



Soils and associated natural resources as decision parameters in the regional planning process  
by Bruce Frank Leeson

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of  
DOCTOR OF PHILOSOPHY in Crop and Soil Science  
Montana State University  
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**Abstract:**

The results of three and a half centuries of persistent wear and tear of their environment has become sorrowfully obvious to Americans only recently. Destruction of natural beauty, loss of human individuality, pollution of air, soil and water, and intensification of an inhospitable urban way of life have combined to create a compelling desire within the American population to "return to the land." Montana's bounty of open space, spectacular natural features, outdoor recreation opportunities and complacent way of life is and will attract a massive invasion of tourists, outdoor aficionados and recreation home and property seekers. That there is an urgency to possess knowledge facilitating efficient resource allocation and land use planning decisions is undeniable.

Interpretations of soil and associated natural resources for land use planning and development should have valuable application in locations where natural beauty is recognized to be an outstanding attribute. Gallatin County, Montana is experiencing extensive land use change which threatens to eventually desecrate the natural heritage which attracts so many immigrants. Formulation of research objectives therefore embodied collection, analysis and interpretation of soil and associated natural resource information pertinent to decision making in the regional planning process.

Soil and associated natural resource factors such as texture, slope and landscape position have been used to rate 39 per cent of the county as having slight, moderate or severe limitations for uses such as roads, septic tank drain fields, foundations and recreation areas. Individual, transparent, colour-coded soil limitation maps were prepared. These maps can be overlain to demonstrate a variety of locations with a wide range of soil and natural resource suitabilities or hazards for particular developments. The interpretations are useful for general planning purposes but do not provide sufficient information for on-site design and construction.

In order to achieve more meaningful predictions and interpretations, detailed soil and on-site investigations were performed for the purpose of facilitating enlarged appreciation for the hazards and costs of contradicting nature. Local development situations, both private and public, which incurred increased cost or reduced utility because of soil and associated resource constraints were examined and analyzed. A demonstration of real-life expenses resulting from poorly informed decision making lends credibility to the importance of using soil and associated resource interpretations as decision parameters in a planned growth undertaking. Such an approach has greater impact in efforts directed towards formulating a public philosophy that a "design with nature" is a rational basis for decision making in the regional planning process.

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ABSTRACT

The results of three and a half centuries of persistent wear and tear of their environment has become sorrowfully obvious to Americans only recently. Destruction of natural beauty, loss of human individuality, pollution of air, soil and water, and intensification of an inhospitable urban way of life have combined to create a compelling desire within the American population to "return to the land." Montana's bounty of open space, spectacular natural features, outdoor recreation opportunities and complacent way of life is and will attract a massive invasion of tourists, outdoor aficionados and recreation home and property seekers. That there is an urgency to possess knowledge facilitating efficient resource allocation and land use planning decisions is undeniable.

Interpretations of soil and associated natural resources for land use planning and development should have valuable application in locations where natural beauty is recognized to be an outstanding attribute. Gallatin County, Montana is experiencing extensive land use change which threatens to eventually desecrate the natural heritage which attracts so many immigrants. Formulation of research objectives therefore embodied collection, analysis and interpretation of soil and associated natural resource information pertinent to decision making in the regional planning process.

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In order to achieve more meaningful predictions and interpretations, detailed soil and on-site investigations were performed for the purpose of facilitating enlarged appreciation for the hazards and costs of contradicting nature. Local development situations, both private and public, which incurred increased cost or reduced utility because of soil and associated resource constraints were examined and analyzed. A demonstration of real-life expenses resulting from poorly informed decision making lends credibility to the importance of using soil and associated resource interpretations as decision parameters in a planned growth undertaking. Such an approach has greater impact in efforts directed towards formulating a public philosophy that a "design with nature" is a rational basis for decision making in the regional planning process.

## I. INTRODUCTION

Throughout the length and the breadth of the North American continent participants in the "good life" of the Western World are becoming increasingly disturbed by the pressing paradoxes of our modern age:

- that as societies grow richer, their environments grow poorer;
- that as the array of obtainable objects expands, the quality of life declines;
- that as we acquire more leisure to enjoy our surroundings, we find less around us to enjoy.

Man and nature are twin conspirators in the perennial revolution which shapes and reshapes the face of the earth. Land use and resource allocation problems have become acute and dramatic since technology and death control have facilitated an explosive growth of population which is amazingly adept at manipulating many of the natural processes of the planet. Man has always competed with other forms of life for space and has always been victorious by ingenious application of his superior intelligence. This same mental efficiency which sadly lacks the instincts of those creatures which we have dominated has bred man's greatest competitor--himself. Residences, business, industry, transport, waste disposal, water supply, agriculture, forestry, military and a host of intangibles are increasingly intensifying the legitimacy of their claim for space and resources. The outcome in many urban-suburban-industrial areas has been outright

disaster and it is the fear of a similar pattern of unplanned and destructive development in unspoiled places which has inspired the recent phenomenon of emotional concern for the environment and how we use it. Because "homo sapiens" are organisms and as such require specialized environments, it is reasonable to think that man cannot continue to indefinitely survive on this planet without utilizing its natural resources prudently. We are greatly impressed by our capability to change our environment, but we should be no less impressed by species vulnerability inherent in our inability to organically adapt to the many hostile environments which we create at a rate far in excess of evolutionary possibilities, e.g., radioactive contamination or biological warfare.

We cannot expect to restore the entire past nor to preserve all the present for future generations. The American pioneer, always short on capital but long on ingenuity and relentless ambition approached the utilization of the assumed limitless resources of the continent with reckless abandon. To be economically and physically secure, he altered nature and his relationship to nature with steadfast determination and undiminished perseverance. The American society is one which has grown very quickly and with unequalled prosperity. We became progressively more production conscious and aware of the profit margin than we were of the effects we were creating in our environment. The reciprocal of the Gross National Product has become a measure of

the state of health of our natural environmental heritage. Never before has a nation of people enjoyed greater luxury, mobility, expendible income and leisure time than do Americans at present. But paradoxically, never before have population centralization, hostile surroundings, degraded environment and threatened depletion of essential resources been so effective in diminishing the potential enjoyment of our affluence. As fast as horizons have been opened to our consciousness they have receded from our grasp. The ideas of desire and forces of ability when frustrated by the realities of nonattainment and disillusion in search of a "better way of life" have acted in concert to bring regional and resources planning into the forefront of American life.

The region may range from a small sleepy crossroads to a huge sprawling megalopolis such as "Bos-Wash." The resource may be as small as a single tree or as large as the total water supply of a continent. Transcending the whole spectrum of the nation's concern however, is a sense of urgency which inspires action to engage in regional resources planning. President Nixon in transferring the First Annual Report of the Council on Environmental Quality to Congress (11) emphasized this point by stating:

"Throughout the nation there is a critical need for more effective land use planning, for better controls over the use of the land and the living systems that depend on it. Throughout our history, our greatest resource has been the land--forests and plains, mountains and marshlands,

rivers and lakes. Our land has sustained us. It has given us a love of freedom, a sense of security, and courage to test the unknown.

"We have treated our land as if it were a limitless resource. Traditionally, Americans have felt that what they do with their own land is their own business. This attitude has been a natural outgrowth of the pioneer spirit. Today we are coming to realize that our land is finite, while our population is growing. The uses to which our generation puts the land can either expand or severely limit the choices our children will have. The time has come when we must accept the idea that none of us has a right to abuse the land, and that on the contrary society as a whole has a legitimate interest in proper land use. There is a national interest in effective land use planning all across the nation.

"I believe that the problems of urbanization which I have described, of resource management, and of land and water use generally can only be met by comprehensive approaches which take into account the evident range of social, economic and ecological concerns. I believe we must work toward development of a National Land Use Policy to be carried out by an effective partnership of federal, state and local governments together, and, where appropriate, with new institutional arrangements (11).

H. Wayne Pritchard, Director of the Soil Conservation Society of America; when addressing the September 1971 Annual Meeting of the Western States Soil Conservation Committees, Commissions and Boards referred to President Nixon's statements when he (Pritchard) proposed,

"that we have now reached the point in our development as a nation where we may be ready to adopt a land use policy for federal, state and local governments that will be recognized as policy.....

"To adopt such a policy it will mean we are ready to accept the concept that legal ownership of land does not necessarily carry with it the right for the owner to use the land as he may desire--use determination will in some manner, become a responsibility of public policy.

"To adopt such a policy it means that well defined characteristics of land types which will aid public decision as to use must be established--and this is where disciplines related to land use will need to consider their recommendations.

"Thus I await with interest the developments that will take place in your respective states in the next few years.....If you do not provide the leadership in this matter of land use policy for your state and community--there will be others less qualified who will do so (57).

Montanans', although they pay for the high quality of their environmental fortune with low per capita income, relative lack of cultural opportunity and high unemployment are very cognizant of their outdoor heritage. In fact it seems likely that most people living in Montana are well aware of the trade-offs involved and are here because of the ready availability of truly unique outdoor opportunities. This is substantiated in part in reasons given by persons who make financial sacrifices to move to Montana (72). Montana, relative to many other states is the enviable possessor of natural beauty, cleanliness and space, and constitutes in the eyes of many people a virtual unscratched gem within the 48 contiguous states. It is this very feature which makes Montana so attractive to "out-of-staters" who are disillusioned with city life elsewhere.

About 73 per cent of the nation's 203.2 million people live in urban areas (10) (79). This constitutes a very small part of the land surface of the United States--about 1 per cent. Montana represents a temporary escape or permanent retreat opportunity for many of these

149 million people who by anxiously searching for a better way of life may constitute a rural migration of modern day land boom proportions. In contrast to the urban migration, this rural influx will not be one for economic reasons but rather will be for rejuvenation of peace of mind. Nevertheless, the demand for and potential change in use of Montana lands will be dramatic.

Day to day indications of the growing interest in land purchase and development activities are relatively subtle in Montana and are analogous to the tip of the real estate iceberg. High visibility is accorded to the Big Sky Recreational Complex in Gallatin Canyon, but while emotions run high on the desirability of this activity, other industrious and similarly imaginative individuals are quietly engaged in land acquisition with development intentions varying from a few acres to thousands of acres. Whether Montana is or is not technically prepared to accommodate this growth and the inevitable land use changes will be evident in the cost and quality of the developments. There is merit therefore in a research project with philosophical objectives of facilitating better informed decision making in resource development and regional planning. Consequently, the specific objectives of the efforts reported in this thesis have been, i. to obtain resource information pertinent to decision making in the regional planning process, ii. to interpret this information and present these predictions in an easily understood context, and iii. to support the predictive land use

ratings with detailed technical and economic investigations. If anyone is unconvinced that preparation is necessary it would be appropriate for him to become informed of the nature and magnitude of national trends because herein lies a major part of the reason for Montana's future growth potential.

#### National Trends Pertinent to Resource Use

There is little doubt that presently prevailing demographic, economic and technical trends in the United States will have a profound effect on natural resource use.

The 1970 census shows 203.2 million people in the United States and although crude birth rate has declined by one-fourth since 1960, there undoubtedly will be more Americans in the future than there are today. Present predictions that there will be somewhat fewer than 300 million persons in the United States in 2000 A.D. are lower than Pickard's 1967 prediction of 314 million by 2000 A.D. The previously mentioned decline in the birth rate during the 60's has prompted this re-evaluation (10). Nevertheless, a population increase of about 30 per cent combined with an assumed steady, or more likely accelerated rate of increase in standard of living intimates a tremendous demand for land, resources and space.

