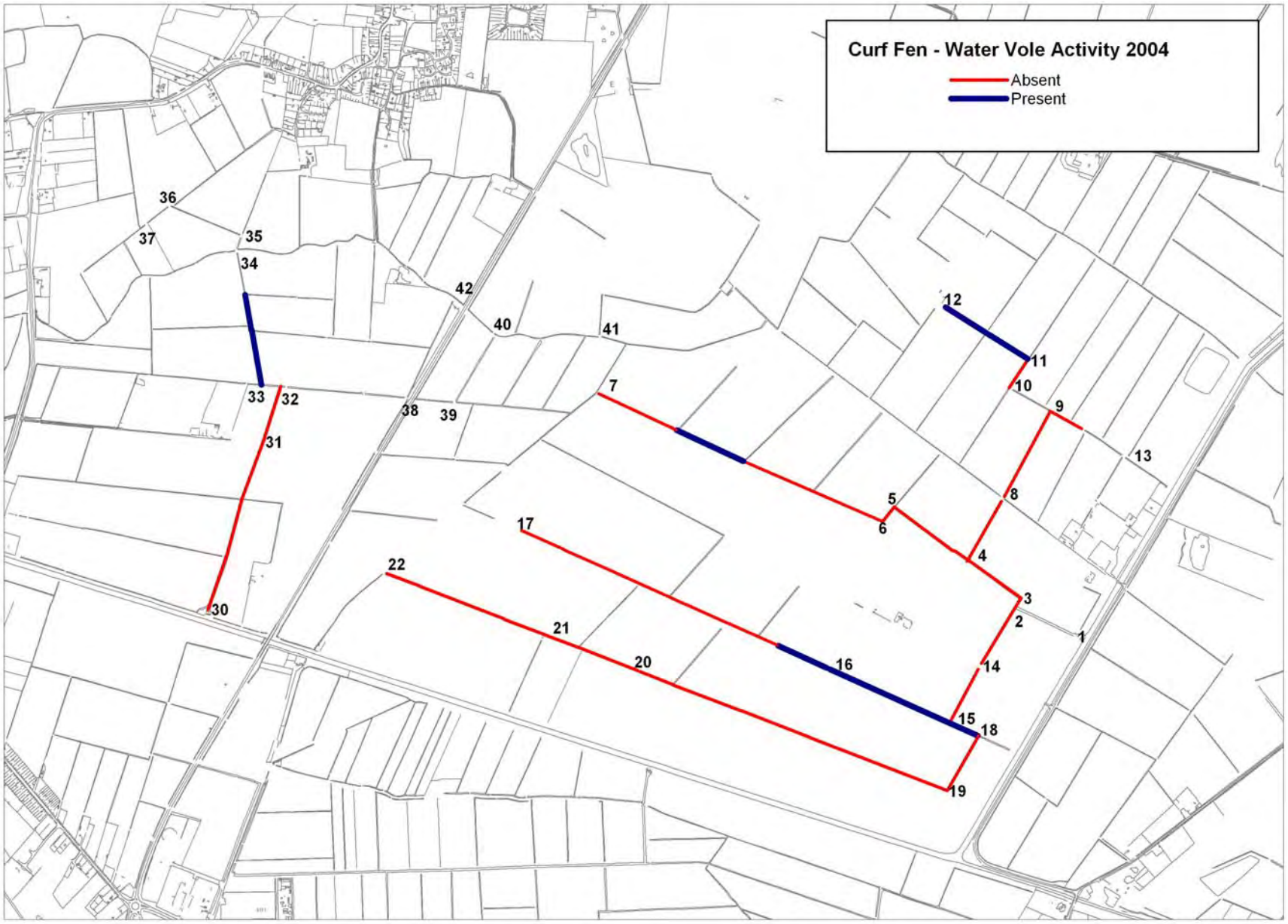
APPENDIX 1 – Survey data recording sheet

Location: **Recorders:** **Date:**

Drain No	Bank height	Water depth	Channel width	Bank Profile	Vegetation	Water vole signs

