Alberta Research Council
Open File Report 1974-2

SOIL SURVEY

of

BOW VALLEY PROVINCIAL PARK

AND ADJACENT KANANASKIS AREA

and

INTERPRETATION FOR RECREATIONAL USE

by

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ALBERTA RESEARCH COUNCIL

1974

Alberta
RESEARCH COUNCIL

PREFACE

A standard explanatory format, beginning with the section entitled "Preface" and ending with the section entitled "Glossary" has been written. Since the same explanatory remarks will pertain to reports written for each of the Alberta Provincial Parks and other areas surveyed, the same standard format will be presented at the beginning of each report.

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INTRODUCTION

The growth in population and per capita income has and will continue to exert an unprecedented demand on the natural resources of Alberta. The nature of today's city living and working makes apparent the recreational value of Provincial Parks. Men and women often work in large factories and plants or in crowded offices, far removed from nature or a natural environment. The work week of forty hours or less, however, provides people with a relatively large amount of leisure time and prompts a constant search for off-time recreation to refresh the spirit. It is this trend in our civilization today that places high priority on comprehensive planning that will bring together the special interests in land use, watershed protection, wildlife, forestry, and parks and recreation based on carefully determined requirements.

Soil being one of the basic resources which man manipulates in his land use activities, requires prudent use, protection and proper management in order to realize its inherent potential on a sustained yield basis (8). Recognition of natural phenomena and physical limitations is no less important in campground construction or septic tank location than it is in crop production. The kind of soil dictates to a large degree the type and location of recreational facilities (7). Some soils are not desirable sites for campgrounds, play areas, picnic grounds, cabin sites or nature study areas; other soils are very desirable sites for recreational uses. Knowledge of the soils of an area provides fundamental information needed in recreation planning. The soil information contained in the reports to follow is designed to be of assistance in planning future development in various Provincial Parks within the Province of Alberta.

Detailed and semi-detailed soil surveys were conducted in the following Provincial Parks during the summer of 1973; Crimson lake, Young's

Point, and Bow Valley. Also included were areas in the following regions: Kananaskis, Lac Ste. Anne, Calling Lake, Wildcat Hills, and Fish Creek. Total area surveyed was approximately 28,640 acres.

ACKNOWLEDGMENTS

The Research Council of Alberta supplied the funds and staff for the field, laboratory and drafting work, and for the writing of the reports. The Parks Planning Branch of the Department of Lands and Forests provided some of the aerial photographs and maps. The Research Council of Alberta published the report and compiled the soil map. The University of Alberta provided office and laboratory space.

Mrs. Pal Foster typed and assisted in compiling and proof reading the reports. Mr. Z. Widtman drafted the final soil map, while Mr. J. Beres and Mr. C. Veauvy determined the physical properties of the soils. The soil chemical analyses were determined by the Alberta Soil and Feed Testing Laboratory.

Able field assistance was given by Mr. R. McMullin and Mr. C. Veauvy.

Special acknowledgment is given to the Park Wardens who co-operated by allowing soil investigations to be conducted throughout the parks and also invariably offered assistance.

METHODS

The areas surveyed were traversed by motor vehicle along all roads and negotiable trails, and on foot along cut-lines and non-negotiable trails. Soil pits were dug at frequent intervals to depths of 2 to 4 feet, to examine and describe soil horizons and classify the soils. Detailed field soil

descriptions were made. Soil boundaries were drawn on aerial photographs with the aid of a pocket stereoscope.

Representative surface and shallow subsurface soil samples were collected for chemical analyses and subsurface samples were collected at depths of 4 to 6 feet for physical analyses.

GENERAL SOIL MAP

The soils were classified according to the System of Soil Classification for Canada (3). The areal extent of each different kind of soil is indicated on the soil map. An explanation of the map symbols follows:

Example: 1 ← map unit

C4 ← surface stoniness rating (Table 2)

topographic class (Table 1)

The map units generally refer to single soil series or soil associations. A soil series is a grouping of all soils which are similar in the number, color, texture, structure, relative arrangement, chemical composition, and thickness of horizons, as well as in the geology of the soil parent material (3). A soil association simply consists of a number of soil series occurring together in characteristic patterns.

Where a map unit consists of a single series, other soil series may be found in close association. However, the dominant series makes up to 80 to 90 per cent of the map unit; the other series are present in such minor amounts that their presence is not considered significant enough to affect the use of a particular map unit for recreation.

Where a map unit consists of a soil association, it was not possible to outline each separate series in the time available to complete the soil survey. However, different series in an association generally possess very

similar properties. The approximate percentage of each series comprising the association is indicated in the soil report. Minor insignificant amounts of other series may be present but are not mentioned in the definition of the association.

Other miscellaneous symbols appearing on the soil map are defined or explained in the soil report.

The topographic classes and stoniness ratings are defined in Tables 1 and 2, which follow:

Table 1. Topographic classes and symbols (3)

Simple topography Single slopes (regular surface)		Complex topography Multiple slopes (irregular surface)	Slope %
A	depressional to level	a nearly level	0 to 0.5
B	very gently sloping	b gently undulating	0.5^+ to 2
C	gently sloping	c undulating	2^+ to 5
D	moderately sloping	d gently rolling	5^+ to 9
E	strongly sloping	e moderately rolling	9^+ to 15
F	steeply sloping	f strongly rolling	15^+ to 30
G	very steeply sloping	g hilly	30^+ to 60
H	extremely sloping	h very hilly	60^+

Table 2. Stoniness ratings (5)

Stony 0 (stone-free land)	- too few stones to be of any hindrance to recreation
Stony 1 (slightly stony land)	- some stones, only slight to no hindrance to recreation
Stony 2 (moderately stony land)	- enough stones to cause some interference with recreation
Stony 3 (very stony land)	- enough stones to constitute a serious handicap to recreation - some clearing is required
Stony 4 (exceedingly stony land)	- enough stones to prevent recreational uses unless considerable clearing is done
Stony 5 (excessively stony land)	- too stony to permit any recreational uses (boulder or stone pavement)

SOIL CHARACTERISTICS AND INTERPRETATIONS FOR RECREATIONAL USES

Soil surveys provide for classifying, defining and delineating each kind of soil and making predictions of soil behavior under specific management (7). The soils within an area are mapped and classified without regard for existing or expected land ownership boundaries, or types of use. Each delineated soil is defined so that the information is available for planning different kinds of land use.

Each kind of soil has its own peculiar set of characteristics and qualities which are described in terms that can be observed (7). These include soil texture; color; structure; consistence; depth (to rock, hardpan, water table, etc.); kind and amount of coarse fragments; kind, thickness and sequence of soil layers; organic matter content; reaction;

and slope. When accurately defined a specific soil can be distinguished from all other kinds of soil.

Most soils can be used for recreational activities of some kind. Some have no soil limitations for specific kinds of recreational uses; others have moderate to severe limitations for certain uses. Many soil properties affect the use limitations of soils for recreation, and the effects of a given soil property often vary with different uses (2).

The soil properties affecting most recreational uses include susceptibility to flooding, wetness, slope, and surface stoniness (2). Other soil properties also having an effect include: depth to sand and gravel, an impeding horizon, and surface soil texture, as they affect permeability and erodibility; texture and plasticity, as they affect shrink-swell potential, and susceptibility to frost heaving; soluble sulphate content, as it affects concrete corrosion hazard; and salinity of the topsoil.

Soils that are subject to flooding during the season of use are considered to have severe limitations for recreation facilities such as camping areas, building sites, and roads. Such areas require permanent design considerations (2, 7). These soils should not be developed for campsites or building sites unless they are protected by dikes, levees or other flood prevention structures, which may be uneconomical. These soils may be better suited for hiking or nature study areas, or for greenbelt open space, if the flooding is not too frequent (7). Montgomery and Edminster (7) suggest one or two floodings during the season of use constitutes only a moderate limitation for picnic areas, playground areas and hiking trails. These are the less permanent facilities that can be

moved with relative ease. Thus, the soils can be managed to a high level without maintenance costs rising beyond the financial capacity of the administration (2).

Soils that are wet all year, even if not flooded, have severe limitations for campsites, roads, hiking trails, playgrounds and picnic areas (7). The economic feasibility of installing subsurface drainage in these soils is questionable (2). Soils that are wet only part of the year or those with a water table that fluctuates without actually reaching the surface are not easily detected. These soils are considered to have moderate to severe limitations for most recreational uses, and if possible should be avoided for the more permanent facilities such as camping areas and building sites. With careful planning, design, and management, however, these soils can be used for most recreational facilities. Soils that dry out slowly after rains also present problems where intensive use is contemplated. The soils that are dry during the season of use and have a water table greater than 3 feet from the surface are considered to have slight to no limitations for most recreational uses (2).

Droughty or very rapidly drained soils also have limitations for many recreational uses. On such sites grass cover needed for playing fields is difficult to establish and maintain. Access roads may be excessively dusty. Vehicles are easily mired down in sandy soils and soil blowing is common. Knowledge of these soil problems enables planners to use corrective conservation practices, such as irrigation, or to choose alternative locations (7).

The ability of a soil to support a load is important in many kinds

of recreational activities. Some soils when wet fail to support structures such as access roads, trails and buildings (7).

Slope affects the use of soils for recreation (2, 7). Generally, slopes of less than 2 per cent offer no limitations for use as playgrounds, campsites, sites for recreation buildings, roads and trails. Slopes greater than 9 per cent constitute a severe limitation for playground areas, since levelling costs would become prohibitive. Slopes of more than 15 per cent constitute a severe limitation for camping areas, picnic areas and some building sites for the same reason. The smaller areas required for these facilities, as compared to playground areas, account for the greater tolerance. On the other hand, steeply sloping soils are essential for ski runs and are desirable for hiking areas and scenic values. Hiking trails are not limited unless slopes are greater than 30 per cent. Of course steep, gently sloping and moderately sloping soils can be levelled for campsites, playgrounds and building sites, where the cost is justified (7). Where this is done it is especially urgent that effective soil conservation practices be applied and maintained, based on the specific conditions at hand.

Permeability is an important property affecting the recreational use of soils (2). Since no permeability measurements were made, it has been estimated from a consideration of texture, structure and depth to an impeding horizon in the profile (9). Soils with very rapid to moderately rapid permeability have no limitations, and soils with slow and very slow permeability have severe limitations (7). The same classes apply to suitability for road subgrade material but are reversed when considering suitability for

reservoir sites. Soils are rated for this purpose on their capacity to hold water without allowing seepage. It should be noted that the degree of limitation due to permeability will vary with climate. In high rainfall areas permeability is much more important than in low rainfall areas (2).