Urbanization is more likely to continue increased expansion rate rather than decrease. While the 1970 national population increased by



13.3 per cent, or 23,888,751 people since 1960, the urban population increased by 24,056,180 people or 19.2 per cent (79). This obviously indicates that a greater number of people took up permanent urban residence during the 1960-1970 decade than what was added to the whole country. While thousands of words and statements have been expounded upon the negative effects of crowded and unhealthful urban environments, the fact remains that more and more people are being attracted to the city. As affluence, mobility and leisure time increase however, an "escape syndrome" becomes established and subsequently much effort, thought and expense is devoted by restless, disillusioned people to getting away to a place in the country (53). The escape route frequently takes the form of a vacation, an outdoor recreational activity and/or the purchase of country property and a second home. An increasing population with more spare cash and more spare time to spend it has set off a recreational explosion of astounding proportions.

Americans spent 58.3 billion dollars in pursuit of leisure activities in 1965, 71 billion dollars in 1967 and 82.6 billion dollars in 1969. It is estimated that 105 billion dollars will be spent for leisure purposes in 1972. This exceeds the outlay for construction of new homes, surpasses the total of corporate profits and is far larger than the aggregate income of U.S. farmers (15). A breakdown of the expected 1972 expenditure is shown in Table 1.

Recreation--sports equipment and activities.....	\$50	billion
Vacations and recreation trips in U.S. ....	\$40	billion
Travel abroad.....	\$ 7.5	billion
Vacation lands and lots.....	\$ 5.5	billion
Second homes.....	\$ 2	billion

Table 1 Expected Expenditure For Leisure Activities by Americans  
in 1972.

Dollar total in sales of leisure equipment have increased about 52 per cent for the past five years. One reason for the upsurge in equipment buying is the increasing desire to "get back to nature." Right now there are four million camping vehicles in the United States. The recreational-vehicle industry estimates that sales this year will exceed 1.8 billion dollars and predicts that there will be 7.5 million camping vehicles in the United States by 1978. The National Parks Service expects a record 212 million visits to its areas this year. A survey by the Department of the Interior shows that 75 per cent of the United States population from age nine upward is involved in some form of outdoor recreation.

Although picnicking and swimming are still two of the most popular activities, the leisure boom is characterized by two modern-day trends which are opening up vast new areas of space requiring activities--use of recreation vehicles and winter sports. Trail bikes, minibikes,

4 WD's, ATV's and dune buggies have come into common usage throughout the nation and their sheer numbers and potential land damage have necessitated use regulation action (48) (68). Snowmobiles however are probably of greater significance in regard to space requirements and the change in attitude towards winter recreation in that areas previously inaccessible due to deep snow have become winter playgrounds. Ironically however, these machines have inspired the wrath and opposition of "anti-vehicle" sportsmen. The interest and engagement in hiking, backpacking, crosscountry skiing and snowshoeing has experienced unprecedented popularity. Increased participation in and expenditures for bicycling, downhill skiing, golf and camping all add up to an overwhelming demand for recognition of a legitimate claim for space and resources of appropriate quality for the proposed activity.

In the ultimate attempt to enjoy "the best of all possible worlds," many urban dwellers are purchasing vacation properties and constructing second homes which serve as a recreational retreat. There are approximately two million American families who own a second home and it is projected that by 1980 a total of six million vacation, or second homes will be owned by American families (66). The complementary but much larger companion of the second home movement is the vacation land and rural lot market. According to the American Land Development Association, a trade group, there are now 9,000 vacation-land-development firms in the United States (15). The American Land Development

Association estimates that the industry sold 650,000 lots valued at 5.5 billion dollars in 1971. The average lot sold for nine thousand dollars and was one-quarter acre in size.

As surely as increased affluence and spare time have permitted indulgence in outdoor recreational pursuits, increased mobility has facilitated it. The American Automobile Association estimates that vacationing motorists will drive 300 billion miles and spend 40 billion dollars getting to and from vacation areas in 1972 (15). The speed and efficiency of air travel has cut distance and travel time considerations drastically as can be demonstrated by Figure 1, pg. 12. The ready availability of rental cars, rental campers, package vacations and guided vacation tours makes virtually any part of the American outdoors accessible to anyone able to afford it. Many major resorts advertise the fallacy of their remoteness by the short-time air flights required to travel from almost anywhere in the nation to their doorsteps, e.g., 300 minutes from anywhere in the United States to Big Sky (6).

That these national trends characterized by a "return to the land" will have a profound effect on the Western United States is a near certainty. This is particularly evident in the Rocky Mountains and is reflected in the dramatic increase in recreational visitor use and in land dealing activities. Problems of recreational overkill and environmental destruction are frequently demonstrated at prominent out-

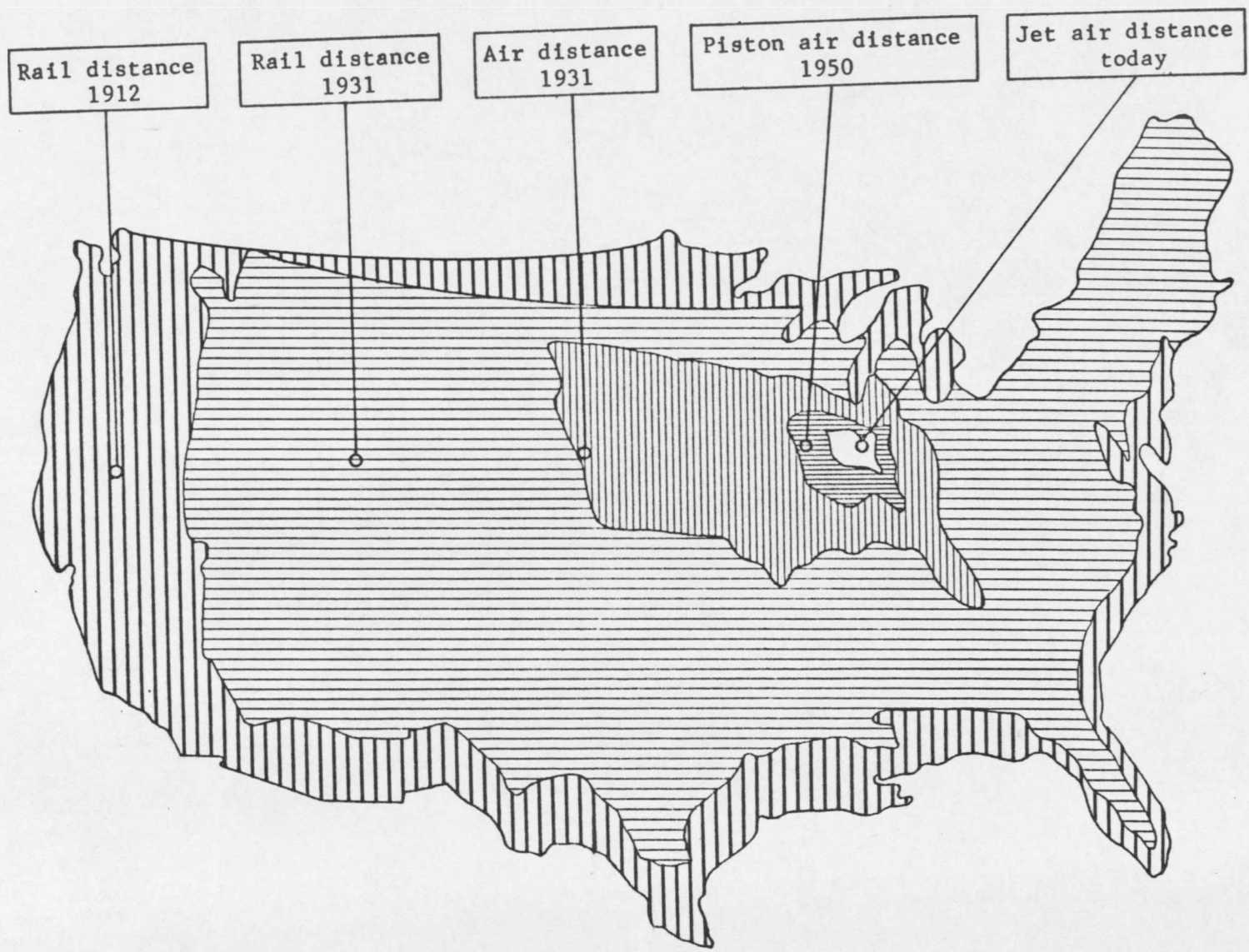


Figure 1. Contraction Of The Nation Since 1912 Due To Transportation Technology.

door attractions such as Yosemite National Park in California. Residential development has severely infringed upon the quality of an outdoor experience in places such as the Wasatch Front in Utah, the Front Range in Colorado and the Lake Tahoe Basin in California and Nevada. Throughout the length and the breadth of the Rocky Mountains, property for recreational and residential purposes is for sale. Similar forces, although less obvious but potentially no less effective are present in Montana.

#### The Rush to Stake Claims on Western Land

In the vast tracts of comparatively empty territory stretching from the Mexican border north to Montana and Idaho, speculators, developers and individuals are buying scenic mountain areas, river bank property, farmland, old mining claims and desolate desert wasteland with eager abandon. Some are fast-buck operators, others are major developers and holding companies making long term investments, and the vast majority of those who end up owning the land are retirement and recreation land seekers. The land acquisition procedure varies from the high-powered, slick approach of companies such as described by Pew in his article "Peddling the Great West," (54) to whole families heading for the hills with all their possessions, not unlike the pioneers, who not knowing where they were going or what they would do when they got there but knowing only that they were grateful to get

away from that which they left behind.

A Lovel, Wyoming real estate agent describing inquiries from all over the country says, "They all have one thing in common--desire for some land where they can get away from traffic jams, pollution, crime and suburban problems.....What they see may be alkali and sagebrush to us, but if it has a stream and a view of the mountains, it is paradise to them and we have a buyer" (46). In Montana, a Missoula real estate agent says that most buyers "think the ideal place is about ten acres with a stream that runs the year around. They want some trees and enough meadows for a couple of horses" (46). Desolate, dry, rocky land in Texas sells as fast as ranches can be subdivided into tracts of six, forty or more acre parcels. "The buyers want something with size, remoteness and wilderness. They are city people who don't want to go from a highly developed urban atmosphere to the same sort of thing in the country" (46). As ready and as capable as people are to buy western property there are others who are more anxious and more willing to sell it to them.

A perusal of enticing real estate advertisements which appear in many popular monthly magazines reveals the nature of the western land market.

"Own a piece of the famous Coeur d'Alene country.....  
Top recreation and investment opportunities in the choice  
location of the beautiful Pacific Northwest. All acreages  
on or near lakes or streams. Secluded, yet near towns and  
commercial transportation.....Low down payment and excellent

terms." Mattawa Land and Cattle Company, Incorporated (50).

"Own your own piece of land in the great Pacific Northwest.....Start buying your own recreation land now in the primitive areas of Montana, Idaho, Washington.....Irreplaceable natural land for enjoyment now, for retirement or investment." Reforestation Incorporated (51).

