THE UNIVERSITY OF CALGARY

THE SUFFIELD MILITARY RESERVE: AN EXAMINATION OF LAND UTILIZATION PATTERNS THROUGH TIME

by

Barry J. Dau

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ARTS

DEPARTMENT OF COMMITTEE ON RESOURCES AND THE ENVIRONMENT

CALGARY, ALBERTA

JUNE, 1983

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "THE SUFFIELD MILITARY RESERVE: AN EXAMINATION OF LAND UTILIZATION PATTERNS THROUGH TIME" submitted by Barry J. Dau in partial fulfillment of the requirements for the degree of Master of Arts.

Supervisor, Dr. R.G. Forbis, Department of Archaeology

Dr. H. Klassen, Department of History

Dr. A.D. Olmsted, Department of Sociology

Dr. R. Klassen, Institute of Sedimentary and Petroleum Geology, Geological Survey of Canada

(DATE): June 30, 1983

ABSTRACT

During the extensive period of time that human beings have lived on the Northern Plains, the area encompassed by the present day boundaries of the Suffield Military Reserve has been occupied by a wide variety of human groups. Each one has made use of the resources provided by the environment in different ways, depending upon its cultural, social or political outlook and technological sophistication. The following study has been designed to examine four of these groups and to try to determine how each one used or abused the harsh environment of one small sector of the Northern Plains grassland biome.

ACKNOWLEDGEMENTS

It has been a difficult decision on my part to determine in what order I should acknowledge all of the individuals who have helped me in this project.

To begin with, I would like to thank Dr. Gordon Hodgson, chairman of the Committee on Resources and the Environment, for having enough faith in my ideas to accept me into a Graduate program. Thanks also to my supervisor, Dr. R.G. Forbis and the members of my committee Dr. A.D. Olmsted, Dr. H. Klassen and Dr. R. Klassen for all of their excellent suggestions and for their support.

Many thanks must be given as well to Colonel Dangerfield, Major Elrick and Captain MacDonald of Canadian Forces Base Suffield. Without their cooperation, the field research for this thesis would have been impossible.

Last, but by no means least, I would like to thank John Brumley of ETHOS Consultants Ltd., Medicine Hat for allowing me free access to his substantial store of raw archaeological data concerning the Suffield Military Reserve.

TABLE OF CONTENTS

SECTION PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

SECTION 1

INTRODUCTION

It is in the very nature of most human beings to exhibit immense curiosity, especially about the world in which they live. This inherent curiosity operates at all levels of society from that of an Australian aborigine to that of a Space Shuttle designer, and has resulted in the accumulation of a vast body of data concerning the natural world. Of course, the most popular subjects for study by human beings are themselves and over the last fifty years there has been an increased interest in understanding the relationship between humans and the environment.

One area where such interest is currently strong is the small portion of the North American grassland ecosystem known as the Northern Plains; defined here as that part of Western Canada stretching north from the 49th Parallel to the Plains/Parkland border and east from the foothills of the Rocky Mountains to the southwest corner of the province of Manitoba. Historically it was the home of various groups of highly mobile bison hunters. Today, it forms part of what is termed the "breadbasket" of North America. There are many localities within the Northern Plains that offer excellent opportunities for the examination of how specific human groups make use of their local environment. One such locale is Canadian Forces Base Suffield, more commonly known as the Suffield Military Reserve.

Located in southeastern Alberta (Figure 1), the Suffield Military Reserve is a vast tract of land that retains evidence of land utilization

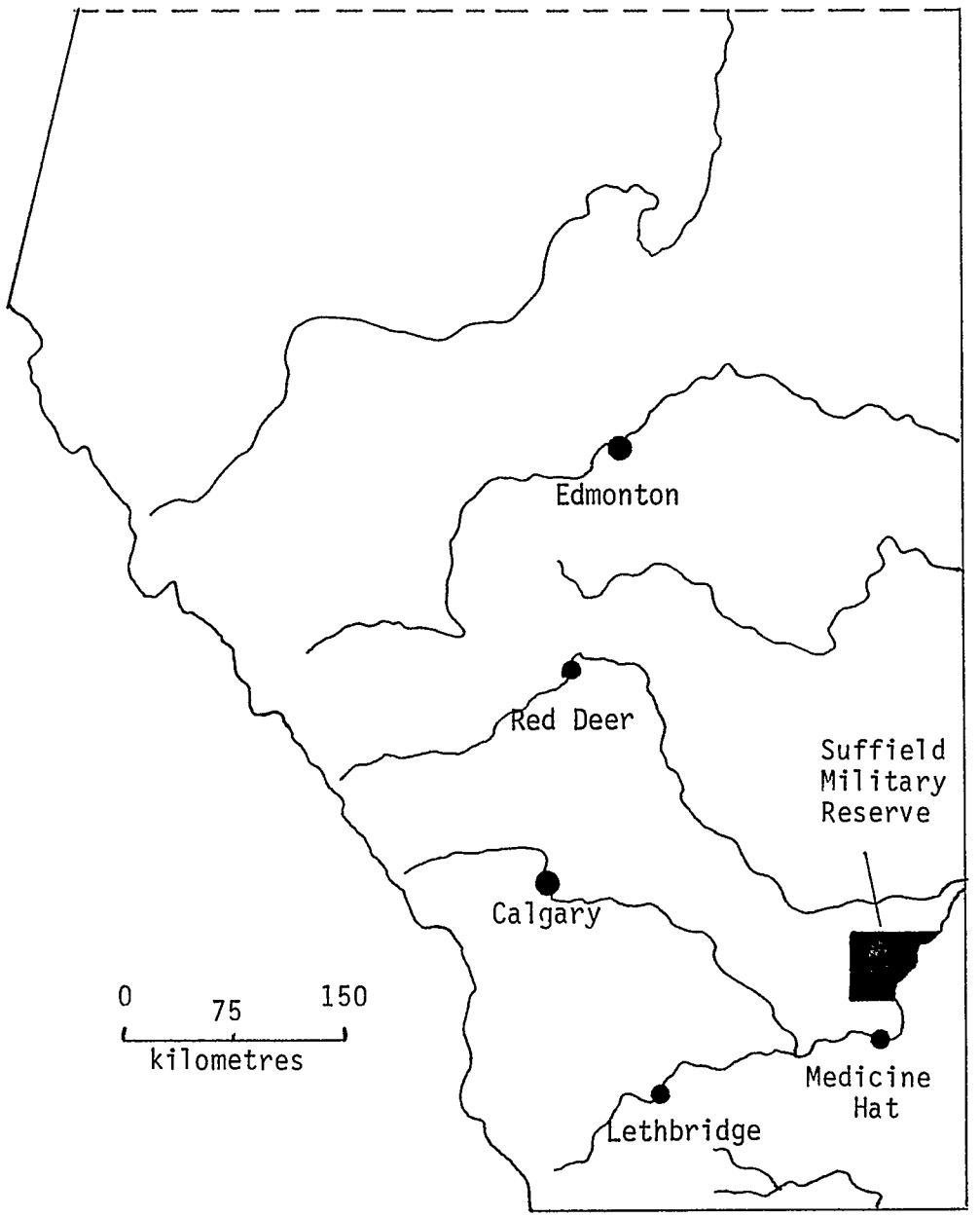


Figure 1: Sketch map of southern Alberta showing location of Suffield Military Reserve.

dating over almost the entire 15,000 year span of human history on the Northern Plains. Some of the data that are available for study are unique to the Reserve. It is, in fact, the only portion of Western Canada that exhibits the effects of surface warfare and is one of the few areas where natural prairie has been allowed to regenerate in a previously cultivated zone.

Few individuals, however, understand the opportunities that are available on the Reserve for studying the interaction between differing human groups and the environment. In fact, few people realize that the Reserve even exists as a discrete entity. It is the purpose, then, of this paper to attempt to examine how a selected sample of these groups utilize(d) the land surface of the Reserve and how they cope(d) with, or lost out to, the harsh environment of the Northern Plains. The examination was loosely based upon the ideas presented in the field of human ecology. This is a very generalized discipline and can encompass studies on a number of levels. Simply defined, human ecology relates to the study of human beings and how their various social and technological institutions adapt to, or are influenced by, the environment in which they operate (Boughey 1975, Levine 1975, Quinn 1971, Sargent 1974).

Within the time frame discussed in this paper, the area encompassed by the present day Suffield Reserve has been utilized by eight different human groups. They are:

1. Prehistoric native groups
2. Historic native groups
3. Early European trader/explorers
4. Historic European ranchers

5. Homesteaders
6. The Canadian and British armed forces
7. Modern ranchers
8. Modern energy developers

Only four of these, however, have been chosen for detailed study in this paper. They are groups 1,5,6 and 8. The remainder will be discussed briefly in Section 4, in order to maintain a certain amount of temporal continuity.

Because of the vast size of the Suffield Military Reserve, it proved difficult to provide raw data on land utilization from the entire area. In order to lessen this difficulty, four one square mile (2.56 square kilometre) study areas were chosen. Each one was designed to provide raw data on a different occupation.

A number of criteria were used in the selection of the study areas. The major land utilization pattern visible in each one had to relate to a single human group and had to be as representative as possible of the Reserve as a whole. In addition, each study area was chosen so that its general environment (topography, surficial deposits, flora, etc.) was as similar as possible to both the other study areas and the most common environmental pattern found on the Reserve. The selected study areas are presented in Figure 2 and are as follows:

Study Area 1: Prehistoric native occupants
Study Area 2: Homesteaders
Study Area 3: The military
Study Area 4: The energy developers

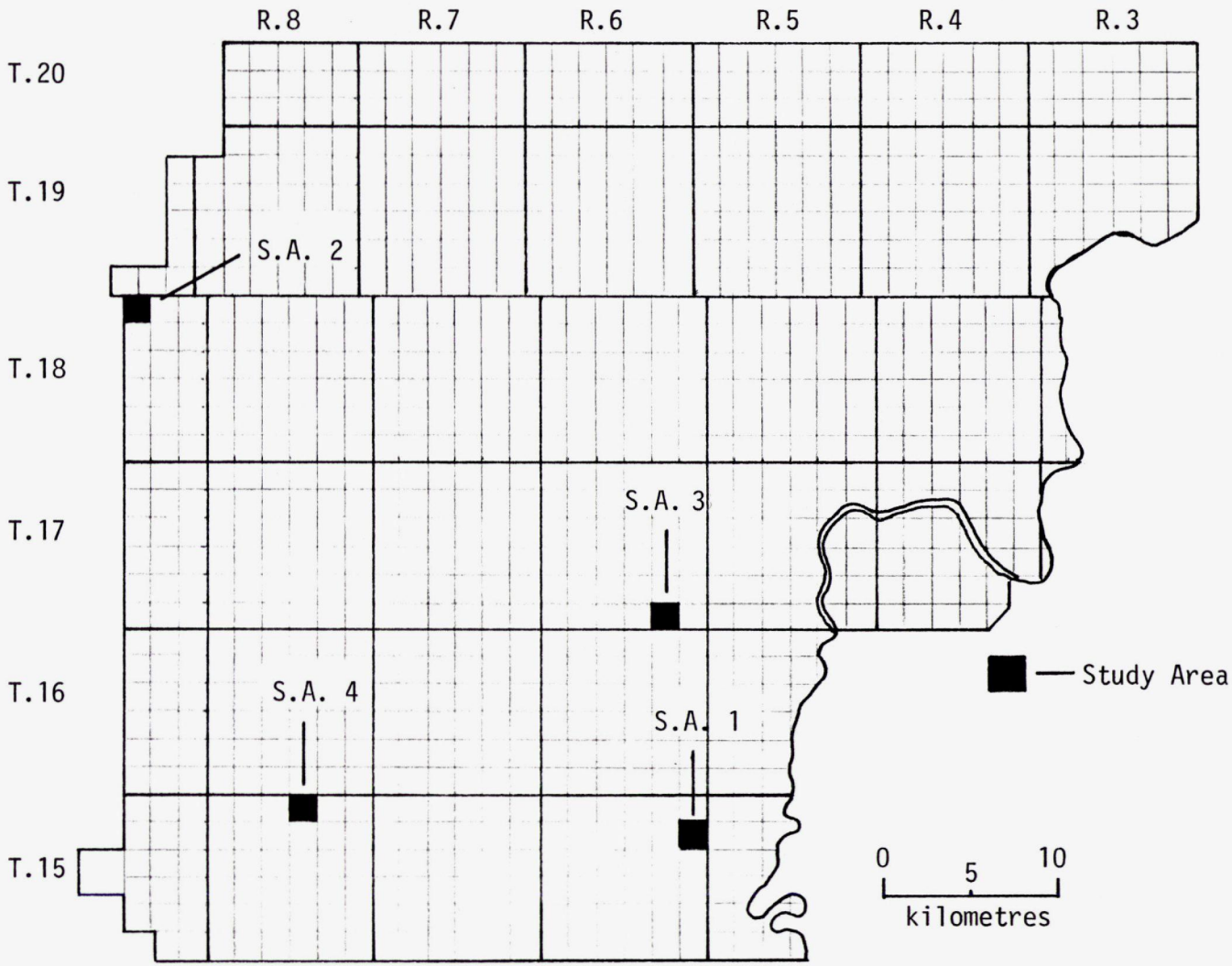


Figure 2: Sketch map of Suffield Military Reserve showing location of Study Areas.

The environment of the Northern Plains was (and still is) very harsh. It had strong effects upon the way at least two of the human groups studied here utilized the land surface of the Suffield Reserve. It is important, then, to begin this examination with a more detailed look at the environment.

SECTION 2

THE REGIONAL ENVIRONMENT OF THE RESERVE

2.1 Introduction

The Suffield Military Reserve is a roughly rectangular shaped block of land situated in the southeast corner of the Province of Alberta. It is located approximately 15 km north of the city of Medicine Hat and 250 km southeast of the city of Calgary (see Figure 1). The Reserve encompasses 2,560 square kilometres of rolling prairie, all but 60 of which are located immediately west of the South Saskatchewan River.

The river itself forms the major eastern boundary of the Reserve with the western boundary marked by a secondary highway running from the hamlet of Suffield to the hamlet of Jenner. The approximate dimensions of the Reserve are 50 km north-south by 60 km east-west and its entire perimeter (except that which fronts onto the river) is enclosed by a clearly marked fence. Access to the interior of the Reserve is strictly controlled by the Canadian Armed Forces and the Alberta Energy Company (AEC). The AEC maintains three primary and three secondary access gates on the Reserves' perimeter, which attempt to control all non-military traffic in the area.

2.2 Bedrock Geology

The Suffield Military Reserve is situated at the southern end of what is sometimes known as the Eastern Alberta Plains (Government of Alberta 1969:5). The bedrock formations of the Eastern Alberta Plains consist of a variety of thick marine and non-marine sediments dating

back to the end of the Cambrian Era. Most prominent, however, are the thick (primarily marine) sandstones, shales and sands of the Cretaceous Era (Government of Alberta 1969:5). The Reserve itself is situated on the crest of a Cretaceous bedrock feature known as the Bow Island Arch (SBSC 1972:G-3).

The Arch lies between the Alberta Syncline and the Williston Basin. Its numerous porous shales, sands and sandstones have acted as excellent hydrocarbon accumulators in the past (SBSC 1972:G-6). Natural gas is abundant at easily accesible depths throughout the Arch and this factor is the main reason for the extensive energy development that has taken place on the Reserve over the last eight years.

Above the Cretaceous beds of the Bow Island Arch are a number of non-porous Tertiary clays, shales and conglomerates that serve to cap and retain the hydrocarbon reserves. Overlying all of this are thick beds of till laid down by various Pleistocene glaciations. The topographic character of the Northern Plains and the nature of the plant communities that live upon it have been strongly affected by these tills and the poorly drained Tertiary sediments

2.3 Surficial Geology

The present surface of the Suffield Reserve consists primarily of rolling (and often quite rugged) prairie terrain dotted with small seasonal ponds and shallow spring-fed lakes. Broadly speaking, the surficial deposits of the area consist of hummocky moraines interspersed with outwash sands and gravels and alluvial silts (McPherson 1972). Because of its size, the Reserve exhibits a number of micro-environments that can

grouped into three generalized physiographic zones: 1)the South Saskatchewan River, 2) the Middle Sand Hills, and 3) the Open Prairie.

The South Saskatchewan River is a typical Northern Plains post-glaciation meandering watercourse. It flows along the east boundary of the Reserve for approximately 110 km. The river valley varies in width from just under 1000 m to slightly more than 2500 m and ranges in depth from 50 m to 120 m. Within the Reserve, the river valley walls are characterized by extremely steep slopes and very rugged terrain created by deeply incised run-off channels and coulees. The only exception to this pattern is the area known as Drowning Ford, a 3000 m long stretch of river valley where the land slopes gently down to the river surface. Drowning Ford was an important historical locale as it was one of the few places downstream from Medicine Hat where the South Saskatchewan River could be easily crossed.

The Middle Sand Hills occupy the entire northeastern portion of the Reserve and are characterized by innumerable stabilized and several small active dunes of fine clean sand. Although the general relief of the area is low, the terrain is highly unpredictable and almost impassable to vehicular traffic. The sand hills are covered by heavy vegetation and provide excellent habitats for Mule and White Tailed Deer as well as several species of small mammals and birds.

By far the largest portion of the Reserve falls within the Open Prairie zone. The terrain in this area is so diverse that it is difficult to describe briefly. In general, the southern sectors of the zone exhibit low relief, changing to hilly terrain in the central and north-

western portions of the Reserve. Elevations range from a low of 624 m ASL near Drowning Ford to a high of just over 830 m ASL in the northwestern corner of the Reserve. Scattered throughout the open prairie zone are a number of prominent hills and ridges. These include Watching Hill (714 m ASL), The Hogsback (747 m ASL), Lone Eagle Butte (754 m ASL), Dubois Hill (823 m ASL), Brutus (817 m ASL), Twin Peaks (771 m ASL), The Look-out (750 m ASL), and Chaisson Ridge (800 m ASL). Archaeological investigations have shown that certain of these features served as important prehistoric camping or observation locales; some are still used for that purpose by the military.

The open prairie also contains hundreds of seasonal water sources. Poor drainage allows the majority of these to retain water in the spring, providing habitats for water fowl and insects. By summer, however, they have dried up and the only permanent water is found in a few widely scattered shallow spring-fed lakes. The most prominent of these are Whitehorse and Dishpan Lakes in the northeastern corner of the Reserve, Beveridge and Easy Lakes in the northwestern corner and several small unnamed lakes in the Reserves' southwestern corner. This lack of adequate permanent water presented problems for both the native occupants and homesteaders in the area and, to a certain extent, the present day energy developers.

The entire Reserve is located within what is known as the Brown Soil Zone of Alberta (Government of Alberta 1969:34). Brown soils are usually formed under semi-arid conditions and are often quite shallow. Their upper horizons rarely contain much organic matter and the underlying ones

are heavily mineralized. On the Reserve, the Brown Soil zone can be broken into three generalized categories: 1) Sands, 2) Chernozems, and 3) Solonetzics. The distribution of these categories can be seen in Figure 3.

The sands are restricted to the very northeast corner of the Reserve and are found in either thick stabilized or shifting dunes. Chernozems exist in a variety of forms over the rest of the Reserve and often consist of only a few centimetres of mineral and organic topsoil underlain by moderately drained loams, sands and clays (Stevens et al 1971). Solonetzic soils are found in the eastern portion of the Reserve mixed with various chernozems. They are often composed of a thin upper horizon containing little or no organic matter underlain by a hard impermeable layer of clays and a high salt accumulation zone (Stevens et al 1971).

On the Reserve, none of the soils can support economically feasible agriculture unaided. With sufficient moisture the chernozems can be made productive. The sands and solonetzics, however, are unsuitable for grain growing even with the aid of irrigation (SBSC 1972:R-14).

2.4 Climate

Like all open plains environments, the Suffield Military Reserve exhibits a highly variable climate, subject to drastic extremes. Over the period from 1942 to 1967 detailed data on the climate of the Reserve were collected and are presented in Figures 4 and 5. The upper graphs of both figures show that the Reserve follows a temperature and moisture cycle common to most temperate areas. The lower graphs are far more in-

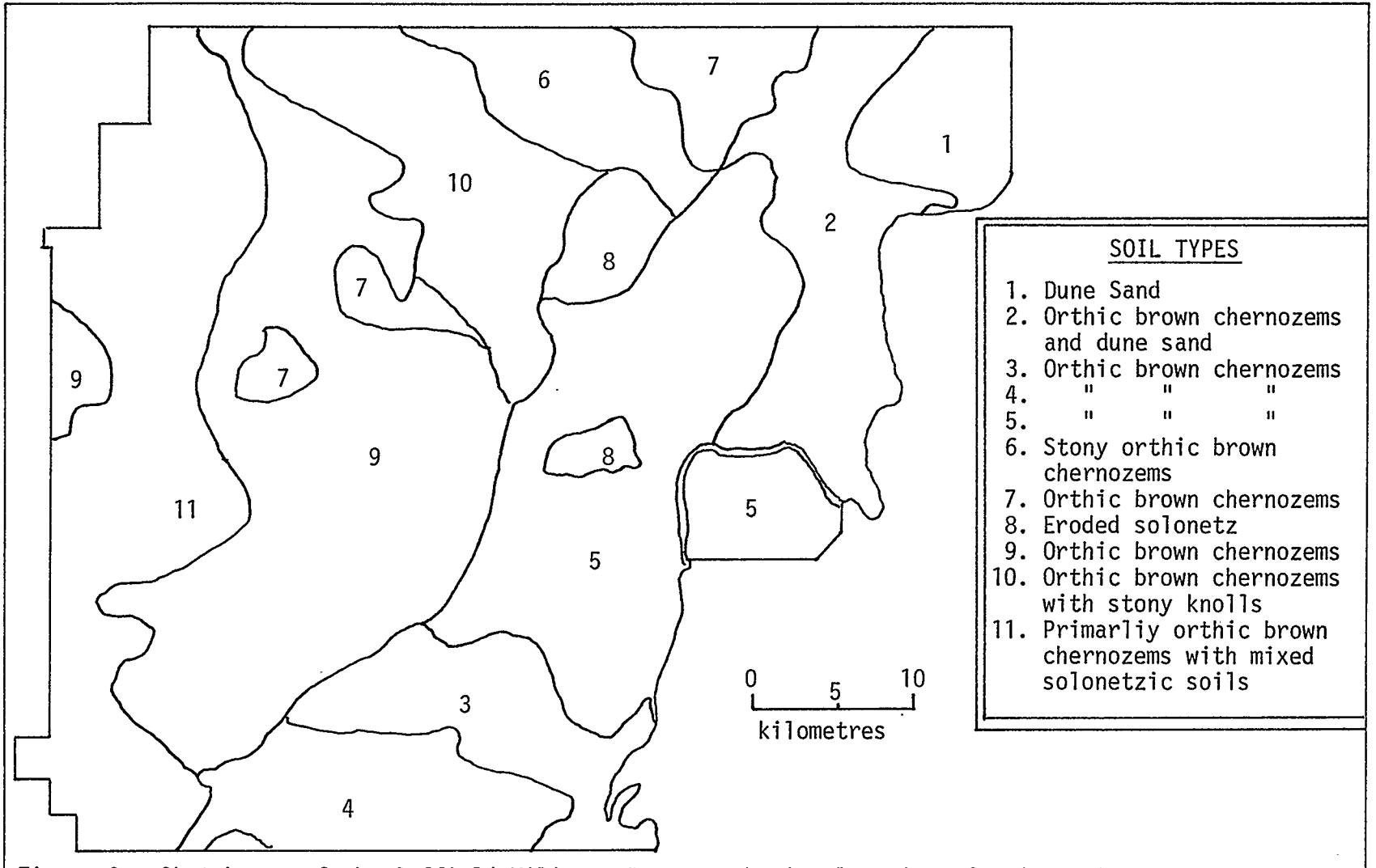
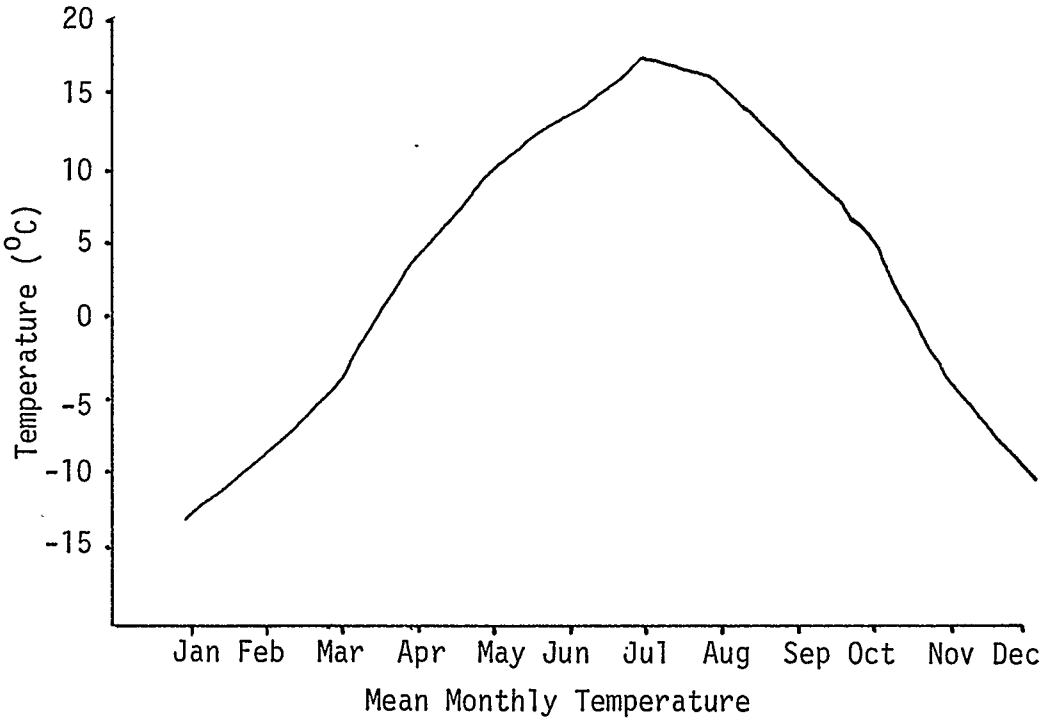


Figure 3: Sketch map of the Suffield Military Reserve showing location of major soil types. (Adapted from Stevens et al 1971)



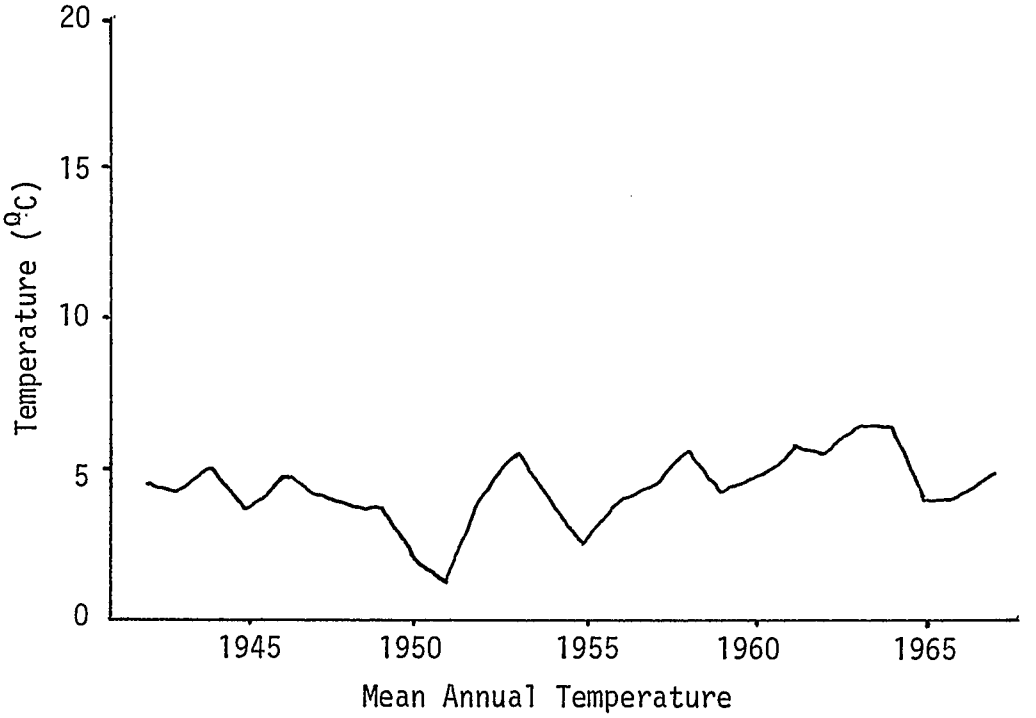
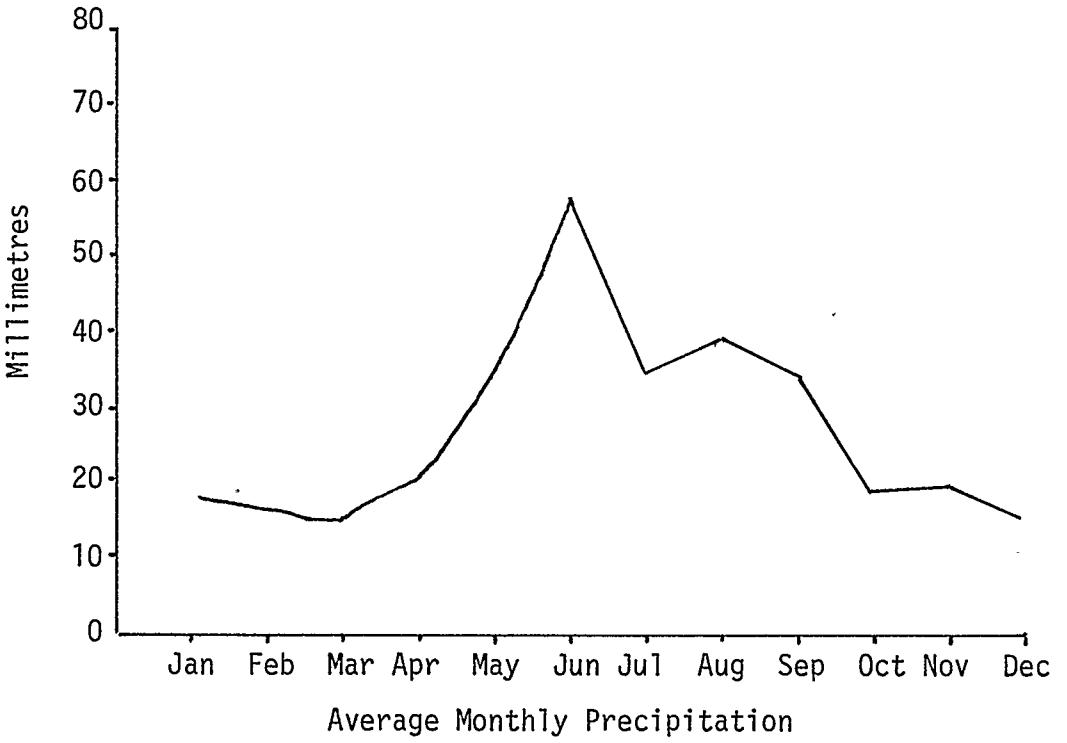


Figure 4: Mean temperature gradients on the Suffield Military Reserve 1942-1967. (Adapted from Boswell 1969)



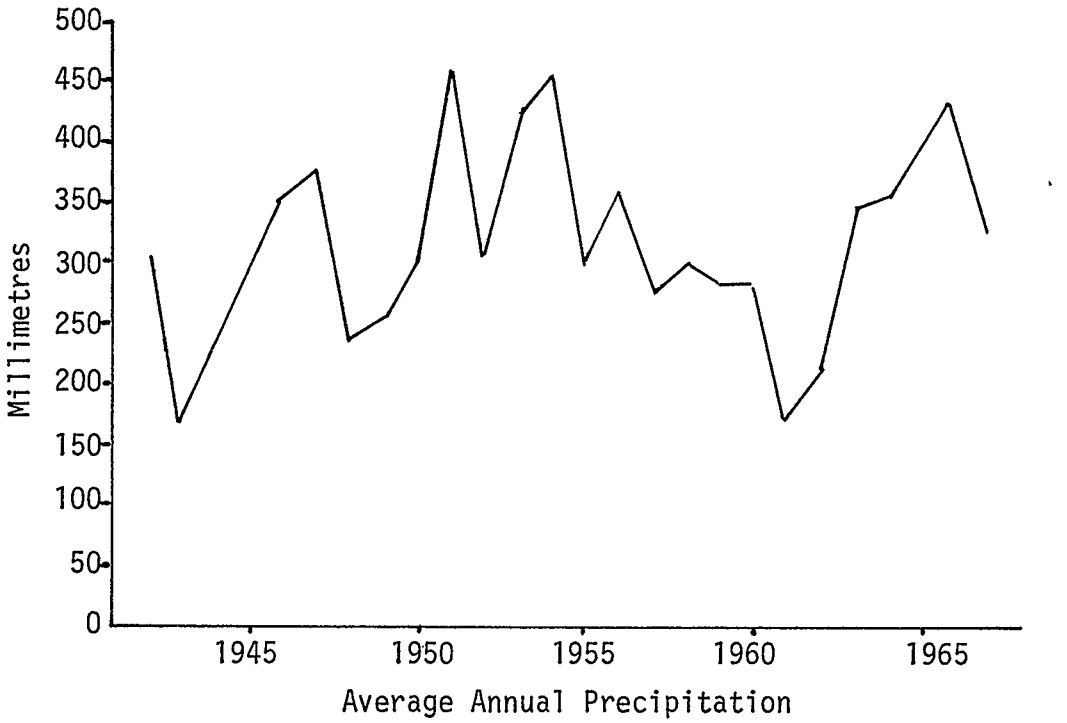


Figure 5: Average precipitation rates on the Suffield Military Reserve 1942-1967. (Adapted from Boswell 1969)

teresting and show that the climate can vary widely from year to year. Maximum and minimum temperatures have ranged from +40°C to -47°C and yearly precipitation has varied from 150 mm to 450 mm (Boswell 1969).