Surface stoniness limits the use of some soils for recreational facilities (2). Generally the non-stony (class 0) to slightly stony (class 1) land offers no limitation for recreational facilities. Very stony (class 3) to excessively stony (class 5) land offers severe limitations for camping areas, playground areas and building sites. The expense of removing the stone hazard is considered prohibitive (2). The very stony (class 3) land is considered to constitute only a moderate limitation for picnic areas and hiking trails because of the lesser areal intensity of use associated with these facilities. In some instances it is feasible to remove the stones, thus eliminating the hazard (7). Rounded gravels and stones present hazards on steeply sloping soils used for foot trails.

Surface texture is an important soil property to consider (2, 7). High clay or sand content in the surface horizon constitutes a severe limitation for playgrounds, campsites or other uses that involve heavy foot traffic by people or horses. Soils high in clay become sticky and slippery when wet and dry out slowly after rains. On the other hand loose sandy soils are undesirable as they are unstable when dry, making it difficult to establish sod grasses capable of withstanding concentrated foot traffic. Generally, sandy loam and loam surface soil textures are the most desirable for recreational uses involving heavy use by people.

Soil depth affects many uses (7). Soils underlain by bedrock or sand and gravel at shallow depths cannot be levelled for playgrounds except at

high cost. Roads, trails, basements and reservoirs are very difficult to construct on soils with shallow bedrock, and soils with shallow sand and gravel are undesirable sites for reservoirs. It is difficult to establish vegetation on shallow soils overlying impervious soil layers, rock, or sand and gravel, thus making them poor locations for playing fields and other intensive use areas.

Sewage disposal is also an important consideration in designing recreation areas (2). Some soils absorb septic effluent rapidly and other soils absorb it very slowly (7). Soils that are slowly or rapidly permeable, poorly drained, subject to flooding, shallow to rock, or steeply sloping all have severe limitations for septic tank filter fields. These include soils of high clay content, sandy soils and Gleysolic soils. The most desirable soils for sewage disposal have a moderate permeability, are well drained and are situated in nearly level areas (2). The most desirable soils for sewage disposal are also the most desirable soils for sanitary land fills. In some cases where soils cannot handle the volume of waste involved, sewage lagoons can be used (7). These also are feasible only in soils that meet the special requirements for sewage lagoons.

Shrink-swell potential is inferred from Atterberg limits (2). Soils with low to medium shrink-swell potential are considered to have no to slight limitations for recreational facilities. Soils with a very high shrink-swell potential are considered to constitute severe limitations for building sites and road subgrade material as these soils tend to be unstable with changing moisture conditions. Soils with a high shrink-swell potential offer moderate limitations for use and thus should be avoided if possible.

The suitability of the underlying soil material for road subgrade depends upon the additional property of susceptibility to frost action (2). Generally soils high in silt content are highly susceptible to frost action. Other factors, such as the availability of water, also affect this parameter. The availability of water is dependent upon climatic conditions and depth to water table. Thus, soils high in silt content may not necessarily undergo appreciable frost heaving unless they are imperfectly or poorly drained, or subject to high rainfall shortly before freezing. This is especially true in Alberta.

The soluble sulphate content of the underlying soil material is an important factor for buildings with concrete foundations, as well as for underground conduits (2). The U.S. Bureau of Reclamation (14) has established classes for sulphate attack on concrete. Soils with 0 to 0.1 per cent soluble sulphate content are considered to have no limitations for standard concrete foundations, and soils with 0.1 to 0.2 per cent are considered to have slight limitations. Soils with 0.2 to 0.5 per cent soluble sulphate content are considered to have moderate limitations, and foundations may require sulphate resistant concrete. Soils with greater than 0.5 per cent soluble sulphate are considered to have severe limitations and should be avoided (2).

Salinity and depth of topsoil affect soil suitabilities for lawns and landscaping, and sources of topsoil. An electrical conductivity of less than 1 (mmhos./cm.) and a depth of topsoil of more than 6 inches offer no limitations. An electrical conductivity of more than 3 (mmhos./cm.) and a depth of topsoil of less than 3 inches render severe limitations.

Productive capacity of soils for vegetation of different kinds is closely related to the feasibility of many recreational enterprises (7). The ability of soils to grow sods that can take concentrated human traffic has already been noted as a factor in such areas as playgrounds and campsites. The development of such vegetative conservation practices as shade tree plantings, living fences, plant screens, and barriers to trespass is guided by soil conditions. The capacity of an area to produce economically harvestable crops of game is dependent in part upon the productive ability of its soils (7).

Thus we find that basic soil qualities and characteristics are closely associated with the various types of outdoor recreational activities (7). By knowing the characteristics and qualities of the different kinds of soils and their behaviors, and with the aid of a soil map, soil scientists and other specialists can develop soil interpretations for recreational uses. Interpretations for recreation can best be made locally by those familiar with the soils and conditions in the area (7).

EXPLANATION OF SOIL INTERPRETATIONS

Soil limitation or suitability ratings are for evaluating each soil for a particular use (8). Interpretations are based on evaluation of the soil to a depth of about 40 inches; however, some interpretations can be made below the 5 foot depth. These interpretations are made largely from detailed soil descriptions obtained during the field soil mapping program. The limited time, resources and trained personnel available did not permit such determinations as bulk density and percolation rate. Only surface and shallow subsurface soil samples were collected for routine chemical

analyses, while only limited numbers of deeper subsurface samples were collected for engineering tests. Engineering properties of some map units sampled were extrapolated to other map units not sampled, where soils of the different map units were developed on the same or very similar parent materials.

It is important that the proper perspective be placed on the use of soil interpretations in recreation planning (7). The interpretations are for soils in the natural state only and not for disturbed areas. Nor do they include other factors, such as location, aesthetic values, and nearness to population centres. A soil survey properly interpreted is a useful guide for general recreation planning and in site selection. However, all soil differences which occur in the field cannot be shown on a general soil map. Thus for design and construction of specific recreational facilities, an "on-site" investigation is often needed.

The soils are grouped into 3 categories according to their limitations or suitabilities for specific uses. They are evaluated by considering the interaction of the various properties to give an overall degree of limitation or suitability to each map symbol. The 3 categories of limitations are as follows:

(1) S - None to slight soil limitations - Soils relatively free of limitations that affect the intended use, or the limitations are easy to overcome.

(2) M - Moderate soil limitations - Soils having limitations that need to be recognized but can be overcome with correct planning, careful design and good management.

(3) V - Severe soil limitations - Soils with limitations severe enough to make the proposed use questionable. It does not mean the soil cannot be used for a specific use but it does mean that careful planning and design, and very good management are needed. This often includes major soil reclamation work. In many cases the limitations will not be economically feasible to correct.

The soils are rated as good (G), fair (F), or poor (P) as sources of topsoil, or sand and gravel. These suitability ratings correspond to the limitations of none to slight (S), moderate (M), and severe (V) respectively and the definitions are essentially the same. The soils may also be rated "unsuitable" as sources of topsoil, or sand and gravel.

Interpretations are not included for wildlife use. However, it is recognized that all soils are suited for some form of wildlife and that this is an important use which is compatible with certain other uses.

DEFINITION OF SELECTED USES

(1) Camp Areas are considered to be used intensively for tents, truck campers and small camp trailers with the accompanying activities of outdoor living (8). It is assumed that little site preparation will be done other than shaping and levelling for tent and parking areas. The soils should be suitable for heavy foot traffic and for limited vehicular traffic. Flooding hazard, depth to water table, slope, permeability, stoniness, and surface texture affect suitability for this use. Soil suitability for growing and maintaining vegetation is not rated but is an item to consider in final evaluation of the site (see ratings for lawns and landscaping).

(2) Foundations for Low Buildings (with or without basements) - Interpretations indicate limitations for construction and maintenance of homes and small buildings (8). They are affected by soil characteristics such as flooding hazard, wetness, slope, stoniness, depth to bedrock, shrink-swell potential, sulphate content, and depth to sand and gravel. (Limitations for on-site sewage disposal is rated separately.)

(3) Play Areas for recreation apply to soils that are to be used intensively for organized games such as football, baseball, volleyball, horseshoes and other similar organized games (8). They are subject to heavy foot traffic. A level surface, good drainage, and a surface soil texture and consistence that gives a firm surface which is not slippery and sticky when wet is generally required. Soils that are sloping, very stony, very shallow, subject to blowing, subject to flooding, or have seasonally high water tables or slow permeability are rated as having severe limitations.

(4) Paths and Trails - Uses are local and crosscountry footpaths, and bridle paths. It is assumed that these areas will be used as they occur in nature and that little or no soil will be moved (excavated or filled) (8). Soil features, such as surface texture and structure, that affect trafficability, dust, and design and maintenance of trafficways should be given special emphasis. Soils that flood frequently, are poorly drained or very stony, or have clay or sand surface textures or steep slopes are rated as having severe limitations.

(5) Picnic Areas are considered to be extensively used as park-type picnic grounds and are subject to heavy foot traffic (8). It is

assumed that most vehicular traffic will be confined to access roads and parking areas. Flood hazard, wetness, slope, permeability, surface stoniness and surface texture affect suitability for this use. Soil suitability for growing vegetation is not rated but is an item to consider in final evaluation of the site. (See ratings for lawns and landscaping.)

(6) Septic Tank Filter Fields - Successful operation of the system depends upon the ability of the soil to absorb and filter the liquid or effluent passed through the tile field (8). Filter fields are influenced by the ease of downward movement of effluent through the soil. Soils with slow permeability are rated severe. Other soil properties that affect septic tank filter fields are flooding hazard, seasonal high ground water, slope, depth to bedrock, and depth to sand and gravel. Clean sands and gravels with rapid permeability may constitute a hazard for ground water contamination.

(7) Road and Parking Location and Suitability for Subgrade Material - These uses are based on features that affect performance for the location of roads, streets, and parking areas (8). The main factors considered are flooding hazard, shrink-swell potential, depth to bedrock, and susceptibility to frost heave.

(8) Lawns and Landscaping - The soil is rated on the assumption that it will be used for lawn turf, shrubs and trees without need for adding topsoil for good establishment, and also that irrigation is provided (8). Soil characteristics affecting this use are flooding hazard, depth to seasonal high water table, slope, stoniness, surface soil texture, depth of topsoil, salinity, and depth to bedrock or sand and gravel.

(9) Sanitary Land Fills are disposal areas for trash and garbage. A good sanitary land fill should be usable all year and should operate without contaminating water supplies or causing a health hazard (8). Soil factors considered in rating the limitations for use are flood hazard, seasonal high water table, slope, permeability, depth to bedrock, and depth to sand and gravel.