"Lewis and Clark Found It--Now You Can Own It. We're in the best position to offer you prime land in the heart of Lewis and Clark country. Much of it still looks the way it did in 1805 and we know where it is. Many five to forty acre tracts for recreation, retirement, investment in Idaho, Montana and Washington.....Low down payment. Easy terms." Western Highlands, Inc. (37).

"For investment, retirement, vacation or recreation--or for full time southern Colorado living four seasons of the year, the Sangre de Cristo Ranches are your chance of a lifetime to acquire a sizeable piece of choice property on exceptionally easy terms." Sangre de Cristo Ranches Incorporated (64).

These are typical excerpts from four of 33 separate real estate advertisements which appear in the April, 1972 issue of Sports Afield magazine (70). Eleven of the advertisements described available property in or closely adjacent to the Rocky Mountains and all extolled the virtues of the high quality outdoor opportunities. While the appeal of all western land agents is to the ready availability of unmatched outdoor recreational experiences--hunting, fishing, riding, hiking--the investment aspect of acquiring western land is carefully emphasized. It is very aptly paraphrased by one advertiser:

"The high profit potential of land investment in America's great Southwest makes this a wonderful opportunity to obtain desirable, low cost property in this high growth area. Because real estate tends to increase in value during periods of rising prices, your ranch may be considered an excellent safeguard against inflation" (64).



Many of the original investors in western lands were attempting to take advantage of the agricultural tax shelter by purchasing farm-lands, investing heavily in improvements, operating at an apparent loss and subtracting such investments and losses from their income taxes. Since the passage of the Tax Reform Act of 1969, this practice has dwindled but the purchase of large blocks of land by corporations has probably increased. Although the return on investment in a ranch operation is only two or three per cent, the four to six per cent annual appreciation in value added to the initial return on the investment (profit) makes ranching a reasonable investment (63). When the efficiency of economy of scale, opportunity for vertical integration, and benefits from lower rates of capital gains taxation combine to increase the potential profit margin, the trend toward corporate ownership and operation of huge ranches is easily comprehended.

Investors, individuals and corporations alike, when seeking a secure, long term growth investment in the face of inflation, uncertain stock markets, labour and union problems, and sky-rocketing manufacturing costs, are turning to land purchases. It is not surprising then for many of the "big names" in the corporate world to move into the land business as a diversified sideline to their operation. A sampling of such companies are General Motors, Ford, Chrysler, Standard Oil Company of California, Aluminum Company of America, U.S. Steel, Bethlehem Steel, American Broadcasting (47). Companies which are actively

engaged in land development enterprises are Forbes Magazine, Northwest Orient Airlines, Chrysler Realty Corp., Northern Pacific Railway, Montana Power Company, Continental Oil Company, Meridian Investing and Development Company and the General Electric Pension Fund (64) (5) (26). In addition, paper and timber companies such as Boise Cascade, Weyerhaeuser, St. Regis, Scott, International Paper and others who own large tracts of land to assure their supplies of raw materials are frequently mentioned in activities capitalizing on the recreation population boom in natural resource developments (35) (8). Major railroads such as Union Pacific and Burlington Northern are big holders of land and real estate, much of it in the West. Burlington Northern chairman, Louis W. Menk, recently announced the results of a six-month land use study of their property--2.3 million acres wholly owned and another 6.2 million acres under partial control. Initial plans are being formulated for rural, urban and recreational land developments to meet the demands of the expanding leisure market which they predict will be about 250 billion dollars by 1975 (41).

The rising demand for outdoor recreation and the increasing competition between outdoor recreation and the other uses of land and water resources have focused attention on the value of such resources when used for outdoor recreation. Total recreation in the national park system and the national forests has increased steadily over the years, at an almost constant rate of eight to ten per cent annually.

The fact that the percentage increase remains constant while total usage is increasing means that the actual numbers of visits is rising rapidly as their total number increases. In essence, the more outdoor recreation the population has, the more it wants. In the early 1950's the increase in recreation visits on national forests from one year to the next was three to five million visits; by the early 1960's the same percentage increases produced an actual increase of 10 to 15 million visits (10). An upward trend at a constant percentage rate is in effect, an exponential growth situation which obviously cannot continue on a fixed quantity of resources. The total acreage of National Forest land has remained almost constant for 35 years. There is no clear evidence of a slackening off and the steady and rapid use in numbers of visitors to many outdoor recreation areas is raising serious problems for the maintenance of the quality of the areas concerned. In light of such national trends in the use of outdoor recreation facilities it is easy to understand the sharp increase in concern for visitor use damage to such unique areas as Montana's Spanish Primitive Area (55). As competition for recreation use confronts noncompatible uses, overcrowding and unrewarding outdoor experiences on public land, many people consider their ownership of a piece of private western land as the only way by which they can assure themselves of an outdoor recreation opportunity of acceptable quality. Montana is a prime attraction for recreation land seekers, as is well testified by the magnitude and the

nature of real estate activity and recreation use.

### The Discovery of The Big Sky Country

Montana is for sale in the classified sections of national magazines. There are plenty of buyers and the land rush is on to one of the last of the wide open spaces in the Rocky Mountain states. Dr. Layton Thompson's land use research indicates almost "feverish" activity in real estate transactions in Gallatin, Ravalli, Missoula, Lake, Flathead, Lewis and Clark and Yellowstone counties (77). A 1970 survey by the State Department of Planning and Economic Development shows land development corporations, many from out of state are buying huge tracts for subdividing, mostly in Granite, Madison, Mineral, Powell, Lincoln and Lake counties (35). Development had also moved into Carbon, Meagher, Garfield, Glacier, Jefferson, McCone, Phillips, Teton, Valley and Yellowstone counties. A surprising amount of activity was occurring in the central counties of Stillwater, Musselshell and Golden Valley. The 1970 State survey indicated literally dozens of land development schemes reported by county assessors.

The Granite County Assessor reported extensive land development projects including four on Rock Creek, a blue ribbon fishery south of Missoula. Powell County's assessor told the planning department of a seven section subdivision development at Helmville by a Spokane firm. Cascade County's assessor described a California operator who was

selling inaccessible, submarginal land to unsuspecting people from Utah and California who had no easements to get to their worthless purchases. Ten or forty acre tracts of hills, rocks and trees in Musselshell County are being sold all over the country. Regardless of the attitudes of many Montanans that some of these operations amount to a swindle of unsuspecting purchasers, the fact remains that many of these people are getting exactly what they wanted and there are many more anxious buyers. What worries Montanans most about all this development is the impending collapse of the western way of life and severe alteration of historic recreation patterns.

The small farms (1000 acres or less) are being forced out of business by a number of market factors and governmental programs which in effect bestow favours on big corporate farms (3). Small farmers are unable to become big farmers when good farm land sells for subdivisions and other developments at a price much higher than could possibly be justified for farming purposes. Frequently, only the very large corporations capable of marshalling huge financial resources can compete in the purchase of land for farming purposes. Such developments, frequently by out-of-state corporations, worry local people because they limit access to the public lands around them. A typical Montana example of such a situation is the lock-out of a northern route to the Gallatin National Forest by a large corporate ranch (18) (20). Such occurrences have become so widespread throughout the Intermountain West that of the

110 million acres of wildlife habitat on the public domain scattered from the Rocky Mountains to the Pacific; more than 16 million acres are considered inaccessible, with at least 5.4 million acres blocked off by operation of private lands (20). Increasingly, outdoorsmen are being pitted against powerful land speculators, developers, investment conglomerates and corporations trading as sportsmen's "clubs" who are buying up and leasing key tracts of private land which blocks access to the public property. Subsequently, the locals find their land and waters being closed after many years of unchallenged public use. Destruction of private property by inconsiderate users has increased trespass violations and access denial problems.

It was inevitable that sooner or later people from "outside big industry" and crowded population centres would recognize the advantages of investing in Montana ranching enterprises. Ranching can satisfy many emotional desires and being a large landowner and rancher adds to ones prestige and has become a status symbol amongst many professional people such as attorneys, doctors, company executives and stock brokers. Besides the investment and prestige attributes there are other benefits to be derived from the purchase of large tracts of western property.

Owning a ranch with private hunting, fishing and other recreation amenities is not only of great value to the owner and his family but it constitutes a unique private club for entertaining guests and business associates. Frequently this phase of the ranch operation can be written

off as a legal tax deduction for business operation purposes. Operating at an apparent loss and participating in government agricultural subsidies and agricultural tax benefits offers even greater opportunities for income enlargement. Because of such monetary benefits and associated recreational values, entrepreneurs are willing and able to pay exorbitant prices for ranch property. This increases all land values. Inability to compete with inflated land prices and high cost of ranch operation is effectively eliminating the small ranch enterprise. In the process of selling out however, many of these displaced ranchers are likely to make more money by the sale of their property to developers than they could ever realize from years of ranch operation. Such transactions frequently result in the disruption of historic recreational use by local people who previously were seldom denied trespass rights.

Granite County's assessor says that one of the reasons for some of the developments along Rock Creek is "to get exclusive control of trout streams" (35). Carbon County's Appraiser says, "We have seen a boom in creek frontage, cabin and cabin site sales unbelievable for this area." Madison County is a prime example of what is happening in Montana. Ten or fifteen years ago there were sixty ranch families in the Madison Valley near Ennis. Now 80 per cent of the land is controlled by six owners from Illinois, Indiana, California and Wisconsin (62). A company called Montana's Treasured Land Corporation bought 1,281 unserviced lots for 15 dollars each in historic Virginia City and by January, 1971

had sold 94 of them for 350 dollars each. Several large subdivision developments are occurring in the Madison Valley and one California developer in announcing his plans stated, "I have travelled all over the United States and this is the prettiest country I have ever seen" (60). This California financed development includes 9000 acres which surrounds the Ennis fish hatchery and extends into the Gravelly Mountains will be divided up into 600 ten or more acre parcels to be sold for summer residences and home sites (60). Another similar residential-ranchette development offers its subdivision lot purchasers exclusive access to part of the nationally famous blue ribbon Madison River. In recent months groups from Ennis have complained to Montana's Fish and Game Commission about denial of access to the Madison River, due to new land developments (35). The activity in land use change in Montana's landscape is mirrored in an examination of the past and predicted increase in recreation and tourism.

Montana Governor Forrest H. Anderson told the Family Camping Federation in Chicago on May 10, 1972 that tourism appears headed for number two spot in Montana's economic picture behind the agriculture-livestock industry (2). Tourism and recreation, now the state's third largest industry is predicted to grow from its present 3,777,600 visitors in excess of 65 per cent in the next fifteen years (38). Lieutenant Governor Thomas L. Judge informed Washington and California



travel agents visiting Bozeman that tourism in Montana which was increasing at about six per cent per year resulted in a 165 million dollar input to Montana's economy in 1969 (23).

Yellowstone and Glacier National Parks act as the main attracting agents in initially enticing recreationists to Montana. Although only a relatively small part of Yellowstone National Park actually lies within Montana borders, three of the five entrances to Yellowstone are accessible only by travelling through part of Montana. Annual visitation to Yellowstone surpassed two million visitors since 1965 and is generally increasing, although there was a slight drop in 1971 (45). A record number of visitors journeyed to the park in 1970 with 2,307,280 checking into the entrances (61). Auto travel is now over 600,000 vehicles per season and a survey in July, 1970 showed cars from every state in the union with California, Utah and Illinois respectively being the most prevalent (45) (61). Winter visitation has been increasing at a rate of 20 per cent per year since 1963, a trend which is expected to continue (45). A new visitor total record is expected in 1971 as well as the 50 millionth visitor (61). Glacier National Park passed the one million annual visitor mark in 1969 and received 1,303,000 visitors in 1971 (21).