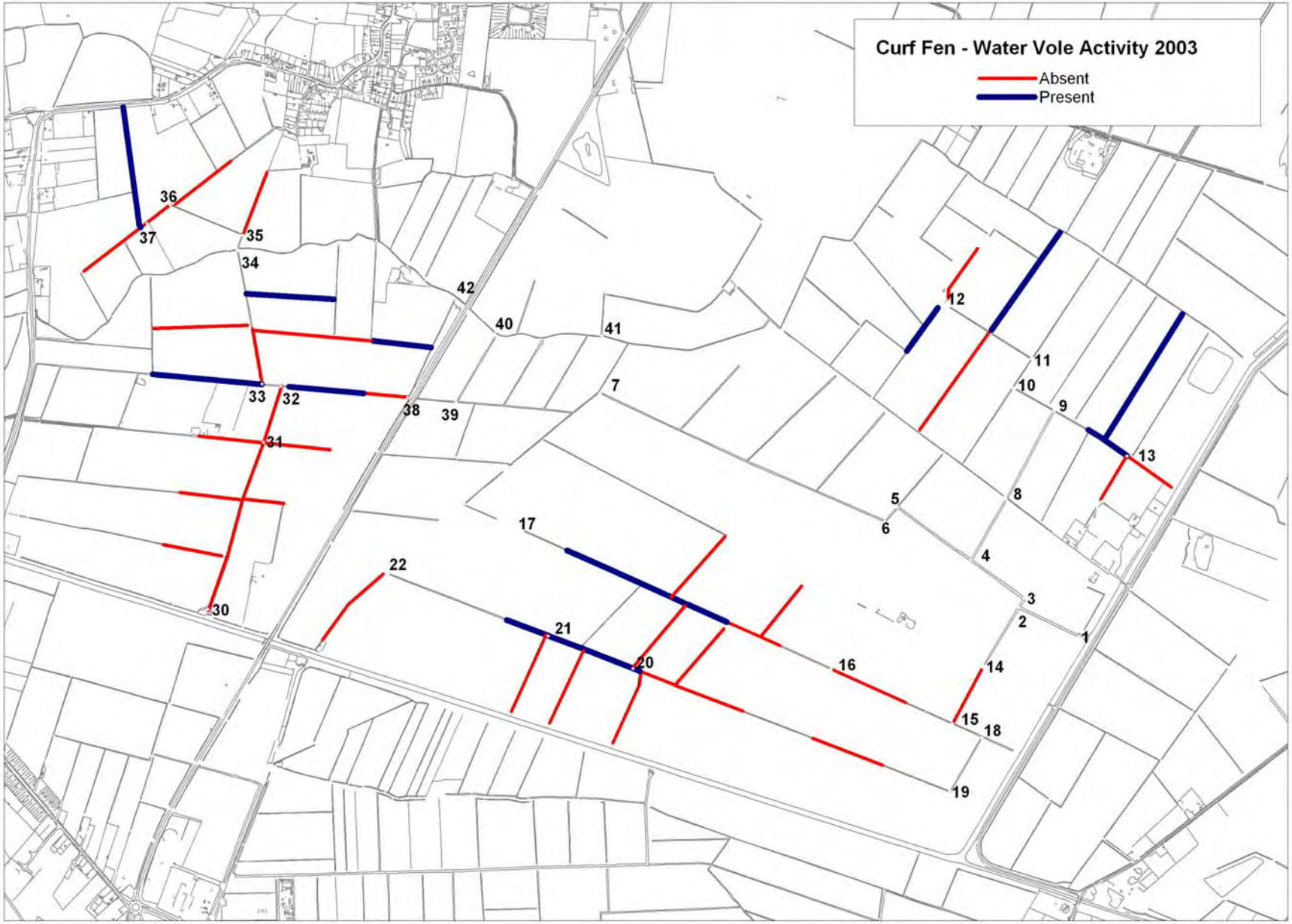
APPENDIX 2

Curf Fen - survey results 2004



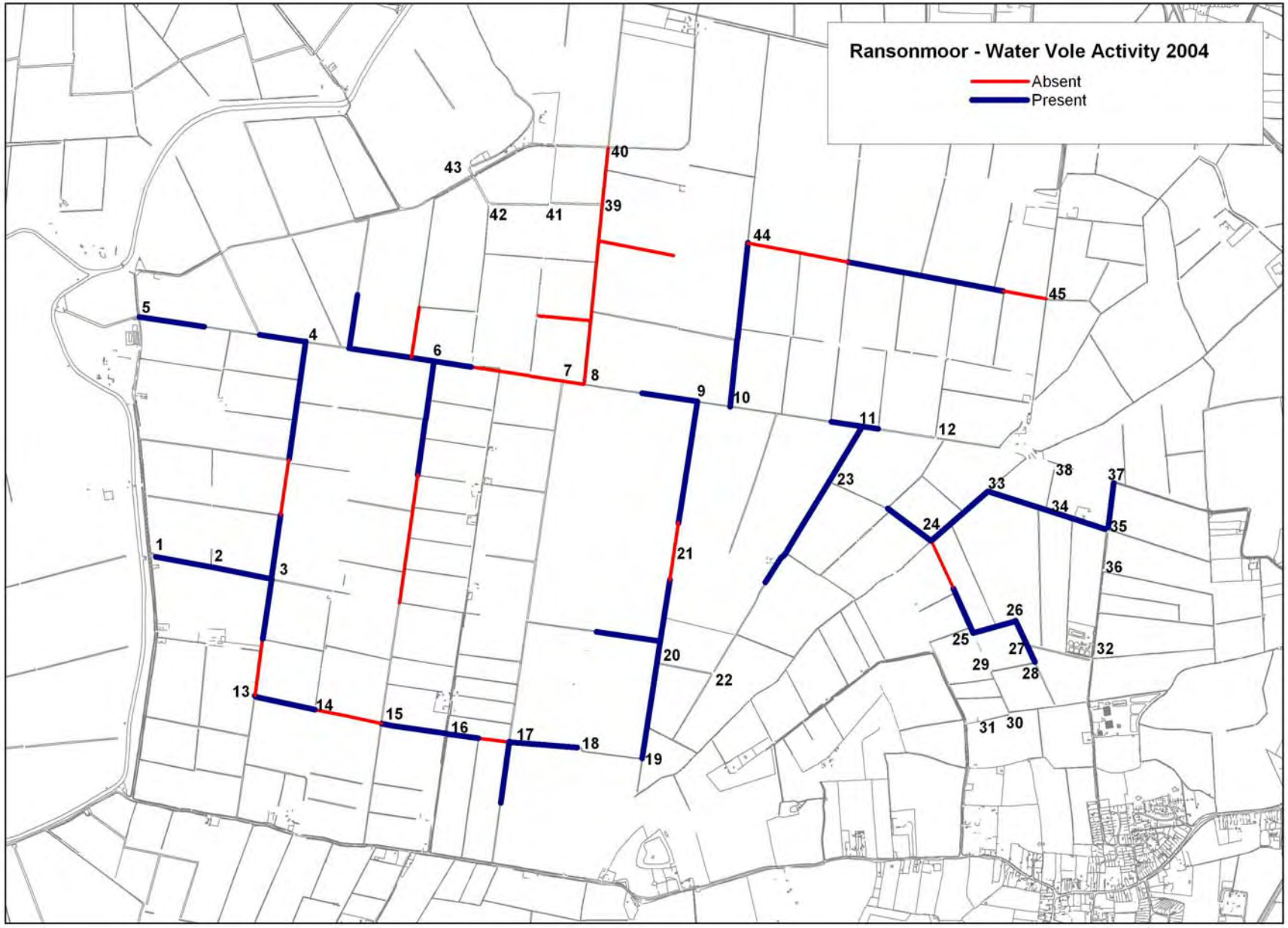
APPENDIX 3

Curf Fen - survey results 2003



APPENDIX 4

Ransonmoor - survey results 2004



APPENDIX 5

Ransonmoor - survey results 2003