(10) Reservoir Sites are rated on the adequacy of the soil material to prevent seepage from the reservoir (8). Soil properties most important are slope, permeability, depth to bedrock and depth to sand and gravel. Depth to water table influences the depth of water in dugouts, pits, etc. in all kinds of soil materials so is not rated for this use.

(11) Suitability as a Source of Topsoil - Topsoil is considered to be used for establishing lawns (8). A rating of "good" means the soil provides a good source of topsoil for removal and transfer to another place, or it can be used in place. Soils are rated on flooding hazard, wetness of the surface layer of undisturbed soils, slope, stoniness, surface texture, depth of topsoil, and salinity.

(12) Suitability as a Source of Sand and Gravel - A particular area outlined on the soil map can be identified as predominantely sand or predominantly gravel by consulting the soil report for a description of the map unit under consideration. Only the suitability as a source for sand and gravel is rated (8). No attempt is made to rate the quality of the sand and gravel for specific uses such as road base, concrete, etc. Quality determinations should be made at the

site of the source, since both grain sizes and shapes of sand and gravel determine suitability for specific uses (8). Soil limitations considered at the site of the source are flooding hazard, wetness, depth to bedrock (influences thickness of sand and gravel deposit), and depth to sand and gravel (determines thickness of overburden that must be removed to reach sand and gravel deposit).

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GLOSSARY

Atterberg limits - Various moisture contents of a soil at which it changes from one major physical condition to another. The Atterberg limits which are most useful for engineering purposes are liquid limit and plastic limit.

The liquid limit is the moisture content at which a soil passes from a plastic to a liquid state.

The plastic limit is the moisture content at which a soil changes from a semisolid to a plastic state.

Plasticity index (P.I.) is defined as the numerical difference between liquid limit and plastic limit.

bedrock - The solid rock underlying the regolith in depths ranging from zero (where exposed by erosion) to several hundred feet.

bulk density, soil - The mass of dry soil per unit bulk volume.

coarse fragments - Rock or mineral particles greater than 2.0 mm. in diameter.

consistence - (a) The resistance of a material to deformation or rupture. (b) The degree of cohesion or adhesion of the soil mass.

droughty soil - Sandy or very rapidly drained soil.

electrical conductivity, soil - Measurement on a saturated soil paste or a water extract of the soil, made to estimate the salt content of the soil.

engineering tests - Laboratory tests made to determine the physical properties of soils that affect their uses for various types of engineering construction.

erodibility - Susceptibility to erosion.

erosion - The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

fertile soil - A soil with an abundant supply of available elements necessary for plant growth.

fertilizer - Any organic or inorganic material of natural or synthetic origin that is added to a soil to supply certain elements essential to the growth of plants.

field capacity (field moisture capacity) - The percentage of water remaining in a soil 2 or 3 days after having been saturated and after free drainage has practically ceased.

frost heave, in soil - The raising of a surface caused by ice formation in the underlying soil.

Gleysolic soil - soil developed under wet conditions resulting in reduction of iron and other elements and in gray colors and mottles.

grain size - The effective diameter of a particle measured by sedimentation, sieving, or micrometric methods.

ground water - That portion of the total precipitation which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

hardpan - A hardened soil layer, in the lower A or in the B horizon, caused by cementation of soil particles with organic matter or with materials such as silica, sesquioxides, or calcium carbonate.

impeding horizon - A horizon which hinders the movement of water through soils under the influence of gravity.

irrigation - The artificial application of water to the soil for the benefit of growing crops.

parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil has developed by pedogenic processes.

pedogenic - Pertaining to the origin, morphology, genesis, distribution, and classification of soils.

permeability, soil - The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

productive capacity, soil - The capacity of a soil, in its normal environment, for producing a specified plant or sequence of plants under a specified system of management. The "specified" limitations are necessary since no soil can produce all crops with equal success nor can a single system of management produce the same effect on all soils.

regolith - The unconsolidated mantle of weathered rock and soil material overlying solid rock.

seepage, soil - (a) The escape of water downward and laterally through the soil. (b) The emergence of water from the soil along an extensive line of surface in contrast to a spring where the water emerges from a local spot.

shrink-swell potential - Tendency of soils to undergo volume changes with changes in water content.

soil blowing - Soil erosion by wind.

soil conservation - (a) Protection of the soil against physical loss by erosion or against chemical deterioration; that is, excessive loss of fertility by either natural or artificial means. (b) A combination of all management and land use methods which safeguard the soil against depletion or deterioration by natural or by man-induced factors.

soil drainage classes - The soil drainage classes are defined in terms of (a) actual moisture content in excess of field moisture capacity, and (b) the extent of the period during which such excess water is present in the plant-root zone. The soil drainage classes are defined as follows:

1. Rapidly drained - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions.

2. Well drained - The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year.

3. Moderately well drained - The soil moisture in excess of field capacity remains for a small but significant period of the year.

4. Imperfectly drained - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year.

5. Poorly drained - The soil moisture in excess of field capacity remains in all horizons for a large part of the year.

6. Very poorly drained - Free water remains at or within 12 inches of the surface most of the year.

soil horizon - A layer of soil or soil material approximately parallel to the land surface; it differs from adjacent genetically related layers in properties such as color, structure, texture, consistence, and chemical, biological, and mineralogical composition.

soil organic matter - The organic fraction of the soil; includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

soil reaction - The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: extremely acid, <4.5; very strongly acid, 4.5 - 5.0; strongly acid, 5.1 - 5.5; moderately acid, 5.6 - 6.0; slightly acid, 6.1 - 6.5; neutral, 6.6 - 7.3; slightly alkaline, 7.4 - 7.8; moderately alkaline, 7.9 - 8.4; strongly alkaline, 8.5 - 9.0; and very strongly alkaline, >9.0.

soil salinity - The amount of soluble salts in a soil, expressed in terms of percentage, parts per million, or other convenient ratios.

soil structure - The combination or arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades.

soil texture - The relative proportions of the various soil separates (sand, silt, and clay) in a soil as described by textural classes. The textural classes may be modified by adding suitable adjectives when coarse fragments are present in substantial amounts; for example, "stony silt loam", or "silt loam, stony phase". The sand, loamy sand, and sandy loam classes are further subdivided on the basis of the proportions of the various sand separates present (fine, medium, coarse). The various classes and subclasses and abbreviations are listed in order from coarse to fine as follows: coarse sand (CS), sand (S), fine sand (FS), very fine sand (VFS), loamy coarse sand (LCS), loamy sand (LS), loamy fine sand (LFS), loamy very fine sand (LVFS), coarse sandy loam (CSL), sandy loam (SL), fine sandy loam (FSL), very fine sandy loam (VFSL), loam (L), silt loam (SiL), silt (Si), sandy clay loam (SCL), clay loam (CL), silty clay loam (SiCL), sandy clay (SC), silty clay (SiC), clay (C), heavy clay (HC).

soluble sulphate - Water-soluble sulphate found in soil.

solum - The upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

subsurface drainage - Removal by artificial means of excess water below the soil surface.

topsoil - (i) The layer of soil moved in cultivation. (ii) The A-horizon. (iii) The Ah-horizon. (iv) Presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

trafficability - The capacity of a soil to withstand traffic by people, horses, or vehicles.

watershed - A drainage area containing a few thousand acres, from which water drains toward a single channel.

water table - The upper surface of ground water or that level below which the soil is saturated with water.

SOIL REPORT

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SIZE AND LOCATION

Bow Valley Provincial Park is situated about 40 miles west of the city of Calgary along Trans Canada Highway Number 1, and is about 2700 acres in size. It is bounded on the north by the Bow River and on the northeast by the Kananaskis River, which flows into the Bow. The park encompasses section 29, and parts of sections 28, 30, 31, 32 and 33, township 24, range 8, west of the fifth meridian.

The portion of the Kananaskis region mapped is situated immediately east and south of Bow Valley Park. The area is bounded on the east by the Kananaskis River, on the west by mountainous terrain, and on the south by Barrier Lake. An area of about 800 acres on either side of Lusk Creek was also mapped on the east side of the Kananaskis River. Lusk Creek flows into the Kananaskis River from the south. The total acreage mapped in the Kananaskis area was about 4,000 acres, including sections 15 and 22, and parts of sections 8,9,10,11,14,16,21,23,26,27, 28 and 34, township 24, range 8, west of the fifth. The total combined acreage mapped in Bow Valley Park and the Kananaskis region was about 6,700 acres.

PHYSIOGRAPHY AND SURFICIAL DEPOSITS

The mapped area is situated in the eastern watershed of the Canadian Rocky Mountains section of the North American Cordillera physiographic province (24). The topography is controlled principally by differential erosion and structure of the bedrock, and has been modified by glacial erosion and deposition.

Bow Valley Park is situated on a relatively flat plain, consisting of low irregular mounds, ridges, and terraces (24). Striking features of this area are ice contact fluvial deposits, consisting of kames, eskers and crevasse fillings. It is difficult to distinguish between them because of superimposition and intergrowth between the features. Surrounding these topographic features are outwash gravels, which sometimes form low terraces with scarps only a few feet high.

The Kananaskis region to the south is mountainous, and the maximum elevation in the mapped area is about 5,500 feet. The elevation of Bow Valley

Park is approximately 4,200 feet. The portion of the Kananaskis region mapped east of the Kananaskis River is drained by Lusk Creek and the Kananaskis River. The remainder of the Kananaskis region mapped is drained by the Kananaskis River, while Bow Valley Park is drained by both the Kananaskis and the Bow Rivers.

The surficial deposit throughout the majority of Bow Valley Park is gravel. A very thin overlay of loess is found over most of the area, and the thickness increases in patches near the Bow River. Loessal deposits are found paralleling the Bow River, and occasional small patches of somewhat coarser textured aeolian deposits are also present. Patches of organic soils are often found in the floodplain of the Kananaskis River.

The same pattern exists in the Kananaskis region east of Bow Valley Park. In addition, gravel bars and alluvial sediments are found in the floodplain of the Kananaskis River. Three small patches of lacustrine (silty clay loam) overlying gravel are found on the south side of Chilver Lake. In the mountainous area to the south, gravel is found at the lower elevations, and till overlying bedrock is found at the higher elevations. East of the Kananaskis River, the surficial deposits between the river and Lusk Creek is loess overlying till. Alluvial deposits occur in the floodplain of Lusk Creek. The majority of the mapped area east of Lusk Creek consists of till overlying bedrock, and numerous sandstone outcrops are present. The steep escarpment bordering the creek consists mainly of gravel and sand.