It is interesting to note however that the Montana Economic Study completed by the Bureau of Business and Economic Research at the University of Montana in 1970 suggested that too much emphasis was being

placed on potential recreation growth as a source of revenue (81). They point out that in the foreseeable future, most Americans will continue to work five days a week and vacations will not lengthen for very many people. Montana has a lot of well-established competition and tourism and recreation commerce encourages the addition of more relatively unskilled, low-paying, seasonal jobs--all of which combine to hold Montana's average per capita earnings well below the national average (82). In general, they conclude that recreation and tourism will not rise appreciably more rapidly than other activities which affect the trade and service industries (81). However, at least one large investment alliance and obviously many others do not agree with these predictions.

Gus Raaum, President of Big Sky of Montana, said the interest generated nationwide by news of Big Sky seemed to refute the university prognostication (59). Raaum said people were almost desperate for a breath of fresh air, and have contacted him by the thousands with a view to using the tourist complex. In addition, he said 1200 to 1500 people want jobs at Big Sky. "These are men who make from \$100,000 a year on down. They want to get away from the cities and develop a business out here. And they will make money." It seems very unlikely that the consortium of big name businesses with the market analysis which they undoubtedly would have utilized would have invested in a recreation/real estate venture as large as Big Sky if there was much

doubt about its financial success. The University of Montana study itself provides information, which, if analyzed in the retrospection of national trends creates some doubt about their recreation growth rate pessimism.

The study points out that the western sector of the United States has 72.3 per cent of the nation's recreation acreage, with only 15.3 per cent of the population (83). The Northeast by contrast has 25 per cent of the national population packed into an area that contains only 4 per cent of the national recreation acreage. Nor is the recreation acreage in the western sector evenly divided--the mountainous region has 48 per cent of the national recreation area for only 4 per cent of the national population, while the Pacific region has 25 per cent of the national acreage for 11 per cent of the population. If, as all analyses indicates, the tremendous national demand for recreation resources materializes, it seems only reasonable that the "return to nature" will occur largely in the western sector and most likely in the mountainous region where the least competition and greatest opportunity for outdoor recreation expansion occurs.

The distribution of recreation acreages and population in Montana also is very enlightening in regard to predicting where the greatest impact from growth might occur in the state. Table 2, pg. 27 indicates the Distribution of Outdoor Recreation Acreage and Population By Fish and Game Planning Regions, Montana (82--pg. 8.18). Figure 2 shows

Table 2. Distribution of Outdoor Recreation and Population By Fish and Game Planning Regions in Montana.

Region	Total Outdoor Recreation Acreage. (1969)	Percentage of State Total	1970 Population	Percentage of State Total
1	5,711,922	29	79,132	11
2	3,783,754	20	100,935	15
3	4,448,749	23	106,694	15
4	3,030,112	15	171,316	25
5	894,573	5	119,227	17
6	605,666	3	73,090	11
7	<u>910,947</u>	<u>5</u>	<u>44,015</u>	<u>6</u>
Total	19,385,723	100	694,409	100

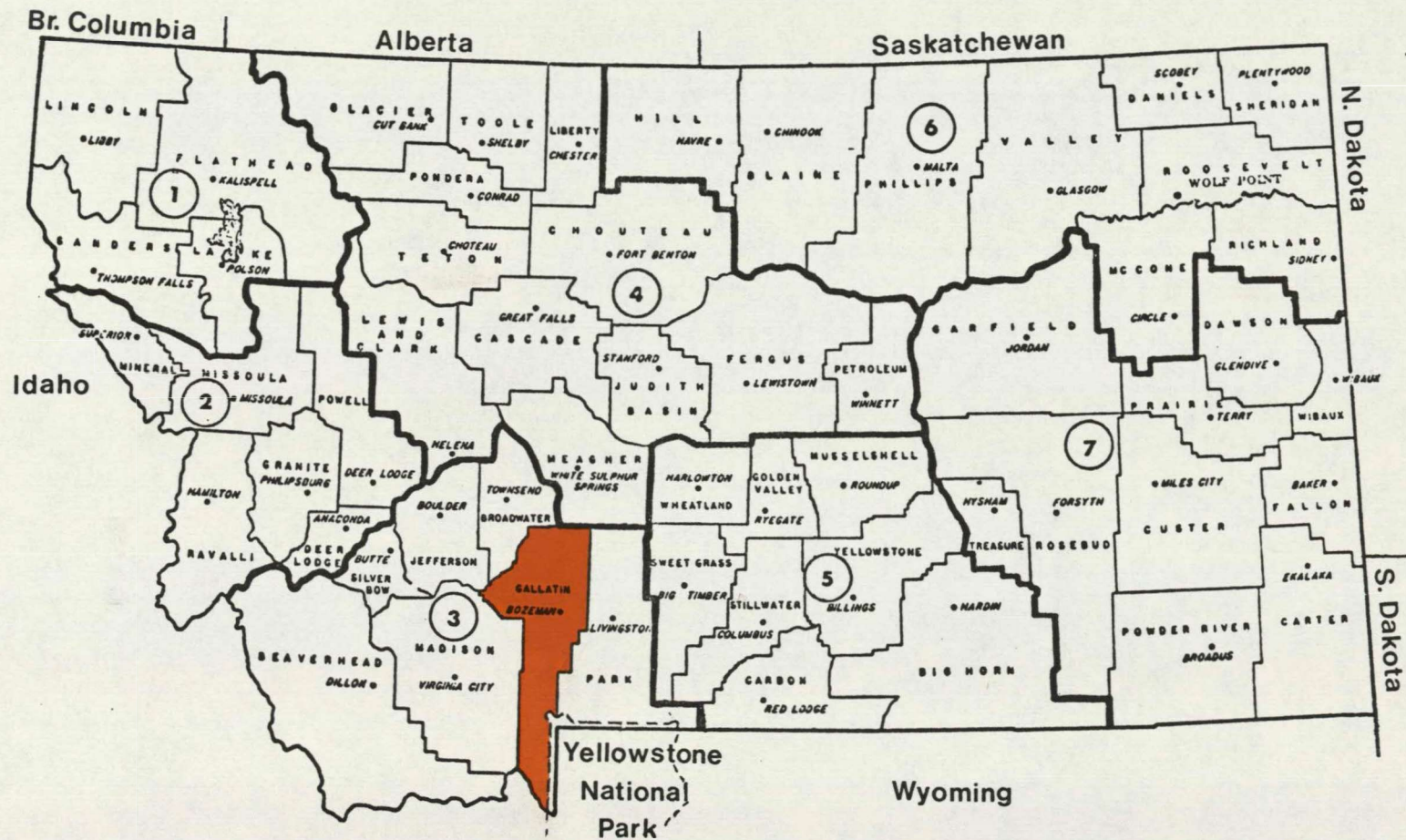


Figure 2. Fish and Game Planning Regions For Montana.

the location of the Fish and Game Planning Regions referred to in Table 2. It can readily be seen that regions 1, 2 and 3, which contain the bulk of Montana's mountainous landscape encompasses 72 per cent of the state's recreation acreage but only 41 per cent of the total population. A reasonable conclusion therefore would be that the greatest impact in recreation or tourism increases will occur in the mountainous western section of Montana. This prediction is further supported by recreationists preference for mountainous landscapes and the impending strip mining of thousands of acres of Eastern Montana with the possible negative effect it is liable to have on recreational attractiveness.

If the reader is willing to assume that the foregoing information does in fact portend the impending demand for use of Montana's land and natural resources, then it should be relatively simple to justifiably conclude that some type of orderly growth should be accommodated in a least wasteful fashion. Many social, economic, political and technological forces have combined to create extravagant uses of natural resources in the past. While this author does not profess to possess more than a layman's amount of insight into the social and political mores of Montana, an observance of the social resistance to planned growth appears to have resulted in a disappointing lack of political decisiveness. It is a mute question as to whether economics shapes or is shaped by such an environment because strong examples of

both can be argued--suffice it to say that economics is an opportunist phenomenon--it shapes where it can and conforms where it must. Use of the land and its resources involves both private and public interests and it appears that fear of encroachment upon private interests may severely compromise both private and public values in the future. If this past failure has resulted from a faulty social organization for equilibrating properly constrained private interests with legitimate public welfare, then at least part of the responsibility for this failure should be attributed to improper decision-making resulting from inadequate knowledge and inappropriate application and presentation of physical techniques used in resource analysis. Herein lies the basic deficiency which lends legitimacy and credence to the subsequently reported research.

#### Soils and Associated Natural Resources as Decision

##### Parameters in the Planned Growth Concept

The planned growth concept is one in which need and demand is efficiently accommodated by supply and allocation of natural resources by an enlightened decision-making body. This body most likely would be composed of a number of elected or appointed individuals, and in the United States it theoretically carries out its function in a state of informed participatory democracy. However, it is nearly impossible for these decision makers to be totally informed about the

intricacies and dynamics of the lithosphere and the biosphere and so decisions, out of practical necessity, are commonly made in a partial knowledge vacuum. As unfortunate as this may be it is even more deplorable that existing knowledge is unused because of a lack of appropriate interpretation from a professional jargon into an applicable and readily understood form. Soil, long recognized as one of the nation's basic natural resources is attaining a new perspective as those who invest large amounts of capital in physical facilities in or on the soil are finding newly interpreted soils information to be as valuable to their diverse purposes as it always has been to plant and animal husbandmen.

Initially, soil maps and reports were used mainly for farming, ranching and forestry purposes and the information was assembled with those uses in mind. In a rapidly urbanizing and expanding industrial economy, however, soil maps are being widely used to predict site suitability to support houses and structures, to absorb septic tank effluent, to provide stable road foundations, to carry pipelines, to develop lawns and playgrounds and to permit lasting installations of many other kinds. As savings were demonstrated and potential disasters averted, a growing demand for soil interpretation and use capacity predictions have increased dramatically. The cost-benefit ratio of one of the newest developments in resource planning technology--soil interpretations for nonfarm use is startling. Most soil surveys for



such purposes pay for themselves in one year and many promise a return benefit of 100, 200 or more times the cost in the 25-or-so years of their usefulness.

A. Klingebiel, Director of the Soil Survey Interpretation Division of the Soil Conservation Service, United States Department of Agriculture has reported on many situations where use of nonfarm soil interpretations have or could have saved much expense and grief in land development projects (32). Some of his examples are:

Sewage System, Massachusetts: The town of Cohasset saved more than \$250,000 on its sewage system by using a Soil Conservation Service soil survey which showed that less than one per cent of the town area was suitable for onsite sewage disposal.

School Grounds, Virginia: Fairfax County lost \$250,000 in avoidable cost by selecting a poor school site when the unconsulted soil survey showed favourable land 500 feet away.

Water Main, Michigan: A town near Detroit is out \$200,000 because its new water main was constructed across a 600 foot wide area of deep peat which was shown on the unused soil maps.