Cloud cover is rare, a feature common to most of southern Alberta. The total number of hours of bright sunshine on the Reserve between 1942 and 1967 has varied from a low of 89.2 in December to a high of 383.3 in July, with a monthly average of 193 (Boswell 1969). The final important climatic factor on the Reserve is the wind, which blows almost constantly from either the west or southwest. In the period 1942 to 1967, the total number of days when the mean wind speed was no less than 64 km per hour varied from a low of 10.5 in August to a high of 12.4 in April with an average of 11 days per month (Boswell 1969).

The importance of the climate as a limiting factor in land utilization on the Reserve has diminished somewhat over the last forty years. Both the military and the energy developers have taken full advantage of modern technology and rarely pay much attention to climatic variations. For both the homesteaders and the native occupants, however, such variations were of extreme importance as they regulated how and when the land surface of the Reserve could be effectively used.

2.5 Flora and Fauna

The most common view of the Suffield Military Reserve is that it is a semi-desert. This is definitely not the case. Its environment supports an extensive variety of plants and animals all operating within a self-regulating grassland ecosystem. The basal components of such systems are the herbaceous species that comprise the floral community (Coupland 1979).

The grasslands of North America can be broken into several smaller zones and the Suffield Reserve is located (depending upon the authority cited) in either the Mixed Prairie Zone (Coupland 1961:135) or the Short Grass Plains (Watts 1960:26). In both zones the dominant surficial deposits of hummocky moraine are covered by brown to dark brown soils. The Reserve itself is situated on the northern edge of the Mixed Prairie (or Short Grass Plains) zone, which extends eastward from the Rocky Mountains in a thin band as far south as northern Texas (Coupland 1961: 135).

The primary floral community on the Reserve is called the Stipa-Bouteloua Association (Coupland 1961:135). Within it are five major grass species: 1) Needlegrass (Stipa spartea), 2) Speargrass (Stipa comata), 3) Northern Wheatgrass (Agropyron dasystachyum), 4) Western Wheatgrass (Agropyron smithii), and 5) Blue Gramma Grass (Bouteloua gracilis). Combinations of these species commonly make up 75% of the floral community in a Mixed Prairie zone (Coupland 1961:147) and up to 82% in a Short Grass Plains zone (Watts 1960:35). On the Reserve, there are nine other grasses often associated with the dominant species:

June grass (Koeleria gracilis)
Prairie muhly (Muhlbergia cuspidata)
Sandberg's bluegrass (Poa secunda)
Niggerwool (Corex filifolia)
Prairie selongela (Selongella densa)
Pasture sage (Artemesia frigidia)
Dwarf Phlox (Phlox hoodie)
Snadgrass (Calamovilfa longifolia)
Sand dropseed (Sporobulus cryptondras)

(SBSC 1972:R-16 and Stelfox 1977:B-5)

Of course, not all of these species show up together in the same community or, if they do, in equal quantities. For example; Snadgrass and dropseed are usually found only in the sand hills portions of the Reserve (Stelfox 1977:B-6). The dominant grasses exhibit excellent adaptive characteristics with the fast growing speargrasses appearing in the moist spring and then giving way to the slower growing (and nutrient retentive) gramma grasses in the hot dry summer. A few other plant species do co-exist with the grasses on the open prairie zone of the Reserve. Sagebrush (Artemesia gnaphalodes), Greasewood (Sarcobetus vermiculatus), Cushion Cactus (Mamillaria viviparia), and Prickly Pear Cactus (Opuntia polyacontha) can be found in area where the terrain permits their growth.

The only two areas where plant species other than those mentioned above survive on the Reserve are along the banks of the South Saskatchewan River and in the Middle Sand Hills. Here, soil and moisture conditions allow for the growth of Cottonwood (Populus sargentii) and Willow (Salix) trees as well as Buffalo berry (Shederdia argentia), Chokecherry (Prunus virginniana), Saskatoon (Amelanchier alnifolia), and Rose (Rosa) bushes.

Like the floral community, there is an extensive variety of animal species on the Reserve. Table 1 provides a list of only the most common fauna found in the area. While all of the snakes and most of the mammals are represented in the table, only about half of the migratory bird species are noted. In a study conducted along the Red Deer River, Wallis (1977) recorded over 250 species of migratory or seasonally resident birds, the

Table 1 : An abbreviated list of animal species found on the Suffield Military Reserve. (Compiled from Atlas of Alberta 1969, Salt 1966, Soper 1964 and Stelfox 1977)

MAMMALS

Pronghorn Antelope (*Antilocapra americana*)	
Mule Deer (*Odocoileus hemionus*)	
White Tailed Deer (*Odocoileus virginiannus*)	
Bobcat (*Lynx rufus*)	(rare)
Canada Lynx (*Lynx canadensis*)	(rare)
Wolf (*Canis lupus*)	(rare)
Coyote (*Canis latrans*)	
Prairie Kit Fox (*Vulpes velox*)	(rare)
Red Fox (*Vulpes fulva*)	
Skunk (*Mephitis mephitis*)	
Porcupine (*Erethizon dorsatum*)	
Beaver (*Castor Canadensis*)	(rare)
Muskrat (*Ondatra zibethicus*)	
Prairie Hare (*Lepus townsendii*)	
Cottontail Rabbit (*Sylvilagus nutalli*)	
Richardson's Ground Squirrel (*Spermophilus richardsonii*)	
Richardson's Pocket Gopher (*Thomomys talipodes*)	
Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*)	
Prairie Long Tailed Weasel (*Mustela frenata*)	
Least Weasel (*Mustela rixosa*)	
Black Footed Ferret (*Mustela nigripes*)	
Kangaroo Rat (*Dipodomys ardii*)	(rare)
Western Harvest Mouse (*Reithrodontomys megalotis*)	
Saskatchewan Jumping Mouse (*Zaprus princeps*)	(rare)
Maxmillian Pocket Mouse (*Perognathus fasciatus*)	
Badlands Whitefooted Mouse (*Peromyscus leucopes*)	
Audobon Grasshopper Mouse (*Onychomys leucogaster*)	
Badlands Meadow Vole (*Microtus pennsylvanicus*)	
American Badger (*Taxidea taxus*)	
North American Plains Bison (*Bison bison*)	(Extinct)

SNAKES

Prairie Rattlesnake (*Croatulus confluentus*)	
Bull Snake (*Pituophis catenifer*)	
Common Garter Snake (*Thomophis sintalis*)	
Hog-nosed Snake (*Hterodon nascius*)	(rare)

Table 1 : (Continued)

BIRDS

Horned Grebe (Podiceps auritis)	
Eared Grebe (Podiceps caspius)	
Great Blue Heron (Ardea herodias)	
Whistling Swan (Olor columbianus)	
Canada Goose (Branta Canadensis)	
Snow Goose (Chen hyperborea)	
Ross' Goose (Chen rossii)	
Mallard Duck (Anas platyrhynchos)	
Gadwall (Anas strepera)	
Pintail Duck (Anas acuta)	
Blue Winged Teal (Anas discors)	
American Widgeon (Moreca americana)	
Lesser Scaup (Aythya affinus)	
Red Tailed Hawk (Buteo jamaicensis)	(rare)
Swainson's Hawk (Buteo swainsonii)	
Roughlegged Hawk (Buteo lagopus)	
Ferruginous Hawk (Buteo regalis)	
Marsh Hawk (Circus cyaneus)	
Golden Eagle (Aquila chrysaetos)	
Bald Eagle (Haliaeetus leucocephalus)	(rare)
Prairie Falcon (Falco mexicanus)	(rare)
Pigeon Hawk (Falco columborius)	(rare)
Sharp Tailed Grouse (Pedioecetes phasianellus)	
Sage Grouse (Centrocercus urophasianus)	
Hungarian Partridge (Perdix perdix)	
Ring Necked Pheasant (Phasianus culchicus)	
Sandhill Crane (Grus canadensis)	
Long Billed Curlew (Numenius americanus)	
Great Horned Owl (Bubo virginianus)	
Long Eared Owl (Asio Otus)	
Short Eared Owl (Asio flammeus)	
Burrowing Owl (Speotyto cunicularia)	
Common Crow (Corvus brachyrhynchos)	
Western Meadowlark (Sturnella neglecta)	
Redwinged Blackbird (Agelaius phoenicus)	
Baird's Sparrow (Ammodrammus bairdii)	
Vesper Sparrow (Pooecetes gramineus)	
Savannah Sparrow (Passerculus sandwichensis)	
Clay Coloured Sparrow (Spizella pallida)	
Common Nighthawk (Chordelles minor)	
Horned Lark (Eremophila alpestris)	
Cliff Swallow (Petrochelidon pyrrhonota)	

majority of which were found along the lower stretches of the river immediately north of the Reserve.

The most common large mammal is the Pronghorn Antelope. It can be found in all areas and it is thought that more than 2000 antelope make the Reserve their permanent home (Stelfox 1977:A-9). Mule and White Tailed Deer can be found in both the Middle Sand Hills and in the terrain along the South Saskatchewan River. In addition, both cattle and horses are now common on the Reserve. Perhaps as many as 350 semi-wild horses roam freely over the area and extensive herds of cattle graze on the southern portions of the Reserve from May to September under the management of the Prairie Farm Rehabilitation Association (PFRA).

Rattlesnakes and Bull snakes are common in the eastern portion of the Reserve, especially along the South Saskatchewan River. Garter snakes can be found in all areas, but the range of the Hog-nosed snake is not known. The vast majority of birds are migratory, stopping on the Reserve briefly during their twice-yearly travels. A smaller number make the area their summer home and perhaps no more than ten species are permanent residents.

Not included in Table 1 are the numerous species of fish found in the waters of the South Saskatchewan River. As detailed studies of fish in this portion of the river have not been conducted, the exact population is not known. It is believed, however, that the three most common species are the Walleye (Stizostedian vitremus), the Goldeye (Hiodon alosoides), and the Northern Pike (Esox lucius).

2.6 Comments

Clearly, the environment of the Suffield Military Reserve is far from barren. The plants and animals interact with each other and the vagaries of the climate in a unique adaptive system. Prior to the arrival of the Europeans, the native occupants were an integral part of the system. With the coming of the homesteaders in 1909, however, the pattern changed. Since then the human occupants of the Reserve have been disruptors of the environment. As of 1983, the Suffield Military Reserve can no longer be considered as an area of "untouched" natural prairie.

SECTION 3

NATIVE OCCUPANTS: STUDY AREA 1

3.1 Introduction

The following section has been designed to examine how the prehistoric native occupants of what is now the Suffield Military Reserve utilized its land surface. The prehistoric period on the Northern Plains covers a substantial period of time from approximately 12,000 B.C. to A.D. 1725, the date commonly accepted as the time when the natives of the area received their first influences from European society. Because of the temporal immensity of the period to be discussed much of what will be presented here is, by necessity, generalized. Raw data for this examination were collected from Study Area 1 and added to the large body of archaeological data already known for the Reserve. This was combined with both ethnographic and historic references for the Northern Plains in the hope that an adequate picture of the lifestyles of the prehistoric natives could be envisioned.

Study Area 1 is situated in the southeast corner of the Suffield Reserve (see Figure 2, page 5) and consists of a single one square mile (2.56 square kilometre) block of land (Figure 6). Surficial deposits in the area are composed entirely of hummocky moraine and it exhibits varied terrain. In the southwest corner of the study area the land is relatively flat, sloping up to a broad band of moderately rolling hills running in a southeast-northwest direction. These hills change gradually into rolling sandy terrain in the northeast corner of the study area. While by no means an exact representation, the topographic pattern described above reflects

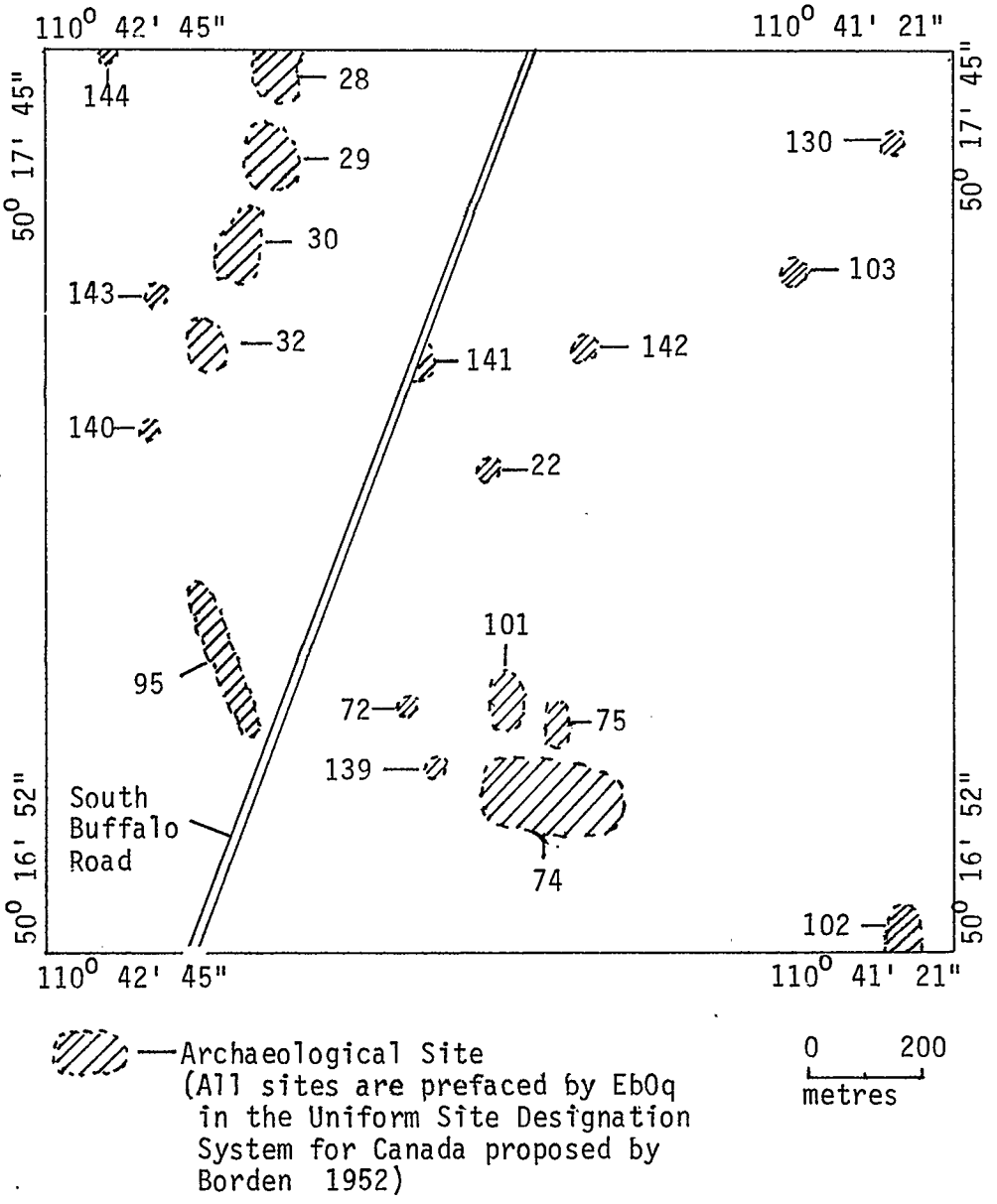


Figure 6: Sketch map of Study Area 1 (Section 25, Township 15, Range 6) showing location of recorded archaeoloigcal sites.

the pattern observed for the Reserve as a whole.

The location of the known archaeological sites in Study Area 1 also reflects the general pattern on the Reserve. Just over 84% of the sites were found in areas of moderately rolling terrain and hummocky moraine. A study, made by the author, of the relevant data from the entire Reserve show that just under 80% of all known archaeological sites are found in similar areas.

The data from Study Area 1 alone cannot be considered as sufficient when attempting to understand land utilization over the entire Reserve. Therefore, a brief overview of the archaeological resources of the area is in order. Intensive surface archaeological surveys began in the early 1970s, in response to the opening of the Reserve for British military training. By 1972 approximately 67,584 hectares of land had been examined (Brumley 1973). These surveys were begun again in 1976 as the development of the fossil fuel resources of the Reserve was initiated. To date, an additional 5,800 hectares of land has been added to the total amount examined (Brumley and Milne Brumley 1977, Brumley 1978, 1979, Brumley and Dau 1980, Dau 1981a and Saylor 1982). At present, approximately 28.7% of the land surface of the Reserve has been examined for archaeological sites.

Over the course of these surveys, a total of approximately 1,650 archaeological sites have been recorded. Table 2 presents a breakdown of them by type. Just under 97% are surface sites very similar to those found in Study Area 1. Although the data available for study from each individual site varies considerably, when examined in their entirety,

Table 2: General inventory of recorded archaeological and historic sites on the Suffield Military Reserve (approximate only)

SITE TYPE	NUMBER OF SITES
Stone Circle	670
Cairn	440
Stone Alignment	40
Stone Circle/Cairn	350
Stone Circle/Cairn/Stone Alignment	9
Stone Circle/Stone Alignment	22
Cairn/Stone Alignment	9
Stone Circle/Cairn/Surface Workshop	1
Buried Campsite	34
Surface Site (Lithic Scatter)	44
Medicine Wheel	5
Bison Kill	3
Historic	14
Others	9
Total	1,650

it should be possible to provide a reasonably accurate picture of prehistoric land utilization.

3.2 Site Survey Procedures and Results

Research procedures in Study Area 1 consisted of a detailed survey of the entire section in order to locate all surface archaeological sites. During this survey, the section was divided into a series of east-west transects varying from 10 m to 50 m in width. Each transect was then covered either by foot or by vehicle and detailed locational data were collected for all sites found. Site recording procedures followed the standard pattern in use in Alberta with the initial completion (for each site) of an Archaeological Survey of Alberta Site Inventory Form and the preparation of a detailed sketch map.

Individual archaeological features were recorded in a variety of ways. Stone circles were recorded with the use of the Mapping Board, a device designed and built by John Brumley and the author after a concept presented by Marc Smith (1974). A detailed description of the Mapping Board can be found in Dau (1981b:39-46). With the help of this device, data were collected on the inside and outside diameter of each stone circle, its long axis and the number of stones in each feature. Other simple observational data collected included the depths below surface of the stones in each feature, the nature and extent of the lichen cover on the stones and the presence or absence of artifacts.

Cairns were recorded in a slightly different manner. The orientation of each feature was determined with the aid of a hand-held compass and its length and width was calculated in detail. In addition, the same observational data that were collected for the stone circles were gathered for each cairn.

The single stone alignment found in Study Area 1 was recorded on a detailed sketch map that noted the orientation and length of the feature. Recognizable cairns in the alignment were recorded in the same manner as the cairns found in the other sites. Time and funding restrictions did not allow excavations to be conducted in Study Area 1. Attempts were made, however, to examine surface artifacts in order to locate diagnostic materials but none were found.

The survey conducted in Study Area 1 resulted in the recording of 19 archaeological sites. Their approximate locations are noted in Figure 6 (page 23) and a simple breakdown of recorded features by site is present-

Table 3: Inventory of surface features from sites recorded in Study Area 1, Suffield Military Reserve.

SITE NUMBER	STONE CIRCLES	CAIRNS	STONE ALIGNMENTS
EbOq-22	1	1	
EbOq-28	7		
EbOq-29	2	6	
EbOq-30	9		
EbOq-32	1	5	
EbOq-72	2	1	
EbOq-74	2	12	
EbOq-75		10	
EbOq-95		5	1
EbOq-101	1	4	
EbOq-102	1	4	
EbOq-103		1	
EbOq-130		3	
EbOq-139		1	
EbOq-140	3		
EbOq-141	1		
EbOq-142	1		
EbOq-143	1		
EbOq-144		1	
Total	32	55	1

ed in Table 3. More detailed raw data on individual features will be presented in Sections 3.3.1, 3.3.2 and 3.3.3. Full descriptions of each site (including sketch maps) are available from the author or the Archaeological Survey of Alberta in Edmonton.

3.3 Recorded Features and Their Functions

In Study Area 1, three types of surface archaeological features were recorded: 1) Stone Circles, 2) Cairns, and 3) Stone Alignments. The data presented in Table 2 (page 25) show that these are the most common surface features on the Reserve with over 92% of the known sites containing one or more of them. If a proper understanding of the nature of prehistoric land utilization is to be achieved, it is important to determine

the specific functions of these features

3.3.1 Stone Circles

Stone circles are perhaps the most conspicuous surface archaeological features on the Great Plains. They are found as far south as New Mexico (Mulloy 1966:2) and as far north as the Parkland/Boreal Forest periphery. All types of terrain can contain stone circle sites, from the high plateaus of the Rocky Mountains (Malouf 1965:5) to the almost desert-like areas of the open plains. They occur in such numbers that Wormington and Forbis (1965:147) were led to suggest that there may be more than 600,000 stone circles on the Alberta plains alone.

On the Suffield Reserve, just under 64% of the approximately 1,650 known sites contain one or more stone circles representing a total of 4,400-4,500 features. With only 28.7% of the land surface examined, it is possible that there may be as many as 15,000 stone circles on the Reserve. Based upon the above data, a projected density of 5.9 features per square kilometre would seem accurate. It is known, however, that large areas of the Reserve are devoid of surface archaeological sites and the density of stone circles is probably much closer to the one found in Study Area 1. Here, 13 of the 19 recorded sites contained stone circles representing a total of 32 features (Table 4) and giving a density of 12.5 features per square kilometre.

The study of stone circles undertaken in Study Area 1 and on the Reserve as a whole was oriented around answering two questions:

Table 4: Selected stone circle data from sites recorded in Study Area 1, Suffield Military Reserve.

Site Number	Stone Circle Number	Inside Diameter(m)	Outside Diameter(m)	No. of Stones	Average Depth Below Surface	Long Axis	Floor* Area(m^2)	Number of Occupants
EbOq-22	1	5.17	6.23	44	10 cm	NNW-SSE	20.98	8
EbOq-28	1	6.07	6.97	70	12 cm	E-W	28.92	12
	2	5.93	7.07	110	14 cm	NE-SW	27.60	11
	3	5.27	6.14	133	14 cm	N-S	21.80	9
	4	4.86	5.86	83	13.5 cm	E-W	18.54	7
	5	4.56	5.42	47	11 cm	N-S	16.32	7
	6	7.18	7.88	93	12.5 cm	NE-SW	40.47	16
	7	Too scattered to map accurately						
EbOq-29	1	5.98	6.80	94	11.5 cm	SE-NW	28.07	11
	2	6.16	6.85	59	10 cm	SE-NW	29.79	12
EbOq-30	1	5.29	6.30	103	11 cm	N-S	21.97	9
	2	7.31	8.01	152	8.5 cm	E-W	41.95	17
	3	4.45	5.25	37	11.5 cm	NE-SW	15.54	6
	4	5.91	6.94	93	14.5 cm	E-W	27.42	11
	5	5.30	6.24	110	19.5 cm	NE-SW	22.02	9
	6	5.29	5.93	33	13 cm	E-W	21.97	9
	7	5.83	6.85	108	15 cm	NE-SW	26.68	11
	8	7.23	7.75	71	14.5 cm	NNE-SSW	41.03	16
	9	3.90	4.92	82	12 cm	SE-NW	11.94	5
EbOq-32	1	4.52	5.40	59	15.5 cm	SE-NW	16.04	6
EbOq-74	1	4.28	4.71	38	10 cm	NNE-SSW	14.38	6

Table 4: Continued

Site Number	Stone Circle Number	Inside Diameter(m)	Outside Diameter(m)	No. of Stones	Average Depth Below Surface	Long Axis	Floor* Area(m^2)	Number of Occupants
EbOq-101	1	4.56	5.23	65	10 cm	NE-SW	16.32	7
EbOq-102	1	4.74	5.72	52	11 cm	N-S	17.64	7
EbOq-140	1	3.76	4.52	28	13 cm	SE-NW	11.10	4
	2	4.66	5.30	23	10.5 cm	NNW-SSE	17.05	7
	3	Too scattered to map accurately						
EbOq-141	1	5.16	5.89	38	13.5 cm	E-W	20.90	8
EbOq-142	1	4.96	5.51	44	11	NNE-SSW	19.31	8
EbOq-143	1	5.33	6.69	73	13.5 cm	SSE-NNW	22.30	9

*All floor areas calculated from inside diameters

1. What function did stone circles serve?
2. What information can be gathered from stone circles that might help to ascertain when and how a site was utilized?

The amount of published data in the historic, ethnographic and archaeological record that relates to the first question is extensive. It would require a paper of thesis length to discuss the subject adequately. That will, of course, not be done here, but a brief overview of the material is certainly in order.

Many of the first European trader/explorers on the Northern Plains saw and commented upon the profusion of stone circles in the area. The two best known historical references concerning stone circle function for the portion of the Northern Plains containing the present-day Suffield Reserve come from the journals of Peter Fidler and Henry Hind. In late August of 1800, while travelling along the South Saskatchewan River near where he was soon to build Chesterfield House, Peter Fidler noted:

> "..... within fine level barren ground great numbers of tent places here & also in several places below.....being distinguished by some few old fragments of wood, fireplaces or a round circles of Stones that are put up on the bottom edges of their tents to prevent the winds from blowing them down." (Johnson 1967:258)

Fifty-eight years later while travelling in the same area, Henry Hind commented upon the nature of the natives and noted that:

> ".....in the days of their power and pride had erected large skin tents, and strengthened them with rings of stones placed round the base." (Hind 1860 Vol. 1:338)

Also:

> "On the high banks of the valley the remains of ancient encampments in the forms of rings of stones to hold down the skin tents are everywhere visible....." (Hind 1860 Vol.1: 340)

These quotations strongly suggest that a least some of the stone circles on the Northern Plains mark the locales where the natives set up their conical, skin covered dwellings - commonly referred to as tipis. There are few references in the ethnographic record to the use of stones to hold down the edges of a tipi cover. Apparently they ceased to be utilized after the arrival of the Europeans. Perhaps the best reference comes from Stanley (1915:692). While studying the Cheyenne, Stanley noted that wooden pegs were the common device for holding down a tipi cover, but that in the past the Cheyenne had used stones when wood was unavailable.

The material presented above indicates that the idea of a stone circle marking the remains of a domestically occupied tipi was a long established one. It was not until the mid-Twentieth Century, however, that detailed archaeological research was undertaken in an attempt to prove or disprove this idea. One of the earliest researchers was Mulloy (1952) who cast some doubt on the possible function of stone circles. He felt that they did not serve to hold down the edges of a skin lodge because:

1. Hearths were rare occurances in most stone circles.
2. Most features lacked packed floors.
3. Many stone circle sites were located in exposed locales, felt (by Mulloy) to be unfit for camping.

4. The shapes of stone circles often deviated from the circular pattern of tipis and occasionally they were found to be overlapping in a single site.

It was Kehoe (1958, 1960), however, who undertook the most extensive of the early studies concerning stone circle function. From the data he collected on the Blackfoot Reservation in Montana, backed up by detailed material from the historic, ethnographic and archaeological record, Kehoe was able to conclude firmly that stone circles were the remains of domestically utilized tipis. Kehoe felt that the lack of hearths and packed floors were the result of tipis occupied by short-term seasonal hunting groups. He also thought that the large numbers of stone circles present on the Plains strongly suggested their use as domestic structures. As a final comment, Kehoe (1960:463) suggested that the term "tipi ring" (meaning a domestically occupied structure) be utilized only when discussing stone circles of average size (7 to 30 feet in diameter).

Malouf (1961:381) and, much later, Grasspointer (1980) also felt that only "average" sized stone circles should be seen as domestic features. Over the last several decades, the term "average" has come to mean stone circles whose diameters vary from approximately 4 m to 6 m (Quigg 1981). In Study Area 1, those stone circles that were complete enough to measure had calculated inside diameters ranging from 3.76 m to 7.31 m with an average of 5.32 m (see Table 4, pages 29 and 30). Data from a further 72 stone circles recorded in other areas of the Reserve between 1976 and 1980 (Brumley et al 1981) (see Table 5) show inside diameters ranging from 3 m to 8 m with an average of 4.81 m. Finally, Finnigan (1981)

Table 5: Selected stone circle data from sites recorded on the Suffield Military Reserve 1976-1980. (compiled from Brumley et al 1981)

Site Number	Stone Circle Number	Inside Diameter(m)	Floor Area(m^2)	Number of Occupants
EbOs-7	1	5.00	19.63	8
EbOs-8	1	6.20	30.18	12
EcOp-78	1	4.80	18.09	7
	2	4.60	16.61	7
	3	4.50	15.90	6
	5	4.50	15.90	6
	6	3.80	11.33	5
	7	4.50	15.90	6
	8	3.60	10.17	4
EcOq-22	1	4.10	13.20	5
	2	5.50	23.75	10
	5	8.00	50.24	20
	6	4.50	15.90	6
	7	6.00	28.26	11
	8	7.70	46.54	19
	9	7.60	45.34	18
	10	4.30	14.51	6
	11	4.90	18.85	8
EcOq-193	1	4.70	17.34	7
EcOq-212	6	3.50	9.61	4
	7	4.30	14.51	6
EcOr-101	1	4.90	18.85	8
	2	4.30	14.51	6
	3	5.00	19.63	8
	4	5.10	20.42	8
EcOr-127	1	6.10	29.21	12
	2	4.60	16.61	7
	20	4.00	12.56	5
EcOs-39	1	3.70	10.75	4
EcOs-50	1	3.80	11.33	5
EcOs-56	1	5.50	23.75	10
EcOs-58	1	4.50	15.90	6
	2	5.20	21.22	8
	3	5.60	24.62	10
	4	5.40	22.90	9
	5	4.90	18.85	8
	6	5.40	22.90	9
	7	5.70	25.50	10
	8	4.10	13.20	5
	9	5.20	21.22	8
	10	4.70	17.34	7
	11	6.60	34.19	14
	12	6.20	30.18	12

Table 5 : Continued

Site Number	Stone Circle Number	Inside Diameter(m)	Floor Area(m^2)	Number of Occupants
EdOp-14	1	4.00	12.56	5
EdOp-93	1	5.50	23.75	10
EdOq-150	1	4.37	14.99	6
	2	4.27	14.31	6
	3	3.47	9.45	4
EdOr-44	1	4.23	14.05	6
	2	4.32	14.65	6
EdOr-45	1	4.27	14.31	6
EdOr-46	1	4.00	12.56	5
	3	3.00	7.07	3
	5	3.90	11.94	5
	6	3.43	9.24	4
EdOr-48	1	4.63	16.83	7
EdOr-51	2	4.33	14.72	6
	3	4.15	13.52	5
	4	6.07	28.92	12
EdOr-77	1	4.27	14.31	6
	2	6.30	31.16	12
EeOo-11	1	6.00	28.26	11
EeOq-31	1	4.37	14.99	6
EeOr-46	1	4.97	19.39	8
EeOr-48	1	5.20	21.23	8
EeOr-53	1	3.18	7.94	3
EeOr-54	1	4.33	14.72	6
	2	4.33	14.72	6
	3	3.90	11.94	5
	5	4.07	13.00	5
EeOr-58	H	5.30	22.05	9
	I	5.30	22.05	9

in his work at the campsite near the British Block Cairn on the Reserve, collected data on fifty stone circles varying in diameter from 2.44 m to 6.77 m with an average of 4.63 m. While by no means conclusive, the data presented above do indicate that the majority of stone circles on the Suffield Reserve are of domestic origin.