CLIMATE

Weather records have been kept at Bow Valley Park for the last 5 years (21). These records are compared to records of the last 10 years for the Kananaskis region, kept at a recording station on the north side of Barrier Lake, about 2.5 miles south of Bow Valley Park (21).

The climate of the Banff region, about 20 miles northwest of the mapped area, has been described as continental (24). From September to June polar marine air masses move inland from the North Pacific across the mountains, being cooled on the

way. By the time these masses reach the Banff region, they resemble continental air, but are not as cold or dry. During summer, Pacific air moving eastward mixes with dry air above and becomes indistinguishable from dry continental air by the time it crosses the Continental Divide. Polar continental air masses developed in the Arctic sometimes affect the climate of the Banff region also, principally during winter. The net effect of these air masses is a fairly evenly distributed monthly precipitation and an extreme seasonal variation in temperature.

The mean annual temperature is 37.8 degrees F. in Bow Valley Park and 36.0 degrees F. in the Kananaskis region. The mean annual precipitation is 23.38 inches with 47% falling as rain in Bow Valley Park, and 26.34 inches with 56% falling as rain in the Kananaskis region. The average frost free period is 75 days in Bow Valley Park, but only 38 days in the Kananaskis region. The coldest month of the year is January, with a mean temperature of 7.9 degrees F. in Bow Valley Park and 10.5 degrees F. in the Kananaskis region. The warmest months of the year are July and August, with mean temperatures of 58.6 degrees F. and 59.8 degrees F. respectively in Bow Valley Park, and 56.3 degrees F. and 56.9 degrees F. respectively in the Kananaskis region.

VEGETATION

Vegetation is an important factor of soil formation. Biological studies of the Provincial Parks and areas being considered for future Provincial Parks are being conducted by the Parks Planning Branch of the Alberta Department of Lands and Forests. Consequently information on the vegetation is available elsewhere, and is not dealt with extensively here. However, a few of the more common plant species observed growing on different soils are listed in the Map Unit descriptions. The common and scientific names of these species are as follows: lodgepole pine (Pinus contorta var latifolia), aspen (Populus tremuloides), balsam poplar (Populus balsamifera), white spruce (Picea glauca), black spruce (Picea mariana), douglas

fir (Pseudotsuga menziesii), white birch (Betula papyrifera), swamp birch (Betula pumila var. glandulifera), willow (Salix spp.), river alder (Alnus tenuifolia), juniper (Juniperus spp.), grass (various species), horsetail (Equisetum spp.) mosses (various species), slough grass (Beckmannia syzigachne), sedge (Carex spp.), and wild mint (Mentha arvensis var.villosa).

SOILS

A total of 28 map units were recognized in Bow Valley Park and the Kananaskis region combined. Seven belong to each of the Regosolic and Brunisolic Orders, 6 the Luvisolic Order, 4 to the Organic Order, and 2 each to the Chernozemic and Gleysolic Orders in the Canadian System of Soil Classification (4).

Some map units exhibit only minor differences among one another. However these differences are generally significant with regard to some recreational or engineering use, and thus justify separation into different map units. The map unit descriptions do not necessarily follow in chronological order. Rather descriptions of similar map units follow in sequence, so as to facilitate understanding differences among them. Horizon thicknesses quoted in the map unit descriptions that follow represent averages. Thicknesses of comparative horizons in identical soil profiles often vary as much as 10 to 40% from the norm at different points in the landscape. The dominant plant species observed growing on different soils are listed, using common names. These are general lists only, and are not attempts at complete or exhaustive species lists.

Map Unit 2

Classification: Orthic Eutric Brunisol.

Parent Material: very thin (less than 8 inches) deposit of loess overlying gravel.

Slope: 0.5 to 60%.

Stoniness: exceedingly to excessively stony (4 to 5).

Drainage: rapidly drained.

Vegetation: forested portions have mainly pine, some white spruce, often some douglas fir, juniper, other shrubs, forbs, grass; nonforested portions have forbs, grass, patches of juniper.

Profile Description: 2 inches L-H; often has 1 or 2 inches Ah silt loam, loose consistence when moist or dry; 3 inches Bm silt loam, soft consistence when dry, very friable consistence when moist; Cca horizon is gravel; in areas of grassland, total thickness of soil solum averages only 2 to 4 inches.

Limitations: slight on gentle slopes for septic tanks and sanitary land fills, otherwise severe; surface stoniness, shallow depth to gravel, rapid permeability (droughtiness), thin Ah horizon, excessive slope.

Map Unit 1

Classification: Orthic Regosol.

Parent Material: loess overlying gravel.

Slope: 0.5 to 60%.

Stoniness: stone free to moderately stony (0 to 2).

Drainage: well drained.

Vegetation: forested portions have predominantly white spruce, some patches of aspen, juniper, other shrubs, forbs, grass; nonforested portions have grass, juniper, forbs.

Profile Description: 2 inches L-H; 24 inches Ck1 silt loam, very friable consistence when moist, soft consistence when dry, thickness of this horizon varies from 8 inches to 4 feet; Ck2 horizon is gravel; tops of knolls which constitute about 30% of these soil areas are exceedingly stony (4), vegetation is grass, and total thickness of L-H and Ck1 horizons averages only 2 to 4 inches.

Limitations: slight on gentle slopes for buildings with basements, moderate on gentle slopes for camp and picnic areas, paths and trails, lawns, and buildings with basements, otherwise severe; slippery or sticky when wet (water erosion hazard), shallow depth to gravel, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance), moderate shrink-swell potential, susceptibility to frost heave, excessive slope.

Map Unit 3

Classification: Orthic Regosol.

Parent Material: loess overlying coarse textured alluvial sediment.

Slope: 5 to 9%.

Stoniness: stone free (0).

Drainage: well drained.

Vegetation: various combinations of white spruce and aspen, juniper, other shrubs, forbs, grass.

Profile Description: 2 inches L-H; 24 inches Ck1 silt loam, soft consistence when dry; Ck2 horizon is very fine sand, loose consistence when dry.

Limitations: slight for buildings without basements, moderate for camp and picnic areas, paths and trails, lawns, buildings with basements, otherwise severe; slippery or sticky when wet (water erosion hazard), shallow depth to sand, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance), moderate shrink-swell potential, susceptibility to frost heave, excessive slope.

Map Unit 4

Classification: Gleyed Orthic Regosol.

Parent Material: loess overlying gravel.

Slope: 0.5 to 5%.

Stoniness: stone free (0).

Drainage: moderately well drained.

Vegetation: white spruce, aspen, balsam poplar, juniper, other shrubs, forbs, grass.

Profile Description: 4 inches L-H; 24 inches Ckgj silt loam, soft consistence when dry; Ckg horizon is very fine sand, loose consistence when dry; water table and gravel usually found about 3 to 4 feet below surface.

Limitations: slight for buildings without basements, severe for buildings with basements, septic tanks, sanitary land fills, reservoir sites, and roads, otherwise moderate; slippery or sticky when wet (water erosion hazard), shallow depth to gravel, rapid permeability, groundwater contamination hazard, seasonally high groundwater table, lack of Ah horizon, high lime content (soil nutrient imbalance), moderate shrink-swell potential, susceptibility to frost heave.

Map Unit 5

Classification: Orthic Regosol.

Parent Material: sand.

Slope: 5 to 30%.

Stoniness: stone free (0).

Drainage: rapidly drained.

Vegetation: white spruce, aspen, shrubs, forbs, grass.

Profile Description: 2 inches L-H; 4 feet Ck1 very fine sand, loose consistence when dry; Ck2 horizon is very fine sandy loam, has loose consistence when dry.

Limitations: slight on gentle slopes for buildings and roads, moderate on gentle slopes for camp and picnic areas, and paths and trails, otherwise severe; sandy surface texture (wind erosion hazard), excessive slope, shallow depth to sand, rapid permeability (droughtiness), groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance).

Map Unit 8

Classification: Orthic Regosol.

Parent Material: coarse textured alluvial sediment overlying gravel.

Slope: 0.5 to 2%.

Stoniness: stone free to moderately stony (0 to 2).

Drainage: rapidly drained.

Vegetation: sparse growth of white spruce, juniper, other shrubs, forbs, grass.

Profile Description: 10 inches Ck loamy fine sand, loose consistence when dry; gravel found at about 10 inches below soil surface, occasionally at surface; numerous patches of loose sand are present, devoid of vegetation.

Limitations: slight for buildings and roads, moderate for camp and picnic areas, and paths and trails, otherwise severe; sandy surface texture (wind erosion hazard), shallow depth to gravel, rapid permeability (droughtiness), groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance), surface stoniness.

Map Unit 13

Classification: Degraded Eutric Brunisol and Orthic Gray Luvisol (these two soils are intimately and unpredictably associated).

Parent Material: medium to coarse textured alluvial sediment overlying gravel.

Slope: 0.5 to 5%.

Stoniness: stone free (0).

Drainage: well drained.

Vegetation: predominantly aspen; some balsam poplar and white spruce; shrubs, forbs, grass.

Profile Description: 2 inches L-H; 8 inches Ae loam or fine sandy loam, soft consistence when dry; 5 inches Btj loam, slightly hard consistence when dry, or Bt clay loam, hard consistence when dry; Cca horizon is fine sandy loam, soft consistence when dry; gravel found about 2 or 3 feet below soil surface.

Limitations: moderate for play areas and lawns, severe for septic tanks, sanitary land fills, and reservoir sites, otherwise slight; shallow depth to gravel, rapid permeability, groundwater contamination hazard, lack of Ah horizon.

Map Unit 6

Classification: Rego Gleysol.

Parent Material: medium to coarse textured alluvial sediment.

Slope: 0 to 0.5%.

Stoniness: stone free (0).

Drainage: poorly drained.

Vegetation: balsam poplar, willow, aspen, forbs, grass.

Profile Description: 5 inches H; Ckg horizon varies from very fine sandy loam to loamy sand, has loose consistence when moist.

Limitations: severe for all uses; seasonally high groundwater table or ponding, shallow depth to sand, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance).

Map Unit 9

Classification: Rego Gleysol.

Parent Material: gravel.

Slope: 0 to 0.5%.

Stoniness: very stony (3).

Drainage: poorly drained.

Vegetation: sedge, wild mint, patches of willow, occasionally some balsam poplar.

Profile Description: 5 inches H; Ckg horizon is gravel.

Limitations: severe for all uses; seasonally high groundwater table or ponding, surface stoniness, shallow depth to gravel, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance).