Residences, Virginia: More than 100 homes in the suburbs of Richmond were flooded resulting in several

hundred thousand dollars worth of damage. This happened two years in a row. A soil survey would have spotlighted this hazard.

The merit of using soil interpretations for planning guides has been so well demonstrated that many states and counties are requiring mandatory soils investigations before land use change and development proceeds. The Southeast Wisconsin Regional Planning Commission estimates that soil information alone will save Wisconsinites \$300 million in the cost of residential development in a seven county area over the next 20 years (4). It is expected that nonfarm soil interpretations will save \$10 million annually in private building costs in a six county Chicago development area (32). Several states such as Maine and California have been leaders in using soil survey interpretations to guide quality nonfarm development (69) (13) (88). Many individual counties in Illinois, Ohio, Michigan, Virginia, New York and other states have been able to realize substantial savings in averting large public expense by using soil interpretations to steer development away from problem soils. Soil surveys can have great value to highway engineers by providing them with accurate, relatively inexpensive information on the soil over which their road will pass (17). Soil survey information has been shown to be a good basis for interim guidance in flood plain planning if detailed studies are unavailable (52).

These interpretations of soil maps are statements or predictions based on research and experience of the nature and severity of problems or limitations of the kinds of soil suitable for various alternative uses. These interpretations which are made by relying on a large amount of local experience and/or observation, and limited physical and chemical data, are for a wide spectrum of potential uses in the area covered. However, a 1971 Joint Task Force of The Western Association of Agriculture Experiment Station Directors and the United States Department of Agriculture recognized that to a considerable degree, the public, planning, zoning and similar activities were moving ahead without adequate research and education in this area (19). The Task Force, among other things, recommended a strengthening of educational services in the area of alternative land uses and the use of soil resource information at this particular time when so much attention and activity is focused on land use and environmental and ecological planning. Moreover, there is much information and many useful concepts available that are not known or readily available to the people who can or will use them. The Task Force emphasizes the importance of recognizing that because our land is a nonrenewable, limited resource, land use and planning are of paramount concern to our total society and therefore there is a great urgency in soil appraisal research directed towards efficient education of decision makers. One of the specific research recommendations is for quantification of interpretive data

now in use in order to effect a better understanding and practical comprehension by potential users (19).

II. OBJECTIVE OF RESEARCH (to Demonstrate the Use of  
Soils and Associated Natural Resources as Decision  
Parameters in the Regional Planning Process)

Although the objectives of the research reported in this thesis were established approximately two years prior to the 1971 report of the Task Force, it is significant that the research purposes defined in 1969 are in very close harmony with those identified by the Task Force as having high priority in 1971. Specifically, the objectives of this research project are:

1. to obtain basic natural resource information pertinent to the regional planning process in an area where rapid growth and land use change is occurring. This natural resource information is to be analyzed and interpreted for the purpose of making land use decisions.

2. to present this information in a suitable fashion so that uninformed persons can understand it. This task involves making the presentation adequately interesting and sufficiently informative in order that persons responsible for making land use decisions can and desire to use the information.

3. to investigate some economic aspects of a land use plan which is based on a "design with nature" concept. It seems rational that long-run economic factors would support rational decisions dictated by physical constraints. An affirmative illustration of such an hypothesis would lend strength to the importance of predictive resource interpretations in the regional planning process.

This research was carried out in Gallatin County, Montana, United States of America. The natural resources investigated were soil and associated resources such as slope, depth to water table, flood plains and geomorphological characteristics. Prior to examining the research procedures however, it is important that the reader be familiar with the past and present trends in Gallatin County which qualify it as being an appropriate site for this research undertaking.

### III. GROWTH TRENDS AFFECTING LAND USE CHANGE IN GALLATIN COUNTY, MONTANA

Gallatin County is located in southeastern Montana within the Rocky Mountain Physiographic Province. The county totals 2,517 square miles and is 50 miles wide in its extreme east to west dimension and 116 miles long in the extreme north to south distance. Fig. 2 , pg.28 shows the location of Gallatin County in Montana. Of the 1,610,800

total acres of Gallatin County, about 65 per cent is mountainous, largely within the confines of the Gallatin National Forest. Bozeman, the county seat, is located about 90 miles north of Yellowstone National Park at an elevation of 4,771 feet in the east end of an intermontane basin, the Gallatin Valley. Historically, the economic backbone of the county has been the agriculture-livestock industry. Bozeman is the home of Montana State University which has largely contributed to education being the second most important commerce activity in the county.

Gallatin County takes its name from the sparkling river which rises in Yellowstone National Park and which was first sighted by Lewis and Clark in July, 1805 when they arrived at the Three Forks of the Missouri River. The river which drains Gallatin County was named for Albert Gallatin, then Secretary of the Treasury under Thomas Jefferson.

The discovery of gold along Alder Creek Gulch gave rise to a stampede of prospectors who erected Bannock and Virginia Cities in the early 1860's. Unsuccessful miners were attracted to the fertile Gallatin Valley and established the first settlement known as Gallatin City in 1862 near the present town site of Three Forks. In 1864 John M. Bozeman led the first wagon train through the now famous Bozeman Pass and with the help of Daniel E. Rouse and Wm. J. Beall, layed out a townsite. Although John Bozeman was killed by Blackfeet Indians near Livingston in April of 1867, his legend lives on in the many local

places which bear his namesake. Fort Ellis was established to control hostile Indians in 1867 and the Northern Pacific Railroad reached Bozeman in 1883. The towns of Three Forks, Belgrade and Manhattan were established in 1882, 1883 and 1884 respectively. West Yellowstone which is near the southern tip of Gallatin Canyon was settled in 1907 and became the official western entrance to Yellowstone Park in that year.

Topography is largely responsible for the changeable climate in Gallatin County, and the mountainous section characterized by the Gallatin Canyon in the south half is generally wetter and cooler than the broad floor of the Gallatin Valley in the north half. West Yellowstone has a normal annual temperature of 35<sup>o</sup> F. and 23 inches of annual precipitation while Bozeman has an average annual temperature of 42<sup>o</sup> F. and 18 inches of annual precipitation.

The Three Forks structural basin which includes the Gallatin Valley, the Madison Valley and the lower Jefferson River Valley was formed as the result of crustal movements in early Tertiary time and is one of the largest intermontane basins in Montana. During and subsequent to the formation of the basin, continued downfaulting and/or downwarping interrupted through drainage. At about the same time the basin became filled to a depth of 4000 feet with volcanic ash and with sand, silt and clay eroded from the surrounding highlands and deposited under both lacustrine and terrestrial conditions. Resumption of through drainage

in late Tertiary time resulted in extensive erosion of these beds. A subsequent mantle of alluvium was deposited in much of the basin in early Quaternary times. The diverse nature of geologic parent materials ranging from fine grained lacustrine deposits to cobbly alluvium has given rise to widely divergent kinds of soils.

Dark coloured soils occupy foothills and mountain slopes in the southeastern part of the valley floor in an area bordering the Gallatin and Bridger Ranges. The topsoil is dominantly silty. Subsoils of the Bridger series which occupy higher mountain slopes and outwash fans contain many rock fragments while those of lower elevation series such as Bozeman are silty materials relatively stone free down to six feet. Further west in the valley extending from Gallatin Gateway through Belgrade and up the east side of Camp and Dry Creeks, two soil textures predominate, the silty soils such as Amsterdam and gravelly soils such as Beaverton. Soils extending from Camp and Dry Creeks to the western side of the valley range from fine sand to silt loam in texture. All the imperfectly drained soils are of alluvial origin and border main streams. Poorly drained soils such as Gallatin silt loam swampy phase occur in flood plains adjacent to both large and small drainageways. The development of irrigated agriculture south and west of Bozeman has resulted in the well-drained soils of this area having unexpectedly high water tables during the irrigation months of June, July, August and September. Underground water supplies are very extensive in the



Gallatin Valley due to the substantial recharge which occurs in late spring and early summer and a subterranean dam near the head of the Missouri River which holds back underground flow (7).

Soils of the Gallatin Canyon area are generally characterized as being high in rock fragments and occurring on steep slopes. Soils on or in close proximity to the West Gallatin River flood plain in the Canyon are alluvial materials. Those soils above the flood plain have generally developed after previous glaciation or colluvial deposit processes and consequently are high in fragment content. Isolated pockets of slowly permeable clayey soils exist as well as the silty soils of the Taylor Fork area. Canyon soils are particularly susceptible to erosion and instability if denuded and this factor combined with steepness of slope and short growing season has restricted any agricultural enterprise to wild range usage--both for domestic stock and big game wildlife. The soils of Gallatin Valley in contrast are very fertile and are largely responsible for the viability of the agriculture industry.

The Gallatin Valley is one of the oldest and most productive agriculture regions in the state. In 1969 \$4,254,100 of crops were produced on 70,300 harvested acres of irrigated land and 97,400 harvested acres of dryland produced crops worth \$4,174,700 (42). Cash receipts for livestock accounted for \$12,916,900 of a total agriculture value of \$21,345,700. Winter wheat has always been the largest dry land crop with 52,000 harvested acres averaging 43.0 bushels per acre, the second

largest average yield per acre in the state in 1969. Most of the irrigated land is used for forage which averaged 2.59 tons per acre in 1969, again the second highest average yield per acre in the state. It is generally considered that a relatively favourable combination of fertile soils and less rigorous climate have permitted Gallatin County to consistently out-produce almost all other Montana counties on an average per acre basis. This reliable and steady agricultural bounty has been instrumental in facilitating the strong growth of Bozeman. The population of Gallatin County by increasing at a 24.8 per cent rate from 26,045 in 1960 to 32,505 in 1970 was one of the largest percentage increases of Montana's 56 counties (80). This in itself has had substantial affects on county activities but it is in and around the city of Bozeman where the most obvious changes are occurring.

The 39.7 per cent population growth which boosted Bozeman's 1960 population of 13,361 to 18,670 in 1970 ranked Bozeman as one of the nation's fastest growing cities (80) (89). The economy of Bozeman has demonstrated considerable strength in the past and there are a number of very significant factors which have been and will be important in the continuing development of Bozeman as a state growth centre.

Montana, like the rest of the United States, is experiencing a steady movement from rural to urban centres. This has contributed to Bozeman's rapid growth as an important service centre, and there is little doubt that Bozeman is developing as a major retail-wholesale

trade centre. Consequently much of the present and future commerce activity in the Bozeman area is associated with the expanding trade and service industry. The Upper Midwest Economic Study predicts that the increased activity within the Bozeman district will centre primarily in the areas of manufacturing, construction, retail trade and services, and government with some actual decline in terms of agricultural employment (25). Predictions in the Montana Economic Study support this hypothesis by anticipating a continued decline in agricultural employment but a substantial increase in federal government jobs and a smaller increase in trade and service industries in Region IV which includes Gallatin County (83). In studying the economic feasibility of a proposed convention centre complex for Bozeman, T.A.P. Incorporated concluded that part of the large increase expected in the service and government areas resulted from the strong growth surrounding Montana State University and the development of both winter and summer recreational activities within the area (24).