Beginning in the 1970s, a sharp increase took place in the amount of research conducted on stone circle sites. Many attempts were made to understand the nature of these features and to provide new methods of collecting raw data. Important to this study was the research undertaken to interpret the relationship between site locale and seasonality. Authors such as Adams (1976, 1978), Calder (1979), Flayharty and Morris (1974), Keyser (1979a,b) and Quigg (1978, 1981) noted that there are two generalized types of stone circle site locale:

1. Winter Locales - where sites are usually found in sheltered areas with access to water and wood (for fuel)
2. Summer Locales - where sites are usually found in exposed terrain with excellent visibility and easy access to hunting terrain.

On the Suffield Reserve both types are present, but the vast majority of stone circle sites appear to occur in areas suspected to be summer locales. This is certainly true of Study Area 1, where all of the sites are found on exposed, hilly terrain. This strongly suggests that the area was probably not a winter campsite, but more likely utilized by short-term summer hunting groups.

While excavations were not conducted in Study Area 1, there are data available for study from other stone circle sites excavated on the Reserve

(Brumley et al 1981). Few of these sites yielded much in the way of artifacts, but those that did contained materials commonly related to domestic activities (hide working and butchering tools, fire broken rock, lithic debitage, etc.). Similar materials were found by Adams (1976,1977) in sites excavated on the Red Deer River immediately north of the Reserve and by Calder (1979) at sites examined near Chin Coulee, located southwest of the Reserve. Several of the stone circles in Study Area 1 contained surface artifacts. All were similar to the materials found in the sites discussed above, another strong point suggesting that the features in the area were of domestic origin.

The data presented here on understanding the function of stone circles have, by necessity, been very brief. A more detailed examination of the available published material can be found in Kehoe (1958, 1960). Perhaps the most up-to-date references, however, can be found in Quigg and Brumley (1982).

The second question posed on page 31 deals with the problem of gathering data from stone circles that might indicate when and how a site was utilized. Without extensive excavations, providing an answer is difficult and must be based upon a certain amount of conjecture. It is possible, however, to gather some information on seasonality and population size through an understanding of the tipi itself and its relationship to the harsh environment of the Northern Plains.

In their study of architecture and climate, Fitch and Branch (1960: 136-137) noted that the tipi was an ideal living structure for the Plains due to the stability of its cone shape, the low amount of heat required

to warm the structure, and the fact that it was easily portable. The tipi is not, however, a true cone in vertical cross-section, but is often strongly tilted (Campbell 1915, 1927 and Grinnell 1901). The steep side of the structure is set facing the wind and the slanted side forms a simple brace, thus reducing somewhat the twisting and fluttering caused by a shifting wind flow.

Campbell (1915:641) also noted that Cheyenne tipis often had an oval shaped floor plan and the natives set them up with their long axes in the same direction as the prevailing wind. In the archaeological record, a high percentage of the stone circles recorded by Adams (1976,1977), Brumley et al (1981), Calder (1979), Finnigan (1981), Flayharty and Morris (1974), Grasspointer (1980), Kehoe (1958,1960), Keyser (1979b) and Quigg (1978) exhibit a distinct oval shape. A possible explanation for this pattern can be found in a simplified understanding of wind flow mechanics.

Wind flowing over a perfectly circular tipi would tend to create a turbulence zone on its downwind face. On the other hand, air flowing over an oval shaped structure (whose long axis faces the wind) would create a turbulence zone away from the downwind face and produce a small "dead air" space. This would reduce somewhat the twisting and fluttering of the structure. The same type of turbulence and "dead air" patterns can be seen in the "slip-stream" behind a fast moving vehicle or in the lift capability of an airplane wing.

Ideally, then, if the long axis of a stone circle could be calculated and data on wind patterns for a specific area were available, some comments could be made on the season during which a specific feature was oc-

cupied. Fortunately, such data are available from the Suffield Reserve. Prevailing winds on the Reserve follow a generalized seasonal pattern, coming primarily from the north in the winter and shifting to the northwest, west and southwest in the spring, summer and fall. In Study Area 1, all of the stone circles were oval in shape. An examination of their long axes (see Table 4, pages 29 and 30) show that all but four have long axes suggesting occupation in the spring, summer or fall. The four exceptions all have long axes suggestive of winter occupation.

This assumption must be tempered by a consideration of the other factors that might influence stone circle shape. An oval pattern might reflect a specific type of stone movement created by the natives during the breakdown and removal of a tipi. It may also reflect some kind of post-depositional movement of stones created by an, as of yet, undetermined factor of the local environment. The data presented above do, however, help to corroborate the suggestion presented on page 36, that Study Area 1 served as a short-term spring, summer or fall hunting camp locale. They also help to counter Mulloy's (1952) original argument that non-circular stone circles were not tipi rings.

Calculations of prehistoric native population size are difficult to make for the Northern Plains as the data available for study are sparse and somewhat contradictory. In terms of those stone circles suspected to be the remains of tipis, determing the possible number of occupants can be based upon the calculation of the floor area ratio (number of persons per square metre) inside an "average" dwelling.

Few historical accounts of Northern Plains tipis present information

on the diameter of the structure. In 1859, John Palliser noted that the lodge of a Blackfoot chief varied from 6.10 m to 6.70 m in diameter (Spry 1963:220), suggesting that an "average" dwelling may have been somewhat smaller. Most historical sources indicate the size of a tipi by the number of bison hides required to make its cover. These figures range from a low of 7-8 hides (Ewers 1958:10) through 10-12 hides (Robinson 1879) and 10-20 hides (Lamb 1957:41) to a high of 40 hides (Ewers 1955:130-133 and Lewis 1942:35). Based upon the above accounts, an "average" tipi probably required 14-16 tanned bison hides for its cover. Finnigan (1981: 20-26) has calculated that a single tanned bison hide covered 2.7 square metres, and he has also provided a formula for determing the diameter of a dwelling if the cover area is known. Using this formula, it appears that an "average" Northern Plains tipi had a diameter of 4.77 m to 5.10 m. Not surprisingly, this figure corresponds well with the accepted average diameter of 4 m to 6 m for prehistoric stone circles. In order to simplify the calculation of a floor area ratio, then, it is suggested here that the average prehistoric tipi was 5 m in diameter.

Historical accounts of the number of people on the Northern Plains who occupied a tipi are remarkably consistent. They vary from lows of 6 persons to highs of 10 (Catlin 1841:52, Ewers 1958:47, Glover 1962:239, Hind 1860 Vol. 1:152-158, Lewis 1942:36 and Nelson 1973:72). Based upon the above material, it appears that an average Northern Plains dwelling probably held 8 individuals.

The floor area ratio for a Northern Plains tipi can now be calculated based upon an average diameter of 5 m and a population of 8 persons.

Using Cook and Heizer's (1968) style of calculation, the ratio works out to 0.40 persons per square metre. The possible number of occupants for each stone circle in Study Area 1 is presented in Table 4 (pages 29 and 30) and the possible number of occupants for the 72 stone circles recorded from other areas of the Reserve is presented in Table 5 (pages 34 and 35).

One last calculation that is required here concerns determining the number of dogs required to transport an "average" prehistoric Northern Plains tipi. Dog travois were the main transportation mechanisms during the prehistoric period. They were constructed from the poles of the dwelling with the largest portion of the weight hauled consisting of the hide cover. Finnigan (1981:20-26) has provided a number of calculations that allow for the determination of the weight of a tipi. Based upon these, an "average" structure would contain approximately 186 kg of materials. Historic accounts of how much weight could be hauled by a single dog vary from as low as 14 kg (Roe 1939:216-217) to as high as 34 kg (Ewers 1958:10). This gives a simple average of 24 kg per animal and would mean that a minimum of 8 dogs would be required to transport an average tipi.

The data presented above on tipis were designed to relate directly to stone circles and to help in the understanding of prehistoric land utilization. It must be remembered, however, that they are assumptions only and while fascinating (and of some importance) may not reflect reality.

3.3.2 Cairns

On the Suffield Military Reserve cairns have been recorded in just over 49% of the 1,650 known archaeological sites. This represents a total of more than 2,000 features ranging in size from a cluster of 3 or 4 stones to the massive British Block Cairn which is over 10 m in diameter, 2 m in height and composed of at least 90 tonnes of stone (Wormington and Forbis 1965:122-124). In Study Area 1, 14 of the 19 recorded sites contain cairns and a total of 55 features were noted. A breakdown of these features by site is presented in Table 6.

Information on the function of small stone cairns is limited in both the historical and archaeological record. At present these features have not captured the imagination of researchers in the same way that stone circles have. The earliest known reference to the possible function of small cairns on the Northern Plains comes from Matthew Cocking who, while travelling just south of the Plains/Parkland border in 1772 saw:

> ".....several stone heaps on the tops of the high hills; which the Natives say were gathered by the Archithinue Natives who used to lie behind those heaps; reconnoitering the Country round....."
>
> (Burpee 1908:108)

Twenty-eight years later, Peter Fidler presented a different explanation for the cairns he noted on the banks of the South Saskatchewan River:

> ".....several old Traps up the bank made of Stones, for killing foxes made by the Indians many years ago....." (Johnson 1967:257)

Ethnographically, the use of cairns as small animal traps was confirmed by Wissler (1910:38-41). Such features may also have served in the ceremonial and religious life of the Northern Plains natives, as burials, or

Table 6 : Selected cairn data from sites recorded in Study Area 1, Suffield Military Reserve.

Site Number	Cairn Number	Shape	Length	Width	No. of Stones	Average Depth Below Surface
EbOq-22	1	Oval	221 cm (N-S)	197 cm (E-W)	48+	8.5 cm
EbOq-29	1	Oval	275 cm (E-W)	194 cm (N-S)	61	21 cm
	2	Irregular	224 cm (E-W)	166 cm (N-S)	21	18 cm
	3	Irregular	171 cm (E-W)	104 cm (N-S)	16	18 cm
	4	Oval	97 cm (E-W)	47 cm (N-S)	10	16 cm
	5	Irregular	101 cm (NW-SE)	64 cm (NE-SW)	10	17 cm
	6	Oval	154 cm (E-W)	76 cm (N-S)	18	12 cm
EbOq-32	1	Oval	164 cm (E-W)	144 cm (N-S)	35	12.5 cm
	2	Rectangular	134 cm (E-W)	33 cm (N-S)	11	12.5 cm
	3	Irregular	250 cm (E-W)	95 cm (N-S)	14	14.5 cm
	4	Irregular	480 cm (NW-SE)	123 cm (NE-SW)	20	15 cm
	5	Oval	160 cm (N-S)	130 cm (E-W)	35	13.5 cm
EbOq-72	1	Oval	139 cm (N-S)	58 cm (E-W)	6	11.5 cm
EbOq-74	1	Oval	120 cm (E-W)	110 cm (N-S)	22	8 cm
	2	Irregular	123 cm (NE-SW)	69 cm (NW-SE)	13	11 cm
	3	Oval	190 cm (N-S)	161 cm (E-W)	52+	Indeterminate
	4	Oval	134 cm (N-S)	81 cm (E-W)	33	14 cm
	5	Oval	146 cm (N-S)	131 cm (E-W)	65+	12.5 cm
	6	Oval	129 cm (Nw-SE)	99 cm (NE-SW)	33	9 cm
	7	Irregular	130 cm (N-S)	75 cm (E-W)	16	12.5 cm
	8	Circular	186 cm (N-S)	184 cm (E-W)	60+	Indeterminate
	9	Oval	191 cm (NW-SE)	175 cm (NE-SW)	65+	12.5 cm
	10	Oval	146 cm (NE-SW)	117 cm (NW-SE)	18	10.5 cm
	11	Ovate	180 cm (E-W)	138 cm (N-S)	44	11.5 cm
	12	Rectangular	161 cm (N-S)	130 cm (E-W)	19	11 cm

Table 6 : Continued

Site Number	Cairn Number	Shape	Length	Width	No. of Stones	Average Depth Below Surface
EbOq-75	1	Irregular	79 cm (N-S)	70 cm (E-W)	6	10 cm
	2	Oval	194 cm (NW-SE)	129 cm (NE-SW)	41+	11 cm
	3	Oval	125 cm (N-S)	83 cm (E-W)	32	12 cm
	4	Oval	122 cm (E-W)	98 cm (N-S)	26	11 cm
	5	Rectangular	114 cm (E-W)	69 cm (N-S)	21	11 cm
	6	Irregular	114 cm (NW-SE)	80 cm (NE-SW)	23	9.5 cm
	7	Rectangular	123 cm (NW-SE)	83 cm (NE-SW)	24	14 cm
	8	Oval	87 cm (E-W)	68 cm (N-S)	14	11.5 cm
	9	Rectangular	100 cm (E-W)	84 cm (N-S)	15	17 cm
	10	Irregular	97 cm (N-S)	74 cm (E-W)	10	11 cm
EbOq-95	1	Oval	147 cm (E-W)	109 cm (N-S)	22	11.5 cm
	2	Irregular	175 cm (E-W)	145 cm (N-S)	8	9 cm
	3	Oval	92 cm (N-S)	76 cm (E-W)	21	10.5 cm
	4	Irregular	115 cm (N-S)	75 cm (E-W)	17	12 cm
	5	Oval	221 cm (E-W)	211 cm (N-S)	75	13.5 cm
EbOq-101	1	Irregular	189 cm (N-S)	71 cm (E-W)	12	7 cm
	2	Irregular	85 cm (N-S)	63 cm (E-W)	8	9 cm
	3	Oval	173 cm (E-W)	82 cm (N-S)	14	11 cm
	4	Oval	275 cm (NW-SE)	135 cm (NE-SW)	35	12.5 cm
EbOq-102	1	Oval	151 cm (NE-SW)	128 cm (NW-SE)	9	14 cm
	2	Oval	126 cm (E-W)	76 cm (N-S)	13	14 cm
	3	Oval	190 cm (E-W)	110 cm (N-S)	14	12 cm
	4	Irregular	107 cm (E-W)	84 cm (N-S)	13	6.5 cm

Table 6 : Continued

Site Number	Cairn Number	Shape	Length	Width	No. of Stones	Average Depth Below Surface
EbOq-103	1	Oval	131 cm (E-W)	90 cm (N-S)	13	11 cm
EbOq-130	1	Irregular	167 cm (E-W)	66 cm (N-S)	8	10 cm
	2	Triangular	100 cm (E-W)	83 cm (N-S)	18	14 cm
	3	Triangular	165 cm (NE-SW)	102 cm (NW-SE)	24	16 cm
EbOq-139	1	Irregular	319 cm (N-S)	179 cm (E-W)	33	9.5 cm
EbOq-143	1	Irregular	121 cm (E-W)	64 cm (N-S)	7	17 cm
EbOq-144	1	Oval	183 cm (N-S)	159 cm (N-S)	36	11.5 cm

as reported by Bodmer (Thomas and Ronnefeldt 1976) to invoke the approach of bison herds.

Archaeological research into the function of small cairns is almost non-existent. Malouf (1962:1-5) suggested that many cairns were ceremonial in origin, built through accretion as various native groups passed by the site locale. Both Adams (1976:94-95) and Keyser (1979b) noted that small cairns are commonly found in stone circle sites, a pattern also visible on the Suffield Reserve. While Keyser never explained the reason for this, Adams (1976:95) suggested that the features he recorded were either caches or locational markers. The idea of cairns as locational markers was also examined by Frison (1981:145), although he felt that many served ceremonial purposes as well.

Perhaps the best archaeological evidence for the function of small cairns comes from a feature excavated in site EeOr-63 located on the northern boundary of the Suffield Reserve (Brumley and Saylor 1979). Here, a small piece of bone, suggestive of a piece of bait left in a deadfall trap, was recovered from the base of a scattered cairn. The bone was submitted for radiocarbon analysis and returned a date of 1240 $\pm$120 years BP (RL-1129)(Brumley and Saylor 1979).

In Study Area 1 it seems unlikely that any of the recorded cairns were ceremonial in origin. Such features are assumed to be situated in highly visible or unusual locales or are of extreme size like the British Block Cairn or the Majorville Cairn (Calder 1977) which is located south of the town of Bassano. As Table 6 indicates, all features in Study Area 1 were small and while the cairns in sites EbOq-30 and EbOq-144 were lo-

cated in highly visible areas, their primary purpose does not appear to have been ceremonial.

Cairns whose function might reflect Cocking's description would also require a specific set of locational and construction factors. They would need to be situated in an area that overlooked a good hunting range and would have to be large enough to conceal a man. In Study Area 1, only the cairn in site EbOq-144 fits the needed requirements. It is easily large enough to conceal a single hunter and is situated on a ridge that overlooks what is, today, one of the best cattle grazing areas of the Reserve. Unfortunately, it is highly unlikely that even detailed excavations would confirm its use in the manner described by Cocking.

It seems apparent, then, that the majority of features in Study Area 1 may have served as deadfall traps. Their shapes, sizes and locations are similar to the cairn in site EeOr-63. Most are found in small groups associated with one or more stone circles and could represent structures utilized only once. At sites EbOq-74 and EbOq-75 large numbers of cairns were recorded. These sites may represent multiple occupations at a good trapping locale or may reflect some kind of "trap line"-like pattern. The only cairns whose functions do not reflect the patterns described above are those in site EbOq-95. They form part of a stone alignment (see section 3.3.3) and are not thought to have served as deadfall traps.

The nature and function of the cairns in Study Area 1 appear to represent the Reserve as a whole. The majority of the 2,000 known cairns in the area probably served as deadfall traps, with only a small percentage used for ceremonial or multiple purposes. It should be clearly evident,

however, that far more research is necessary before these features are fully understood.

3.3.3 Stone Alignments

The stone alingments found on the Suffield Military Reserve are, for the most part, enigmatic structures. Like all such features found on the Northern Plains, they consist of distinct lines of individual stones and/or small cairns. On the Reserve 94 stone alignments have been recorded to date. They vary in length from less than 10 m to over 1600 m and most are found in a broad band along both sides of the South Saskatchewan River from Study Area 1 north to Drowning Ford. The stone alignment in Study Area 1 (Figure 7) is located the furthest south of all such features on the Reserve.

Most stone alignments appear to have served a guides in directing bison to a specific kill site. Major bison kills in Alberta such as Head-Smashed-In (Reeves 1978) are often associated with extensive stone alignment complexes. Historic and ethnographic references to the function of stone alignments are virtually non-existent. There are, however, several references that discuss bison kills and provide descriptions of gathering lanes that correspond well to the conceived picture of stone alignment function.

In 1772, Matthew Cocking observed the plains natives using wood in their drives lanes and noted;

> ".....from the entrance small stakes are laid on each side like a fence in form of an angle extending from the Pound; beyond these to about 1½ mile distant. Buffalo dung, or old roots are laid in Heaps in the same direction as the fence." (Burpee 1908:109)

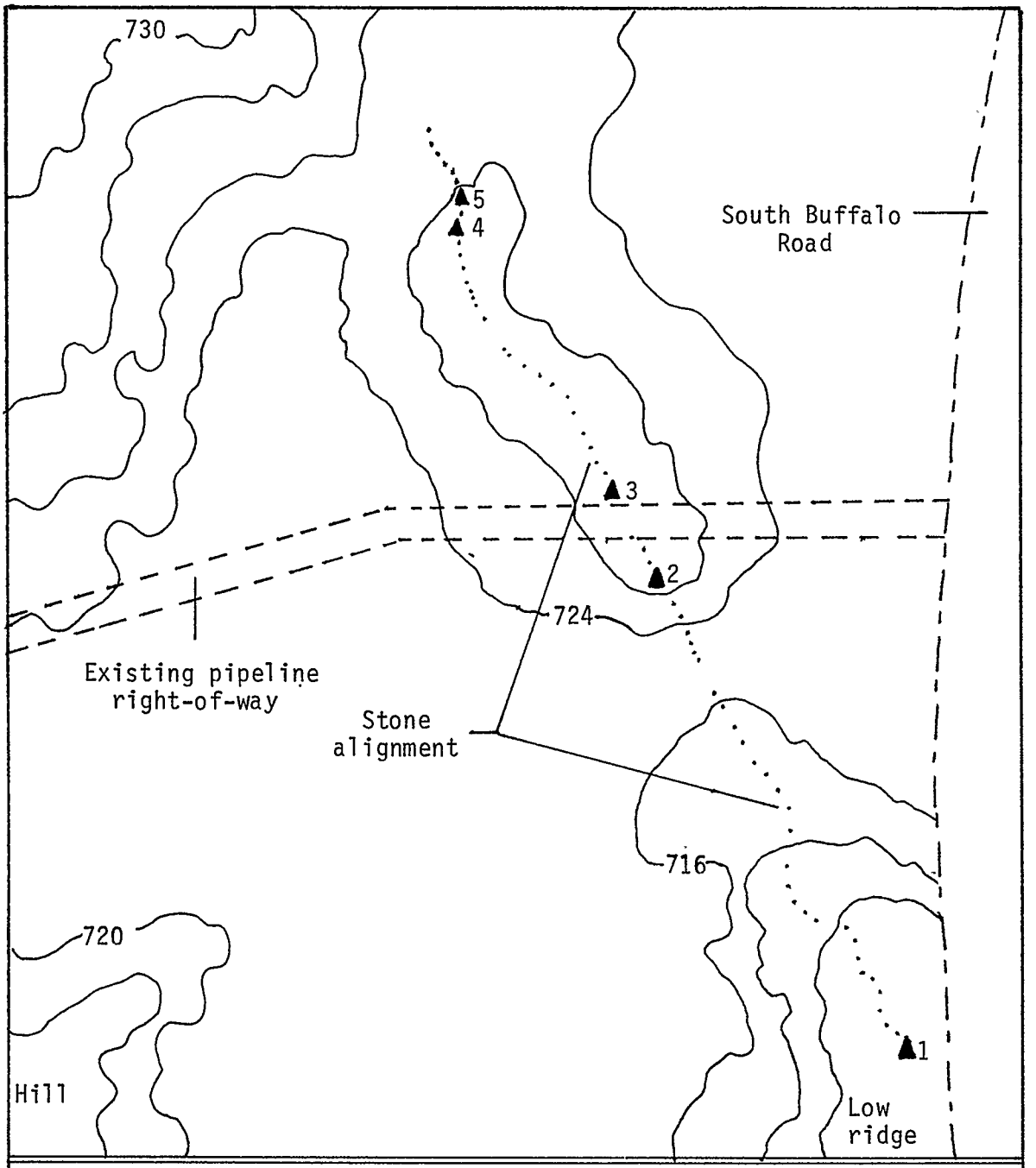


Figure 7 : Sketch map of EbOq-95

While in the foothills of southern Alberta during 1792, Peter Fidler noted lines of bison dung stretching back from a kill site for distances of up to 3.2 km (MacGregor 1966:68). Finally, in the early 1800s Daniel Harmon observed the plains natives at one bison pound using four foot high poles supported by piles of bison dung to create a drive lane (Lamb 1957:209).

It was mentioned at the outset that the stone alignments on the Reserve were enigmatic. This is because, with the exception of those associated with the Ramillies Bison Kill (Brumley 1977), none appear to point towards a distinct kill area. Both Adams (1976:98-99) and Keyser (1979b:20) noted similar problems in their studies. It is assumed that the alignments on the Reserve were used to bring bison to some type of kill site in the rugged terrain along the South Saskatchewan River. Unfortunately, despite several attempts by the author and others to trace possible gathering routes, no kill sites have been discovered that can be directly related to a stone alignment complex.

In Study Area 1, the single recorded stone alignment is situated in a position that strongly suggests its use as a guide for directing bison. It runs in a north/northwest-south/southeast direction and rests on two ridges (see Figure 7). These two ridges lie between two areas of low terrain that would be ideal for moving bison to a kill site. It is possible that the alignment was set up to prevent animals from moving between the two areas during a communal hunt. At present, however, there are no data available that indicate which area of natural terrain was used to gather the bison, the direction that the animals were moved, the season during which the site was utilized or whether or not it represents a multiple

use feature.

3.4 The Problems of Temporal Placement

Of importance to the understanding of land utilization during the prehistoric period is the capacity to determine an occupation date for a site. At present, the best method of doing this is through the analysis of materials recovered from excavation. No excavations were undertaken in Study Area 1, but it is possible to gain some idea of when the sites may have been occupied through a brief examination of the other sites that have been excavated on the Reserve. Since the early 1970s between 40 and 50 archaeological sites on the Reserve have been subjected to some type of subsurface testing and have provided a certain amount of data on the prehistory of the area. In the following discussion the temporal subdivisions proposed by Reeves (1969) for the Northern Plains will be used.

The Early Prehistoric Period (ca 12,000 - 7,500 BP) is characterized by the use of projectile points that appear to have been designed for stabbing or throwing spears. The types of animals hunted during the period included the Mammoth (Mammuthus) and the giant bison (Bison Antiquus). Five cultural complexes for this period are recognized in Alberta: the Clovis, the Folsom-Midland, the Agate Basin-Hell Gap, the Alberta-Cody, and the Lusk-Frederick (Reeves 1969:21-24). No Early Prehistoric sites have yet been found on the Reserve. Such sites are rare in Alberta but they have been found on the open plains, along river systems and in sandy terrain. As all of these physiographic zones are present on the Reserve, it is suspected that Early Prehistoric sites will eventually be discovered.

The Middle Prehistoric Period (ca. 7,500 - 1,800/1,200 BP) exhibited a shift in hunting technology to the use of the atlatl. Archaeological evidence from the Great Plains in general shows that hunting strategies developed at this time (Bison Jumps, Bison Pounds, etc.) remained in use well into the historic period. The five most common cultural complexes or phases for this period in Alberta are: the Mummy Cave, the Oxbow and the McKean Complexes plus the Pelican Lake and Besant Phases.

The earliest dated site on the Reserve has been identified with the Mummy Cave Complex. A single Bitteroot Side Notched projectile point (7,500 - 5,550 BP) was recovered from a site in the Middle Sand Hills (Brumley et al 1981). One of the largest Middle Prehistoric sites on the Reserve is the Cactus Flower site (Brumley 1975) which is located approximately 6,000 m southeast of Study Area 1. Excavations, here, recovered materials belonging to the McKean Complex and Pelican Lake Phase Radiocarbon analyses suggested an occupation date ranging from 4,130 $\pm$85 years BP (S-782) to 2,770 $\pm$95 years BP (S-784)(Brumley 1975, Wilmeth 1978). Situated approximately 5,000 metres northeast of Study Area 1 are two other Middle Prehistoric sites. Both are bison kills and contain materials belonging to the Pelican Lake and Besant Phases. Radiocarbon analyses here suggested an occupation date between 2,600 $\pm$130 years BP (RL-1295) and 2,010 $\pm$55 years BP (S-1213)(Brumley, personal communication). Finally, a single Besant Phase (1,800 - 1,200 BP) projectile point was recovered by the author from a possible bison kill site (EbOq-138) located approximately 4,500 metres northwest of Study Area 1.

The most important fact to remember about the known Middle Pre-

historic sites on the Reserve is that they are buried components and are not directly associated with surface stone features. This strongly suggests that the majority of sites in Study Area 1 are not of Middle Prehistoric age. Surface stone features belonging to this period have, however, been discovered near the Reserve (Quigg 1982) and it is possible that some of the sites in Study Area 1 are old enough, but this cannot be confirmed in the absence of diagnostic materials.

The Late Prehistoric Period (ca. 1,800/1,200 BP - AD 1725) exhibited a final shift in hunting technology to the use of the bow. Two distinct phases have been defined for this period in Alberta: the Avonlea and the Old Women's. Sites of Late Prehistoric age have been found in all areas of the Reserve and the majority have been associated with surface stone features.

Perhaps the best known of these is the Ramillies Bison Kill (Brumley 1976) located approximately 16 km north/northwest of Study Area 1. Materials from both the Avonlea and Old Women's phases were recovered here and radiocarbon analyses suggested an occupation date between 965 $\pm$65 years BP (S-1015) and 660 $\pm$115 years BP(S-1016)(Brumley 1976, Wilmeth 1978). Avonlea materials were also recovered from site EcOs-41 located 30 km north/northwest of Study Area 1. A radiocarbon date of 940 $\pm$110 years BP (RL-1125)(Brumley et al 1981) was recovered from this site.

The two nearest Late Prehistoric sites in terms of Study Area 1 are the already mentioned possible kill site of EbOq-138 located 4,500 m northwest of the study area,where several Avonlea projectile points were discovered, and the stone circle site EcOp-78 located 11 km north/north-

east of the study area. No projectile points were recovered from this site, but a radiocarbon date of 240 $\pm$110 years BP (RX-1128) was returned, suggesting an Old Women's occupation (Brumley et al 1981).

While the data presented above are by no means conclusive, they do suggest that the sites in Study Area 1 were occupied during the late-Middle to Late Prehistoric periods. Of course, only deatailed excavations could prove this hypothesis. For the purposes of this study, however, the occupation date will be accepted as is, for the simple reason that hunting strategies and possible land utilization patterns of the natives changed little during the Middle and Late Prehistoric periods. This makes it possible, then, to present a generalized discussion of prehistoric lifestyles on the Suffield Reserve.

3.5 A Model for Prehistoric Land Utilization on the Reserve

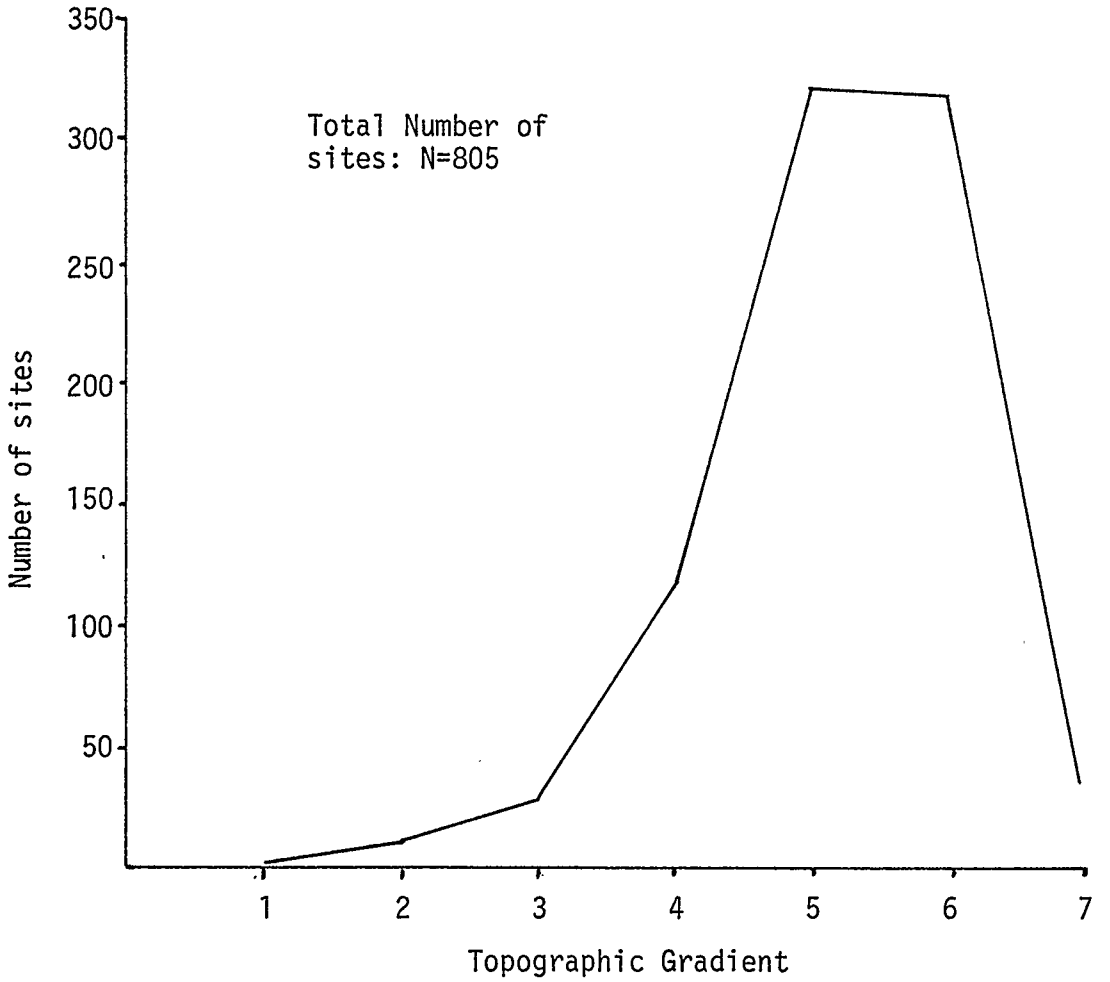
The environment of the Northern Plains is by no means an amenable one yet the people who occupied it prehistorically appear to have been very successful, taking advantage of every aspect of that environment which might have ensured their survival. Because this environment is varied, its use by the natives must also have varied both geographically and temporally. It is interesting to note, however, that the archaeological record exhibits a remarkable stability through time in the technological adaptations of the natives to the grassland biome. Whether or not their social organizations reflected this stability is a problem that will not be examined here and may, in fact, be one that will never be solved.