Map Unit 10

Classification: Orthic Gray Luvisol.

Parent Material: gravel.

Stoniness: moderately to exceedingly stony (2 to 4).

Drainage: well drained.

Vegetation: aspen or pine; shrubs, forbs, grass.

Profile Description: 2 inches L-H; 3 inches Ae loam or sandy loam, soft consistence when dry; 8 inches Bt clay loam, very friable consistence when moist, slightly hard consistence when dry, very gravelly horizon; Cca horizon is gravel.

Limitations: slight on gentle slopes for septic tanks and sanitary land fills, otherwise severe; surface stoniness, shallow depth to gravel, rapid permeability, lack of Ah horizon, excessive slope.

Map Unit 16

Classification: Orthic Gray Luvisol.

Parent Material: medium to fine textured till.

Slope: 2 to 30%.

Stoniness: very stony (3).

Drainage: well drained.

Vegetation: pine, shrubs, forbs, grass, aspen clumps, occasional white spruce.

Profile Description: 2 inches L-H; 3 inches Ae fine sandy loam, soft consistence

when dry; 7 inches Bt clay loam, firm consistence when moist, very stony and gravelly horizon; Cca horizon is gravelly loam, slightly hard consistence when dry, very friable consistence when moist, texture grades to clay loam about 10 inches below top of Cca horizon and material contains fewer stones.

Limitations: slight on gentle slopes for septic tanks and sanitary land fills, moderate on gentle slopes for picnic areas, paths and trails, reservoir sites, and roads, otherwise severe; surface stoniness, lack of Ah horizon, moderate shrink-swell potential, excessive slope.

Map Unit 11

Classification: Orthic Gray Luvisol.

Parent Material: fine textured lacustrine overlying gravel.

Slope: 2 to 5%.

Stoniness: stone free (0).

Drainage: well drained.

Vegetation: aspen, shrubs, forbs, grass, occasional white spruce.

Profile Description: 2 inches L-H; 1 or 2 inches Ae loam, slightly hard consistence when dry; 6 inches Bt1 silty clay loam, slightly hard consistence when dry; 15 inches Bt2 silty clay, very firm consistence when moist, very dense; 15 inches BC silty clay loam, very firm consistence when moist; Cca horizon is silty clay loam, very firm consistence when moist; gravel generally found about 5 feet below soil surface.

Limitations: slight for paths and trails, buildings without basements, sanitary land fills, moderate for picnic areas, lawns, buildings with basements, reservoir sites, severe for camp and play areas, septic tanks, roads; slow permeability, lack of Ah horizon, moderate to high shrink-swell potential, excessive slope, shallow depth to gravel, susceptibility to frost heave.

Map Unit 12

Classification: Orthic Dark Gray Chernozem.

Parent Material: fine textured lacustrine overlying gravel.

Slope: 2 to 5 %.

Stoniness: stone free (0).

Drainage: well drained.

Vegetation: forested portions have balsam poplar, aspen, forbs, grass; nonforested portions have grass and forbs.

Profile Description: 2 inches L-H (absent under grass); 16 inches Ah silt loam, soft consistence when dry; 12 inches Bm or Bt silty clay loam or silty clay, very friable consistence when moist; Cca horizon is clay loam, firm consistence when moist; gravel commonly found about 5 feet below soil surface.

Limitations: severe for septic tanks and roads, slight for lawns, buildings without basements, sanitary land fills, otherwise moderate; slippery or sticky when wet (water erosion hazard), slow permeability, moderate to high shrink-swell potential, susceptibility to frost heave, shallow depth to gravel, excessive slope.

Map Unit 14

Classification: Gleyed Rego Dark Gray Chernozem.

Parent Material: medium textured till overlying gravel.

Slope: 2 to 5%.

Stoniness: slightly stony (1).

Drainage: imperfectly drained.

Vegetation: various mixtures of aspen, white spruce, balsam poplar, shrubs, forbs and grass.

Profile Description: 2 inches L-H; 16 inches Ah loam, very friable consistence when moist, contains a few sand pockets; gravel and water found about 3 or 4 feet below soil surface.

Limitations: slight for camp and picnic areas, paths and trails, and buildings without basements, moderate for lawns and roads, otherwise severe; shallow depth to gravel, rapid permeability, groundwater contamination hazard, seasonally high groundwater table, moderate shrink-swell potential, excessive slope.

Map Unit 15

Classification: Orthic Regosol.

Parent Material: medium to fine textured till overlying gravel.

Slope: 30 to 60%.

Stoniness: very stony (3).

Drainage: well drained.

Vegetation: pine, shrubs, forbs, grass.

Profile Description: 1 inch L-H; Ck horizon has texture varying from loam to clay loam, slightly hard consistence when dry, friable consistence when moist; gravel commonly found about 2 feet below soil surface.

Limitations: severe for all uses; excessive slope, surface stoniness, shallow depth to gravel, rapid permeability, groundwater contamination hazard, lack of Ah horizon, high lime content (soil nutrient imbalance).

Map Unit 17

Classification: Degraded Eutric Brunisol and Orthic Eutric Brunisol.

Parent Material: medium to fine textured till.

Slope: 2 to 30%.

Stoniness: slightly stony (1).

Drainage: well drained.

Vegetation: aspen, shrubs, forbs (very dense growth), grass, a few very large douglas fir.

Profile Description: 2 inches L-H; usually has 1 inch Ae and 5 inches AB, both loam, soft consistence when dry (these 2 horizons sometimes not present); Bm or Bt horizon varies from loam to clay loam in texture, slightly hard consistence when dry; Cca horizon found about 3 feet below soil surface, varies from loam to clay loam in texture, very stony.

Limitations: moderate on gentle slopes for play areas, lawns, reservoir sites, and roads, otherwise slight on gentle slopes; excessive slope, moderate permeability, lack of Ah horizon, moderate shrink-swell potential, susceptibility to frost heave.

Map Unit 18

Classification: Orthic Gray Luvisol and Degraded Eutric Brunisol (these two soils are intimately and unpredictably associated).

Parent Material: loess overlying medium textured till.

Slope: 2 to 60%.

Stoniness: stone free to moderately stony (0 to 2).

Drainage: well drained.

Vegetation: pine, shrubs, forbs, grass, some aspen and white spruce.

Profile Description: 2 inches L-H; 3 inches Ae very fine sandy loam, soft consistence when dry, very friable consistence when moist; 4 inches Bt variable texture of loam to clay loam, slightly hard consistence when dry, friable to firm consistence when moist, or 8 inches Bm variable texture of fine sandy loam to loam, soft consistence when dry, very friable consistence when moist; Cca horizon varies from very fine sandy loam to very fine sand in texture, often has layers of silt loam at variable depths, consistence varies from soft to loose when dry and very friable to loose when moist; very stony gravelly till usually found about 6 feet below soil surface, occasionally within 3 feet of surface; soil found on some south facing slopes, devoid of forest cover, is Orthic Regosol with 1 inch L-H overlying Cca horizon in loess.

Limitations: moderate on gentle slopes for play areas, lawns, buildings with basements, reservoir sites, severe for roads, otherwise slight on gentle slopes; excessive slope, lack of Ah horizon, moderate shrink-swell potential, moderate permeability, susceptibility to frost heave.

Map Unit 19

Classification: Orthic Eutric Brunisol and Orthic Regosol (these two soils are intimately and unpredictably associated.)

Parent Material: gravel.

Slope: 30 to 60%

Stoniness: exceedingly stony (4).

Drainage: rapidly drained.

Vegetation: forested portions have pine, douglas fir, shrubs, forbs, grass, some aspen; nonforested portions have juniper, cinquefoil, forbs, sparse grass.

Profile Description: Regosol - ½ to 1 inch L-H overlying Ck horizon in gravel.
Brunisol - ½ to 1 inch L-H; 1 or 2 inches Ah gravelly sand, loose consistence when dry; 5 inches Bm in gravel; Cca horizon is in gravel.

Limitations: severe for all uses; excessive slope, surface stoniness, shallow depth to gravel, rapid permeability, groundwater contamination hazard, thin Ah horizon, high lime content (soil nutrient imbalance).

Map Unit 20

Classification: Degraded Eutric Brunisol (forested portions)and Orthic Regosol (non-forested portions).

Parent Material: sand overlying gravel.

Slope: 30 to more than 60%.

Stoniness: stone free (0).

Drainage: rapidly drained.

Vegetation: forested portions have douglas fir, a few pine and aspen, little or no undergrowth; nonforested portions have juniper and a few forbs.

Profile Description: Regosol - ½ inch L-H overlying Cca horizon in loose sand.
Brunisol - ½ inch L-H; 1 inch Ae, 18 inches Bm, and Cca horizon, all in loose sand; gravel generally found in both these soils more than 5 feet below surface, but varies from 2 to 7 feet.

Limitations: severe for all uses; excessive slope, sandy surface texture (wind erosion hazard), lack of Ah horizon, high lime content (soil nutrient imbalance), shallow depth to sand and gravel, rapid permeability (droughtiness).

Map Unit 21

Classification: Orthic Eutric Brunisol and Orthic Melanic Brunisol (these two soils intimately and unpredictably associated).

Parent Material: medium textured till.

Slope: 5 to 30%.

Stoniness: slightly to moderately stony (1 to 2).

Drainage: well drained.

Vegetation: aspen, shrubs, forbs, grass, occasional white spruce.

Profile Description: 2 inches L-H; 0 to 4 inches Ah (variable thicknesses, sometimes absent) loam to sandy loam, loose consistence when dry; 34 inches Bm loam, soft consistence when dry; Cca horizon is clay loam with sand and gravel pockets, friable consistence when moist.

Limitations: moderate on gentle slopes for lawns, reservoir sites, and roads, severe for play areas, otherwise slight on gentle slopes; thin Ah horizon, moderate shrink-swell potential, excessive slope, surface stoniness.

Map Unit 22

Classification: Lithic Orthic Gray Luvisol.

Parent Material: medium textured till overlying sandstone.

Slope: 15 to 30%.

Stoniness: very stony (3).

Drainage: well drained.

Vegetation: pine, shrubs, forbs, grass, occasional white spruce.

Profile Description: 2 inches L-H; 5 inches Ae loamy sand, loose consistence when moist; 10 inches Bt gravelly clay loam, firm consistence when moist; Cca horizon is gravelly clay loam, very friable consistence when moist; hard sandstone found at about 2 feet below soil surface.

Limitations: moderate on gentle slopes for paths and trails, severe for all other uses; excessive slope, surface stoniness, shallow depth to bedrock, lack of Ah horizon, moderate shrink-swell potential.