The importance of the university with its expanding education and research responsibilities within the past ten years is well demonstrated by the surge of activity which grips Bozeman at registration time each September and the relative calm which descends upon the city over summer break. However, the university growth may be slower than anticipated and future development may be curtailed by funding cuts which occurred during Montana's 1971 legislative session and drop-off in

student enrollments. Consequently, there is considerable reason to anticipate that of the three big factors in Bozeman's growth, agriculture, education and recreation and tourism, that recreation and tourism is likely to be the largest contributor to future growth and prosperity in Bozeman.

As was previously indicated the recreation industry in Montana is expected to be a very significant economic activity, and a major part of the growth is taking place within the Bozeman area, both in terms of winter and summer sports. The summer activity centres around the bountiful outdoor recreation opportunities of the natural resources of the area, including tremendous mountain scenery, rivers, streams, forestry and wildlife which annually entice tourists, recreationists and new home seekers by the thousands. Bozeman's geographic location in proximity to Yellowstone National Park, the Gallatin National Forest, the Spanish Peaks Primitive Area and the blue ribbon fishery in the Madison, Gallatin and Yellowstone Rivers is of great importance in attracting people to Gallatin County. The Gallatin Canyon area is renowned for its beauty and recreational attributes. Over one-half million people annually enter the west entrance of Yellowstone Park through the West Yellowstone gateway (74). One can logically assume that approximately the same number leave by this gate which indicates that the tourist activity within the Gallatin Canyon is very significant. With the development of Big Sky of Montana, a recreational/real

estate complex offering nature lovers the grandeur of unspoiled natural wonders without the sacrifice of all the modern comforts and conveniences (6) in the West Fork-Lone Mountain area of the upper Gallatin River, it is certain that many more people will visit and eventually reside in Gallatin County. Even without Big Sky the trends in use of Gallatin County recreational resources indicates substantial increase. Table 3, pg.44 shows the changes in visitor day use in the Gallatin National Forest since 1967. A visitor day is defined as one person

Table 3. Visitor Days and Per Cent Increase in Visitor Days on the Gallatin National Forest

	Visitor Days	Per Cent Increase Over Previous Year
1971	1,676,500	9
1970	1,526,500	6.5
1969	1,428,300	6.8
1968	1,331,100	6.4
1967	1,251,300	---

spending a full twelve hours in the Gallatin National Forest (24). The Gallatin Forest has historically experienced more recreation visits than the other Region One forests. One of the largest increases in recreational activity in the Gallatin National Forest has occurred in

winter use. Table 4, pg. 45 details the increase in skier visits to Bridger Bowl, located 18 miles northeast of Bozeman on the east-facing slope of the Bridger Range. The tremendous rate of increase of skier days at Bridger Bowl was interrupted by a poor '71-'72 season caused by a late opening, an early closing and unusually high winds. Skiing

Table 4. Skier Visits and Per Cent Increase in Skier Visits at Bridger Bowl.

Season	Skier Visits	Per Cent Increase Over Previous Years
71-72	140,128	-0.62
70-71	141,000	+24
69-70	114,000	+58
68-69	72,265	+38
67-68	52,425	---

has been growing nationally at approximately 25 per cent per year. Bridger Bowl, with the exception of the '71-'72 season has consistently been above that annual growth, running in the 30 to 35 per cent increase range. This high rate of increase can be expected to continue in view of the Big Sky ski development, improved air transportation, enlarged Bozeman accommodations and increased national advertising. Favourable snow conditions and terrain combine to make the Gallatin Forest a

destination of national renown for snowmobile users as well as skiers (86).

Two of the largest rallies on the international snowmobile tours are held at West Yellowstone. An early season December rally usually draws more than 4,000 people and a late season March rally attracts about 6,000 people. The 120 mile "Big Sky Snowmobile Trail" between West Yellowstone and Bozeman attracts both in-state and out-of-state visitors. Growing recreation use in the Gallatin National Forest has resulted in increasing conflict with historic uses such as grazing, mining and lumbering. The Forest Service is presently engaged in a concerted effort to fulfill local, state, regional and national goals, both economic and social, by multiple-use planning which includes public participation in determining priorities or "key-values" in resource management (86) (87). As strongly as the recreation impact of temporary and permanent migration to Gallatin County is, the effect is less dramatic than the changes which occur in real estate transactions, county government activity, transportation and nonfarm land development.

In the fall of 1970 the Gallatin County Clerk and Recorder's Office reported that they had filed as many plat changes in the three past years as were handled in all the previous years since 1864 (73). The single item that increased the work load in the office was the recording of subdivisions and the platting of land. This comes about

with more and larger areas of land being divided into acreages. In 1970 the county assessment office reported a 23 per cent increase in listings over 1966 and an increase of 80 per cent in office paper work.

There is a trend toward larger blocks of land being officially committed to subdivision development outside of the city limits. In 1971, 1077 acres were registered for subdivision development with the city-county planning office, much more than the 539 acres in 1970. A similar trend for subdivision plats is being established in 1972 with about 450 acres presented for subdivision approval at one meeting (56) (40). The assessed value of subdivision tracts increased from \$933,685 in 1967 to \$1,284,910 in 1971 (58). Assessed improvements on subdivision land increased from \$5,448,045 in 1967 to \$6,974,481 in 1971. Mobile homes assessed for the years 1967, '68, '69, '70 and 1971 have increased from 640 to 739, 956, 1028 and 1584 respectively.

Development outside of Bozeman's city limits has resulted in an annual rise in the number of septic tank permits issued, and records show a 1970-'71 increase of 31 per cent in septic tank installations (75). Treasurer's office records show 22,998 vehicle registrations for 1971, a 36 per cent increase over the 16,917 registrations in 1967. More cars, more people and more outlying developments have created increased work problems for county road maintenance. Gail Thompson, Head of the Gallatin County Roads Department stated that a large part of their work load increase resulted from scattered residential



development which was quickly followed by requests for road and access improvements to areas which had adequately served in a relatively unchanged condition for many years (76).

Montana Power customer accounts out of the Bozeman office increased from 6505 in 1967 to 7264 in 1971 (43). Telephone hookups of 14,393 in February, 1971 show a definite increase over 13,493 in February of 1970 (89). In conducting a study for the Montana Aeronautics Commission, T.A.P. Incorporated pointed out the eight fold growth in passengers at Gallatin Field over the 1960's and predicted another eight fold increase during the 1970's. One of the most interesting results of growth in Gallatin County has expressed itself in real estate activity.

Dr. Layton Thompson has analyzed 665 land sale transactions, part of an investigation of 1200 sales which occurred in Gallatin County between 1965 and 1970 (78). Of these 665 sales, 96 were of 40 or more acres which were defined as farms, 210 were located in officially platted subdivisions and 359 occurred in an unorganized pattern throughout the county. All of the nonfarm sales were less than 40 acres and most were less than 20 acres in size. Gallatin Canyon river-front property in 1972 is selling for about \$5000 per acre and Gallatin Valley non-farm property is averaging about \$2000 per acre. Farmland in contrast brings \$300-\$500 per irrigated acre and \$175-\$225 per acre for dryland farming operations.

Interviews with several local real estate agencies indicate most inquiries for purchase of land come from out of state, particularly California (9) (22) (14). Most prospective purchasers are interested in investment, recreation and speculative ventures. Prominent Bozeman realtor P. K. Dudley stated that, "good farmland sells for less than a pile of rocks if they're pretty" because the greatest interest is in "recreation property." The present and anticipated market in land development is so great in Gallatin County that four new real estate agencies are being established to share in the activity which is already supporting 15 real estate offices.

The foregoing, although it is only a cursory description of the resources and the nature of trends and activities which characterize the growth in Gallatin County, it is sufficient to demonstrate the propriety of the area as a site for research which attempts to provide information useful for decision making in the regional planning process.

#### IV. METHODS AND RESULTS

##### Soil Interpretations For Land Use Planning and Development in the Gallatin Valley Area, Montana

A soil survey of the Gallatin Valley Area was conducted and published by DeYoung and Smith in 1931 (12). The area they surveyed covers 802 square miles, or approximately 30 per cent of the total land area of the county, and includes most of the irrigated land, together with much of the nonirrigated farming and grazing land of the higher valley slopes or benches and the adjacent foothills that border the mountains. All assessment of soil capability was for farm or agriculture purposes and no mention was made of soil suitabilities for nonfarm use. Although almost all the basic information necessary to accomplish nonfarm soil interpretations is contained in the report, this was not done, supposedly because there was no demand. In the fall of 1969 a project was undertaken to provide such interpretations under the guidance of G. A. Nielsen, F. A. Boettcher and R. L. Moshier<sup>1</sup>.

Information used in making the soil interpretations came primarily from the 1931 survey, but it was augmented with knowledge gained from local experience and observation. A description of the Gallatin

<sup>1</sup> See Appendix, page 125.

Valley soils is contained in the Appendix, page 139 to page 154. An unpublished Soil Conservation Service memorandum for Interpreting Engineering Uses of Soils, which has since been revised, was used to evaluate soil and soil associated conditions which would constitute various degrees of hazard for specific uses. Each of the 32 soils occurring in the Gallatin Valley was given a suitability rating for each of 16 different uses. Some of these uses are building foundations, septic tank filter fields, roads and streets, recreation areas and sanitary land fills. A complete list of all uses considered appears on page 129 in the Appendix. Fifteen separate soil and landscape properties or hazards such as flooding, slope, frost heave potential and load bearing capacity were considered when rating each soil as having a slight, moderate or severe limitation for each particular use. A complete list of all fifteen soil or soil associated properties and hazards considered appears in the Appendix on page 134. Soils rated as slight are relatively free of limitations or have limitations that are easily overcome. Soils rated as moderate have limitations that need to be recognized but can be overcome with good management and careful design. A severe rating indicates limitations that are difficult or costly to overcome. A severe rating does not mean the soil cannot be used for a specific use, but it means that careful planning and design and very good management are important. These interpretations are designed for general planning. On-site investigation is needed for

specific design and construction because all soil differences which occur in the field cannot be shown on a general soil map. The 16 selected uses of soil and the properties considered important in evaluating soils for each use are given in the Appendix, page 129. The estimated Gallatin Valley soil limitations or suitability for selected uses are displayed in Appendix Table, pages 136, 137 and 138.

#### Colour-Coded Soil Limitation Maps--Gallatin Valley

Transparent maps on which soil limitations--slight, moderate and severe were colour-coded as green, yellow and red respectively, were prepared at the same scale as the original soil map for each use considered. The map material used was .003 inch transparent, matte finish mylar and the green, yellow and red colour material was transparent, matte finish, adhesive-backed film. The soil map placed underneath the transparent mylar provided the base lines for applying and cutting out the appropriate coloured adhesive film with sewing needles. In this way individual soil suitability maps showing colour-coded slight, moderate and severe soil limitations were created for septic tanks, foundations for low buildings with basements, roads and streets and cropping. A base map showing the survey outline boundaries, cities, rivers and major transportation routes was prepared to overlay the limitation maps in order to facilitate geographic orientation. These maps at a scale of 1 inch = 1 mile have overall dimensions of 51

inches long and 40 inches wide. These maps are on file at the Department of Plant and Soil Science, Montana State University, Bozeman, Montana.