3.5.1 Settlement Patterns

On the Suffield Military Reserve there appears to be a direct correlation between the location of known archaeological sites and three aspects of the local environment: 1) topographic gradient, 2) surficial deposits, and 3) distance to the nearest river. Data on these aspects were examined in detail for sample of 805 sites from the Reserve and the results are presented in Figures 8,9 and 10.

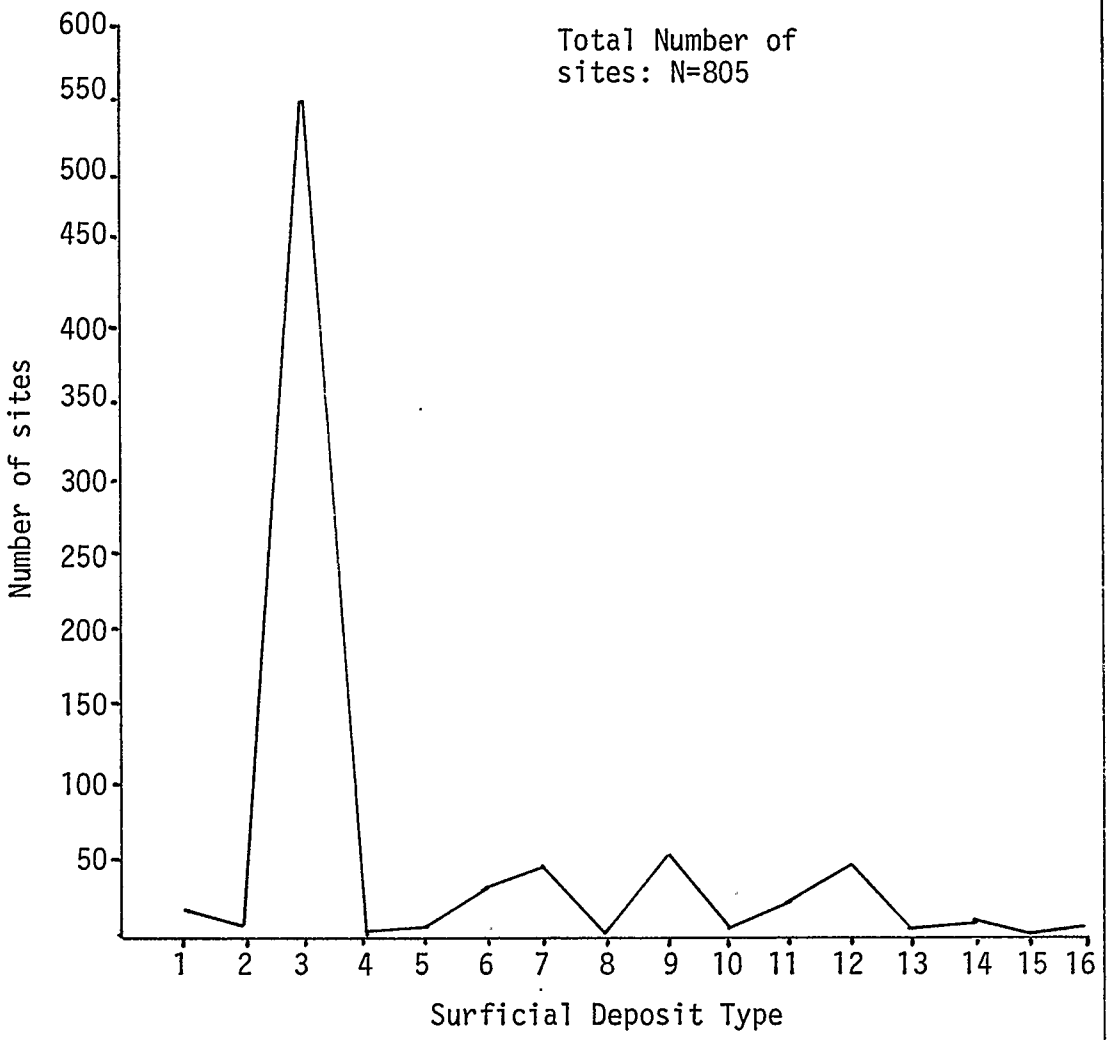
From Figures 8 and 9 it can be seen that the vast majority of sites occur in areas of gently to strongly rolling terrain composed of hummocky moraine. The most obvious reason for a pattern of this type is that the stones needed for the construction of stone circles, cairns, stone alignments, etc. are more accessible in hilly areas where erosion has exposed the moraine deposits. However, it is also possible that these areas were specifically chosen by the prehistoric natives in order to insure their survival. Any attempt to determine the reasons for such selection would be extremely difficult as it would involve suppositions concerning social organization that can not be deduced from the archaeological record. All that can be said is that the pattern of site location in areas of strong relief and stony terrain is not unique to the Reserve. It has been noted by Adams (1976,1978), Frison (1978,1981), Kehoe (1985,1960), Keyser (1979b) and Malouf (1962) as well as many other researchers in all areas of the Great Plains.

There also appears to be some kind of relationship on the Reserve between site locale and distance to either the South Saskatchewan River or the lower stretches of the Red Deer River. As Figure 10 shows, site



1. Nearly Level (0-0.5% slope)
2. Gently Undulating (0.5-2% slope)
3. Undulating (2-5% slope)
4. Gently Rolling (5-9% slope)
5. Moderately Rolling (9-15% slope)
6. Strongly rolling (15-60% slope)
7. Rough Broken (> 60% slope)

Figure 8: Frequency of archaeological sites on the Suffield Military Reserve by topographic gradient.



1. Ground Moraine
2. Hummocky and Ridged End Moraine
3. Hummocky Moraine
4. Eskers and Crevasse Fill
5. Kame and Kame Moraine
6. Meltwater Channel Sediment
7. Outwash Sand and Gravel
8. Glaciolacustrine Silt and Clay
9. Glaciolacustrine Sand and Silt
10. Mixed Glaciolacustrines
11. Aeolian Sand
12. Lacustrine Silt and Clay
13. Lacustrine Sand
14. Alluvium
15. Stream Alluvium
16. Eroded Slope

Figure 9: Frequency of archaeological sites on the Suffield Military Reserve by surficial deposit type.

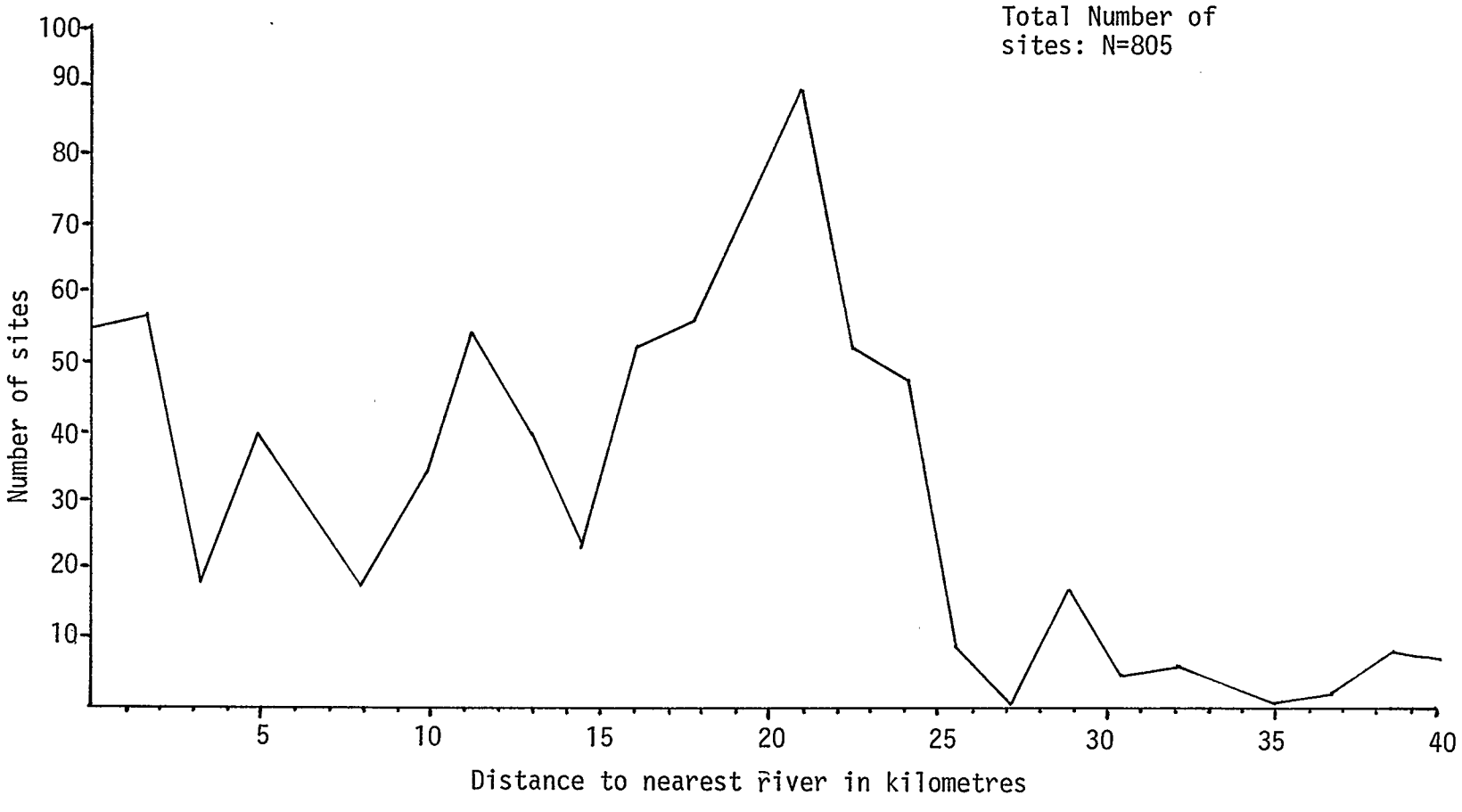


Figure 10: Location of archaeological sites on the Suffield Military Reserve in relation to the nearest river.

density peaks at approximately 1.5 km, 5 km, 11 km, and 21 km. In almost all cases these peaks reflect the location of areas of hummocky moraine and hilly terrain, already mentioned as having a high site density. There is, however, another possible explanation for this pattern.

The high site density noted within 2 km of the South Saskatchewan River suggests that it served as an important avenue of prehistoric travel in the area. Adams (1976,1978) noted a similar pattern for the Red Deer River. On the Northern Plains, river valleys were ideal site locales as they offered the natives year round access to shelter, water, and wood for fuel. They would not, however, provide much in the way of food. The chief food source of the prehistoric natives, the bison, would be out on the open plains for perhaps 70% of the year. This would necessitate travel away from the rivers in search of the bison and the pattern noted in Figure 10 may reflect the daily travel rate of prehistoric native hunting groups.

Historic references to the daily travel rate of Northern Plains native groups are scarce. Wedel (1963:12) suggested that pre-horse groups travelled 13 km to 16 km per day. Ewers (1958:11), on the other hand, felt that their daily travel rate was only 8 km to 10 km. In 1754-55, while crossing the Northern Plains by both foot and horse, Anthony Henday and his native guides travelled 11 km to 22 km per day (Burpee 1907). Another European trader/explorer, Matthew Cocking, travelled between 5 km and 22 km per day while crossing the plains in 1772. Finally, in the early 1800s, Daniel Harmon observed a native group using dog travois and travelling 40 km to 48 km each day (Lamb 1957). It is suggested here that

Harmon's estimate is far too high for an average pre-horse native group and that a daily travel rate of between 5 km and 20 km was probably more common. If this hypothesis reflects reality, then the information presented in Figure 10 indicates that virtually all of the land surface of the Reserve was no more than two days travel from a major river system. This would help to support the already mentioned hypothesis that the Reserve served as a short-term spring, summer and fall hunting locale. The data also suggest that the native populations in the area could have made the river systems their permanent homes, sending out small hunting parties only to exploit the extensive bison herds that are thought to have existed on the Northern Plains.

3.5.2 Prehistoric Plains Natives and the Bison

> "The main source of subsistence on the Prehistoric Plains were a variety of grasses, forbs and shrubs that supported a grazing and browsing mammalian fauna, which in turn provided for a small number of human groups sometimes rather precariously perched at the top of the food chain."
> (Frison 1978:8)

Frison's statement provides a reasonably accurate (albeit simplified) view of the relationship between prehistoric natives and their environment. On the Northern Plains, the natives' chief resource animal in the mammalian fauna was the bison. Because of its large size and dense population, the bison was ideal, providing a high protein and energy source in comparison to the energy expended in capture (Reher 1977:21). The dependence of the prehistoric natives on the bison was so great that it led Roe (1970:4) to state:

> "The presence of this animal has deeply affected the civilization of the North American continent — perhaps more vitally than has ever been the case with any other single species in its indigenous environment in any portion of the globe."

In terms of total population, Larsen (1940:116-117) has estimated that a single bison required 8 to 12 hectares of plains grassland to support itself and perhaps 20 to 40 million animals ranged the prehistoric plains. Reher (1997:24), on the other hand, suggests a figure of 4.8 to 20-28 hectares per animal depending upon climatic conditions, with a total population varying from 6.5 to 37.5 million bison. Based upon Reher's estimates the total number of bison that might have survived on the Reserve at any one time vary from approximately 9,100 to just over 50,000. Of course, the reliability of this calculation is somewhat limited but it does suggest that the bison available on the Reserve probably greatly exceeded the needs of the native occupants.

Historical references to the bison (and their vast numbers) are very numerous and it would be impossible to quote them all here. The four presented below were chosen because they are more or less typical of the comments made by the European trader/explorers on the Great Plains.

In the fall of 1754, while travelling near the Plains/Parkland periphery, Anthony Henday commented:

> "15. Sunday. Travelled 7 miles W.S.W. Level land, no woods to be seen; passed by a lake: the Buffaloe so numerous obliged to make them sheer out of our way." (Burpee 1907:333)

Peter Fidler crossed the Red Deer River near the present town of Carbon Alberta, in the fall of 1792, and while doing so noted of the bison:

> "I am sure there were some millions in sight as no ground could be seen for them in a compleat semi-circle extending for at least 10 miles round." (MacGregor 1966:20)

George Catlin, who travelled across the plains in the late 1830s, made this comment on the bison:

> "The running season which is in August and September is the time when they congregate into such masses as to literally blacken the prairie for miles together." (Catlin 1941:249)

Finally, during his travels along the boundary between Canada and the United States in 1875, Samuel Anderson (1876:291) noted:

> "For about 100 miles of longitude the plain was swarming with countless numbers of Buffalo; and as they travelled the scant vegetation was everywhere nibbled close so that our own horses and oxen fared badly."

The prehistoric natives, when required, utilized every part of the bison. Its hide became clothing and tipi covers. All of its flesh could be consumed if necessary and the bones provided grease and, in some cases, ornaments (Ewers 1966). The bison was a substantial animal, with bulls standing up to 180 cm in height and weighing as much as 900 kg (Arthur 1975:35). In terms of available food, anywhere from 50% (Gilbert 1969: 285) to 54% (Arthur 1975:35) of the live weight of the animal could become dressed meat. Gilbert(1969:286) has suggested that the average daily meat consumption of plains native groups was approximately 1 kg per person. Based upon this, a single 600 kg bison could provide enough meat to support one person for 300 days!

As an example, the daily meat requirements were calculated for site EbOq-30 in Study Area 1. In order to simplify the calculations it has been

assumed that all the features in the site represent a single occupation. The total population was determined to be 83 individuals (see Table 4, page 29). The killing and proper dressing of one 600 kg bison would provide enough meat to support the occupants of site EbOq-30 for 3.5 days. If the amount of meat required to feed the dogs at the site is included, using Dyck's (1977:57) suggestion of 3.6 kg of meat per dog per day and it is assumed that the minimum number of dogs at the site was between 80 and 100, then one day's food supply would require a minimum of two bison. While this example probably does not reflect reality, it does suggest that, when required, a substantial number of natives could subsist on a small number of bison.

Historic evidence, however, shows that in the Eighteenth and Nineteenth Centuries, the Northern Plains natives rarely had to utilize all the meat of a bison. Bison were so numerous and so easily captured that often only choice pieces of the animal were taken, leaving the remainder for the scavengers. This pattern probably existed in the prehistoric period, suggesting that an encampment the size of site EbOq-30 may have utilized far more than two bison per day.

Another important factor involved in determining the number of bison needed to support an encampment the size of site EbOq-30, is a calculation of the number of animals needed to provide covers for the tipis present. Using Finnigan's (1981) calculations, a minimum of 170 animals would be needed to replace all the tipi covers. It is quite likely that replacement of worn out covers occurred during all seasons and at widely separated places as the camp moved across the plains. Thus the drain on any

single localized bison population, even when it was scattered during the summer, was probably quite small.

3.5.3 Seasonal Activity

For the vast majority of Northern Plains native groups, life followed a cyclical pattern. The annual cycle of the bison in a specific locale likely determined the life cycle of the natives in the same area. Both Arthur (1975) and McHugh (1958) have noted that bison are local in their habits and tend to stay in the same general area throughout their lives. Within this area they follow a seasonal pattern based upon changes in climate and availability of vegetation.

During the summer, when grasses were available almost everywhere, the bison would be scattered in small groups across the open plains. With the onset of fall and the beginning of the rutting season, they would congregate into large herds at specific locales. As winter arrived the large herds would break up into smaller groups and the bison would travel to any available sheltered area to wait out the cold months. Upon the arrival of spring they would move out onto the open plains to begin the cycle again (Frison 1978, Geier 1974, McHugh 1958). The favoured winter locales of Northern Plains bison were the sheltered valleys of the foothills, the Parkland/Boreal Forest region, and any of the plains river valleys that provided shelter and food. In terms of the Suffield Military Reserve, both the South Saskatchewan and Red Deer River valleys could have been utilized as winter locales.

The patterns followed by the Northern Plains natives appear almost identical to that of the bison. Small family groups would be spread out

over the plains in summer, hunting the dispersed bison herds and moving perhaps 50 to 100 times during the season (Frison 1978:12). In the fall, they would operate large communal kills during the bison's rutting season and in the winter would move to the same sheltered locales as the bison. Large communal kills might be operated again in the spring before the natives spread over the plains to repeat the cycle.

The description given above is quite generalized and cannot be considered as completely accurate in all areas of the Northern Plains or at all periods of time. Reher (1977:21) has noted that the seasonal activities of the natives could have fluctuated widely depending upon the bison and their reaction to changes in the environment. Thus the commonly accepted pattern of fall aggregation and winter dispersion could have easily shifted to year round communal hunts, summer aggregation and winter dispersion, or intensive hunts in the spring rather than the fall (Reher 1977:22).

On the Suffield Military Reserve the information presented in this study strongly suggests that the prehistoric natives followed the general pattern of summer dispersion and fall aggregation. It is conceivable, however, that the open areas of the Reserve could have been utilized at specific times during the winter. Chinooks are (and were) common to southeastern Alberta and lengthy ones can remove the entire snow cover and keep temperatures above $0^{o}C$ for days. If the bison that wintered in the sheltered river valleys of this area reacted to such short-term climatic shifts and moved onto the open plains in search of forage, it is likely the natives followed them. It has already been suggested that few areas of the Reserve were more than two day's travel from the river valleys

and it is possible that some of the known archaeological sites represent short-term occupations during long winter Chinooks.

Perhaps the most important fact to remember is that the prehistoric native occupants of the Northern Plains were human beings. While they were forced by their technology to adapt to rather than modify the environment, when the opportunity presented itself they were more than willing to adjust their traditional patterns of seasonal movement to whatever system would best insure their survival.

3.6 Comments

This examination of prehistoric land utilization on the Suffield Military Reserve has, by necessity, been very lengthy. The period of time involved stretches over a minimum of 12,000 years and, like all archaeological examinations, the data presented are often hypothetical. Assumptions must be explained in detail and backed up by extensive referencing. Fortunately, this is relatively easy for the Suffield Military Reserve as the material available for study is far more extensive than for any of the other human groups discussed in this paper.

Even though the Northern Plains natives were eminently adapted to the environment of the area and had reigned for at least 12,000 years, their rule came to an abrupt end. In less than 150 years their way of life was extinguished on the Northern Plains. This process began in the early Eighteenth Century with the arrival of the first European trader/explorers.

SECTION 4

FROM THE HORSE TO THE RAILROAD

4.1 Introduction

The following section has been designed to discuss, briefly, the approximately 200 year span of time between the beginning of the Historic Period on the Northern Plains in 1725, when the natives acquired both the horse and European trade good, and the opening of the Reserve for homesteading in 1909. Unlike the other sections in this paper, no study area was chosen for detailed examination. This was due to the fact that no single one square mile (2.56 square kilometre) area on the Reserve can accurately reflect the nature of land utilization during this period. The focus, then, will be on covering the highlights of the period and examining the changes that took place in the attitudes of the people who were interested in the Northern Plains.

Between 1725 and 1909 a large portion of southwestern Saskatchewan and southeastern Alberta (including the Suffield Military Reserve) was considered by many Europeans to be an almost useless hinterland. As a result, many native groups living within the area were able to continue their traditional ways of life well into the 1870s, bothered only slightly by the tide of early European trader/explorers. In addition, the practice of "free range" ranching which was so popular in southern Alberta during the 1880s and 1890s was able to continue here until the early Twentieth Century. Finally, it was one of the last areas of the Canadian West to be opened for homesteading. In many ways, the area was a "Last Refuge" (to utilized Nelson's (1973) term) for a wide variety of lifestyles.

4.2 The End of an Era

The beginning of the Eighteenth Century brought with it a substantial increase in European interest towards the interior of the North American continent; interest that was fostered by the already proven rich fur resources of the area. The developing European trade network upset the societies of the natives and changed their lifestyles forever. On the Northern Plains, the influences of European trade arrived twenty or so years before the Europeans themselves, but the results were the same.

In the beginning, however, these influences had a beneficial effect upon the natives. Both the introduction of the horse and the initial patterns of the fur trade tended to improve rather than disrupt their lifestyles. Of the two, the horse may have had the most profound influence. The importance of this animal can be seen in Roe's (1939:225) statement:

> "What must be considered a really remarkable feature in Plains Indian culture is the almost phenomenal rapidity with which they mastered their early fears [of the horse] and developed into one of the two or three foremost equestrian peoples of the world."

Horses were probably introduced accidently to the Great Plains by Spanish explorers travelling through what is now the southern United States. The first animals may have come from Don Juan de Oñates colonization trip to New Mexico in 1598 (Newcomb 1974:85). The horse was rapidly adopted by the plains natives and by the mid-Eighteenth Century could be found everywhere.

On the Northern Plains the commonly accepted date for the arrival of horses has been set at AD 1725. This date was chosen primarily because of a story in the journals of David Thompson. While staying with a band of

Piegan in southern Alberta during the early 1780s, Thompson met an aged Cree warrior named Saukamapee. Saukamapee told Thompson about his (and the Piegan's) first encounter with the horse (Glover 1962:240-245) and it has been estimated that the date was sometime between 1720 and 1730. For the purposes of simplicity, this date has been set at 1725. There is some question concerning the validity of Saukamapee's story, however, as Thompson dictated it from memory several decades after he had heard it. Roe (1955:103-105) rejects the story completely and favors a later date for the acquisition of the horse. The exact date with probably never be calculated, but it is well known that by the time Anthony Henday contacted the Northern Plains natives in 1754 (Burpee 1907), they were fully equestrian in their habits.

It would be impossible here to discuss all the effects that the horse had on plains native culture. Important to this study is the fact that the acquisition of the horse removed some of the restrictions on the natives' seasonal round of activities (Roe 1955:193, Wissler 1914:14-15). Horse mounted groups were far more mobile than pedestrian ones and it is possible that the entire resource area of the Suffield Military Reserve was accessible from a river edge camp in one day's travel rather than two or three. This increase of an easily accessible exploitation zone may have helped to reduce the possibility of starvation during lean winter months.

The developing European fur trade also had a great effect upon the Northern Plains natives. Both Ray (1974) and Lewis (1942) feel that it may have been more important than the horse. At first, the natives benefitted from the fur trade. For their easily obtainable furs they could

receive guns and metal trade goods through native middlemen. There was no need to deal directly with the Europeans who tended to stay in their trading posts on Hudson's Bay (Ray 1974:10-18).

By the mid-Eigtheenth Century, however, the Hudson's Bay Company began to expand its network and eventually virtually all Northern Plains natives were able to trade directly with the Europeans at their trading posts along the Plains/Parkland border. The presence of these posts and the now easily obtainable trade goods (especially alcohol) drastically changed the way in which the natives operated their society. As their wealth increased so did their aggressivness. Raiding for horses and European goods became more pronounced and by the end of the century, most Europeans had acquired a healthy fear of the Northern Plains natives.

In southeastern Alberta, few attempts were made to establish trading posts. The natives in the area were more isolated and may have felt the deleterious effects of European trade to a lesser extent, or at least at a later date than other native groups. It is difficult to ascertain how they may have changed their utilization of the land surface. Quite likely, there was an increase in the trapping of small fur-bearing animals and the large number of cairns (suspected to be small animal traps) found on the Suffield Military Reserve may reflect a change in land use during the Historic Period. Without extremely detailed excavations, however, such an hypothesis cannot be easily proved.

Perhaps the most important point to stress here is the fact that the effects of European trade reached the natives of southeastern Alberta long before the Europeans themselves. The natives quickly acquired a taste for

these luxuries and when attempts were finally made to establish a trading post in the heart of the Northern Plains, they were more than anxious to do business.

4.3 The Early European Trader/Explorers

There is some argument concerning which European trader/explorer was the first to enter the Northern Plains. The journeys of both Henry Kelsey in 1691 and La Verendrye in the 1740s may have reached the fringes of the area but perhaps the best recorded early journey was that of Anthony Henday who, between 1754 and 1755, made an attempt to entice the Blackfoot natives to Hudson's Bay to trade (Burpee 1907). His attempt was unsuccessful. Further penetrations of the Northern Plains were made by Matthew Cocking in 1772-73 (Burpee 1908), David Thompson in the 1780s and 1790s (Glover 1962) and Peter Fidler also in the 1790s (MacGregor 1966). It was not until the first year of the Nineteenth Century, however, that an attempt was made to establish a trading post near what is now the Suffield Military Reserve.

Flushed with the success of their Plains/Parkland trading centres, the Hudson's Bay Company was anxious to determine if trade could be established in the interior of the Northern Plains. In the early summer of 1800, Peter Fidler set out from York Factory on Hudson's Bay, charged with the task of establishing trading contact with the Blackfoot, and of examining the land for further trading prospects (Johnson 1967:250). Fidler followed the standard river route to the interior until he reached the forks of the Saskatchewan Rivers. Rather than taking the north branch, he travelled up the south branch until he reached a point on the

north side of the South Saskatchewan River near the mouth of the Red Deer River. Here, on September 26, 1800, Fidler set up his trading post and called it Chesterfield House (Johnson 1967:266). This post as well as the one established by the XY Company a few days later were located approximately 45 kilometres northeast of what is now the Suffield Reserve.

Fidler found the natives eager to trade (especially for alcohol) and by November 20 his stock consisted of:

470	grey foxes
28	red foxes
158	wolves
26	badgers
10½	beaver
3	common cats
2,000 lbs.	bladder fat
2,000 lbs.	back fat

(Johnson 1967:277)

Trade remained brisk all winter and by March 20, 1801, Fidler had collected 12,000 MB (Made Beaver) worth of furs. It is intersting to note that this was the largest single return of furs from any trading post dealing with York Factory that year and provided 27% of the Factory's total fur return (Johnson 1967:Appendix A).

Fidler returned to Chesterfield House on September 27, 1801 and remained there until April 20, 1802. The trade was not as brisk as the year before and much animosity was created between Fidler's company and the natives. Only 7,495 MB worth of furs were collected (Johnson 1967:Appendix A) and while this was second only to York Factory itself in terms of trade for 1802, Fidler decided to abandon the post permanently. Exactly why he

did so is uncertain but it may have been due to either a substantial fear of the natives or, as Nelson (1973:48) suggests, the fact that by 1802 it was well known that furs were much more easily obtainable in northern Alberta and the Rocky Mountains.

While at Chesterfield House, Fidler and his men were more traders than explorers and there is no indication that any trips away from the post reached as far upstream as the Suffield Reserve. The presence of a European trading house so close, however, probably did have an effect upon the natives who then occupied the area. The change in land utilization hypothesized on page 70 may have been brought about, at least in part, by the presence of Peter Fidler and Chesterfield House.

Slightly more than twenty years passed before another attempt was made to establish direct trade in the vicinity of the Suffield Reserve. During the intervening period, drastic changes took place in the fur trade business. Competition between the Hudson's Bay Company, the Northwest Company and the short-lived XY Company was so fierce that by 1820 it threatened to bankrupt all three organizations. As a result, all three were amalgamated under the Hudson's Bay Company in 1821 and the new company took over exclusive trading rights to an area that encompassed most of what is now known as Canada.

The new governor of the Company, George Simpson, was anxious to initiate an economic recovery and in order to do so, organized the Bow River Expedition of 1822-23. Over 100 men under the leadership of Donald McKenzie were sent out onto the Northern Plains to exploit the supposedly vast supplies of furs in the Cypress Hills region (Nelson 1973:60). In the fall of 1822 the Expedition set up its headquarters on the South

Saskatchewan River a few miles downstream from Fidler's old post.

The presence of a new European trading house in the area attracted large numbers of natives and it was estimated that by October 11, 1822 a minimum of 6,000 people were camped near the post (Nelson 1973:64). The size of this camp and the apparent hostility of its occupants caused much fear among the members of the expedition. Such fear might have been overcome if the richness of the Cypress Hills had been proven. Unfortunately it was no more than a myth and the new trading house was quickly abandoned in the spring of 1823. The failure of the expedition ensured that the Hudson's Bay Company would never again try to operate a trading post in the interior of the Northern Plains.

In terms of the Suffield Military Reserve, the presence of the Bow River Expedition probably had little effect upon the manner in which the natives utilized its resources. The expedition can be considered important as it sent out several exploring parties, two of which may have passed over what is now the Reserve. The first of these was headed by Francis Heron who, in November of 1822, travelled up the Red Deer River, crossed overland to the Bow River and then passed downstream to the headquarters of the expedition (Nelson 1973:70). He could not have avoided travelling down the portion of the South Saskatchewan River now within the Reserve and may have been the first European to examine that specific area of land. The second explorer was John Harriot who made two trips to the Cypress Hills between November, 1822 and February, 1823 (Nelson 1973:71). The details of Harriot's trips are unclear but he may have passed over the portion of the Reserve known as Koomati, situated on the eastern bank of

the South Saskatchewan River.

The failure of the Bow River Expedition fostered a strong European disinterest in the Northern Plains. More than thirty years passed before the area again came under European scrutiny. The focus of the new explorations, however, was not directly on trade and they reflected a sharp change in popular opinion towards the nature of the Northern Plains.

4.4 A Change of Attitudes

> "Between 1856 and 1869 the image of the West was transformed in Canadian writings from a semi-arctic wilderness to a fertile garden well adapted to agricultural pursuits; subsidiary to this was a new interest in the possibilities of mining, trade and transportation."
> (Owram 1981:3)

Owram's statement provides an adequate summation of the attitudinal change that took place in the 1850s. While it was brought about by a number of reasons, the two most important appear to have been national sentiment and American expansionism.