Map Unit 23

Classification: Lithic Orthic Gray Luvisol and Lithic Orthic Eutric Brunisol (these two soils intimately and unpredictably associated).

Parent Material: medium textured till overlying sandstone; till contains a large proportion of weathered sandstone.

Slope: 30 to 60%.

Stoniness: very stony (3).

Drainage: well drained.

Vegetation: forested portions have pine, douglas fir, white spruce, some shrubs, forbs, grass; nonforested portions have grass and forbs.

Profile Description: Luvisol - 2 inches L-H; 10 inches Ae gravelly loam, soft consistence when dry; 16 inches Bt gravelly clay loam, slightly hard consistence when dry; II CCa horizon is hard sandstone and commonly found about 20 to 30 inches below soil surface.

Brunisol - 2 inches L-H overlying Bm horizon, which varies from gravelly loam to gravelly sandy loam in texture, and contains sand pockets, loose consistence when dry or moist; II Cca horizon is hard sandstone and found about 30 to 40 inches below soil surface.

Limitations: severe for all uses; excessive slope, surface stoniness, shallow depth to bedrock, lack of Ah horizon.

Map Unit 24

Classification: Lithic Orthic Gray Luvisol and Lithic Degraded Eutric Brunisol (these two soils intimately and unpredictably associated).

Parent Material: medium textured till overlying shale; till contains a high proportion of weathered shale.

Slope: 2 to 60%.

Stoniness: moderately stony (2).

Drainage: well drained.

Vegetation: various mixtures of white birch, pine, aspen, white spruce, shrubs, forbs, grass.

Profile Description: 3 inches L-H; 5 inches Ae loam or sandy loam, soft consistence when dry; Btj loam, slightly hard consistence when dry, or Bt clay loam, slightly hard consistence when dry, very friable consistence when moist, II Cca horizon is hard shale, commonly found about 2 feet below soil surface.

Limitations: slight on gentle slopes for picnic areas, and paths and trails, moderate on gentle slopes for camp areas, lawns, buildings without basements, and roads, otherwise severe; surface stoniness, shallow depth to bedrock, excessive slope, lack of Ah horizon, moderate shrink-swell potential, susceptibility to frost heave.

Map Unit 7

Classification: Lithic Orthic Regosol.

Parent Material: gravel overlying rock.

Slope: 30 to 60%.

Stoniness: exceedingly stony (4).

Drainage: well drained.

Vegetation: sparse small aspen and white spruce, some pine and willow, juniper, forbs and grass.

Profile Description: 1 inch L-H; 0 to 5 inches (variable depth) Ck horizon overlying rocks, gravelly loamy fine sand, loose consistence when dry; numerous outcrops of rock throughout area.

Limitations: severe for all uses; excessive slope, surface stoniness, shallow depth to bedrock, lack of Ah horizon, high lime content (soil nutrient imbalance).

M. (Organic Soil)

Classification: undifferentiated Mesisol.

Parent Material: peat.

Slope: 0 to 0.5%.

Stoniness: stone free (0).

Drainage: very poorly drained.

Vegetation: grass, moss, scattered swamp birch, willow, black spruce.

Profile Description: about 12 inches fibric peat at surface, remainder of profile consists predominantly of mesic peat, may be occasional thin layer of fibric or humic peat; total thickness of peat generally more than 52 inches.

Limitations: severe for all uses; organic soil, high groundwater table, lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, susceptibility to frost heave.

H. (Organic soil)

Classification: undifferentiated Humisol.

Parent Material: peat.

Slope: 0 to 0.5%.

Stoniness: stone free (0).

Drainage: very poorly drained.

Vegetation: various mixtures of willow, balsam poplar, swamp birch; horsetail, forbs, grass.

Profile Description: profile consists predominantly of humic peat, may be occasional layer of mesic peat; total thickness of peat generally more than 52 inches.

Limitations: severe for all uses; organic soil, high groundwater table, lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, susceptibility to frost heave.

T. H. (Organic Soil)

Classification: Terric Humisol.

Parent Material: peat overlying mineral soil.

Slope: 2 to 15%.

Stoniness: stone free (0).

Drainage: very poorly drained. .

Vegetation: white spruce, alder, swamp birch, horsetail, moss, forbs, slough grass.

Profile Description: profile consists of about 30 inches humic peat overlying mineral soil; these soils occur in areas of very wet groundwater discharge near the base of steep banks along the Kananaskis River.

Limitations: severe for all uses; organic soil, high groundwater table, lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, susceptibility to frost heave.

T. H. - G. (Organic soil)

Classification: Terric Humisol and Rego Gleysol, peaty phase (these two soils are intimately and unpredictably associated).

Parent Material: peat overlying gravel.

Slope: 0 to 0.5%.

Stoniness: stone free (0).

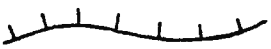
Drainage: poorly drained.

Vegetation: forested portions have white spruce, some balsam poplar and aspen, willow, horsetail, other forbs, grass; nonforested portions have slough grass, scattered willow, wild mint.

Profile Description: profile consists of humic peat overlying gravel, peat thickness varies from 1 to 3 feet.

Limitations: severe for all uses; high groundwater table, organic surface layer more than 6 inches thick, lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, shallow depth to gravel, rapid permeability, susceptibility to frost heave.

MISCELLANEOUS LAND TYPES

1. Er. This symbol indicates steep eroded slopes possessing little or no vegetation. The parent material varies but is commonly that of adjacent soil types. These areas have severe limitations for all uses.
2. R. This symbol indicates bare rock outcrops on steep mountain slopes, where little or no vegetation exists. These areas have severe limitations for all uses.
3. Gv. This symbol indicates alluvial gravel bars in the floodplain of the Kananaskis River. These areas have severe limitations for all uses.
4. SLF. This symbol indicates a sanitary land fill site.
5. G.P. This symbol indicates a gravel pit.
6. B.P. This symbol indicates a borrow pit, excavated during highway construction.
7. R.F. This symbol indicates rock fill placed in a gully during highway construction.
8. D.O. This symbol indicates a man made dugout or reservoir.
9. O This symbol is used to indicate open water in ponds. Clumps of sedge are often found around the margins.
10.  This symbol is used to indicate steep escarpments.
11.  This symbol is used to indicate a sandstone outcrop.

SOIL INTERPRETATIONS

Soil interpretations are predictions of soil performance under different uses, not recommendations for land use (22). They do not eliminate the need for land use planning; rather they are valuable tools that can be used to assist the planner. They indicate limitations and suitabilities of the various kinds of soil for any particular use. The planner can then predict the type and degree of problem likely to be encountered, and plan the kind and amount of on site investigation needed to determine corrective measures. However the actual number of on site investigations can be reduced considerably by the use of a detailed soil survey map.

Using the basic soil survey data of an area, it is possible to make soil performance predictions, based on soil morphology and the associated soil physical and chemical properties. Soils in the provincial parks are used mainly for recreational pursuits, and as construction materials.

A wide variety of soils and parent materials is found in the mapped area, and numerous limitations exist for recreational development. This does not mean the soils cannot be used; rather the limitations should be recognized and procedures followed to overcome them during construction.

Soils most suitable for recreational development are those of map units 13, 14, 17, 18, and 21; and soils of map units 1, 3, 4, 5, 8, 10, 12 and 24 have moderate limitations. Many of the soils have severe limitations for use as road construction materials. However, the most suitable soils are those of map units 5, 8, 10, 13, 14, 16 17, 21, and 24. Very little topsoil can be found in the mapped area, while abundant supplies of gravel are present. The limitations most prevalent in Bow Valley Park are surface stoniness, shallow depth to sand or gravel, rapid permeability (droughtiness) groundwater contamination hazard, excessive slope, lack of Ah horizon, and high lime content (soil nutrient imbalance). Other less frequent limitations are susceptibility to frost heave, moderate to high shrink-swell potential, high clay content, slow permeability, slippery or sticky when wet (water erosion hazard), sandy surfact texture (wind erosion hazard), seasonally high groundwater table or ponding, organic soil, and organic surface layer more than 6 inches thick.

The most common limitations in the mapped area south of Bow Valley Park are excessive slope, surface stoniness, shallow depth to sand or gravel, rapid permeability (droughtiness), lack of Ah horizon, and shallow depth to bedrock. Other limitations also present are high lime content (soil nutrient imbalance), moderate to high shrink-swell potential, groundwater contamination hazard, sandy surface texture (wind erosion hazard), organic soil, and seasonally high groundwater table or ponding.

The limitations and suitabilities of the various soils for selected uses are shown in Table 4. The ratings were determined on the basis of soil morphological, physical, and chemical properties, as well as steepness of slope. The principal limiting property(s) is indicated by numerals which correspond to those listed in Table 3. The limiting properties are generally listed in decreasing order of importance in Table 4.

Table 3. Limiting Soil Properties and Hazards

2. Seasonally high groundwater table or ponding
3. Excessive slope.
4. Surface stoniness.
5. Sandy surface texture (wind erosion hazard).
6. Slippery or sticky when wet (water erosion hazard).
7. High clay content.
8. Shallow depth to sand and/or gravel.
9. Rapid permeability (droughtiness).
10. Moderate permeability.
11. Slow permeability
12. Groundwater contamination hazard.
13. High shrink-swell potential.
14. Susceptibility to frost heave. *
16. High lime content (soil nutrient imbalance).
17. Shallow depth to bedrock.
18. Thin Ah horizon.
19. Organic soil.
20. Organic surface layer more than 6 inches thick.
21. Thick overburden above gravel or sand.
22. Moderate shrink-swell potential.
24. Thin deposit of sand or gravel.

* Contingent upon an abundant supply of moisture. Frost heaving is not generally considered to be a serious problem for roads in Alberta except in poorly drained locations where the water table is near the soil surface (22). In well drained locations the water table is normally low enough so that frost heaving rarely takes place. Consequently the hazard "susceptibility of soils to frost heaving" has been given only minor consideration in determining a soils' overall limitation for a particular use. Exceptions are soils having high or fluctuating water tables. These soils may be highly susceptible to frost heaving, depending upon texture.

In Table 4 the soil limitations for various uses have been designated as slight (S), moderate (M), and severe (V). As a source of topsoil or as a source of sand and gravel the soils are simply rated as good (G), fair (F), poor (P), and unsuitable (U).