An example of soil limitation maps for cropping and roads and streets appear on pages 54 and 55 respectively. The single use maps showing soil limitations for septic tank drain fields, roads and streets and foundations can be overlain to produce a composite map showing a variety of colour combinations from solid red to solid green. Figure 5, page 56 shows the effect of laying the septic tank drain field soil limitation map over the building foundations soil limitation map. Figure 6, page 57 shows the result of laying the roads and streets soil limitation map over both the septic tank drain field and building foundations soil limitation maps. The range of colours produced is an overall indication of the geographic variability of soil limitations for nonserviced developments and represents various degrees of subdivision development difficulty.

Prior to the construction of the large maps using coloured adhesive film as described above, similar maps of the Bozeman area were made on mylar using felt-tip marking pens. These maps were sprayed with a protective plastic material. When affixed to a firm backing, these maps are easily transported and are used for presentations when the large size of the valley maps precludes their use. The smaller maps measure 40 inches long and 21 inches wide.

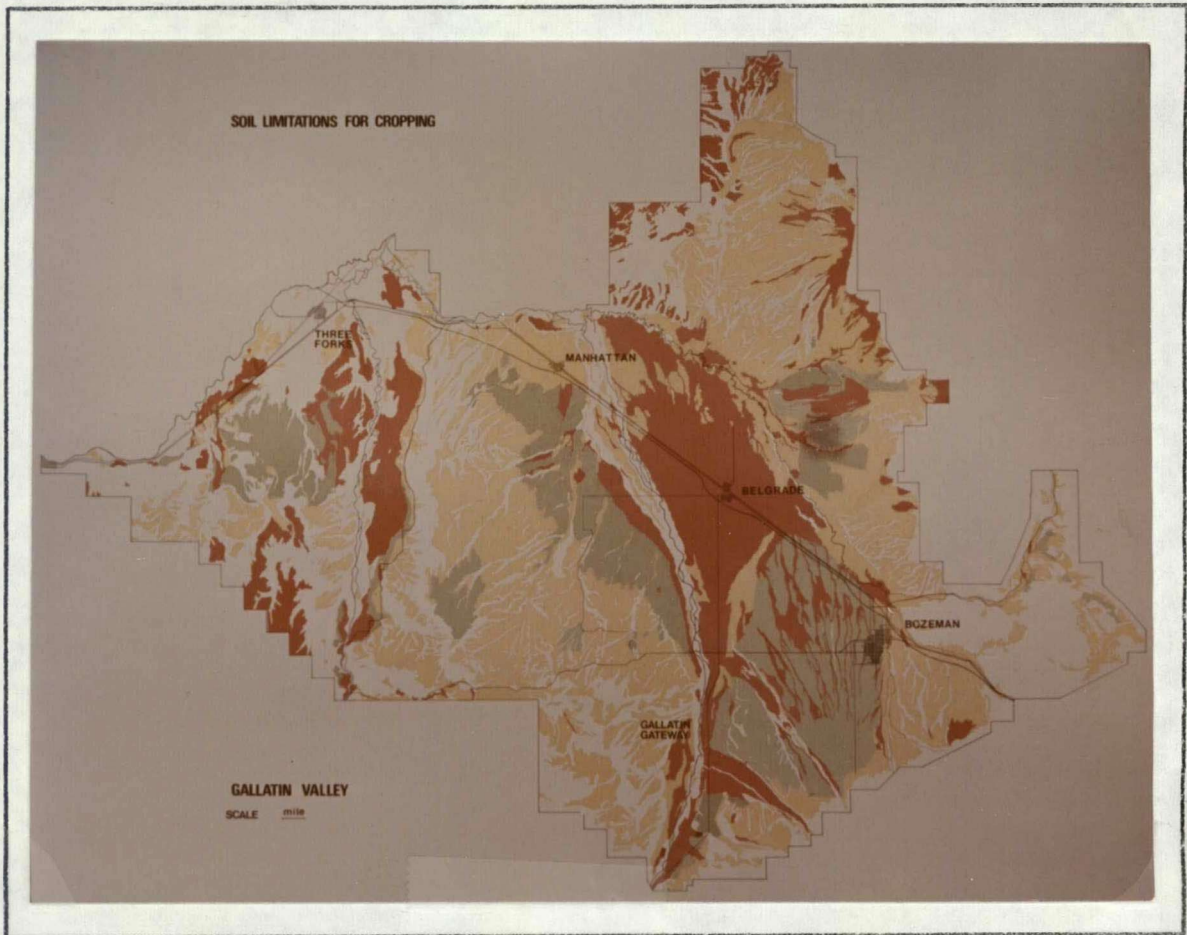


Figure 3. Soil Limitations For Cropping.



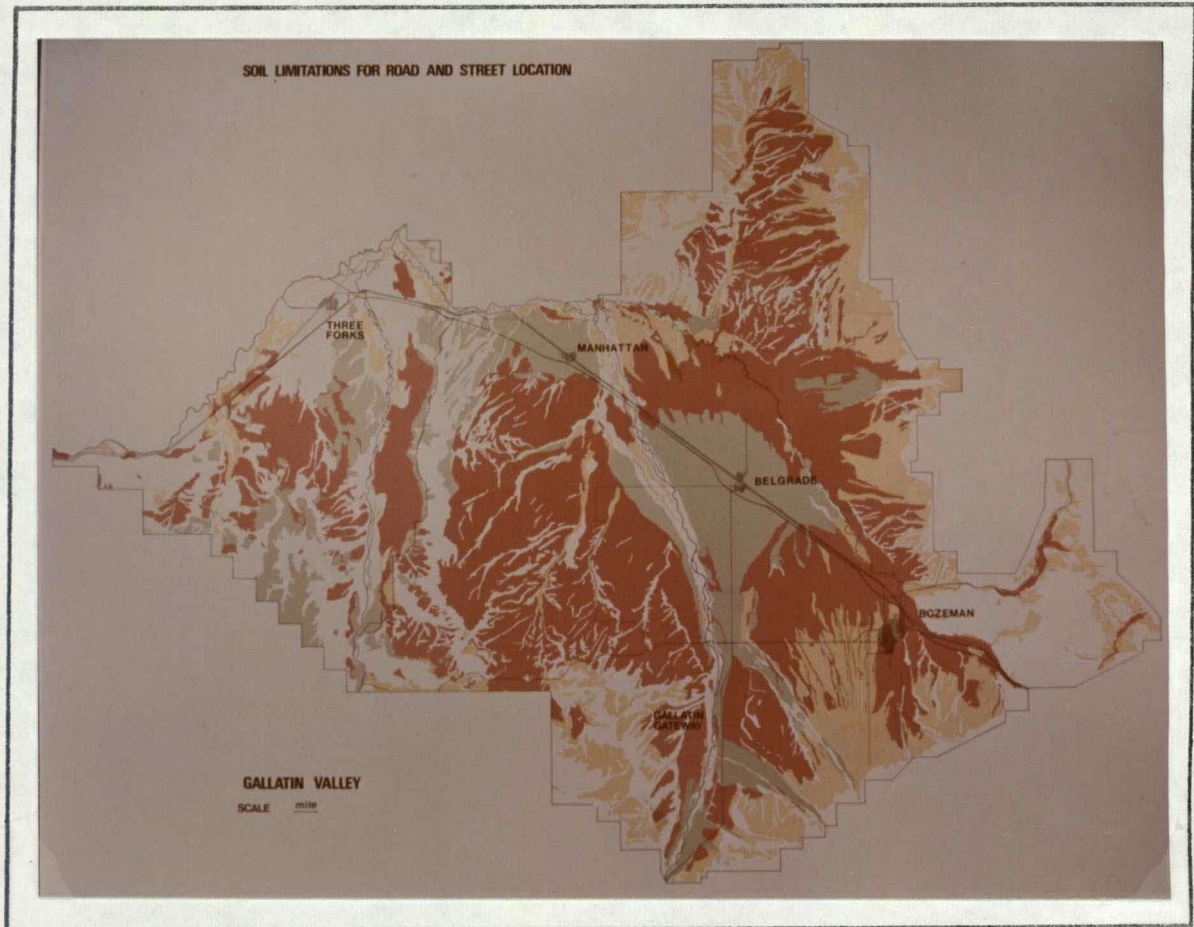


Figure 4. Soil Limitations For Roads and Streets.



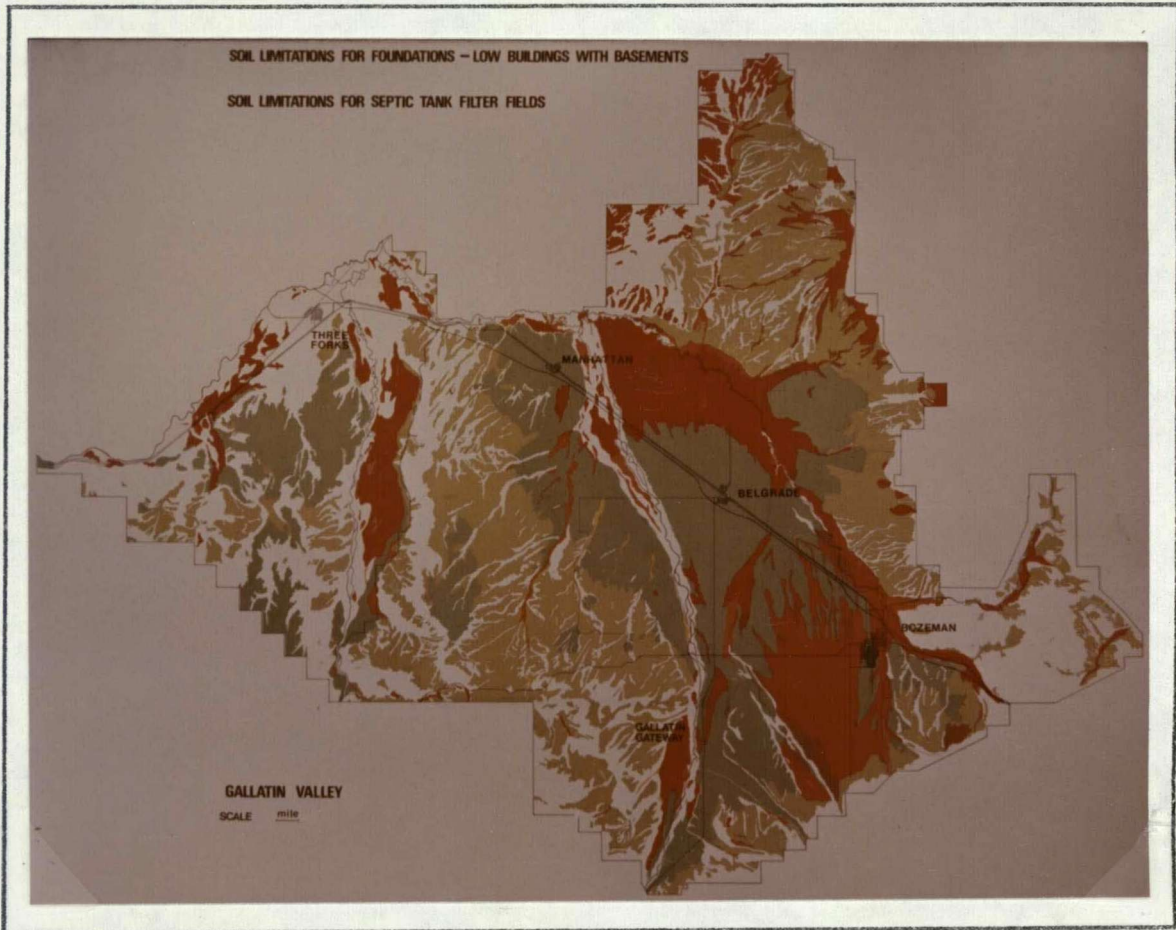


Figure 5. Soil Limitations For Septic Tank Drain Fields and Foundations For Low Buildings.