By the 1850s the colonial governments of Upper and Lower Canada had become heavily involved in designing the new Dominion of Canada. Of primary importance to this design was the need to create a "coast-to-coast" nation. Unfortunately between the known eastern seaboard and the partially examined western seaboard was a vast wilderness that needed to be evaluated in detail. Directly related to this was an almost paranoid fear of the rapidity of American expansion into the West after 1850. The politicians (and businessmen) of Upper Canada felt that if a "Canadian" West was not soon established, the Americans would engulf the entire area and their dreams of a "sea-to-sea" nation would be shattered.

In response to these concerns, a number of exploring and survey expeditions were sent to the West. For the Northern Plains, the two most important were the expeditions of John Palliser, sent out by the British government in the period 1857 to 1860 (Spry 1963), and those of Henry Hind, financed by the Canadian colonial government in 1857 and 1858. The primary purpose of both expeditions was to provide a scientific survey of the Northern Plains and to assess its potential in terms of agricultural development.

Of the two, Palliser's journey gained the most publicity even though both arrived at basically the same conclusions. Hind and Palliser depicted a vast fertile belt on the Plains/Parkland border that they saw as ideal for agriculture. Both also examined a vast tract of land that they felt was unfit for settlement. Called The Palliser Triangle, it encompassed all of southeastern Alberta, much of southern Saskatchewan and a small portion of southwestern Manitoba. With the exception of their northern borders, The Palliser Triangle and the Northern Plains (as defined here) are geographically identical. The idea of this area being unfit for settlement was later dismissed by explorers such as Dawson (1875) and John Macoun (Mackintosh 1934:40) who felt the entire Northern Plains was fit for, at least, cattle ranching. Despite this, the name Palliser Triangle has remained with the area to the present day.

Palliser was perhaps the second or third European to traverse what is now the Suffield Military Reserve. His trip up the South Saskatchewan River in 1858 passed along the eastern boundary of the Reserve and it is possible he crossed into the area at Drowning Ford. In fact, it is thought that Palliser first coined that name for the crossing (Spry 1963). The

expeditions of both Palliser and Hind were of extreme importance to the development of the Northern Plains. Not only did they help to bring the area to the attention of the western world, but were also instrumental in bringing about the demise of the indigenous native groups.

The years between the 1860s and the 1880s were disastrous for the Northern Plains natives, primarily because of the destruction of the bison. Bison hunting became a popular European pastime and Roe (1934: 14-15) has estimated that between 1875 and 1879 over 115,000 bison hides were brought to Fort Macleod and Fort Edmonton. It is probable that far larger numbers went to the important American trading centres such as Fort Benton in Montana. The bison were so numerous on the Northern Plains, however, that it was not until the mid 1880s that they were finally exterminated. Morrow (1923:15) has noted that the last wild bison herd in southeastern Alberta was killed on the present site of the city of Medicine Hat in the fall of 1882.

For the natives, the real end arrived on the cool morning of September 17, 1877. At the Blackfoot Crossing on the Bow River, Treaty Number 7 was signed and the natives were relegated to specific Reserves (Morris 1880:260). After the signing of the treaty, the Northern Plains became the true property of the Dominion of Canada and the way was opened for the first ranchers and the new railroad.

4.5 Ranchers and Railroads

Beginning in the 1870s European economic interest in the Northern Plains shifted from speculation to reality. This was brought about initially by the development of a "free range" ranching system and later by the

construction of the Canadian Pacific Railway.

Cattle ranching was an extremely popular enterprise on the Northern Plains in the late Nineteenth Century. In southern Alberta it began shortly after 1870 (Breen 1972:10-27, George 1955:33, Lupton 1967:50), but did not really get under way until after 1880 when the British placed an embargo on American beef. With need for a new source of beef, the British saw the Canadian plains as ideal. Vast cattle ranches were quickly established, financed from Britain and often run by the second sons of British nobility. This "second-son" network resulted in a very interesting lifestyle in southern Alberta during late Victorian times (Breen 1972: 28-32).

The popularity of ranching lay in the fact that ranches were relatively inexpensive to operate, offered high returns for the initial investment and provided a great deal of luxury and prestige for the ranch owners. After 1881 unfenced or "free" range land could be leased on a 21 year basis for the price of 1¢ per acre per year (Lupton 1967:51, Morton 1938:91). So cheap was the land that by 1886 there were 58 ranches in southern Alberta alone, leasing a total of 2,098,670 acres (Murchie 1936: 55). Few of these, however, were able to maintain their leases for the entire 21 year period as after 1885 they could be split up for homesteading on as little as two years' notice. Despite this problem, the late Nineteenth Century has been seen as the Golden Age of "free range" ranching on the Northern Plains (Breen 1972).

In the area surrounding the Suffield Military Reserve, data on "free range" ranching are scanty. Lupton (1967:53) has noted that prior to 1900

there were eleven grazing leases in the Suffield-Medicine Hat area with an average size of 13,076 acres per lease. The most famous of these were the Medicine Hat Ranching Company, established in the late 1880s south and east of Medicine Hat (Kelly 1913:193, George 1955:34) and the various ranches started east of Medicine Hat by Sir John Lister-Kaye (Hargrave n.d., Gershaw 1967:84).

Prior to 1900 there appears to have been only one "free range" ranch in the area now encompassed by the Suffield Military Reserve. It was called the Drowning Ford Ranch and was established shortly after 1884 (Morrow 1923:45), with the ranch buildings located on the east bank of the South Saskatchewan River in the portion of the Reserve now known as Koomati (Bray 1960). An intensive search by the author of the available literature failed to uncover any detailed information on the Drowning Ford Ranch. Very scanty references to the ranch do occur, however, in various issues of Medicine Hat's local newspapers up to the year 1908, suggesting that it remained in operation until the beginning of the homestead period in the area.

Cattle ranching in the Suffield-Medicine Hat area was always a risky business. Over 50 acres were needed to support a single animal (Lupton 1967:53), one of the highest ratios in southern Alberta. By 1900 the average size of a ranch in the area had dropped to 1,400 acres and by 1911 large scale ranching was more or less at an end (Lupton 1967:57). Small scale ranching, however, remained an important economic pattern and has existed in some form on the Reserve at all times except during the Second World War. In the 1970s, under the guidance of the PFRA,

large areas of the Reserve were opened for communal grazing (Stelfox 1977) in a pattern very similar to the "free range" ranches of the Nineteenth Century.

Without a doubt, however, the most important impact on the economic development of the Northern Plains came from the building of the Canadian Pacific Railway. There are more data available in the historic record on the development of this railway than almost any other facet of Western Canadian history and it would be unreasonable to attempt a lengthy discussion here. The economic and political complexties involved in the creation, construction and maintenance of the CPR were so enormous that studies like the one done by Martin (1938) cover only the highlights.

For the area of the Northern Plains that includes the Suffield Reserve the CPR is important because it hindered rather than helped settlement. By the time the CPR had reached southern Alberta, the land grant financing system used to build it had undergone many changes (Morton 1938: 268). In Alberta, the CPR was allowed to sell land in the odd numbered sections in all townships stretching back 20 miles on both sides of the main line. They could, however, reject any amount of this allotment if it was considered unfit for settlement and replace it with a similar sized area elsewhere in western Canada. Martin (1938:273-291) notes that the CPR made good use of this clause and rejected almost all of the land north of the main line between Medicine Hat and Calgary. The result of this was that the rejected area was not actively homesteaded until 1909 and was one of the last portions of the Northern Plains to be opened for this type of settlement.

SECTION 5

THE HOMESTEADERS: STUDY AREA 2

5.1 Introduction

With the advent of the Twentieth Century came a great rush of immigrants to the Northern Plains. For the first time people of European descent attempted to establish permanent homes in the area of the Suffield Military Reserve. In the following section an examination will be made of the reasons why the Reserve was opened for homesteading , how the land surface was utilized and why the farming experiment in the period from 1909 to 1941 was a failure.

The study area chosen for detailed data recovery was Section 34, Township 18, Range 9, located in the northwest portion of the Reserve (see Figure 2, page 5). This section was ideal for a study of homesteading as it contains the three main utilization patterns observed for the area: 1) Land under ownership but never cultivated, 2) Land cultivated but abandoned prior to 1941, and 3) Land under more or less continuous cultivation in the period from 1909 to 1941.

Study Area 2 (Figure 11) is bordered on the west by the boundary of the Suffield Military Reserve and a major secondary highway known as Jenner Road. On its northern boundary is Hussar Trail, one of the main east-west access roads on the Reserve, and both its east and south borders are marked by sporadic trails. The topography is primarily gently rolling (5-9% slopes) with surficial deposits consisting of hummocky moraine and soils varying from clay to gravel. The study area is exposed to the prevailing westerly winds and shelter is virtually non-existent.

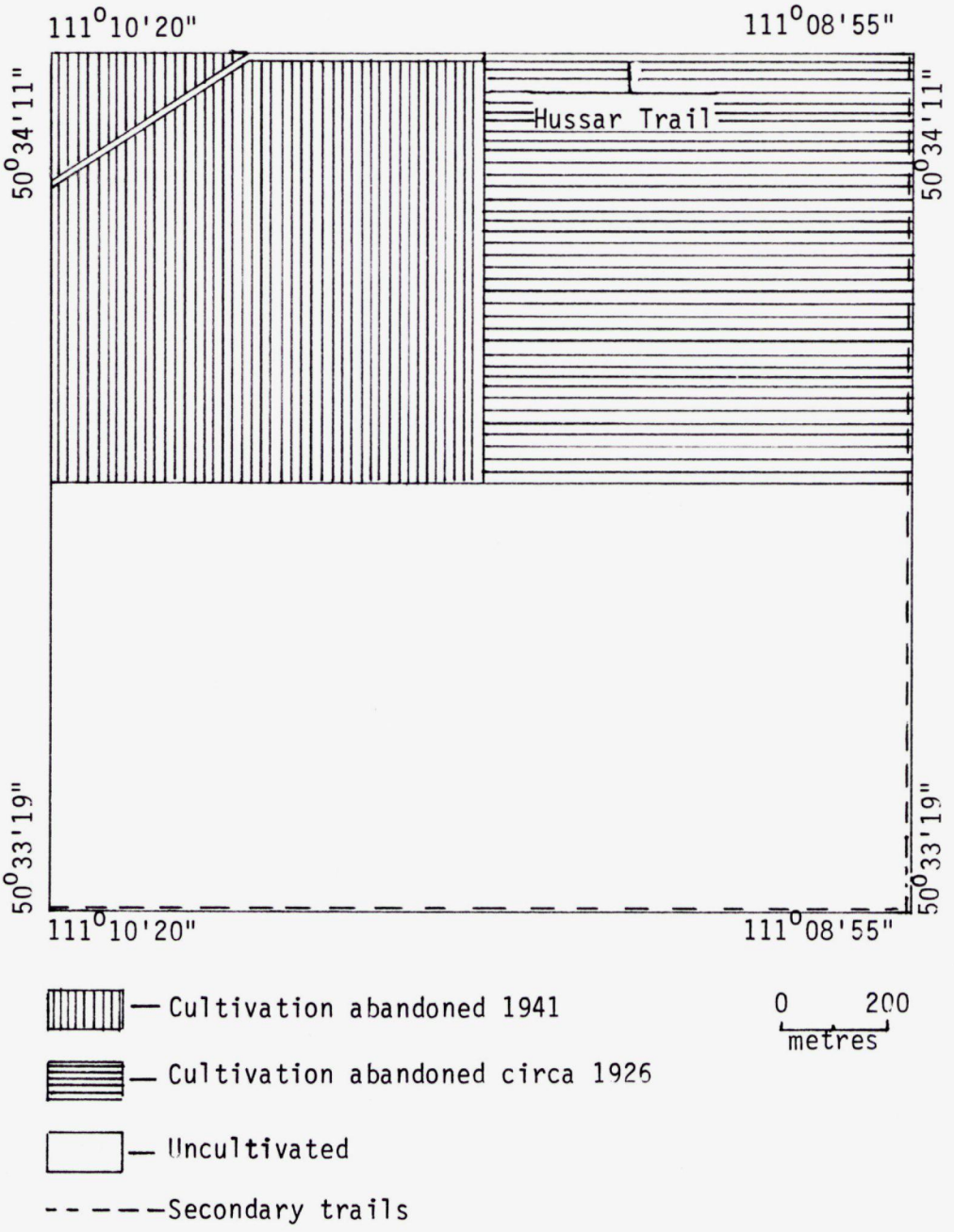


Figure 11 : Sketch map of Study Area 2 (Section 34, Township 18, Range 9) showing cultivated and uncultivated portions of the section.

Field research consisted of an initial attempt to locate any remaining indicators of pre-military occupation. The attempt resulted in the discovery of two faint lines of stones, one running east-west at the half section mark and the other running north-south at the quarter section mark, separating the two cultivated portions of the section. In addition, a small cluster of trees and bushes was noted in the northeast corner of the section, possibly all that is left of a small farm locale.

The second part of the field research was the selection of 100 one square metre collection zones scattered more or less randomly over the study area. In each zone the density of the dominant grasses was calculated in order to help ascertain the speed at which natural prairie is regenerated in a previously cultivated area. The results of this study will be presented later in this section.

The greatest research effort was, however, of an historical nature. Unfortunately, very little information dealing directly with the Suffield Reserve was found. As a result, some of the data presented here deal on a general basis with all of southern Alberta. This does not present too great a problem, as the conditions for homesteading in southern Alberta during the first four decades of the Twentieth Century were essentially the same in all areas.

5.2 Opening the Area for Homesteading

As has already been mentioned the area of the Suffield Military Reserve was not within the boundaries of the CPR land grant deal and was not settled as rapidly as the rest of the Northern Plains. It was, in fact, part of a block of 25,000,000 acres still mostly unsurveyed and

unsettled when the new province of Alberta was formed in 1905. After 1905 this area was set aside as "Dominion Lands" (Martin 1938:403) administered by the federal government. The provincial government was able, however, to share in the sale of the land by receiving $1.50 for each purchased acre in return for creating and maintaining municipal governments and education facilities.

Both governments realized that it was in their interest to initiate the settlement of this area as soon as possible and they began the process with an intensive survey program. The Dominion Land Survey crews created a substantial amount of "land fever" among the local residents and when the area was finally opened in the spring of 1909, the Medicine Hat Land Titles Office was swamped with enormous lines of men and women waiting for their 160 acre plot (Gershaw n.d.:98).

The land in the area of the Suffield Reserve was perhaps the worst agricultural property on the Northern Plains. Initially, however, there were no shortages of people willing to attempt farming. One of the main reasons for this was the offer of cheap land under the Homestead Act. Initiated by an Order-In-Council on March 1, 1871 (Strange 1954:13), the Act allowed any adult male to receive 160 acres (64 hectares) of land for a fee of $10. After a residence period of five years, the title to the land was turned over to him. The Act was revised several times between 1871 and 1882 with the most important changes including a reduction of residence time from five to three years and the addition of a "pre-emption" clause. This allowed a registered homesteader to purchase or "pre-empt" a 160 acre plot adjoining his original homestead (Martin 1938:397).

The "pre-emption" system was of great help to the CPR, which made sure that a homesteader receiving his $10 plot inside the CPR land grant block had to "pre-empt" his/her extra 160 acres from company owned land.

The prices paid for "pre-empted" land varied greatly during the Nineteenth Century depending upon its quality and distance from the main line of the railway. Various political machinations brought the "pre-emption" system to an end sometime around 1900, but by 1908 public outcry had caused it to be reinstated (Martin 1938:417). For the settlers moving into the area of the Suffield Military Reserve the "pre-emption" system was the same as described above except that all land was owned by the government and an individual's adjoining 160 acres could be purchased at a flat rate of $3.00 per acre paid off over a five to seven year period (Martin 1938:419). This held for all lands in a Township except sections 8 and 26 which were owned by the Hudson's Bay Company and sections 11 and 29 which were kept as School Lands (Strange 1954:13). Land in these sections were sold at current market rates that ranged from as low as $11.08 per acre in 1909 to highs of $19.61 per acre in 1921 (Mackintosh 1935:285).

Residence patterns under the Homestead Act had been extensively relaxed by 1909. An individual had to cultivate only 50 acres of his/her homestead per year and reside upon the land for only 6 months of each year over a 6 year period (Martin 1938:419). The federal government also stressed the need for each homesteader to have a minimum farm size of 320 acres by keeping "pre-empted" land prices down and allowing those individuals who could not "pre-empt" an adjoining plot to buy a 160 acre

plot as a "purchased" homestead in an area not immediately adjacent to his/her original land (Martin 1938:420). While the system was somewhat complex and subject to numerous changes it was eminently successful. Between 1909 and 1915 Canada saw 253,895 homestead entries (Mackintosh 1935:280), the vast majority of which were in either Alberta or Saskatchewan. The Homestead Act remained operable in Canada until 1918 when it was replaced by the Soldier's Settlement Act (Strange 1954:13).

Data concerning land ownership on the Suffield Reserve itself in the period between 1909 and 1941 are very scanty. The Cummins Rural Directory maps for the period around 1918 (Figure 12) show that approximately 246,240 acres (98,496 hectares) were held under individual title, representing just over 38% of the total land surface of the Reserve. The majority of homesteads at this time were 320 acres in size, increasing to between 500 and 1,000 acres by 1926 (Murchie 1936:42).

In Study Area 2, the Cummins Rural Directory maps for 1918 indicate that the owner of the west half of the section was L.C. Furey. The northeast quarter section was owned by W.A. Foxton, who also owned the north half of section 35. The southeast quarter section was owned by M.L. Imeson. either as an original or "purchased" homestead. While the information is unclear, it appears that these individuals were the original settlers in the area.

Figure 12 also shows that large portions of what is now the Reserve were held by two separate companies. The largest is the Canada Land & Irrigation Company which was, apparently, a subsidiary of the Southern Alberta Land Company. The Southern Alberta Land Company was a real estate

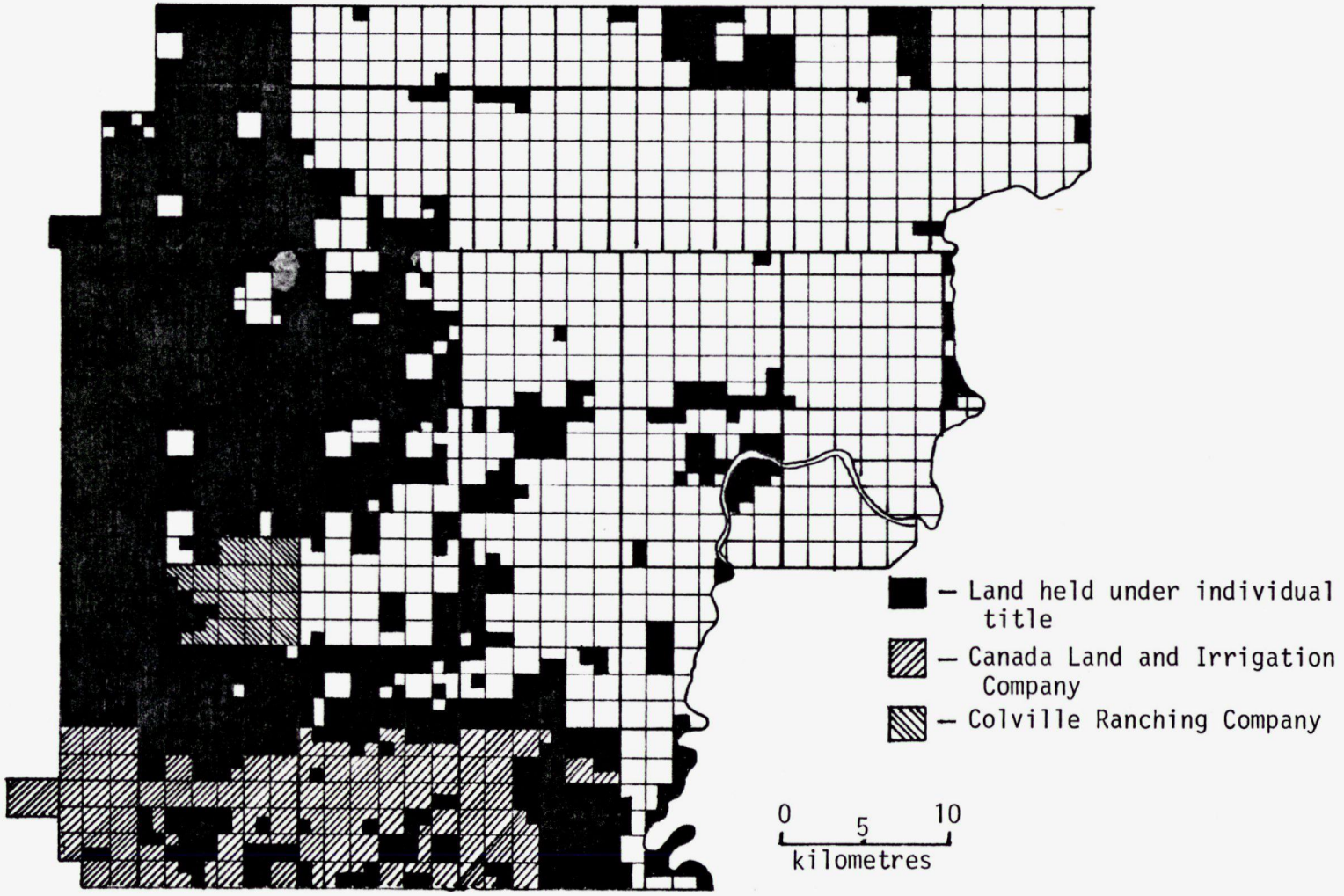


Figure 12: Land ownership patterns on the Suffield Military Reserve circa 1918. (Compiled from Cummins Rural Directory Maps Nos: 43,44,52-55)

venture financed in Britain and begun around 1902. It appears to have been an attempt to re-create the British atmosphere that existed in southern Alberta during the "free range" ranching days. The Company purchased from the federal government a block of 250,000 acres (100,000 hectares) in the vicinity of the present-day hamlet of Suffield with the promise of constructing a series of irrigation canals to the Bow River approximately 80 km away (Pennie 1963:7). Just under 81,000 acres (32,400 hectares) of the grant appear to have been within what is now the Suffield Reserve.

By 1909 the Company had realized that its irrigation scheme was doomed to failure and it set up Canada Wheatlands Ltd. This new company was to oversee the creation of a large scale dry farming operation that would hopefully cover the expenses of the irrigation scheme (Pennie 1963: 8). Approximately 11 million dollars was raised abroad and poured into the new company. By 1914, 22,000 acres (8,800 hectares) had been seeded to wheat, oats or flax. The centre of the operation was the hamlet of Suffield and by 1910 it had become one of southeastern Alberta's first "boom" towns.

Canada Wheatlands Ltd. took over only 64,000 acres (25,600 hectares) of the original land grant. The rest appears to have been administered by the Canada Land & Irrigation Company which attempted to sell land to propsective homesteaders. A series of crop failures between 1919 and 1924 were disastrous for the Southern Alberta Land Company and it was forced into permanent closure in 1924 (Pennie 1963:9). The Canada Land & Irrigation Company appears to have remained in operation until at least 1927 (Cummins Rural Directory Maps for 1927: Map No. 44). Today, nothing re-

mains of what was once the largest grain farming operation in Canada except the remnants of the main irrigation canal that crosses the southwest corner of the Suffield Reserve.

The other large land owner noted in Figure 12 is the Colville Ranching Company. In 1918 it had possession of 7,860 acres (3.072 hectares) within the Reserve. Despite a detailed search, little information was found concerning the largest piece of privately owned rangeland on the Reserve in the period between 1909 and 1941. A possible suggestion as to how this land was utilized was presented by L.P. Ericksen. Ericksen (1969:6) commented that there was a large scale sheep ranching operation on the Reserve in the period between 1918 and 1922. He guessed that several thousand sheep were being grazed in an area located approximately 32 km northeast of the hamlet of Suffield. Although Ericksen's data are inconclusive, it is possible that the Colville Ranching Company was the operation that he mentioned.

It is interesting to note that while more than 300,000 acres (120,000 hectares) of the Reserve were held by various individuals and companies during the 1920s, a study made by the military in 1942 indicated that the total amount of land placed under cultivation was only approximately 97,000 acres (38,800 hectares). The reason for this will probably never be fully known, but a large part of the problem seems to have resided in early Twentieth Century dry farming techniques and the inability of many homesteaders to cope with the Northern Plains' harsh environment.

5.3 Boom and Bust: Farming in The Palliser Triangle

"Seven miles to water,
Fifteen miles to wood.
You can have my desert homestead,
I'm leaving it for good." (Anonymous)

The above poem, found scrawled on the door of an abandoned farm house in the Medicine Hat area (Gershaw n.d.:100), provides an excellent commentary on two of the many problems faced by the early settlers of The Palliser Triangle. As both Bennett (1969) and Nelson (1967) have noted, many of these people came from small-farming traditions located in relatively humid areas. They were woefully unaware of the harsh environment of the Northern Plains and the extent to which they would have to adjust their views on how the land should be utilized.

In the area of the Suffield Military Reserve, the first settlers were of Dutch, Polish, Russian and German descent (Mackintosh 1934:80, Murchie 1936:272). They came in droves and helped to raise the population of Alberta in the period between 1901 and 1911 from 73,072 to 347,633 (Morton 1938:126). After 1911, the majority of settlers came from either the United States, eastern Canada or Britain (Common 1967:287-289).

Farming in The Palliser Triangle would probably never have been attempted, however, if it had not been for three important factors. The first of these was the discovery that dry farming techniques would work on the Northern Plains. Strange (1954:27) has attributed this discovery to the Northwest Rebellion of 1885. During the rebellion horses were in much demand in Manitoba and, as horses provided the power for ploughing, substantial areas of land had to remain in summerfallow. Upon re-

seeding these areas many farmers found an increased yield, due primarily to the increased retention of both organic material and moisture in the soil.

The idea caught on rapidly and by 1888 the Canadian Government had begun to establish a chain of Dominion Experimental Farms across the Northern Plains in order to test dry farming techniques (Strange 1954:27). One of the last to be established was located just east of the town of Medicine Hat in 1907 (Ingles 1973:16). Many of the patterns of crop rotation and summerfallowing experimented with on these farms have remained the most imporant elements of dry farming on the Northern Plains.

Associated directly with the implemenation of dry farming after 1907 in the area of the Reserve was the beginning of a mild climatic period. The disastrous winter of 1906-07 which had all but destroyed the cattle industry in southern Alberta ushered in more than 10 years of relatively moist, warm weather. Settlers arriving in the area were able to plant crops almost immediately and could expect a profitable return in a few months. Yields of wheat during this period in southeastern Alberta accurately reflect the climatic trend, reaching a high of 37.5 bushels per acre in 1915 (Murchie 1934:128). This was substantially greater than the average yield of 14 bushels per acre in the area during the period between 1909 and 1941 (Strange 1954:Appendix II).

Finally, agriculture in The Palliser Triangle was given a boost with the creation of several strains of early maturing wheat. Before 1911 the most important strain of wheat was known as Red Fife (Morton 1938:149). After 1911 it was rapidly replaced by several disease resistent and fast

growing types, the most famous of which was called Marquis (Morton 1938: 149, Strange 1954:33). The success of these "short-season" wheats is partly exhibited by the fact that the acreage sown to wheat in Alberta increased from 1,639,974 (665,990 hectares) in 1910 to over 5,719,749 (2,287,900 hectares) in 1925 (Morton 1938:171).

There can be little doubt that wheat was king on the Northern Plains. The new strains developed after 1910 allowed a farmer a certain amount of security in the fall. In additon, the introduction (also after 1910) of the gasoline tractor and the practice of custom threshing made the bringing in of a crop reasonably inexpensive (Ingles 1973:60-63). Data on crop distribution on the Suffield Reserve between 1909 and 1941 are almost nonexistent. Of the almost 38,800 hectares brought under cultivation in the area it is likely that the majority were sown to wheat, followed by oats and perhaps barley or flax. Given the terrain and soil conditions in the portion of Study Area 2 that was under cultivation, the most likely crop was wheat.

Wheat farming was, for a time, a relatively profitable business in The Palliser Triangle. For example; if the northwest quarter section of Study Area 2 was sown entirely to wheat in the period between 1917 and 1920, the owner (L.C. Furey) could have expected an annual cash return of approximately $5,800. This is based upon an average wheat yield in the area during that period of 18 bushels per acre and an average price of $2.01 per bushel (Morton 1938:171).

For most of the farmers in The Palliser Triangle the "boom" was short lived. After 1920, wheat prices dropped sharply from highs of over $2.50

per bushel in 1917 to under $1.40 in the period between 1921 and 1925 (Morton 1938: 171). Coupled with this was a change in climate that drastically reduced crop yields. Lands that had yielded over 20 bushels per acre prior to 1920 dropped to less than 8 in the period between 1921 and 1925 (Mackintosh 1934:128). Also of importance to the failure of agriculture in the Medicine Hat area was the unreliability of the crop, estimated by Mackintosh (1934:183) to have had an annual yield variability of almost 50% in the period between 1921 and 1930.

These factors were greatly enhanced by the massive crop failure of 1925, which signalled the end of the farming boom in the area of the Suffield Reserve. Demographic figures for 1926 show that in the area north of Medicine Hat, 55% of all cultivated land was abandoned, the highest proportion in all the prarie provinces (Mackintosh 1934:119). Information on land abandonment for the entire Reserve is lacking, but there is some comparative material for its southwest corner. Tables 7 and 8 show the land onwership patterns in a 91,904 hectare block in 1918 and 1927. They indicate a drop in land held under individual title of just over 27%. This does not tell the entire story, however. Of the 44,416 hectares held under individual title in 1927, almost 10,000 were owned by various banks, trust companies and mortgage firms. These lands were probably taken in lieu of unpaid debts and may never have been actively cultivated again. If this figure is taken into account, the actual percentage of land abandonment in the area is closer to 44%.

Study Area 2 is located within the block discussed above and also shows a change in land ownership. By 1927, the northeast quarter section

Table 7: Land ownership patterns on the Suffield Military Reserve, Townships 15 to 18, Ranges 7 to 9 circa 1918. (Compiled from the 1918 Cummins Rural Directory Map No. 44)

	Type	Area
1.	Land held under individual title	60,928 ha (152,320 acres)
2.	Canada Land and Irrigation Company	15,808 ha (39,520 acres)
3.	Colville Ranching Company	3,072 ha (7,680 acres)
4.	Hudson's Bay Company property, School lands and unoccupied lands	12,096 ha (30,240 acres)
	Total:	91,904 ha (229,760 acres)

Table 8: Land ownership patterns on the Suffield Military Reserve, Townships 15 to 18, Ranges 7 to 9 circa 1927. (Compiled from the 1927 Cummins Rural Directory Map No. 44)

	Type	Area
1.	Land held under individual title	44,416 ha (111,040 acres)
2.	Canada Land and Irrigation Company	16,768 ha (41,920 acres)
3.	Crown Lands	13,376 ha (33,440 acres)
4.	Grazing leases	7,296 ha (18,240 acres)
5.	Hudson's Bay Company property, School lands and unoccupied lands	10,048 ha (25,120 acres)
	Total:	91,904 ha (229,760 acres)

(owned by W.A. Foxton) had been returned to the Crown along with the rest of Foxton's holdings. L.C. Furey still retained the west half of the section but the southeast quarter section had been taken over from M.L. Imeson by E.A. Brown.

The pattern of land abandonment on the Reserve that began in 1925-1926 continued throughout the 1930s. It was fed by increasingly adverse weather conditions, low wheat yields and wildly fluctuating prices. Of the more than 5,000 people who occupied the area in the 1920s, 500 remained in 1941. They were living on 125 farms, only five of which were profitable (Lowry 1981:18).

One of the main reasons why agriculture was a failure in the area of the Suffield Reserve was that the majority of individuals who attempted farming did not have the technological capability to cope with the environment. Dry farming techniques, which were successful at first, soon became inadequate due to the fact that the shallow soils of the Reserve could not regenerate their moisture and organic content after lying fallow for just one year. As a result, in a period of less than twenty years they were totally depleted.