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TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:										Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil *	Sand and/or gravel
1 bo	M6	M6	M6,8	M6	M18,16	M22	S	V8,9,12	V8,9,12	V8,9	V14,22	P18,16	F21
1 c0	M6	M6	V3,8,6	M6	M18,16,8	M22	S	V8,9,12	V8,9,12	V8,9	V14,22	P18,16	F21
1 c1	M6	M6	V3,8,6	M6	M18,16,8	M22	S	V8,9,12	V8,9,12	V8,9	V14,22	P18,16	F21
1 c2	M6,4	M6	V3,8,6,4	M6	M18,16,8,4	M22,4	M4	V8,9,12	V8,9,12	V8,9	V14,22	P18,16,4	F21
1 d0	M6	M6	V3,8,6	M6	M18,16,8	M22	S	V8,9,12	V8,9,12	V8,9	V14,22	P18,16,3	F21
1 f0	V3,6	V3,6	V3,6,8	M6,3	V3,18,16,8	V3,22	V3	V8,9,12 3	V8,9,12	V8,9,3	V3,14,22	P3,18,16	G
1 G1	V3,6	V3,6	V3,6,8	V3,6	V3,18,16 8	V3,22	V3	V8,9,12 3	V8,9,12,3	V8,9,3	V3,14,22	P3,18,16	G
2 b5	V4	V4	V4,8	V4	V4,18,8,9	V4	V4	S	S	V8,9	V4	U	G
2 c4	V4	V4	V4,8	V4	V4,18,8,9	V4	V4	S	S	V8,9	V4	U	G
2 c5	V4	V4	V4,8	V4	V4,18,8,9	V4	V4	S	S	V8,9	V4	U	G

Legend: S - none to slight, M - moderate, V - severe, G - good, F- fair, P - poor, U - unsuitable

* Topsoil being considered here is Ah - horizon or its equivalent (see glossary)

TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land - scaping	Buildings		Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil *	Sand and/or gravel
						with basement	without basement						
2/d4	V4	V4	V4,8,3	V4	V4,18, 8,9	V4	V4	S	S	V8,9	V4	U	G
2/d5	V4	V4	V4,8,3	V4	V4,18, 8,9	V4	V4	S	S	V8,9	V4	U	G
2/e4	V4,3	V4,3	V3,4,8	V4	V4,18, 8,9,3	V4,3	V4,3	M3	S	V8,9,3	V4,3	U	G
2/f4	V3,4	V3,4	V3,4,8	V4,3	V4,3,18, 8,9	V4,3	V4,3	V3	M3	V3,8,9	V3,4	U	G
2/f5	V3,4	V3,4	V3,4,8	V4,3	V4,3,18, 8,9	V4,3	V4,3	V3	M3	V3,8,9	V3,4	U	G
2/G4	V3,4	V3,4	V3,4,8	V3,4	V3,4,18, 8,9	V3,4	V3,4	V3	V3	V3,8,9	V3,4	U	G
2/g4	V3,4	V3,4	V3,4,8	V3,4	V3,4,18, 8,9	V3,4	V3,4	V3	V3	V3,8,9	V3,4	U	G
3/d0	M6	M6	V3,8,6	M6	M18,16, 8	M22	S	V8,9, 12	V8,9, 12	V8,9,3	V14,22	P18,16	F21
4/bo	M6	M6	M6,8	M6	M18,16	V2,22	S	V8,9,2, 12	V8,9,2, 12	V8,9	V14, 22, 2	P18,16	F2,21
4/c0	M6	M6	V8,3,6	M6	M18,16, 8	V2,22	S	V8,9,2, 12	V8,9,2, 12	V8,9,3	V14,22, 2	P18,16	F2,21

Legend: S - none to slight, M - moderate, V - severe, G - good, F- fair, P - poor, U - unsuitable

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						with basement	without basement						
5 do	M5	M5	V3,5,8	M5	V8,9,5, 18,16	S	S	V8,9,12	V8,9,12	V8,9,3	S	P5,18, 16,3	G
5 fo	V3,5	V3,5	V3,5,8	V3,5	V8,9,3, 5,18,16	V3	V3	V3,8,9, 12	V8,9, 12,3	V3,8,9	V3	P3,5,18, 16	G
6 a0	V2	V2	V2	V2	V2,18,16	V2	V2	V2,8,9, 12	V2,8,9, 12	V8,9	V2	P2,18,16	P2
7 G4	V3,4	V3,4	V3,4,17	V3,4	V3,4,17, 18,16	V3,4,17	V3,4	V3,17.	V3,17	V3,17	V3,4,17	U	P24
8 b0	M5	M5	V8,5	M5	V8,5,18, 16	S	S	V8,9,12	V8,9,12	V8,9	S	P5,18, 16	G
8 b2	M5,4	M5	V8,5,4	M5	V8,5,18, 16,4	M4	M4	V8,9,12	V8,9,12	V8,9	S	P5,18, 16,4	G
9 a3	V2,4	V2,4	V2,4,8	V2,4	V2,4,18, 16	V2,4	V2,4	V2,8,9, 12	V2,8,9, 12	V8,9	V2,4	P2,4,18, 16	P2
10 b4	V4	V4	V4,8	V4	V4,8,18	V4	V4	S	S	V8,9	V4	P4,18	G
10 c2	M4	S	V8,3,4	S	V8,18,4	M4	M4	S	S	V8,9,3	S	P18,4	G
10 c4	V4	V4	V4,8,3	V4	V4,8,18	V4	V4	S	S	V8,9,3	V4	P4,18	G

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* Topsoil being considered here is Ah - horizon or its equivalent (see glossary)

TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land - scaping	Buildings		Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil *	Sand and/or gravel
						with basement	without basement						
10 d4	V4	V4	V4,3,8	V4	V4,8,18	V4	V4	S	S	V8,9,3	V4	P4,18,3	G
10 e4	V4,3	V4,3	V3,4,8	V4	V4,8,18 3	V4,3	V4,3	M3	S	V8,9,3	V4,3	P3,4,18	G
10 f4	V3,4	V3,4	V3,4,8	V4, 3	V4,3,8, 18	V3,4	V3,4	V3	M3	V3,8,9	V3,4	P3,4,18	G
10 g4	V3,4	V3,4	V3,4,8	V3,4	V3,4,8, 18	V3,4	V3,4	V3	V3	V3,8,9	V3,4	P3,4,18	G
11 do	V7,11	M7,11	V3,7,11	S	M18	M22	S	V7,11	S	M8,3	V13,14	P18,3	P21
12 co	M6,7, 11	M6	M6,7,11	M6	S	M22	S	V7,11	S	M8,3	V13,14	G	P21
13 bo	S	S	M8	S	M18	S	S	V8,9, 12	V8,9,12	V8,9	S	P18	G
13 c0	S	S	V3,8	S	M18,8	S	S	V8,9, 12	V8,9,12	V8,9	S	P18	G
14 cl	S	S	V8,3	S	M8	V2	S	V2,8,9, 12	V2,8,9, 12	V8,9	M2,22	F2	F2,21
15 g3	V3,4	V3,4	V3,4	V3,4	V3,4, 18,16	V3,4	V3,4	V3,8,9, 12	V3,8,9, 12	V3,8,9	V3,4	P3,4, 18	F21

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TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land-scaping	Buildings		Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil	Sand and/or gravel
						with basement	without basement						
16 c3	V4	M4	V4	M4	V4,18	V4	V4	S	S	M3	M4,22	P18,4	U
16 d3	V4	M4	V4,3	M4	V4,18	V4	V4	S	S	M3	M4,22	P18,4,3	U
16 f3	V3,4	V3,4	V3,4	M3,4	V3,4,18	V3,4	V3,4	V3	M3	V3	V3,4,22	P3,18,4	U
17 ci	S	S	M3	S	M18	S	S	S	S	M3,10	M22,14	P18	U
17 dl	S	S	V3	S	M18	S	S	S	S	M3,10	M22,14	P18,3	U
17 fl	V3	V3	V3	M3	V3,18	V3	V3	V3	M3	V3,10	V3,22, 14	P3,18	U
18 c0	S	S	M3	S	M18	M22	S	S	S	M10,3	V14,22	P18	U
18 do	S	S	V3	S	M18	M22	S	S	S	M10,3	V14,22	P18,3	U
18 f0	V3	V3	V3	M3	V3	V3,22	V3	V3	M3	V3,10	V14,3, 22	P3,18	U
18 fl	V3	V3	V3	M3	V3	V3,22	V3	V3	M3	V3,10	V14,3, 22	P3,18	U

Legend: S - none to slight, M - moderate, V - severe, G - good, F- fair, P - poor, U - unsuitable

* Topsoil being considered here is Ah - horizon or its equivalent (see glossary)

TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land - scaping	Buildings		Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil	Sand and/or gravel
						with basement	without basement						
18 g2	V3,4	V3	V3,4	V3	V3,4	V3,22,4	V3,4	V3	V3	V3,10	V3,14, 22	P3,18, 4	U
19 g4	V3,4	V3,4	V3,4,8	V3,4	V3,4,18 8,9,16	V3,4	V3,4	V3,8,9 12	V3,8,9, 12	V3,8,9	V3,4	P3,4, 18,16	G
20 g0	V3,5	V3,5	V3,5	V3,5	V3,5,18, 16,8,9	V3	V3	V3	V3	V3,8,9	V3	P3,5, 18,16	G
20 ho	V3,5	V3,5	V3,5	V3,5	V3,5,18 16,8,9	V3	V3	V3	V3	V3,8,9	V3	P3,5, 18,16	G
21 d1	S	S	V3	S	M18	S	S	S	S	M3	M22	F18,3	U
21 f1	V3	V3	V3	M3	V3,18	V3	V3	V3	M3	V3	V3,22	P3,18	U
21 f2	V3,4	V3	V3	M3	V3,18,4	V3,4	V3,4	V3	M3	V3	V3,22	P3,18,4	U
22 f3	V3,4	V3,4	V3,4,17	M3,4	V3,4,18 17	V3,4,17	V3,4	V3,17	V17,3	V3,17	V3,4,17 22,14	P3,18, 4,5	U
23 g3	V3,4	V3,4	V3,4,17	V3,4	V3,4,18 17	V3,4,17	V3,4	V3,17	V3,17	V3,17	V3,17	P3,18,4	U
24 c2	M4	S	V17,3,4	S	M18,4, 17	V17,4	M4	V17	V17	V17	M17,22, 14	P18,2	U

Legend: S - none to slight, M - moderate, V - severe, G - good, F- fair, P - poor, U - unsuitable

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TABLE 4. SOIL LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol	Soil Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Play Areas	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Filter Fields	Sanitary Land Fills	Reservoir Sites	Roads, Parking, Subgrade Material	Topsoil	Sand and/or gravel
24 e2	M3,4	M3	V17,3,4	S	M18,4, 3,17	V17,4,3	M3,4	V17,3	V17	V17,3	M3,17, 22,14	P18,3,2	U
24 f2	V3,4	V3	V3,17,4	M3	V3,18, 4,17	V3,17,4	V3,4	V3,17	V17,3	V3,17	V3,17, 22,14	P3,18,2	U
24 g2	V3,4	V3	V3,17,4	V3	V3,18, 4,17	V3,17,4	V3,4	V3,17	V3,17	V3,17	V3,17, 22,14	P3,18,2	U
M.	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19	V19,2, 13,14	U	U
H.	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2 13	V19,2	V19,2 12	V19,2, 12	V19	V19,2, 13,14	U	U
T.H.	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19	V19,2, 13,14	U	U
T.H.-G.	V2,20	V2,20	V2,20	V2,20	V2,20, 18	V2,20, 13	V2,20	V2,12	V2,12	V8,9	V2,20, 13,14	U	P2

Legend: S - none to slight, M - moderate, V - severe, G - good, F- fair, P - poor, U - unsuitable

* Topsoil being considered here is Ah - horizon or its equivalent (see glossary)

APPENDIX

Chemical Analyses of the Soils

The chemical analyses carried out on representative soil samples are presented in Table 5. The samples analyzed are surface and subsoil samples, taken of the map units at representative sites. Surface samples are taken from the 0 to 6 inch depth, and the subsoil samples are taken in 6 inch increments between the 6 and 18 inch depth. Each surface sample consists of 5 separate samples taken at random locations and bunched together into one composite sample. A brief explanation of the significance of each chemical analysis follows.