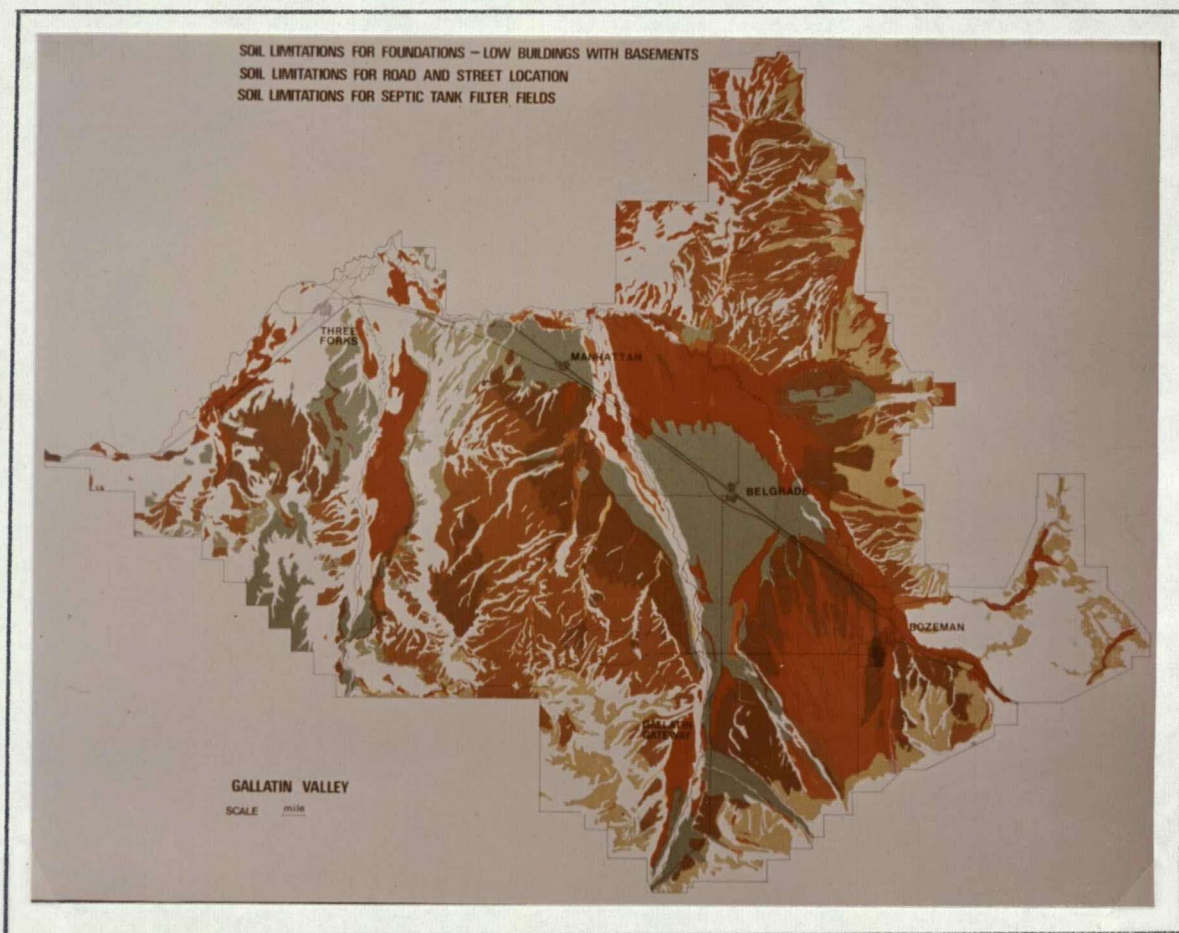


Figure 6. Soil Limitations For Roads and Streets, Septic Tank Drain Fields and Foundations For Low Buildings.

All of these maps are used in public presentations to audiences concerned with land use planning. Although most presentations have been in Gallatin County, the maps and information have been presented to audiences as far away as Edmonton, Alberta and St. Louis, Missouri. A documentation of the presentations appears in Appendix table 12, page 155.

Shortly after the announcement of the proposed Big Sky Montana development in the Gallatin Canyon (5), Montana State University received a National Science Foundation Grant to study the Environmental Impact of a Large Recreational Development on a Semi-Primitive Environment. Consequently the soil and associated natural resource interpretations project was expanded from the valley up the Gallatin Canyon to the northern boundary of Yellowstone National Park.

#### Soil Survey of the Gallatin Canyon Area, Montana

A soil survey under the direction of A. Olsen, Soil Scientist with the Helena office of the Soil Conservation Service was carried out for the Gallatin Canyon area in the summer of 1970. The area surveyed encompassed 117,500 acres, beginning at the mouth of the Gallatin Canyon approximately 15 miles southwest of Bozeman, and extends to the Yellowstone Park boundary, about 30 miles north of West Yellowstone. The survey area includes the flood plain of the Gallatin River and its main tributaries as well as the adjacent hills and steep bedrock

mountains on either side of the valley. The survey boundary shown on the General Soils Map in the Appendix pocket extends approximately four miles into Madison County to a point on the west side of Lone Mountain, and four and one-half miles to the east of the Gallatin River in the vicinity of Elkhorn Creek.

The field survey was carried out at a reconnaissance level of detail and delineations were made on the basis of 18 different soil or soil complex mapping units. The mapping units were established after a two week initiation period during which time soils and landscapes were examined throughout the proposed survey area prior to actual mapping. Field mapping was done on aerial photos at a scale of 4 inches = 1 mile or 1:15,840. Odd numbered aerial photos within flight lines were used as field sheets and even numbered aerial photos were used to provide stereo coverage for air photo interpretation purposes. Standard soil survey procedures of air photo interpretation, landscape, vegetation, elevation and aspect considerations were used to augment actual soil investigations in determining placement of soil delineations. The original air photos on which field lines were drawn are at the Bozeman office of the Soil Conservation Service. Copies of these photos are also on file at the Department of Plant and Soil Science, Montana State University, Bozeman, Montana.

Thirteen individual soil series were identified and correlated with the National Cooperative Soil Survey Program. Each of these soil

series has been described in detail and sampled according to horizonation. This was done to depths of approximately 60 inches at benchmark sites representing a modal member of each particular soil series or variant. Characteristics such as colour, structure, consistence, fragment content and estimated permeability were recorded. These descriptions, site locations and soil samples are on file at the Department of Plant and Soil Science, Montana State University, Bozeman, Montana. A generalized description of all established soil series and other soil mapping units is contained in the General Soils Map located in the Appendix pocket.

The General Soils Map of the Gallatin Canyon shows 10 main groups of soils called soil associations. Each association consists of several different kinds of soils termed soil series. Soil series are distinguished on the basis of natural drainage, texture, depth and certain chemical and physical properties, some of which were referred to above. Thus the General Soil Map does not show the specific kind of soil at any particular place, but associations of several different soils that occur together in characteristic patterns. Soil associations are named for the major soil series in them. Soil series of one association may be present in other associations. The acres of each soil association and per cent composition by series is shown in the Legend and in Table 1 of the General Soils Map report. Each soil association is described in terms of i slope range, ii topography, iii

precipitation range, iv elevation variation, and v major vegetative species present, in addition to specific soil patterns.

Information on Gallatin Canyon climate, recreation, timber and geology appears in the General Soils Map report.

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All soils were evaluated for each of 16 different uses. Some of these uses are building foundations, septic tank filter fields, recreation sites and suitability as a source of construction materials. A complete list of the uses and significance or importance of soil properties and other factors affecting the use appears in the General Soils Map report under the heading Definition of Selected Uses. Twenty-two separate soil properties or hazards such as flooding, texture, slope and compaction characteristics were considered when rating each soil as having a slight, moderate or severe limitation for each particular use. Ratings used for "suitability as a source of construction materials" were good, poor or fair. A complete list of factors considered appears in the General Soils Map report under the heading, Limiting Soil Properties and Hazards Indicated by Number in Table 1. These soil interpretations for selected uses of land which appear in Table 1 of the General Soils Map report may be used to guide the development of general plans but they do not eliminate the need for on-site soil

investigations for design and construction. A revised draft of the Guide For Interpreting Engineering Uses of Soils was used in making the interpretations of Gallatin Canyon soils for nonfarm purposes (33).

#### Coded Soil Limitations Maps--Gallatin Canyon

Colour-coded soil limitations maps using green, yellow and red colours to indicate slight, moderate and severe hazards for particular uses were prepared for the Gallatin Canyon area. Maps for all the following uses were constructed: foundations for low buildings, septic tank filter fields, roads and parking, lawns and landscaping, camping areas, picnic areas, playgrounds, and trails and paths. These maps at a scale of 1 inch = 1 mile or 1:63,360, can be used as overlays in a variety of combinations and are similar in appearance and use as the maps previously described for the Gallatin Valley. These Gallatin Canyon Soil Limitation Maps are on file at the Department of Plant and Soil Science, Montana State University, Bozeman, Montana.

In addition to the colour-coded maps, smaller scale, 1 inch = 4.36 miles, soil limitation maps were prepared. These maps are constructed using a reduced copy of the General Soils Map overlain by boundary outline maps on a light table. The underlying soil boundaries were thus adequately discernible to serve as guidelines in cutting out the film material. Grey tone, dot screen film was used in this case, instead of coloured film, but the process of application and cutting

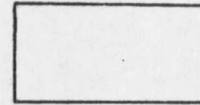
out with sewing needles was identical. The major difference between the colour-coded maps and the grey tone maps is that the slope factor was removed from the soil rating considerations in the latter. Slope is the most prominent naturally occurring factor which limits soil use and conventional land development in the Gallatin Canyon and in the colour-coded maps was primarily responsible for a near totally red map. Consequently, slope considerations were omitted in preparing the grey tone maps in order to allow expression of other naturally occurring limitations to use. Grey tone maps for foundations for low buildings with basements, foundations for low buildings without basements, septic tank filter fields, roads and parking, lawns and landscaping, camp areas, picnic areas, playgrounds, and trails and paths appear on pages 65, 66, 67, 68, 69, 70, 71, 72, and 73 respectively. The grey tone slight, moderate and severe soil limitations legend appears on page 64. A composite recreation map in which soil limitations for camping areas, picnic areas, playgrounds, and trails and paths were analyzed, again omitting slope, and presented as slight, moderate and severe ratings for overall recreation suitability for the activities included appears on page 74.

#### Computerized Slope Map

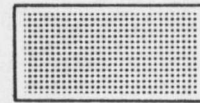
Because slope is such an important factor affecting resource development in the Gallatin Canyon area, a separate slope classification



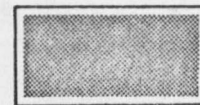
SLIGHT



MODERATE



SEVERE



SCALE

1 inch = 4.36 miles

Figure 7. SLIGHT, MODERATE AND SEVERE SOIL LIMITATIONS FOR FIGURES 8 THRU 17





























































































































































































































