An examination of the length of time required to deplete the soil on the Reserve under agriculture is impossible at present. Some idea of the time required, however, can be gained through a study of the time needed to regenerate natural prairie in a previously cultivated zone. This was done by comparing the average densities of the dominant grasses in the cultivated and uncultivated portions of Study Area 2. The average grass density in the uncultivated south half of the section was 3,732 plants

per square metre. In the northeast quarter section where cultivation ceased prior to 1927, the density was 3,624 plants per square metre. Finally, in the northwest quarter section where cultivation took place until the military arrived in 1941, the grass density was only 2,104 plants per square metre. Although these data were not collected in a highly scientific manner and are thus subject to some error, they do suggest that the time required to regenerate natural prairie plant cover is far longer than the 15 to 40 years intially calculated for the process (SBSC 1972:R-20). It appears that it is much closer, at least on the open plains portions of the Suffield Military Reserve, to 55 years.

5.4 Comments

In the period between 1909 and 1941 the most intensive utilizers of the land surface of the Reserve were the homesteaders. While they were primarily farmers, many also attempted to raise horses as draft animals and cattle for supplemental income. Often an individual would grow grain on one 160 acre plot of a homestead and leave the other in natural grass for cattle and horses. It is suspected that L.C. Furey utilized this pattern in Study Area 2. This type of mixed farming was almost as unsuccessful as straight grain farming, due in part to the fact that cattle prices fluctuated as wildly as grain prices on the Northern Plains (Bennett 1969).

As has already been mentioned, however, cattle grazing by non-resident ranchers has remained an important economic activity on the Reserve. After World War Two the military allowed local ranchers to run cattle on parts of the Reserve virtually unchecked and by the 1960s the grassland biome was heavily threatened. In response to this an agreement was signed

between the military and the PFRA putting restrictions on grazing. At present, under PFRA scrutiny, approximately 180 local ranchers run up to 7,000 head of cattle on 56,000 hectares of land in the south and east portions of the Reserve at a price of 13¢ per animal per day.

In addition to homesteading, a small portion of the present day Reserve was used for another purpose in the period between 1909 and 1941. In 1922 the federal government set up Wawaskesey National Park, a 54 square mile (138 square kilometre) block of land in the Middle Sand Hills. The park was designed to provide a protective habitat for the dwindling populations of pronghorn antelope in the area. It was an unqualified success. By 1938 the pronghorn had recovered and the park was abolished. Today, the entire Reserve serves the same purpose as Wawaskesey Park. It is a wildlife preserve and provides a vast habitat for numerous herds of antelope and deer.

Between 1909 and 1941 the last hinterland on the Northern Plains was opened to European intervention. Farming was attempted and proved to be relatively unsuccessful. As a result, the area was declared unfit for agriculture under the Special Areas Act of 1938 (Dunlop 1970:160). It is no wonder that when an "uninhabitable" area of land was needed for research and training during World War Two, the military had little difficulty in selecting this small portion of the Palliser Triangle.

SECTION 6

THE MILITARY: STUDY AREA 3

6.1 Introduction

The Suffield Military Reserve was created as a direct result of the problems faced by the British Commonwealth during the first years of the Second World War. Its development brought about important changes in the utilization of a small portion of the Palliser Triangle, changes which have proved unique on the Northern Plains. Attempts will be made in the following section to examine the reasons why this specific area was chosen as a military base, how it was created and how it has been used both in the past and at present by the various military groups who operate within its confines.

Detailed data on the effects of military activity were collected from Study Area 3 (see Figure 2, page 5). It consists of Section 2, Township 17, Range 6 and is located within the annual summer training zone of the British Army Training Unit Suffield (BATUS), the largest military utilizer of the Reserve. Surficial deposits in the study area are composed entirely of hummocky moraine covered by a thin layer of prairie chernozems supporting a standard collection of climax prairie grasses. Topography is moderately rolling (5-9% slopes) with two prominent hills in the northwest corner and a long east-west running ridge in the southwest corner of the section. The study area is typical of the open plains portions of the Reserve and offers excellent physiographic contrasts for military training.

Field research in Study Area 3 consisted of driving and/or walking

over the entire section and recording all surface indications of military activity (tank track scars, military vehicle trails, shell craters, small arms targets, etc.). This examination resulted in the definition of 5 areas of intensive military activity connected by a number of well used vehicle trails (Figure 13). The activity noted in the study area relates to present day military activities only. It was not intensively utilized prior to 1971 and data on the first thirty years of military occupation must come from the historical record.

6.2 The Military Take Over

The beginning of the Second World War was disastrous for the British and her allies. In 1940 they lost their joint chemical research facilities with the French in Algeria (Defence Research Board 1961:1). Although chemicals were never utilized operationally during the war, the British felt it was necessary to maintain a testing facility for such weapons as a defensive measure. The problem that they faced in 1940 was one of finding a suitable locale.

The British were looking for an area that would meet the following criteria:

1. A large expanse of land in the Commonwealth that was of little economic value and could be easily controlled by the military
2. An area within relatively easy reach of a railhead to allow for the transportation of men and materials
3. An area isolated enough to to protect non-involved citizens, yet close enough to a population centre to provide recreation facilities for the staff

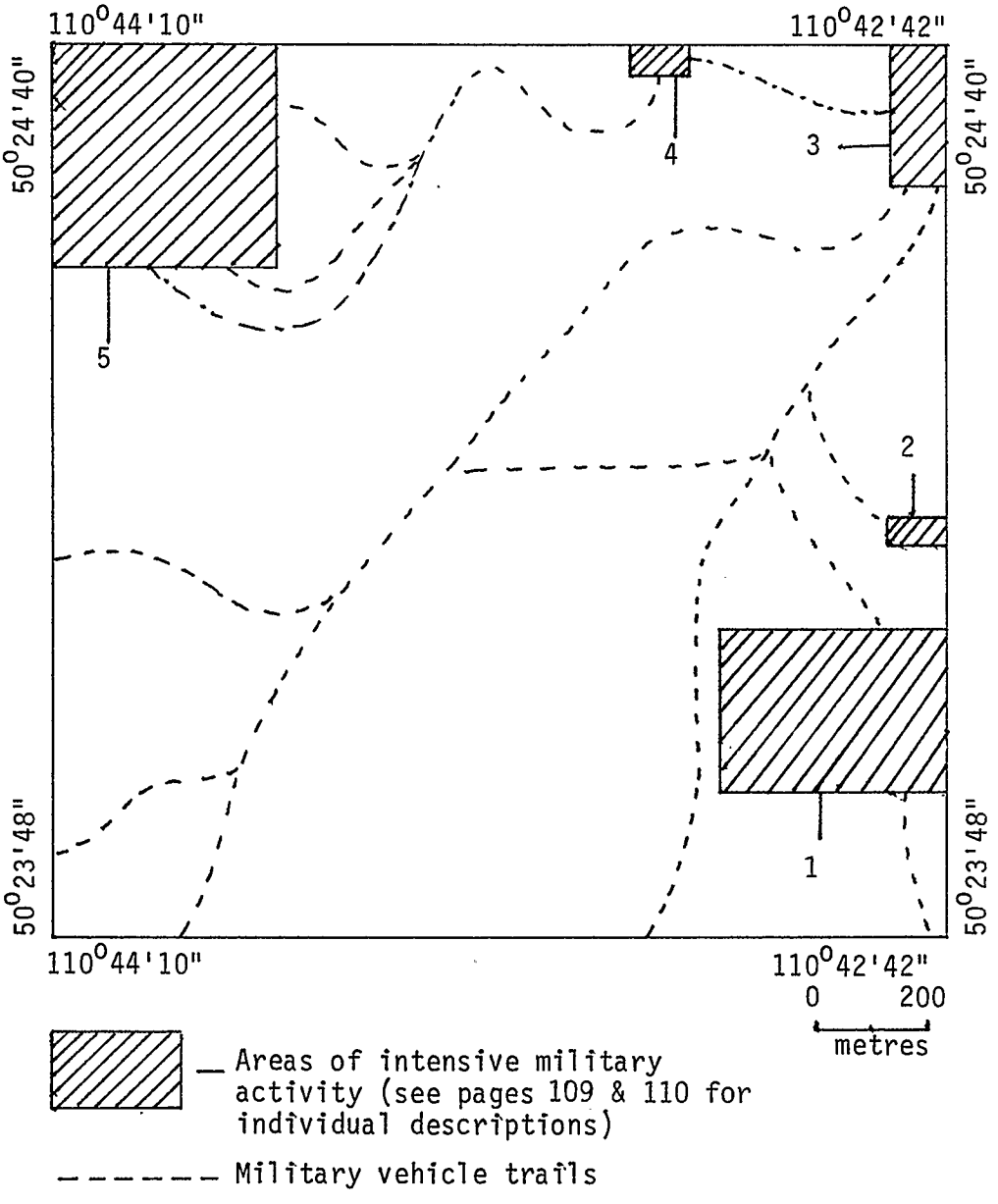


Figure 13: Sketch map of Study Area 3 (Section 2, Township 17, Range 6) showing location of major activity areas and access trails

The task of finding such an area was given to Mr. E. Davies who, in 1940, was Head of Experiments at the British testing centre in Porton, England (Defence Research Board 1961:1). Davies immediately rejected all areas in England (because of the population density) or in Australia (because of its isolation) and decided upon Canada.

An evaluation was made in 1940-41 of a number of possible test locales in Canada. The sites in New Brunswick, northern Quebec and northern Ontario were rejected because of isolation and access problems. A site in Manitoba was turned down because of its proximity to a major population centre and one in Saskatchewan was turned down because of the conflict that would be created with the indigenous farming population (Lowry 1981:19). Finally a site was found in southeastern Alberta that appeared to fit all the necessary criteria. It was in a sparsely populated locale bordered by the main line of the CPR and both the South Saskatchewan and Red Deer Rivers. After a brief consultation between the governments of Britain and Canada, the decision was made to take over the area as a military base. On April 9, 1941, by federal Order-In-Council PC 2508 (Defence Research Board 1961:16), the Canadian government, in conjunction with the British government and aided by the government of Alberta, took over approximately 1,000 square miles (2,560 square kilometres) of land just north of the hamlet of Suffield and the area eventually became known as the Suffield Military Reserve.

The factors involved in choosing this area under the stated criteria were numerous and not solely based upon expediency or political manoevering. The need to find an economically useless block of land was impor-

tant to the British and the course of events in the area north of Medicine Hat between 1925 and 1941 must surely have attracted their attention. More than 55% of the land originally occupied had been abandoned by 1941 and was held by either the federal government as Crown lands or the provincial government as grazing leases. Also; perhaps as much as half of the land had never been homesteaded at all, thus making its acquisition easier. These reasons combined with the low population and the designation of the area as being unfit for agriculture under the Special Areas Act of 1938, made the choice of a testing zone easy for the British.

Another factor that favored this block of land was the presence of an important railway near to the proposed testing locale. The British were even luckier in the fact that the railway was the CPR, a government subsidized operation. This meant that they would have little difficulty in transporting men, equipment or dangerous chemicals and there would be no public outcry.

In addition, the area chosen was open prairie, easily accessible to all types of military vehicles for most of the year, and had a constant and relatively predictable wind pattern, thus allowing clouds of toxic gas to have their paths plotted. Perhaps the only problem that presented itself was the semi-isolation of the Reserve. The base facilities were located more than 45 km from the town of Medicine Hat and this isolation was a prime factor in the building, after the war, of the military satellite community of Ralston, which contains its own recreation factilities and is situated less than 3 km from the base.

The first problem that the military faced before the Reserve could be established in fact was the removal of the remaining 125 families in the area. This was completed through the simple process of buying all the land still under private ownership. The government paid the residents a price of $1 per acre for freehold land and 50¢ or less per acre for lease land. The amount was not entirely equitable as land in Alberta during the previous decade had sold for $7 to $24 per acre (Murchie 1936: 270). Because it was a wartime situation, however, the residents were forced to accept the amount offered and had no real chance to resolve their grievances.

A few of the larger farms were sold for $3,000 to $4,000, but the majority of land owners received $1,500 or less for their property (Thomas 1971b:33). The people and their belongings were moved out between April and June of 1941 by the military who also aided in the moving of any farm buildings the residents wished to relocate. The remaining buildings and any fences left in the area were either removed or destroyed, and what land was still under cultivation was seeded to grass. This work was completed by June 11, 1941 and the United Kingdom/Canada Field Experimental Station began its operations.

6.3 Military Land Utilization Patterns

The land surface of the Suffield Military Reserve has been under continuous use by the military since 1941, the only military base in Canada to have that distinction (Defence Research Board 1961:i). How this area as been utilized has varied widely depending upon national and international political concerns, but each military user has left

its distinct mark on the land.

The first military use of the Reserve began in the summer of 1941 when 10 chemical experts from Britain took up residence at the newly built research centre. Located in the southwest corner of the Reserve, the station was administered by the Canadian army and costs were shared on a fifty-fifty basis with the British government (Defence Research Board 1961:2), through a two-year renewable contract. The size of the research centre (renamed the Experimental Station Suffield late in 1941) grew rapidly and by 1945 consisted of 584 professional, technical and field personnel. Its initial job was to conduct experiments and field trials of mortar and rocket delivered chemical warheads. Between 1941 and 1945 over 1,500 tons of mustard and phosgene gas were delivered to the Reserve in one ton containers. At first this material was stored in slit trenches but was later transferred to concrete bunkers (Defence Research Board 1961:3).

A sizeable quantity of this material was left over after the war and, on occassion, was trucked out to some isolated area of the Reserve and simply buried. As the permanent staff of the research station were not responsible for these toxic materials (Defence Research Board 1961: 3), the locations of many of the smaller dumps were never recorded. With the vast increase in use made of the Reserve after the mid 1970s, these deposits began to turn up regularly. This has caused numerous problems as the materials are as dangerous today as they were in 1945.

During the Second World War the prime purpose of the research station was to conduct experiments on dangerous chemicals. The military

did not, however, let the opportunity for testing other items (in such a vast area) go to waste. It appears that high altitude bombing tests were made along with tests of various artillery pieces, new types of insecticides and experiments with smoke and flame warfare.

After the war, the British lost interest in the Reserve and, by Order-In-Council PC 101/1727, it became an all Canadian operation on April 30, 1947 (Defence Research Board 1961:4). It was placed under the administration of the Defence Research Board and renamed, in 1950, the Suffield Experimental Station (SES)(Lowry 1981:22). By the mid 1950s the main base and its satellite community of Ralston housed several thousand people, all involved in various aspects of research on the Reserve.

The 1950s and early 1960s were the period of what has been called the "Cold War". Secrecy was of utmost importance and much of what took place on the Reserve during this period remains classified. It is known that a highly sophisticated laboratory was built on the base in 1955 (Defence Research Board 1961:4). The lab was fully capable of undertaking biological warfare experiments, but whether or not such experiments actually took place is not known.

In the early 1960s the Reserve was utilized for a series of spectacular high explosive tests. Several blasts of 100 tons of TNT were ignited and in 1964 a 500 ton charge was set off. This was one of the largest non-nuclear explosions ever created. After that, the nature of research conducted on the Reserve became more public in orientation. Secrecy was less important and the scientists on the base shifted their

research to the studies of the effects of insecticides and herbicides on a large scale basis.

Today, the Defence Research Establishment Suffied (DRES) is one of the largest research centres of its type in Canada and employs approximately 200 people. Roughly one quarter of the land surface of the Reserve is directly controlled by DRES who use it for wind tests of various chemicals. The research conducted by DRES is of importance and often gains public attention, even though they are not the largest military user of the Reserve. That honor goes to the British military who have been training in the area since 1971.

In 1969 the British lost their armoured training areas in North Africa, due to the change in government in Libya (Thomas 1971a:21). In order to maintain their NATO commitments, the British needed a new area in which to train and the obvious choice was the Suffield Military Reserve. After a series of brief negotiations a 10 year access agreement was signed with the Canadian government in August, 1971 (Thomas 1971a: 21). This agreement was renegotiated for another 10 year period in the summer of 1981. Under its terms, the British Army Training Unit Suffield (BATUS) has priority use of approximately 650 square miles (1,660 square kilometres) of the Reserve for armoured unit training (Lowry 1981:28).

One good aspect of the arrival of BATUS was that is caused the government to initiate a series of excellent environmental studies on the Reserve. Most were oriented towards examining the effects of military training on the flora and fauna of the area. The results of these studies helped to create two large military Out-of-Bounds zones, one en-

compassing the entire Milldle Sand Hills and the other consisting of a one-mile wide strip along the South Saskatchewan River (Thomas 1971a: 34).

The necessity of coordinating all of the various activities on the Reserve, after 1971, resulted in a final adiministrative change. The entire Reserve was renamed Canadian Forces Base Suffield and put under the control of the Canadian Army Mobile Command. At present, they maintain an administrative and range conrol staff who attempt to oversee all the various military and non-military operations within the boundaries of the Reserve.

As has been noted, the BATUS training groups are the most intensive military users of the Reserve. They operate on a seasonal basis, using the area in the period from May to November each year. During this time, seven Battle Groups descend upon the Reserve, each group containing approximately 1,000 personnel (Bilodeau 1979:3). A Battle Group often consists of over 500 vehicles of seventeen different types. This includes forty to fifty Chieftan Tanks, each one weighing sixty tons. When fully mounted, a Battle group contains: two tank squadrons, a self-propelled artillery squad, one anti-tank missile squad, two mechanized infantry squads (one Canadian), two reconnaissence troops (one Canadian), one engineer platoon, and one helicopter group.

Only one Battle Group is allowed on the Reserve at a time. The actual area used for BATUS training is quite small during the 15 to 20 day exercise, and for environmental reasons, is rotated regularly (Bilo-

deau 1979:3). By far the largest portion of 1,660 square kilometre training area is utilized as a buffer zone. The 120 mm cannon of the Chieftan Tank can lob a shell up to 32 kilometres in any direction and this buffer zone is required for the protection of all non-involved personnel. Only the Suffield Reserve is large enough to undertake exercises of such size and it is the largest live-firing training area of all the NATO countries (Lowry 1981:28).

Initially, few people were happy to see BATUS commence training on the Reserve. Attitudes have changed, however, over the last 10 years and most people either support the training or are indifferent to it. Over $11,000,000 in payroll is paid out by the military each year and much of this remains in the district. It has proven to be a welcome source of revenue and is more stable (although far smaller) than the revenue generated by the fossil fuel resources of the area.

In terms of environmental disturbance, the 40 year occupation of the military on the Reserve has been substantially damaging. This is certainly not due to an intentional lack of concern for the environment by the military, but reflects the general attitude that they have towards the land surface of the Reserve. It is seen as a treeless wasteland unfit for anything except military activity. This attitude combined with the fact that military training and testing (by its very nature) is destructive has resulted in much disturbance to the grassland biome.

The military are not totally ignorant of environmental concerns, however. The setting aside of the two Out-of-Bounds zones already men-

tioned were admirable measures on the part of the military. Also to be admired is the job that they do in enforcing strict parameters on the non-military use of the Reserve and their attempts to protect the large mammal populations and important archaeological sites. Perhaps the most unfortunate aspect of the watchdog policy is that it is rarely utilized to adjust military activity, especially that of BATUS.

As has already been mentioned, Study Area 3 is within the area intensively utilized by BATUS for summer training. The five areas of military activity noted during the field research all probably relate to BATUS training. A description of these areas is presented below (see Figure 13 for areal reference):

AREA 1: A total of 120,000 square metres of land surface is within this area and it covers both sides of a prominent east-west running ridge. Military vehicle scars cover the entire area. Those created by Chieftan Tanks have removed all of the sod layer and are as much as 10 cm to 15 cm in depth. Scattered throughout the area are 25 pits of various sizes. Nineteen appear to have been created to hold pop-up targets and are 100 cm to 120 cm in depth. Four others appear to have been created to hold refuse and are 150 cm to 180 cm in depth. The remaining two are shell craters approximately 50 cm in depth. At present there is no indication of any plant regeneration in the area with the exception of a few weeds growing in some of the older vehicle scars.

AREA 2: This area encompasses approximately 5,000 square metres and contains 12 pits varying from 50 cm to 120 cm in depth. They hold pop-up targets utilized by the infantry companies of a Battle Group. Two shell craters are present in the area plus a substantial number of small military

vehicle scars. Many of the pits are recent in origin and there is no evidence of any vegetation regeneration in the disturbed portions of the area.

AREA 3: Within an area of approximately 25,000 square metres is a densely packed network of tank track and small vehicle scars. They vary from 5 cm to 10 cm in depth and show no evidence of vegetation regeneration. Only a small amount of natural prairie remains between the scars.

AREA 4: This area covers approximately 5,000 square metres and is situated on the top of a small hill. It is covered in small military vehicle scars interspersed with a few tank track scars averaging 8 cm to 16 cm in depth. Very little natural prairie remains in the area and there is no evidence of vegetation regeneration.

AREA 5: This is the largest zone of military activity in Study Area 3 and covers 160,000 square metres. A large number of small-arms targets are scattered throughout the area, which is criss-crossed by tank and small vehicle scars. There are also a few widely distributed shell craters. The greatest amount of disturbance is in the northwest corner where a small east-west running coulee contains a 400 metre long barbed wire fence. The prairie on either side of this fence is so disturbed that is almost impassible for small vehicles. Little or no natural vegetation remains near the fence and none of the disturbed portions of the area show regeneration of natural prairie.

The five areas discussed above encompass a total of 315,000 square metres and, excluding the numerous vehicle trails, represent just over 12% of the total land surface of Study Area 3. The vehicle trails are

so varied in terms of their size and the amount of disturbance present that they are difficult to discuss. Also, at least two of them serve as access trails for energy development personnel, thus creating problems when examining the origin of surface disturbance.

Study Area 3 is more or less typical of the approximately 1,660 square kilometres under the control of BATUS. Some portions exhibit greater disturbance (especially along major tank access routes) and others show less (espcecially along the fringes of the buffer zone). The nature of the disturbances noted in the five activity zones reflect all aspects of BATUS training. Often such disturbances are not noticeable until directly encountered and the military feel that environmental clean-up on this scale is unnecessary.

Attempts are made to reduce disturbance by rotating areas of intensive activity on a two year basis. Unfortunately this is far from enough time. In Section 5 of this paper it was shown that total regeneration of the prairie surface on the Reserve may take as much as 55 years. The military, however, are unwilling to wait even a fraction of this time before an area is re-used.

While the disturbances noted in Study Area 3 are the most common made by the military on the Reserve, there is one other that is far more spectacular --- the prairie fire. The nature of BATUS training is such that live ammunition is required, and its use sets off numerous fires. The chief problem with this occurs when a single area is burned over on a regular basis. There is no chance for the grass to recover and often large areas are denuded. Fortunately the military are now taking steps

to rectify this problem by allowing a burned area several years to regenerate before being re-used.

Prairie fires can also have a beneficial effect upon the environment. Such was the case with the fire of 1978, when perhaps as much as forty per cent of the Reserve was burned over in a single event. Despite its intensity, this fire helped the grasslands by removing several years' growth of old plants and returning many nutrients to the soil. Fires have also affected the other human groups who used (or are using) the Northern Plains. A slightly more detailed examination of the relationship between fires and humans is presented in the Appendix (pages 160-168).

6.4. Comments

Any discussion that deals with military land utilization is fraught with problems. The most common question posed by opponents of military activity is: "Of what value is the military compared to the environmental damage done or the greater economic advantages of recovering the fossil fuel resources of the Reserve?" For those who support the military or are neutral in their opinions, the most common question posed is: "Who cares if some useless prairie is damaged when the fate of the western world may be at stake?"

Both of these questions have merit and both are somewhat idealistic. Environmentalists are often loathe to face reality and will pick up on any subject that gains public attention. Over the last ten years the Reserve has come into the public eye on several occasions and many environmentalists were quick to join in the outcry against military activity. On one level, this was a commendable action and resulted in the creation of two large Out-of-Bounds areas. On another level, the environ-

mentalists, supported by the energy developers, went so far as to demand the cessation of all military activity on the Reserve. This, at the moment, is an unattainable goal. The Reserve is a military base and will remain so for an extended period of time. The only hope for the environmentalists is to protect what they can and to initiate cooperation between themselves and the military. It appears at present that this is, thankfully, becoming common practice on the Reserve.

The supporters of the military see the Reserve, of course, as a useless wasteland that can be bombed and ground up without serious problems. If military power is essential to western society, and if a training area is required to keep the military up-to-date, why not use this piece of prairie "desert"? To a certain extent this type of attitude is acceptable. While a substantial amount of environmental disturbance is created by the military on the Reserve, it is kept out of the public eye and restricted to a tiny portion of Canada. This is, probably, the best that can be expected of a society where those in political power see military training as an integral part of national security. The chief problem of this attitude lies in the fact that the military jealously enforce strict environmental controls on non-military activity and let their own personel disturb what is a very fragile landscape.

Military activity is a fact on the Reserve and will continue for some time. Fortunately, over the last 7 or 8 years, some cooperation has developed between the military and non-military utilizers of the Reserve. This may be best reflected in the relationship that has grown between the military and the energy development personnel.

SECTION 7

ENERGY DEVELOPMENT: STUDY AREA 4

7.1 Introduction

A period of developmental paranoia was created among the nations of the western world in the early 1970s. This was due, in part, to a supposed shortage of fossil fuels and resulted in a frantic search for new production locales. In Alberta, the election of a development-minded government in 1971 greatly enhanced this search. No area of the resource rich province was left unconsidered as a source for fossil fuels and on the top of the list was the Suffield Military Reserve. As a result the Reserve has seen, since 1973, the most intensive utilization of its land surface since its creation.

Virtually every square mile of the Reserve exhibits some evidence of energy development. However, because of its vast size and the nature of the development plan proposed for the area, no single square mile contains evidence of all types of development. Study Area 4, which consists of Section 34, Township 15, Range 8 (see Figure 2, page 5), was chosen because it exhibits the five most common developmental features. They are:

- drilling for shallow natural gas
- construction of pipelines
- major access road construction
- upgrading of military access roads
- surface disturbance created by equipment and vehicle storage

Topographic relief in the study area is moderately rolling (5-9% slopes) with no prominent hills. Surficial deposits are composed ex-

clusively of hummocky moraine and these are covered in a thin layer of prairie chernozem soils. Plant cover is typical climax prairie grassland containing a substantial amount of pasture sage.

Field research in Study Area 4 was relatively simple. It consisted of an examination of the entire section by vehicle or foot traverse. All features indicative of energy development were recorded and these are presented in Figure 14. Upon completion of this stage, a study of the process of plant regeneration along the pipeline rights-of-way in the area was made. The density of the dominant grasses were calculated in 30 one square metre collection zones, 15 inside and 15 outside but immediately adjacent to the rights-of-way. The results of this study will be presented later.

7.2 The Energy Resources of the Reserve

The presence of a fossil fuel resource (in the form of natural gas) in southeastern Alberta was known long before the so called "Energy Crisis" of the 1970s. In fact, the first discovery of natural gas in Alberta occurred only a few kilometres west of the present-day Suffield Reserve.

In December of 1883, a drilling crew was attempting to sink a water well for the CPR at what was then known as Langevin Siding (Pan Canadian Petroleum Ltd. 1981:3). When they reached a depth of approximately 340 metres, they had failed to find water, but had discovered a reservoir of natural gas. The well subsequently caught fire and burned spectacularly. It was finally brought under control in the spring of 1884 (Pan Canadian Petroleum Ltd. 1981:4). A second well was drilled in the fall of

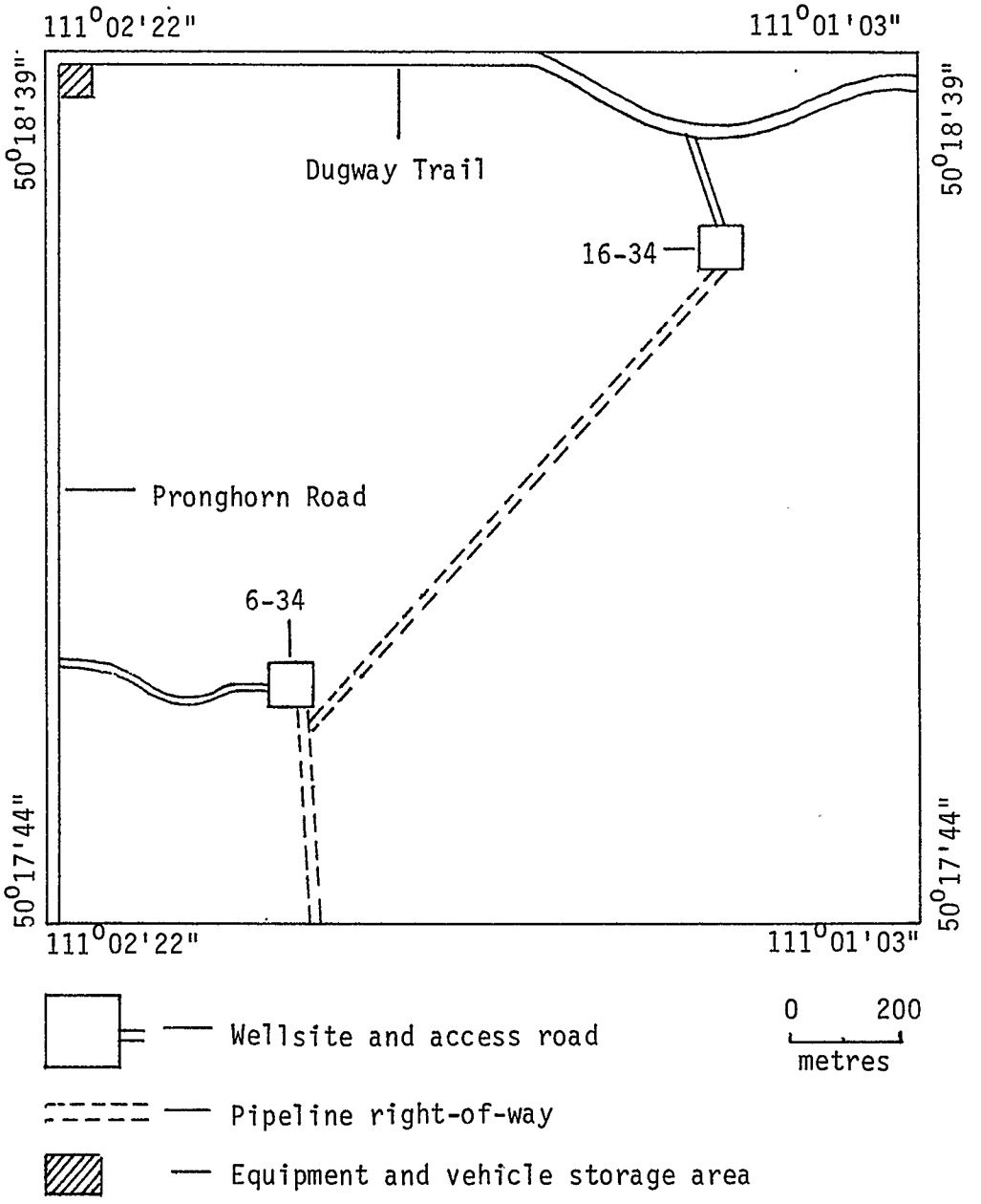


Figure 14: Sketch map of Study Area 4 (Section 34, Township 15, Range 8) showing location of existing gas wellsites, pipeline rights-of-way and major access roads.

1884 using natural gas from the first well to power the cable drilling tool. This well was sunk into what is now known as the Milk River Formation and the natural gas recovered was used to heat and light the station house of the small community of Carlstadt (renamed Alderson during the First World War).

The first well continued to provide some natural gas until the decision was made to abandon it in either 1934 or 1935. The abandonment proved inadequate and the well continued to leak. Several attempts were made to close it off in the period between 1942 and 1954. Finally, after almost 70 years of continuous flowing, the well was sealed on September 30, 1954 (Pan Canadian Petroleum Ltd. 1981:7).

From the 1890s onward some exploitation took place of the large quantities of natural gas known to exist in southeastern Alberta. Medicine Hat became quite famous for its cheap source of heat and light. Its first boom in the early decades of the Twentieth Century may have been due, in part at least, to its abundant supply of natural gas and it seems only fitting that its latest boom has been due to the same resource.

It was not until after the Second World War that drilling for natural gas in and around the Suffield Reserve was considered. At that time, Western Canada began to switch to natural gas rather than coal and oil as home heating fuels. On the Reserve itself only a few wells were drilled and these provided heat for the military base and the community of Ralston (Lowry 1981:35).

With the arrival of the 1970s, the search for fossil fuels on the

Reserve began in earnest. Economically viable gas fields had already been exploited on the edges of the Reserve, strongly suggesting that there were potential fields within its boundaries (SBSC 1972:RC-10). In response to this a 3.5 million dollar testing program was undertaken in 1973 and 1974. Seventy-seven wells were drilled to depths varying from 430 m to 1100 m and all encountered reserves of natural gas (Lowry 1981:37-38).

The most economically productive reserves were found in what was termed the "shallow gas" zone at depths no greater than 700 metres. Three formations within this zone were determined to be the best producers — the Milk River, the Medicine Hat and the Second White Specks. Their location can be seen in the chart of geological formations for southern Alberta presented in Figure 15.

The Milk River Formation consists of a variety of marine desposited sandstones, siltstones and shales reaching up to 100 metres in thickness. Most of the formation contains thinly interbedded layers of its component materials and these retain large quantities of natural gas (SBSC 1972:G-8), kept in place by an overlying bed of semi-pervious shale. The second gas-bearing formation, the Medicine Hat Sandstone, consists of up to 12 metres of lenticular bedded fine to medium grained sandstones and shales (SBSC 1972:G-11-12). Natural gas is trapped between these beds and while this formation is not as rich as the Milk River, it is still economically productive. At the bottom of the "shallow-gas" zone is the Second White Specks Formation. It consists of a series of well preserved off-shore sandstone and shale bars up to 75 metres in thickness and con-

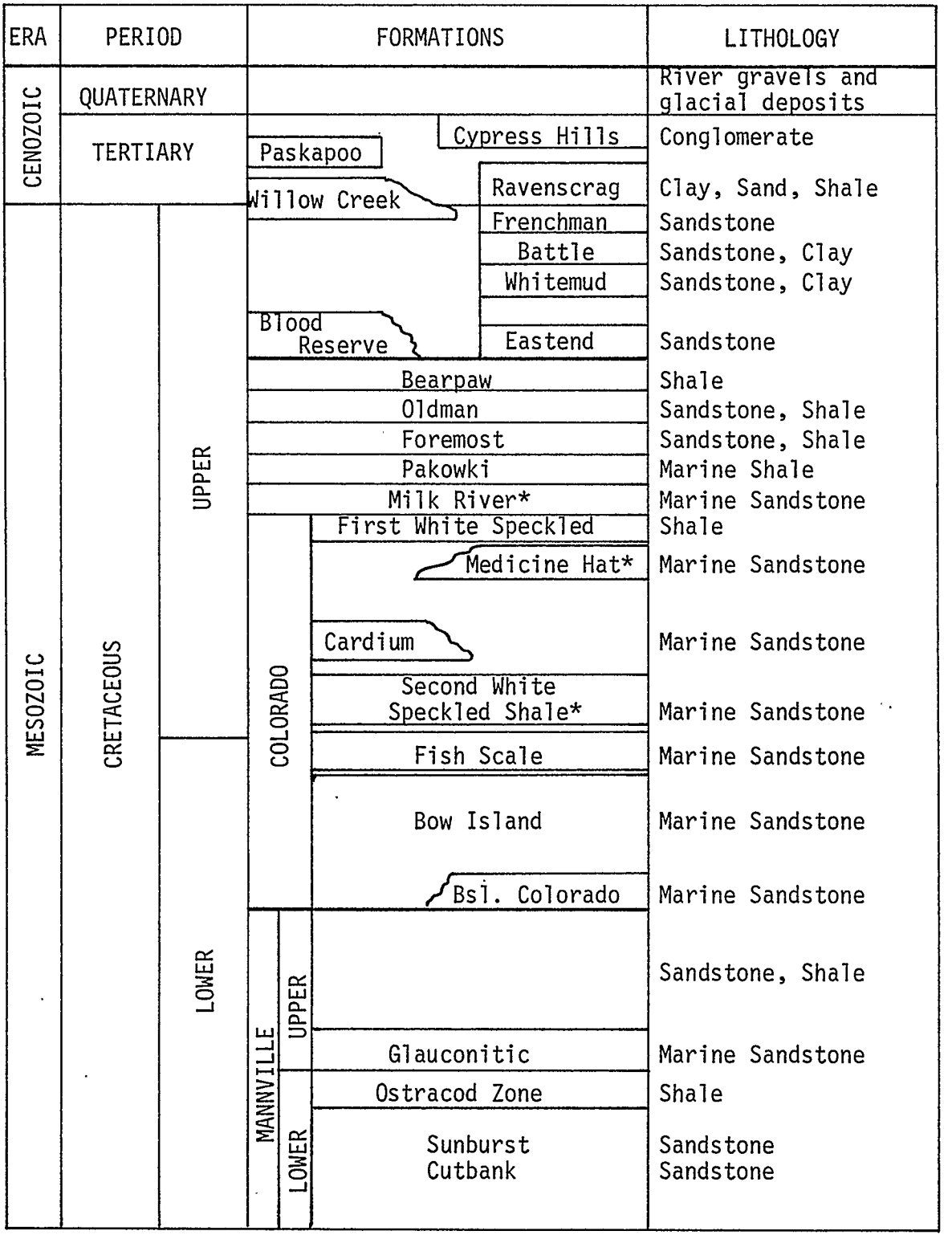


Figure 15: Chart of Upper Mesozoic and Cenozoic formations in southern Alberta. (Adapted from SBSC 1972; Figure G-1)

taining substantial quantities of natural gas (SBSC 1972:G-13-14). Gas and heavy oil have also been found in other formations and at depths of up to 1100 metres.

Once the natural gas reserves at Suffield proved to be economically recoverable, the Government of Alberta was faced with a sizeable problem. While it retained the mineral rights to 95.5% of the Reserve, the Federal government retained full surface access rights. If the natural gas was to be recovered, some kind of agreement had to be reached between the Provincial government and the Department of National Defence. Public interest was aroused at this time, and, in 1974, it was proposed that the base be permanently closed in favor of energy development (Johnson 1974:52).

Fortunately a more reasonable solution was found, and in 1975 a provincial crown corporation known as the Alberta Energy Company (AEC) was set up in order to oversee the development of the fossil fuel resources of the Reserve. In September of that year AEC purchased from the Alberta government the petroleum and natural gas rights in 613,000 acres (245,200 hectares) of the Reserve. The price paid was $54 million and the repayment scheme was more than equitable. Only $14 million was to be paid immediately, with a further $10 million due 90 days after the first gas sales from the Reserve. The remainder was to be paid in three annual installments of $10 million beginning one year after AEC had recovered all of its development expenses (AEC 1976;5). As of 1982 these final payments had not yet been made (AEC 1982:11).

Shortly after this purchase, AEC signed an access agreement with

the Department of National Defence. The Suffield Access Agreement (Lowry 1981:40) was a complex document setting down the parameters under which AEC would be allowed to develop the natural gas and petroleum resources of the Reserve. Not only did AEC have to comply with military training schedules, it had to undertake extensive environmental protection procedures. In order to ensure AEC's maintenance of these procedures, the Suffield Environmental Advisory Committee (SEAC) was set up. It is the job of SEAC, in conjunction with the Energy Resources Conservation Board (ERCB), to monitor all development by AEC on the Reserve and to keep the company within the agreed upon environmental guidelines.

The signing of the access agreement gave AEC develomental rights on the Reserve for a period of twelve years beginning in 1976. The area was divided into six developmental zones (see Figure 16) and work was to be conducted in each zone on a two-year basis in the following pattern:

Area A: 1976-77
Area B: 1978-79
Area C: 1980-81
Area D: 1982-83
Area E: 1984-85
Area F: 1986-87 (including Koomati)
(AEC 1976:5)

This rotational pattern was felt to be the best as it would minimize the conflict between what were considered two mutually incompatible users of the Reserve: AEC and the military.

By 1977 AEC had found (much to its surprise) that cooperation between itself, the military and the environmentalists (especially the

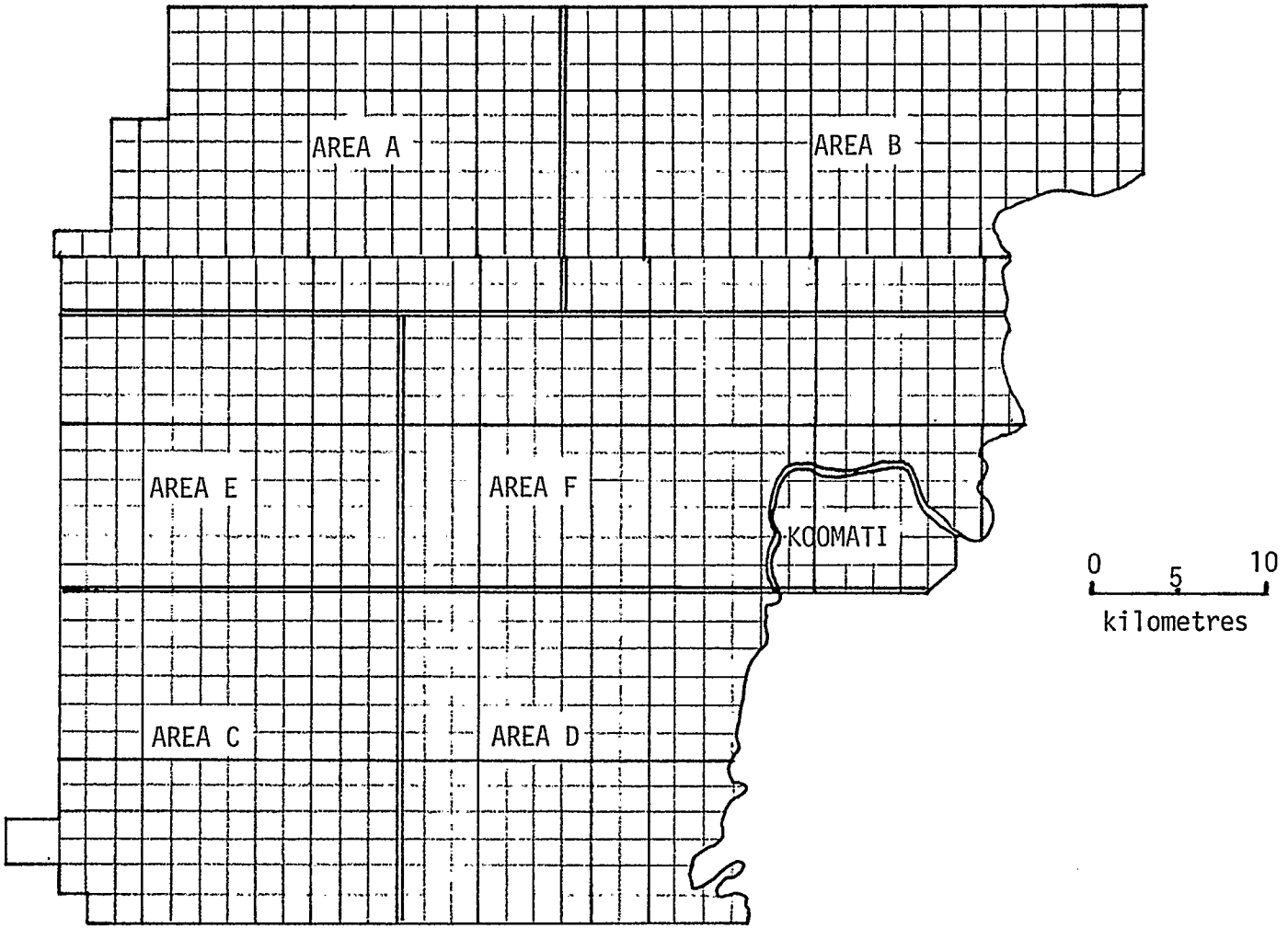


Figure 16: Sketch map of Suffield Military Reserve showing location of AEC energy development zones.

archaeologists) was easy and it was able to abandon its original pattern in favor of accelerated development. As a result, AEC was able to complete the first phase of its development in 1982, five years ahead of schedule.

7.2 Energy Development Land Utilization Patterns

Through AEC, the Suffield Military Reserve has undergone its most intensive utilization to date. The search for and production of oil and natural gas is such that, as of 1982, there were no areas of the Reserve that could be considered as "untouched" prairie. Much of the work done by AEC in the production of natural gas is only moderately disfiguring to the environment. In the case of oil production, however, the disturbance is highly visible.

7.3.1 Oil Production

Almost immediately after receiving access rights to the Reserve, AEC began the search for commercial oil in Area A (see Figure 16). With Westcoast Petroleum as a sub-contractor, AEC searched for and found several small pools of heavy oil. As of 1981, the facilities in Area A produce 53 cubic metres of oil per day from a reserve estimated at 48 million cubic metres (AEC 1982:9). Current technology can recover only about 1% of this oil and at present production rates the recoverable oil will run out in approximately the year 2000.

In 1980-81, however, a new project called the Suffield Heavy Oil Project (SHOP) was begun in Area A. Its purpose was to test the possibility of increasing heavy oil recovery by heating the oil below surface.

The oil was ignited late in 1981 but it will not be until 1984 or 1985 that the economic feasibility of this method is fully tested (Lowry 1981: 51).

The chief problem encountered by AEC during the recovery of the oil deposits was that virtually all the necessary facilities had to be built above ground. The low daily production rate per well meant that pipelines would be inefficient transportation mediums. As a result, above ground storage tanks had to be constructed beside the above ground pumping facilities and gathered oil had to be removed by truck along an extensive network of all-weather gravel roads. None of this activity was compatible with the live-firing training methods of BATUS.

On November 14, 1977, therefore, AEC signed another agreement with the Department of National Defence (AEC 1978:9). Called the Oil Access Agreement, it gave AEC exclusive rights to an approximately 50 square mile (128 square kilometre) portion of Area A until 1997. In return, AEC gave up development rights from April 15 to November 1 each year in a similer sized portion of Area B (Lowry 1981:49).

While the amount of oil recovered from the Reserve is small, the process of recovery is a highly visible activity. Visitors to the Oil Access Area see the terrain dotted with large pumps and storage tanks and crossed by literally dozens of heavily utilized roads. This activity has caused extensive disturbance to the environment, little of which has been corrected by either AEC or Westcoast Petroleum.

7.3.2 Gas Production

By far the most intensive use made of the Reserve by AEC is through

the recovery and production of natural gas. It has been estimated, that as of 1981, after five years of steady production, the Reserve still contains 45.4 million cubic metres of recoverable natural gas (AEC 1982: 11). The testing completed in 1973-74 had shown that natural gas was present underneath the entire Reserve and, as a result, AEC set up a drilling program that called for (in its first phase) a well density of two per section over the entire 1,000 square mile area. After completion of this phase the decision would be made whether it would be economic to double or even quadruple this spacing.

As of December 31, 1981, 1,900 gas well had been drilled. Of these, 1,681 were connected to a gathering system consisting of 2,316 km of pipeline reaching 9 Compressor Stations (AEC 1982:9). In 1982 the final 100 wells of the first phase were drilled and the second phase was initiated in various portions of Area F. The wells connected to the gathering system in 1981 produced 4.5 million cubic metres of natural gas per day and if production rates do not rise above 1982 levels, the natural gas should last until sometime shortly after the year 2000.

The search for and production of natural gas on the Reserve has produced a number of disturbances to the environment. The majority of these are created during the drilling of gas wells and the laying of pipelines. On the Suffield Reserve a standard gas well is drilled within a 90 m x 90 m block of land and, by regulation, all developmental activities must take place within this 8,100 square metre area.

The selection of a specific wellsite is based upon the splitting of a section (one square mile) into sixteen 400 metre square LSDs (Land

Subdivision). The LSDs are numbered in the same manner as the sections in a Canadian township. AEC then selects LSDs 6 and 16 and places a wellsite in the southwest corner (if possible) of each. The well spacing pattern for Study Area 4 (see Figure 14) is typical of all sections of the Reserve under the first phase of AEC's drilling project.

Once the wellsite has been chosen and a 15 m wide access road to the nearest major road has been selected, the entire area to be disturbed is examined by an archaeologist. He or she then clears the site for drilling or, if an archaeological site is found, recommends: 1) relocation of the development area, or 2) excavation of that portion of the archaeological site to be disturbed. Both wellsites in Study Area 4 were examined in this manner by the author (Brumley and Dau 1980). No archeological sites were found and drilling was allowed to proceed.

Up to this point virtually no damage has been done to the prairie surface within the development area. The next phase of construction, however, is much more disruptive and consists of the digging of three large "mud" pits and a small "flare" pit. The "mud" pits are located in a pattern surrounding the spot chosen for actual drilling and are usually 3 m in width, 10 m to 15 m in length and up to 2 m in depth. The "flare" pit is located downslope from the wellhead and varies in size and depth. It usually serves as a dump for the garbage created during the drilling of the well.

The pits themselves take up only a small portion of the allotted wellsite, but during their construction a large part of the allottment can be disturbed by heavy vehicle traffic. The access road to the well-

site may be heavily disturbed at this time as well, especially if it crosses rugged terrain; then it must be ploughed smooth for the passage of the drilling machinery. Once the pits are dug, drilling may take place but it is usual on the Reserve for a period of time to elapse between pit construction and well drilling. This varies from less than 24 hours to several weeks, depending upon the schedule of the drilling team. In Study Area 4, the pits in both wellsites were constructed 7 to 10 days before drilling took place.

The next phase of development is the drilling of the well itself. Drilling machinery (known as the "Rig") is transported to the wellsite in numerous pieces by heavy vehicles. Depending upon weather, terrain and surfical deposits, the grass cover in both the wellsite and the access road can be totally removed by this process. In Study Area 4, the access road to the wellsite in LSD 16 (see Figure 14) shows evidence of total removal of its grass cover while the access road to the wellsite in LSD 6 shows virtually no damage at all.

Once the "Rig" has been set up, drilling proceeds rapidly. First a 20 cm in diameter hole is drilled to a depth of approximately 20 m and a 15 cm in diameter conductor pipe is cemented into it (SBSC 1972: ENG-4). Drilling then commences using standard techniques and the hole is sunk to a depth of 15 m below the natural gas reserve to be tapped. During drilling, the hole is filled with water and chemicals known as "mud" that are stored in the "mud" pits when not in use. After completion of drilling a 10 cm in diameter pipe is run down the hole to its bottom and the well is capped (SBSC 1972:ENG-4). The entire process usually takes no more than two days and the "Rig" is quickly moved to a new

locale.

After the "Rig" has left a simple clean-up is done on the wellsite. The garbage is collected and the pits are filled in. The water in these is allowed to flow into the surrounding terrain and once the ground around the wellhead is firm the well is perforated. Because the natural gas on the Reserve is under low pressure, it does not flow quickly to the surface. In order to facilitate gas flow, the walls of the drill pipe are perforated with thousands of tiny holes at the depth of the gas reserve to be tapped. The hole is then filled with 10,000 to 15,000 kg of coarse sand through which the gas percolates to the surface. The well is then allowed to blow to atmosphere, in order to clear out any impurities (water, sand, etc.), for three days and recapped (SBSC 1972: ENG-4).

The final step in drilling is the placement of the wellhead. In the areas of the Reserve where military activity takes place, the wellhead is placed approximately 2 m below the surface. It is surrounded by a thick corrugated pipe that reaches to the surface. The top of the pipe is covered by a heavy grating capable of withstanding the full weight of a Chieftan Tank and the grating is covered by plywood to protect any animals that might wander into the wellsite (Lowry 1981:47). Another simple clean-up is done and the wellsite is left until the arrival of the pipeline that will connect it to the gathering system. In Study Area 4 the wellsite in LSD 6 was drilled in the summer of 1979 and the wellsite in LSD 16 was drilled in the summer of 1980.

7.3.3 Pipelines

The last step in the recovery of natural gas comes with the connection of the pipeline to the wellhead. All pipelines on the Reserve are constructed within a 15 m wide right-of-way and before construction can commence the right-of-way has to be examined by an archaeologist. The archaeologist can then either clear the right-of-way or recommend relocation or excavation in the same manner as is done with wellsites. In Study Area 4, a short section of the pipeline right-of-way to the wellsite in LSD 16 was relocated to avoid an archaeological site noted by the author (Dau 1981a).

The procedures involved in laying pipelines on the Reserve have followed two patterns. Initially, all pipelines were laid in a trench excavated by specialized equipment. The trench followed the center of the staked right-of-way and was approximately 60 cm in width and 150 cm in depth. The pipe was laid in the bottom of the trench and covered over with earth by a bulldozer. This procedure often resulted in the total destruction of the prairie surface within the right-of-way.

The destructive nature of this type of pipeline construction presented extensive problems for AEC in the environmentally sensitive area of the Middle Sand Hills. The damage created was expensive to correct and required post-clean-up monitoring. As a result, a second method of laying pipe was experimented with, beginning in 1980. This procedure involved a specially designed plough pulled by several bulldozers. The plough digs into the earth to the correct depth and pulls the pipe underground behind it, resulting in a small amount of surface damage that is

easy to clean up. Although it was designed for use in the Middle Sand Hills, the plough is at present laying pipeline wherever possible on the whole Reserve.

Natural gas from a series of wells on the Reserve flow into a system of pipelines called a "gathering system". One or more gathering systems carry gas to one of 9 Compressor Stations situated on the borders of the Reserve. Here, the gas is pumped up to a pressure that allows it to flow into the main lines that carry it to prospective markets in Canada and the United States. The pipelines in Study Area 4 were laid in the fall of 1980 using the "trench" method. They are connected to a gathering system that transports gas to Compressor Station "C" situated in the southwest corner of the Reserve.

Upon completion of all development activities in a specific area, AEC is required to undertake an extensive clean-up and reclamation program. Unfortunately, at present, the clean-up procedures completed by AEC are only minimal. In the Sand Hills, attempts are made to restrict travel along a pipeline right-of-way or across a wellsite until some type of vegetation regeneration has occurred. These attempts are not carefully monitored, however, and rarely extend beyond the Sand Hills.

For the majority of wellsites and pipelines, clean-up procedures are simplified. This includes re-seeding the disturbed areas to grass, but does not include follow-up monitoring when the grasses fail to take hold. In Study Area 4, the two wellsites drilled and their attendant access roads encompassed a total of 25,950 square metres of land. Of this approximately 11,600 square metres had the original prairie sur-

face removed and, at present, there is no evidence that the areas have been reseeded to grass.

The problems with reclaiming land in pipeline right-of-ways is compounded by the fact that the vast majority are used as access roads by AEC and others. As a result, it is almost impossible for reseeded grasses to take hold. In Study Area 4, the pipeline rights-of-way encompassed 25,000 square metres of land, 20,000 of which had been totally disturbed. In a selected sample of collection zones the density of dominant grasses was calculated, both inside and immediately outside of the disturbed portions of the rights-of-way. The results show that the average density of the dominant grasses in the undisturbed areas was approximately 4,800 plants per square metre. Within the disturbed areas the density drops dramatically to 1,400 plants per square metre. Although this difference is due primarily to the length of time needed to regenerate the full grass cover, it is also due to the fact that both rights-of-way in Study Area 4 serve as continuously utilized access roads.

7.3.4 Other Developments

While the activities directly associated with the drilling for and production of natural gas represent the heaviest utilization of the land surface of the Reserve, there are other development features that are important. The most noticeable of these are the roads. Prior to the arrival of AEC, most of the Reserve was accessible only seasonally along a few roads that were little more than bulldozed trails. In order to properly exploit the natural gas resources of the area AEC was required to upgrade many of these roads. Upgrading consisted of digging ditches

to facilitate all-weather travel, straightening sharp curves and gravelling road surfaces where necessary. This upgraded system was not extensive enough, however, and between 1977 and 1980 AEC constructed a network of almost 300 km of high-grade gravel roads.

In Study Area 4, both an upgraded existing road and a new high-grade gravel road are present. Crossing the north boundary of the study area (see Figure 14) is Dugway Trail. It stretches the entire width of the Reserve, along the boundary between Townships 15 and 16 and the portion passing through the study are was upgraded either in 1980 or 1981. In Study Area 4 it varies from 18 m to 25 m in width and encompasses 34,000 square metres of totally disturbed prairie.

Running in a north-south direction along the western edge of Study Area 4 is Pronghorn Road (see Figure 14), which was built by AEC in 1978 to provide all-weather access for development area C. Like all major access roads on the Reserve, Pronghorn Road was constructed within a 20 metre wide right-of-way and encompasses a total of 32,000 square metres of land surface. The road is bordered by ditches varying from 100 cm to 150 cm in depth and it is perhaps the most heavily utilized access road in Area C.

As has already been mentioned, AEC is responsible for a certain amount of environmental restoration on the Reserve. It is not clear at present, however, whether this responsibility includes the reseeding of ditches along major access roads. In Study Area 4 it appears that no attempt has been made to accomplish this and the ditches are often full of weeds and tumbling mustard.

The final indicator of energy development in Study Area 4 is a small (3,025 square metre) portion of land at the junction of Pronghorn Road and Dugway Trail (see Figure 14). Surrounded by a deep fireguard, this area has been utilized by AEC and its sub-contractors as a storage point for equipment and vehicles since 1978. Approximately 88% of the natural grass cover in the area has been disturbed and those grasses that remain are being choked out by a succession of annual weeds. Disturbance zones such as this are not common on the Reserve due to the restrictions placed by the military on equipment storage, but they occasionally occur at the junctions of major access roads.

The search for and production of natural gas on the Suffield Reserve is a land intensive operation. Depending upon changes in the economy and the political structure, the number of wells (and their connecting pipelines) on the Reserve could be doubled or even quadrupled. This fact strongly suggests that the disturbances to the environment created by energy development will very likely increase rather than decrease over the next few decades.

7.4 Comments

In most respects the work done by AEC on the Reserve is similar to that done by other energy developers in Alberta. There are a few important differences and these create both advantages and disadvantages for AEC. One of the biggest problems faced by most energy developers is the need to create friendly relations with the owners of the land upon which drilling operations take place. Few of these can prevent such work as virtually all mineral rights are held by the province. They can, however,

cause difficult access problems and demand extensive clean-up operations. On the Reserve, AEC does not have this problem. They have signed an access agreement with the only land owner in the entire area, the Department of National Defence, and have learned to cooperate with the military in a commendable fashion. This cooperation has flourished despite the fact that AEC must adhere to military training schedules and must maintain, at its own expense, entrance and safety facilities.

A problem that is not often faced by most energy developers in Alberta is that of general access to their development locales. Much of the province is serviced by a reasonable road network, but on the Reserve this was initially not the case. As a result, AEC was required to commit development funds for the upgrading of existing roads and the construction and maintenance of hundreds of kilometres of new road.

The access agreement signed by AEC in 1975 also included a series of very strict environmental regulations. At first they were far more demanding than those required for other energy developers in Alberta, but over the last eight years the situation has become more balanced. Because it was assumed that AEC would follow (to the letter) the regulations set down in the agreement, they were allowed to develop the energy resources in the environmentally sensitive areas of the Middle Sand Hills and South Saksatchewan River. To date, AEC has done only the barest minimum of clean-up and environmental reclamation and, in some places, has created so much disturbance that it may take several decades before the prairie surface even begins to recover.

Like the military, AEC does not intentionally ignore the environment. It is well aware of the disturbances created by the search for

and production of fossil fuels but (like all large corporations) it attempts to cut costs in all areas felt to be non-essential. Also; it is only rarely that the knowledge of the need for environmental protection reaches down from the administration of the company to the field personnel responsible for the disturbance in the first place. Perhaps only in the process of protecting the archaeological resources of the Reserve has knowledge reached all levels of AEC. This is due to the well developed lines of communication created between AEC and the archaeologists working on the Reserve and demonstrates that friendly co-operation between developers and environmentalists is possible.

It must be noted that AEC does attempt to maintain minimum environmental standards, but over the last eight years they have realized that minor infractions are rarely noticed. Such infractions have now become common. They are due, in part, to the vast size of the Reserve, to the quantity of work done and to the limitied monitoring done by the watch-dog committee SEAC. They may also be due to the adoption by many AEC personnel of the military's attitude towards the Reserve, that it is an almost useless wasteland cared about by no one.

Unfortunately this is an attitude that is unlikely to change quickly. The economic viability of energy development will probably always override environmental protests. In 1981, AEC received over $200 million from sales of oil and natural gas (AEC 1982:32), a large portion of which came from the Reserve. This kind of financial situation virtually assures AEC's presence as an important user of the Suffield Military Reserve at least until the end of this century.

SECTION 8

CONCLUSIONS AND COMMENTS

The primary purpose of this study was to examine how four distinct human groups utilized the environment of the Suffield Military Reserve. Based upon the concept of human ecology, the study was able to include data and methodology from a variety of disciplines, including Archaeology, Anthropology/Ethnology, Geology, Geography, History and Environmental Sciences. Each of the selected human groups was discussed from a different perspective utilizing one or more of the above disciplines.

The study of the prehistoric native occupants dealt almost exclusively with archaeology and ethnology and involved the collection and manipulation of a sizeable amount of archaeological data. Because of the hypothetical nature of virtually all archaeological studies, it was difficult to arrive at definite conclusions. The material presented did serve, however, to indicate that it is possible to collect important data on prehistoric land utilization from surface stone features that are not rich in artifacts. With the help of such information, combined with a strong understanding of the physical environment, it was possible to provide corroborative evidence for the hypothesis that most of the Suffield Reserve was utilized by the natives for short-term hunting camps during the spring, summer or fall.

There are a few problems encountered when discussing the effect upon the environment of prehistoric native occupation. While the natives' social institutions may have been complex, their technology was limited. As a result, they were forced to cope with rather than modify, in any

significant way, the harsh environment of the Northern Plains. They developed a mobile society that could take every advantage of the seasonally abundant resources of the area, and their small population apparently created little or no environmental disturbance. Whatever damage that may have been created has been repaired by nature in the 250 years since the end of the prehistoric period.

The sections that dealt with the period from 1725 to 1909 and with the homestead period from 1909 to 1941 were primarily historical in orientation. Both suffered somewhat from the fact that detailed historical data concerning the Suffield Reserve are lacking. It was possible, however, to indicate how the natives reacted to the arrival of Europeans and how the Europeans themselves changed their opinions of the Northern Plains in the mid-Nineteenth Century.

For the homesteaders, it was possible to provide a partial explanation for the failure of agriculture in the area. Contrary to popular opinion, it was not the arrival of the military in 1941 that ended the agricultural process. Apparently it was doomed to failure almost from the beginning. Raised in the traditions of European small-farming or American high production, the majority of homesteaders were not equipped, technologically or psychologically, to cope with the Northern Plains' environment. They expected a fertile heaven; what they found was a dry rocky grassland. This unpreparedness, combined with Bennett's (1969:9-11) suggestions that their farming style was too sedentary and relied too heavily upon wheat and cattle as sources of income, made life almost impossible in the area. Bennett (1969) does show, however, that given

enough time, many homesteaders were able to adapt to the Northern Plains and were able to create economically viable farming communities. Whether or not this would have happened on the Suffield Reserve is an academic question as the military put an end to the process in 1941.

The study of the military involved both a brief historical examination and a discussion of present-day environmental disturbances created by military activity. The material presented also indicated that the arrival of the military in 1941 (and the creation of the physical boundaries of the Reserve) created a sharp change in attitudes toward the area. It was no longer viewed simply as another rural district, similar to countless others, but as an important strategic locale at both the national and international level. The Reserve became a type of hinterland, exploited by the metropolitan-based military authorities in Ottawa and London. The arrival of the BATUS training groups in 1971 did nothing to lessen this attitude. The nature of BATUS training is short-term and seasonal and most military personnel see their time on the Reserve as a period of "roughing it" in the wilderness before returning to the "real" world. To a certain extent the apparent disinterest in environmental protection exhibited by the military comes from this attitude.

The examination of the use made of the Reserve by the energy developers (especially AEC) was most heavily involved with environmental science. Because AEC utilizes the largest percentage of the Reserve, the effects upon the environment of its type of development are most widespread. This factor made it important to determine why the energy developers exhibit an apparent lack of interest in environmental protec-

tion.

The idea of the Reserve as an exploitable hinterland did not change radically with the arrival of AEC in 1975. None of AEC's personnel live permanently on the Reserve and the company has used all the resources of a highly developed technology to override the harsh environment. While variations in weather and soil conditions (or persistent archaeologists) may halt development for short periods of time, it eventually continues. Like the military, AEC's personnel see themselves as working "out in the wilds" and the energy resources of the area go towards the fostering of a national rather than local developmental policy. This attitude along with the economic viability of energy development has created a certain amount of disinterest in the need for extensive environmental protection.

It seems appropriate at this point to expand slightly upon a concept that has threaded its way throughout this paper. This concept reflects one of the basic tenets of Canadian historiography, the idea of a Frontier/Metropolitan developmental progression in western Canada. The data presented in this paper indicate that since the beginning of the fur trade period the resources of the Reserve (defined here as the "Frontier") have been exploited by, and the environment disturbed at the behest of, the "Metropolis" (defined here as eastern Canada or Britain) rather than the local populations.

The resources of the fur trade went, via the Hudson's Bay Company, to London. The change in attitude towards the Northern Plains that came about in the 1850s was created by eastern Canadian politicians and businessmen. "Free range" ranching was financed from Britain with the idea of

increasing British economic power. Also, the pressure towards homestead settlement that began in 1909 was intended to improve the economies of both the Federal and Provincial governments.

With the arrival of the military in 1941, London once again became the chief exploiter and disruptor of the environment of the Reserve, replaced in 1947 by Ottawa. Finally, the process of fossil fuel recovery, while directed from Edmonton, is designed to assist an energy program developed in Ottawa. What is perhaps most interesting about this hypothesis (in terms of the Reserve) is that corroborative data for the Frontier/Metropolitan idea can be gathered from an area as small as one square mile, an extremely tiny fraction of the entire Northern Plains.

What, then, does the future hold for the Suffield Military Reserve. Should the environment be protected and if so, how? Both of these questions are difficult to answer as they involve adjusting the deeply rooted attitudes of both the politically supported military and the economically powerful energy developers. Some of the data presented in this study do, however, indicate the probable future of the Suffield Military Reserve and provide some suggestions concerning what should be done to protect the environment.

The political situation on both the national and international level strongly indicates that the Suffield Reserve will remain a military base until at least the expiry of the current BATUS training agreement in 1991, and probably until the end of the century. In addition, even though depressed at this time (1983), the nature of the economy of the western

world strongly suggests that AEC's activities will continue in some form on the Reserve. These are the two heaviest disturbers of the environment and there is no indication, at present, that this disturbance will decline in the near future. For those who are interested in protecting the environment, these factors must be taken into consideration.

Any evaluation of the need for environmental protection must also include the fact that, as of 1983, there are few areas of the Reserve that can be considered as "untouched" or "natural" prairie. The process of changing the land surface began with the arrival of the homesteaders in 1909 and has continued for 74 years. Many of the arguments for closing the Reserve, put forth by environmentalists, are based upon the false assumption that large portions of the area remain as natural prairie zones. This is definitely not the case.

The situation is by no means completely bleak, however. While those who wish to protect the Reserve's environment have almost overwhelming oppostion at present, there is no indication that this will continue indefinitely. It is possible that, in the future, the political and social power of the environmentalist will outweight the political and economic power of both the military and the energy developers. Until that time arrives, the chief operating principle of environmentalists on the Reserve must be one of cooperation. Like the prehistoric native occupants of the area, they must learn to cope with, rather than fight, the system.

The environmental studies done in the early 1970s that led to the creation of the two military Out-of-Bounds zones and the ongoing pro-

tection policy of AEC towards the archaeological resources of the Reserve are strong indicators that a cooperative protection/utilization agreement is possible. Exactly what form this agreement might take is a difficult problem to assess. It is the personal opinion of the author, however, that the prime operative factor in the development of a protection/utilization policy is the changing of the attitudes of the environmentalists, the military and the energy developers. For the environmentalists, attempts should be made to inform them of the political and economic necessities of continuing both military and energy development activities. Also, all administrative and filed personnel levels of both the military and the energy development companies should be informed of the need for increased protection of the environment of the Reserve. Of course, it will be difficult to change the deeply rooted attitudes that these groups have and it will require concerted effort on behalf of all the parties involved. If successful, however, important military and energy development activities should be able to continue in conjunction with an increased protection plan for the environment.

The study that has been presented here has been only one of many that have been conducted on the Suffield Reserve. The majority of the others, however, have dealt with only one specific aspect of the environment or one specific human group. Few have attempted, as in this case, to provide an overview of land utilization patterns through time across the entire Reserve. Such studies are important if a complete picture of this area is to be achieved and it is the firm opinion of the author that much more research must be done. Fortunately, the Suffield Military

Reserve encompasses a vast area and remains a rich locale for the collection of data that relate to the interactions between humans and the harsh environment of the Northern Plains.

BIBLIOGRAPHY

Adams, Gary

1976 Prehistoric survey of the lower Red Deer river, 1975. Archaeological Survey of Alberta Occasional Paper No. 3. Edmonton.

1978 Tipi rings in southern Alberta: the Alkali Creek sites lower Red Deer river. Archaeological Survey of Alberta Occasional Paper No. 9. Edmonton.

Alberta Energy Company Ltd. (AEC)

1976 Annual report for 1975. Published by the Alberta Energy Company Ltd., Edmonton.

1978 Annual report for 1977. Published by the Alberta Energy Company Ltd., Edmonton.

1982 Annual report for 1981. Published by the Alberta Energy Company Ltd., Edmonton.

Anderson, Samuel

1876 The North American boundary from the Lake of the Woods to the Rocky Mountains. Proceedings of the Royal Geographical Society Volume XV, Session 1875-76: 274-296.

Arthur, George W.

1975 An introduction to the ecology of early historic communal bison hunting among the northern Plains indians. National Museum of Man Mercury Series No. 37. Ottawa.

Bennett, John W.

1969 Northern plainsmen: adaptive strategy and agrarian life. Aldine Publishing Company, Chicago.

Bilodeau, Paul

1979 A look at activities on the Suffield Reserve. The Medicine Hat News. Wednesday, March 28:3.

Borden, Charles E.

1952 A uniform site designation scheme for Canada. Anthropology in British Columbia. No. 3:44-48. British Columbia Provincial Museum, Victoria.

Boswell, W.H.

1969 Climate of Suffield 1942-1967. Project D-32-01-10 DRES. Department of National Defence, Ottawa.

Boughey, Arthur S.

1975 Man and his environment: an introduction to human ecology and evolution. Second Edition. MacMillan Publishing Co., Inc. New York.

Bray, Colin

1960 Articles on early ranches in southern Alberta. Manuscript copy on file with the Glenbow Alberta Instotute Public Archives, Calgary.

Breen, David H.

1972 The Canadian west and the ranching frontier 1875-1922. Unpublished Ph.D. dissertation, Department of History, The University of Alberta, Edmonton.

Brumley, John H.

1973 Suffield archaeological project: preliminary report. Manuscript copy on file with ETHOS Consultants Ltd., Medicine Hat.

1975 The Cactus Flower site in southeastern Alberta: 1972-1974 excavations. National Museum of Man Mercury Series No. 46. Ottawa.

1976 Ramillies: a Late Prehistoric bison kill and campsite located in southeastern Alberta. National Museum of Man Mercury Series No. 55. Ottawa.

Brumley, John H. (continued)

1978 An inventory and evaluation of archaeological resources examined within energy development locations on the Suffield Military Reserve between July 1 and December 31, 1977. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

1979 A summary of energy development locations examined for archaeological sites on the Suffield Military Reserve, Alberta during 1978. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

Brumley, John H. and Laurie Milne Brumley

1977 An inventory and evaluation of archaeological resources examined within energy development locations, Suffield Military Reserve, Alberta. Report prepared for and on file with the Alberta Energy Company Ltd., Clagary.

Brumley, John H. and Stanley Saylor

1979 Report on evaluation excavations conducted at archaeological site EeOr-63. Report prepared for and on file with Westcoast Petroleum Ltd., Calgary.

Brumley, John H. and Barry Dau

1980 A summary of energy development locations examined for archaeological sites on the Suffield Military Reserve, Alberta during 1979. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

Brumley, John H., B.J. Dau and Leigh Heikkila

1981 1976 to 1980 salvage investigations on the Suffield Military Reserve, Alberta. 3 Volumes. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

Burpee, Lawrence J.

1907 York Factory to the Blackfeet country - journal of a journey performed by Anthony Henday. Proceedings and Transactions of The Royal Society of Canada. Third Series Volume 1:307-364.

1908 An adventurer from Hudson's Bay - journal of Matthew Cocking from York Factory to the Blackfeet country 1772-73. Proceedings and Transactions of the Royal Society of Canada. Third Series, Volume II, Section II:89-121.

Calder, James M.

1977 The majorville cairn and medicine wheel site, Alberta. National Museum of Man Mercury Series No. 62. Ottawa

1979 Archaeology in southern Alberta: stone circles at Chin Coulee Archaeological Survey of Alberta Occasional Paper No. 13. Edmonton.

Campbell, Stanley

1915 The Cheyenne tipi. American Anthropologist 17:685-694.

Campbell, Walter Stanley

1927 The tipis of the Crow indians. American Anthropologist 29:87-104.

Catlin, George

1841 Letters and notes on the manners, customs and conditions of the North American indians. 2 Volumes. Reprinted 1965 by Ross and Haines Inc., Minneapolis.

Common, R.

1967 Early settlement about Medicine Hat, Alberta. Geographical Bulletin 9(3):284-293.

Cook, Sherburne F. and Robert F. Heizer

1968 Relationships among houses, settlement areas and population in aboriginal California. In Settlement Archaeology, edited by K.C. Chang. pp. 79-116. National Press Books, California

Coupland, Robert T.

1961 A reconsideration of grassland classification in the northern Great Plains of North America. Journal of Ecology 49:135-167.

Coupland, Robert T. (editor)

1979 Grassland ecosystems of the world: analyses of grasslands and their uses. Cambridge University Press, London.

Cummins Map Company

1918 Cummins rural directory maps for Alberta. Published by the Cummins Map Company, Winnipeg.

1927 Cummins rural directory maps for Alberta. Published by the Cummins Map Company, Winnipeg.

Dau, Barry J.

1981a A summary of energy development locations examined for archaeological sites on the Suffield Military Reserve, Alberta during 1980. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

1981b Three methods or rapidly recording and testing archaeological sites. Megaliths to Medicine Wheels. pp 39-46. Papers of the Eleventh Annual Chacmool Conference, the University of Calgary.

Dawson, George Mercer

1875 Report on the geology and resources of the region in the vicinity of the 49th parallel from the Lake of the Woods to the Rocky Mountains. Dawson Brothers, Montreal.

Defence Research Board

1961 Suffield experimental station, Ralston Alberta 1941-1961. Published by the Defence Research Board of Canada at Ralston, December 1961.

Dunlop, J.S.

1970 Changes in the Canadian wheat belt 1931-1969. Geography 55:156-168.

Dyck, Ian G.

1977 The Harder site: a middle period bison hunters campsite in the northern Great Plains. National Museum of Man Mercury Series No. 67. Ottawa.

Ericksen, L.P.

1969 Personal sketch on the Canadian Wheatland Company and Suffield Alberta. Manuscript copy on file with the Glenbow Alberta Institute Publis Archives, Calgary.

Ewers, John C.

1955 The horse in Blackfoot culture, with comparative material from other western tribes. Smithsonian Institute Bureau of American Ethnology, Bulletin 159.

1958 The Blackfeet: raiders of the northwestern plains. University of Oklahoma Press, Norman.

1966 The importance of the buffalo to plains indian culture. Wyoming Archaeologist IX(1):21-26.

Finnigan, James T.

1981 Tipi rings and plains prehistory: a reassesment of their archaeological potential. M.A. Thesis, Department of Anthropology and Archaeology. The University of Saskatchewan, Saskatoon.

Fitch, James Morton and Daniel P. Branch

1960 Primitive architecture and climate. Scientific American 203(6):134-144.

Flayharty, R.A. and Elizabeth Ann Morris

1974 T-W Diamond, a stone ring site in northern Colorado. Plains Anthropologist 19(65):161-175.

Frison, George C.

1978 Prehistoric hunters of the high plains. Academic Press Inc., New York.

1981 Linear arrangements of cairns in Wyoming and Montana. Megaliths to Medicine Wheels. pp 133-147. Proceedings of the Eleventh Annual Chacmool Conference. The University of Calgary.

Geier, Clarence R.

1974 Some ecological aspects and their implications for settlement archaeology. Plains Anthropologist 19(63):45-54.

George, Ernest S.

1955 Ranching in southern Alberta. Alberta Historical Review 3(2):33-39.

Gershaw, Senator F.W.

n.d. A brief history of southern Alberta: the shortgrass area. Manuscript copy on file with the Medicine Hat Public Library, Medicine Hat.

1967 Saamis: the medicine hat. Val Marshall Printing Ltd., Medicine Hat.

Gilbert, B. Miles

1969 Some aspects of diet and butchering techniques among prehistoric indians in South Dakota. Plains Anthropologist 14(46):277-294.

Glover, Richard (editor)

1962 David Thompson's Narrative 1784-1812. The Champlain Society. Toronto.

Government of Alberta

1969 Atlas of Alberta. Government of Alberta Publication. The University of Alberta Press.

GrassPointer, Andreas

1980 Archaeology and ethno-history of the Milk River in southern Alberta. Western Publishers. Calgary.

Grinnell, G.B.

1901 The lodges of the Blackfeet. American Anthropologist 3:650-658.

Hargrave, Thomas A.

n.d. Early ranching in the Medicine Hat area. Manuscript copy on file with the Glenbow Alberta Institute Public Archives, Calgary.

Hind, Henry Youle

1860 Narrative of the Canadian Red River exploring expedition of 1857 and of the Assiniboine and Saskatchewan exploring expedition of 1858. 2 Volumes. Longman, Green, Longman and Roberts. London.

Ingles, Ernest Boyce

1973 Some aspects of dry-land argriculture in the Canadian prairies to 1925. Unpublished M.A. Thesis, Department of History, The University of Calgary.

Johnson, Alice M. (editor)

1967 Saskatchewan journals and correspondence: Edmonton House 1795-1800; Chesterfield House 1800-1802. The Hudson's Bay Record Society. London.

Johnson, Paul

1974 Hargrave seeks Suffield repreive. The Calgary Herald. Saturday, March 9:54.

Kehoe, Thomas F.

1958 Tipi rings: the direct ethnological approach applied to an archaeological problem. American Anthropologist 60(5):861-873.

1960 Stone tipi rings in north-central Montana and the adjacent portion of Alberta, Canada: their historical, ethnological and archaeological aspects. Smithsonian Institution, Bureau of American Ethnology Bulletin 173. Paper No. 62:421-474.

Kelly, L.V.

1913 The range men: the story of the ranchers and indians of Alberta. William Briggs. Toronto.

Keyser, James D.

1979a Variation in stone ring use at two sites in central Montana. Plains Anthropologist 24(84):133-143.

1979b Late Prehistoric period bison procurement on the Milk River in north-central Montana. Archaeology in Montana 20(1):1-161.

Lamb, W.K. (editor)

1957 Sixteen years in the indian country: the journal of Daniel Williams Harmon 1800-1816. The MacMillan Company of Canada Ltd., Toronto.

Larson, Floyd

1940 The role of bison in maintaining the short grass plains. Ecology 21(2):113-121.

Lewis, Oscar

1942 The effects of white contact upon the Blackfoot culture: with reference to the role of the fur trade. American Ethnological Society Anniversary Publication. The University of Washington Press.

Levine, Norman D.

1975 Human ecology. Dusbury Press. Massachusetts.

Lowry, D. Jean (Hardy Associates 1978 Ltd.)

1981 Drill rigs, tanks and pronghorns: the Suffield Military Reserve. Report prepared on behalf of the Alberta Department of the Environment, Edmonton.

Lupton, A.A.

1967 Cattle ranching in southern Alberta 1874-1910: its evolution and migration. Alberta Geographer 3:48-58.

Malouf, Carling

1961 The tipi rings of the high plains. American Antiquity 26(3) Part 1:381-389.

1962 Stone piles. Archaeology in Montana 3(4):1-5.

1966 Tipi rings. Wyoming Archaeologist IX(4):4-6.

Martin, Chester

1938 Dominion lands policy. Canadian Frontiers of Settlement II(II):191-571. The MacMillan Company of Canada Limited, Toronto.

MacGregor, J.G.

1966 Peter Fidler: Canada's forgotten surveyor 1769-1822. McClellan and Stweart Limited, Toronto.

Mackintosh, W.A.

1934 Prairie settlement: the geographic setting. Canadian Frontiers of Settlement I. The MacMillan Company of Canada Limited, Toronto.

1935 Economic problems of the prairie provinces. Canadian Frontiers of Settlement IV. The MacMillan Company of Canada Limited, Toronto.

McHugh, Tom

1958 Social behaviour of the American buffalo (Bison bison bison). Zoologica 43(1):1-40.

McPherson, R.A.

1972 Surficial geology, Medicine Hat 72L. Research Council of Alberta Map, Scale 1:250,000. Edmonton.

Morris, Alexander

1880 The treaties of Canada with the indians. Belfors, Clarke and Co. Publishers, Toronto.

Morrow, J.W.

1923 Early history of the Medicine Hat country. Manuscript copy on file with the Medicine Hat Public Library, Medicine Hat.

Morton, Arthur S.

1938 History of prairie settlement. Canadian Frontiers of Settlement II(I):1-186. The MacMillan Company of Canada Limited, Toronto.

Mulloy, William

1952 The northern plains. Archaeology of the Eastern United States. Edited by J.B. Griffin. University of Chicago Press.

1966 Late prehistoric stone circles. Wyoming Archaeologist IX(4):2-3.

Murchie, R.W.

1936 Agricultural progress on the prairie frontier. Canadian Frontiers of Settlement V. The MacMillan Company of Canada Limited, Toronto.

Nelson, J.G.

1967 Man and landscape changes on the western plains of Canada. Canadian Geographer XI(4):251-264.

1973 The Last Refuge. Harvest House, Montreal.

NewComb, William W. Jr.

1974 North American indians: an anthropological perspective. Texas Memorial Museum, Austin.

Owram, Doug

1981 The promise of eden: the Canadian expansionist movement and the idea of the west 1856-1900. The University of Toronto Press.

Pan Canadian Petroleum Limited

1981 Alberta's first natural gas discovery. Information booklet published for the centenary of the Canadian Pacific Railway. Lawson Graphic Western Limited.

Pennie, A.M.

1963 A cycle at Suffield. Alberta Historical Review 11(7):7-11.

Quigg, J. Michael

1978 Tipi rings in southern Alberta: the Lazy Dog tipi ring site. Archaeological Survey of Alberta Occasional Paper No. 8. Edmonton.

1981 Stone circle excavations in Alberta to 1978. Megaliths to Medicine Wheels. pp 47-67. Proceedings of the Eleventh Annual Chacmool Conference, the University of Calgary.

1982 Ross Glen: mitigation of a Besant stone circle site in Alberta. Report prepared for and on file with Hat Development, Medicine Hat.

Quigg, J.M. and John H. Brumley

1982 Stone circles, a revue, appraisal and future directions. 3 Vols. Report prepared for the Division of Archaeology and Historic Preservation, State Historical Society of North Dakota, Bismarck.

Quinn, James A.

1971 Human ecology. The Shoe String Press, Hamden Connecticut.

Ray, Arthur J.

1974 Indians in the fur trade: their role as trappers, hunters and middlemen in the lands southwest of Hudson's Bay 1660-1870. The University of Toronto Press.

Reher, Charles A.

1977 Adaptive process on the shortgrass plains. In For theory building in archaeology. pp 1-35. Edited by L.R. Binford. Academic Press, New York.

Reeves, Brian O.K.

1969 The southern Alberta paleo-cultural, paleo-environmental sequence. Post-pleistocene man and his environments on the northern Plains. pp 6-46. The Student's Press, Calgary.

1978 Head-Smashed-In: 5500 years of bison jumping in the Alberta plains. Bison procurement and utilization: a symposium. pp 151-174. Plains Anthropologist Memoir No. 14, Lincoln.

Robinson, H.M.

1879 The great fur land or sketches of life in the Hudson's Bay territory. Facsimilie edition published 1972 by Coles Publishing Company, Toronto.

Roe, Frank G.

1934 The extermination of the buffalo in western Canada. Canadian Historical Review XV(1):1-23.

1939 From dogs to horses amon the western indian tribes. Proceedings and Transactions of the Royal Society of Canada Third Series XXXIII(II):209-275.

1955 The indian and the horse. University of Oklahoma Press.

1970 The North American buffalo: a critical study of the species in its wild state. Second Edition. The University of Toronto Press.

Salt, W. Ray

1966 The birds of Alberta. Second Edition. Department of Industry and Development. The Queen's Printer, Edmonton.

Saylor, Stanley G.

1982 Archaeological examinations of energy development locations within the Suffield Military Reserve, Alberta during 1981. Report prepared for and on file with the Alberta Energy Company Ltd., Calgary.

Sargent II, Frederick

1974 Nature and scope of human ecology. In Human ecology. pp 1-25. Edited by Frederick Sargent II. American Elsevier Publishing Company Inc., New York.

Smith, Marc B.

1974 Rapid method for recording stone circles. Archaeology in Montana 15(3):47-48.

Soper, J. Dewey

1964 The mammals of Alberta. The Hamly Press Ltd., Edmonton.

Stelfox, J.G.

1977 Effects of livestock grazing on mixed prairie range and wildlife within PFRA pastures, Suffield Military Reserve. Report prepared by the Range-Wildlife Study Committee, Edmonton.

Stevens, W.E., J.G. Stelfox and A.A. Kjearsgaard

1971 Environmental considerations on the use of the Suffield Military Reserve for tank and artillery training. Report prepared for the Canadian Wildlife Service, Edmonton.

Spry, Irene M.

1963 The Palliser expedition: an account of John Palliser's British North American Exploring expedition of 1857-1860. The MacMillan Company of Canada Limited, Toronto

Strange, H.G.L.

1954 A short history of prairie agriculture. Published by the Searle Grain Company Limited, Winnipeg.

Suffield Block Study Committee (SBSC)

1972 A resource evaluation: Suffield Block. Report prepared for the Province of Alberta, Edmonton.

Thomas, Bob

1971a Suffield: ranchers, archaeologists want to keep tanks out. The Calgary Herald. Tuesday, October 19:21 and 34.

1971b Suffield "British Block" wiped out many homesteads. The Calgary Herald. Wednesday, October 20:33.

Thomas, David and Karin Ronnefeldt.

1976 People of the first man. E.P. Dutton and Co., New York.

Wallis, C.

1977 Red Deer resource evaluation. Report prepared for the Resource Assessment and Management Section, Parks Planning and Design Branch, Alberta Parks, Recreation and Wildlife. Edmonton.

Watts, F.B.

1960 The natural vegetation of the southern Great Plains of Canada. Geographical Bulletin 14:25-43.

Wedel, Waldo

1963 The high plains and their utilization by the indians. American Antiquity 29(1):1-16.

Wilmeth, Roscoe

1978 Canadian archaeological radiocarbon dates (revised edition) National Museum of Man Mercury Series No. 77. Ottawa.

Wissler, Clark

1910 Material culture of the Blackfoot indians. Anthropological Papers of the American Museum of Natural History. Volume V, Part 1.

1914 The influence of the horse in the development of plains culture. American Anthropologist 16(1):1-25.

Wormington, H.M. and R.G. Forbis

1965 An introduction to the archaeology of Alberta, Canada. Denver Museum of Natural History, Denver.

APPENDIX

Prairie Fires, Humans, and the Northern Plains

Few people who have witnessed a large prairie fire in progress or observed the aftermath of such an event can forget how awe-inspiring such a process can be. For virtually all the human occupants (both past and present) of the Northern Plains the prairie fire was important and, as Nelson and England (1971:295) have pointed out, any study of the relationship between humans and the environment must take into account the effects of fire.

The importance to, and impact of, prairie fires on a specific human group has depended upon the cultural orientation and technological sophistication of that group. For the prehistoric native occupants of the Northern Plains, fires were undoubtedly more important than they are for modern western Canadian agriculturalists (Nelson 1973:138). Also, the effects of fire on the landscape itself was probably greater before the development of a European farming society.

One surprising aspect of the data that are available for study is that they suggest humans may have held a greater responsibility for setting fires than natural causes. Both Arthur (1975) and Nelson and England (1971) have noted that perhaps the only natural cause of prairie fires is lightning. Both note, however, that the information on such events is limited and often unreliable. Whatever the cause, it is apparent that fires may have played an important role in maintaining the geographical extent of the grassland biome.

Arthur (1975:20-25) has examined a number of reports on the effects of fires on grasslands and all indicate that the size and intensity of

such events would be sufficient to prevent the growth of trees on the open plains. Fires burning over an area only bi-annually would be more than adequate to prevent the growth of seedlings by destroying not only the above-ground suckers but the developing root systems as well. It is interesting to note that both David Thompson in the 1780s (Glover 1962: 24-25) and Henry Hind in the 1850s (Hind 1860 Vol. 1:337) suggested that the plains maintained their size in this manner. Both Arthur (1975) and Nelson and England (1971) also note that the present-day southward movement of the Plains/Parkland border and the eastward extension of the Foothills forests may be due, in part, to the prevention of extensive prairie fires.

Data on the use of fire by the native occupants of the Northern Plains are fairly extensive and quite interesting. Nelson and England (1971:297) have noted that in 1792, Peter Fidler found the native setting fires by accident, for ceremonial purposes, as offerings for fair weather, to note the success of a hunt, and to control the bison. Palliser in 1858 (Spry 1963) also noted the natives firing the plains for such trivial purposes as signalling the success of a war party or a hunt.

By far the most sophisticated use that the natives made of fire, however, was in the process of controlling and/or hunting bison. It appears that some native groups would burn large areas in the fall, providing green forage in the spring and thus attracting bison to a specific locale (Hind 1860 Vol. 2:107). Arthur (1975:24-25) notes native groups in all areas of the Northern Plains utilizing this process. In addition, prairies fires were set in order to move bison to new grazing areas and Arthur (1975:22) also comments that during the historic period

the natives often started fires around trading posts to drive off the local bison herds and make their provisions more valuable to the European trader/explorers.

During communal hunts, fire could be utilized in two ways. Fires were used as barriers to surround small herds of bison, which were then funnelled through an opening in the fire-wall to a specific kill locale. Also, where large bison jumps or kills were utilized, fires would be set in various areas in order to drive the bison into the gathering lanes that led to the kill site (Arthur 1975:23). It is important to remember that in order to use fire effectively in these patterns, the natives must have had a sophisticated knowledge of the weather, wind direction and velocity, topography and bison behaviour in addition to a substantial store of practical knowledge concerning the local environment (Arthur 1975:23).

Prairie fires have a tendency, however, to easily get out of control and whether intentionally set by the natives or not, they had the potential to devastate large areas. In 1859, John Palliser (Spry 1963) recorded a fire that apparently covered over 500 square kilometres. Hind (1860 Vol. 1:292) noted a far larger fire that supposedly occurred in 1856 and was thought to have covered as much as 1.25 million square kilometres. Fires of this size were certainly disruptive to the environment. If intensive enough they could destroy even the root systems of the grasses, thus disrupting the basic food source on the Plains. Also, they could injure or kill entire herds of bison, deer or antelope and, if set in the early summer, could destroy entire populations of ground nesting birds and the young of most small mammals (Nelson and England 1971:299).

By the late Nineteenth Century, and the establishment of a strong European presence on the Northern Plains, fires were no longer considered as important or beneficial. They were seen as nuisances, and often quite dangerous ones. The extermination of the bison removed one of the main hindrances to widespread fires. Bison have a tendency to crop the grass short and in doing so help to restrict any fire that might be attempting to spread (Nelson and England 1971:303). Due to overhunting by the Europeans, large portions of the Northern Plains were allowed to grow long grasses and increase the hazard of fire. Nelson and England (1971:300-302) also note that the presence of coal-burning locomotives on the railways must have resulted in an increase of prairie fires, due to the sparks released from the engines' smokestacks. For the "free range" ranching community on the Northern Plains, fires must have been an ever-present threat and caused much concern. Both Breen (1972) and Kelly (1913) have hinted that many southern Alberta ranchers maintained some type of mobile fire patrol during hot, dry periods.

After 1909, and the full homestead development of the Northern Plains, data on the effect of prairie fires becomes scarce. The ploughing of large blocks of land and the creation of extensive road networks (that could serve as fireguards) apparently reduced the possibility of large prairie fires. Such events did occur, however, and were hazardous for the local residents.

For example, the massive fire called The Great Fire of 1909 (Rose Lynn Book Club 1978:10) caused substantial problems for a number of homesteaders in southeastern Alberta. On September 28 or 29, 1909, a

local farmer lost control of the small fires he had set to clear a network of fireguards. Due to the strong and shifting winds that were present that year the fire spread rapidly and did not die out until the second week of October. It has been estimated that the fire devastated almost 23 million hectares of grassland (Rose Lynn Book Club 1978:10).

The area that was burned stretched from the Red Deer River near the town of Buffalo north to the town of Provost and from the community of Hanna east to the Alberta/Saskatchewan border. The local residents were unable to cope with a blaze of such size as they had only horse ploughs and shovels for fireguard construction and only grain sacks and blankets to beat the flames. Despite this handicap, they were able (within 7 days) to create a 60 mile long fireguard on the Alberta/Saskatchewan border that eventually halted the eastward spread of the fire (Rose Lynn Book Club 1978:10).

The destructive impact of this fire is evidenced by the fact that more than a dozen families were forced to move from the area in 1910. Their farms had been destroyed and the grass cover was eliminated, leaving no natural forage for their horses and cattle. In fact, the grass was so badly damaged that the area did not fully recover until the spring of 1912 (Rose Lynn Book Club 1978:10). Such fires as this were uncommon on the Northern Plains but the ever-present threat of such an event did cause a deeply rooted fear of fires among the homestead populations.

Up to this point, the causes and effects of prairie fires on the Northern Plains can be seen as similar in virtually all areas. With the creation of the Suffield Military Reserve in southeastern Alberta in

1941, however, a 2,560 square kilometre block of the plains was subjected to another causal agent of fires —— military activity. Initally, the testing of various weapons and (after 1971) the training of British armoured units all involved the use of live ammunition. Prairie fires of all sizes and intensities were (and still are) the all-too-common result of such activity. On the Suffield Reserve such events can occasionally be beneficial, removing old grasses and returning nutrients to the soil. Fires can also be very damaging, especially if military activity causes one area to be burned over regularly and if extensive surface vehicle activity occurs in the same area. In these cases, the entire prairie surface is often removed.

It has always been a policy of the military to attempt to contain any fires that are set on the Reserve and they maintain a fire-control staff for this purpose. After the arrival of the energy developers in 1975 the work of this staff increased greatly. With the increase in use made of the land, even small fires could not be ignored as both human lives and incredibly expensive machinery might be threatened. The energy development personnel help in this process by maintaining extremely strict fire safety regulations and by creating functional fireguards around hazardous areas when required. Unfortunately, most energy development personnel come from large metropolitan centres and, as a result, do not understand how destructive even a small fire could be.

While very brief, the above discussion has indicated that prairie fires were an important aspect of life on the Northern Plains. The effects of such events on the environment and the human groups who lived in the

area have varied widely. Today, they are no longer as dangerous as they were even as little as fifty years ago. The Northern Plains are so heavily settled that there are few areas left where large fires could start and spread. Combined with this factor is a highly developed technology that is able to exercise greater control over any fire that might be generated. Despite this, the prairie fire is still seen by the agricultural community as one of the most hazardous events that can occur on the Northern Plains grassland.

REFERENCES CITED

Arthur, George W.

1975 An introduction to the ecology of early historic communal bison hunting among the Northern Plains indians. National Museum of Man Mercury Series No. 37. Ottawa.

Breen, David H.

1972 The Canadian west and the ranching frontier 1875-1922. Unpublished Ph.D. dissertation, Department of History, University of Alberta. Edmonton.

Glover, Richard (Editor)

1962 David Thompson's Narrative 1784-1812. The Champlain Society. Toronto.

Hind, Henry Youle

1860 Narrative of the Canadian Red River exploring expedition of 1857 and of the Assiniboine and Saskatchewan exploring expedition of 1858. 2 Volumes. Longman, Green, Longman and Roberts. London.

Kelly, L.V.

1913 The range men: the story of the ranchers and indians of Alberta. William Briggs. Toronto.

Nelson, J.G.

1973 The last refuge. Harvest House. Montreal

Nelson, J.G. and R.E. England

1971 Some comments on the causes and effects of fire on the Northern grasslands of Canada and the nearby United States ca. 1750-1900. Canadian Geographer XV(4):295-306.

Rose Lynn Book Club

1978 Roads to Rose Lynn: a history of the Halladay, Sheerness, Stanmore, Scotfield, Richdale and Berry Creek areas. Inter-Collegiate Press.

Spry, Irene M.

1963 The Palliser expedition: an account of John Palliser's British North American exploring expedition 1857-1860. The MacMillan Company of Canada Ltd. Toronto.