1. Nitrogen.

Plant growth in regions where rainfall is adequate is determined more by soil nitrogen than by any other mineral element supplied by the soil (26). Nitrogen is of special importance because plants need it in rather large amounts and it is easily lost from the soil.

Soil nitrogen supply can be markedly affected by climatic conditions, native vegetation, and soil texture.

In humid areas, where forests predominate, the higher rainfall causes much leaching and the removal of most soil nitrogen from upper horizons. In contrast, in areas of somewhat limited rainfall where grass predominates, much more nitrogen remains near the soil surface.

A clay or clay loam soil commonly contains 2 to 3 times as much nitrogen as does a very sandy soil under the same type of climatic conditions. Poorer aeration and less leaching favour the retention of nitrogen in the finer textured soils.

TABLE 5. CHEMICAL ANALYSES OF SELECTED MAP UNITS *

Map Unit	Sample Depth (inches)	Pounds per Acre			Sodium**	Sulphur**	Soil Reaction (pH)	Conductivity (mmhos.)	Sulphate **	Organic Matter**	Free Lime ** ($CaCO_3$)	REMARKS
		Nitrogen (N)	Phosphorus (P)	Potassium (K)								
1	0-6	1	5	420	L-	M-	8.0	0.4	-	M	M-	Native forest
1	6-12	2	0	555	L-	L	8.2	0.4	-	M	H+	Native forest
2	0-6	1	8	610	L-	L+	8.0	0.4	-	M-	M-	Native grass
2	0-6	1	36	700	L-	M	8.0	0.4	-	M-	L+	Native forest
3	0-6	2	6	385	L-	H+	7.8	1.3	-	M	L+	Native forest
3	6-12	2	2	315	L-	M	8.0	0.4	-	M	M	Native forest
4	0-6	1	3	450	L	M-	8.3	0.4	-	L+	H+	Native forest
4	6-12	4	1	180	L-	-	8.6	0.4	-	L+	H+	Native forest
5	0-6	2	7	355	L-	L+	8.1	0.4	-	M	L+	Native forest
5	6-12	3	1	310	L-	L-	8.1	0.3	-	M	M-	Native forest
8	0-6	1	2	120	L-	M	8.0	0.3	-	M-	H+	Native forest
10	0-6	2	21	345	L-	M-	7.2	0.3	-	M	-	Native forest
11	0-6	2	15	820	L-	L+	7.5	0.2	-	M-	-	Native forest
11	6-12	2	2	1055	L-	L	7.3	0.2	-	L+	-	Native forest

* Chemical Analyses done by Alberta Soil and Feed Testing Laboratory.

** These tests are rated into four categories: high (H), medium (M), low (L), and none (-). The degree within each category is indicated by a plus or minus sign. The tests for organic matter and free lime are estimates only.

TABLE 5. CHEMICAL ANALYSES OF SELECTED MAP UNITS *

Map Unit	Sample Depth (inches)	Pounds per Acre			Sodium**	Sulphur**	Soil Reaction (pH)	Conductivity (mmhos.)	Sulphate **	Organic Matter**	Free Lime ** ($CaCO_3$)	REMARKS
		Nitrogen (N)	Phosphorus (P)	Potassium (K)								
12	0-6	2	11	905	L-	M-	7.4	0.4	-	M-	L-	Horse pasture - grass
12	6-12	1	3	390	L-	-	7.9	0.3	-	M-	-	Horse pasture - grass
13	0-6	2	18	370	L-	M-	6.4	0.2	-	M-	-	Native forest
13	6-12	2	4	265	L-	L	6.5	0.1	-	M-	-	Native forest
14	0-6	2	33	515	L-	M-	6.7	0.3	-	M	-	Native forest
14	6-12	2	7	315	L-	L+	7.0	0.2	-	M	-	Native forest
16	0-6	1	25	425	L-	M-	6.1	0.2	-	L	-	Native forest
16	6-12	1	4	505	L-	M-	7.0	0.4	-	L+	L	Native forest
17	0-6	2	40	1085	L-	L	6.0	0.3	-	L+	L-	Native forest
17	6-12	0	6	730	L-	L-	6.6	0.1	-	L	-	Native forest
18	0-6	1	28	240	L-	M-	6.5	0.2	-	L	-	Native forest
18	6-12	0	3	200	L-	L-	7.0	0.1	-	L	-	Native forest
24	0-6	3	57	545	L-	M-	6.7	0.3	-	M-	-	Native forest
24	12-18	2	21	1090	L-	L-	7.0	0.2	-	L+	-	Native forest

* Chemical Analyses done by Alberta Soil and Feed Testing Laboratory.

** These tests are rated into four categories: high (H), medium (M), low (L), and none (-). The degree within each category is indicated by a plus or minus sign. The tests for organic matter and free lime are estimates only.

In general, low soil nitrogen levels will likely occur in virgin soils, in soils low in organic matter, and in soils that are cold or poorly drained.

General soil test ratings for supplies of available nitrogen, expressed in pounds per acre, are: low, 0 to 20; medium, 21 to 50; and high, 51 or more. *

The primary natural source of soil nitrogen is air. Important artificial sources are fertilizers, animal manures, green manures, and various crop residues.

2. Phosphorus.

Phosphorus is present in all living tissue. It is particularly concentrated in the younger parts of the plant, and in the flowers and seed (26).

As phosphorus does not move appreciably in the soil, accumulations are found in the first foot of soil.

Most of the total phosphorus supply is tied up chemically in a form that is not usable by plants; it is not available to the growing plant. The available soil phosphorus originates from the breakdown of soil minerals and soil organic matter or from the addition of phosphate fertilizer. The available soil phosphorus is usually only about one percent of the total soil phosphorus.

Soil tests show that a majority of Alberta soils are low in available phosphorus.* Plants respond markedly to phosphate fertilizer on deficient soils.

General soil test ratings for supplies of available phosphorus, expressed in pounds per acre, are: low, 0 to 30; medium, 31 to 70; and high, 71 or more.

3. Potassium.

Plants need large amounts of potassium, one of the three major plant nutrients (26). It is supplied to roots by soil minerals, artificial fertilizers, manures and crop residues.

* - Alberta Soil and Feed Testing Laboratory

Most Alberta soils contain adequate amounts of potassium.* Deficiencies occur most frequently on peat soils or poorly drained soils.

General soil test ratings for supplies of available potassium, expressed in pounds per acre, are: low, 0 to 150; medium, 151 to 300; and high, 301 or more.

4. Sulphur.

Sulphur is essential to life (26). Many plants use about as much sulphur as they do phosphorus. Plants obtain sulphur from the soil, rain and irrigation water, artificial fertilizers, and the atmosphere.

General soil test ratings for supplies of available sulphur are: low (L), medium (M), high (H), and none (nil). The degree within each category is indicated by a plus or minus sign. *

The soil test determines whether adequate amounts of sulphur are available for normal plant growth. Where the sulphur test is low, a sulphur containing fertilizer should be applied; where it is medium, a field test using sulphur and non-sulphur fertilizers should be conducted. Plant responses to sulphur fertilizer can vary considerably within very small areas.

5. Soil Reaction (pH).

This test measures soil acidity or alkalinity. Acid soils have pH values of less than 6.6; decreasing pH values indicate increasing soil acidity. Neutral soils have pH values of 6.6 to 7.3; alkaline soils have pH values of more than 7.3. Increasing pH values indicate increasing soil alkalinity.

The best pH range for most crops in Alberta is 5.5 to 7.5. *

* - Alberta Soil and Feed Testing Laboratory

6. Soil Salinity and Conductivity Test.

Conductivity is a measure of the total soluble salt concentration in a soil. Soluble salts are present in soils at all times; however, when the salt concentration is high, plant growth is reduced and the soil is considered "saline". Sulphates and sodium are determined to identify specific salts commonly causing salinity.

In general, lawn growth is affected on soils having conductivity readings as follows: *

0 to 1, negligible salt effects.

1.1 to 3, lawn growth noticeably restricted.

3.1 or more, lawn growth considerably restricted.

The sulphate and sodium tests are rated in four categories; high (H), medium (M), low (L), and none (nil). The degree within each category is indicated by a plus or minus sign.

A high sodium test may indicate a solonetzic soil which is characterized by poor physical structure and requires special management. A high sulphate test may indicate a hazard of sulphate attack on concrete, indicating a need for sulphate resistant concrete to be used in constructing foundations and underground conduits.

7. Organic Matter and Free Lime.

These tests are estimates of the amounts contained in the soil. Results are rated into four categories: high (H), medium (M), low (L), and none (-). The degree within each category is indicated by a plus or minus sign. *

Organic matter influences physical and chemical properties of soils far out of proportion to the small quantities contained therein (20). It commonly accounts for at least half the cation exchange capacity of soils and is responsible, perhaps more than

* - Alberta Soil and Feed Testing Laboratory

any other single factor, for the stability of soil aggregates. Furthermore, it supplies energy and body building constituents for the soil microorganisms.

Free lime is present in some soils and may reduce nutrient availability to plants in the following ways (20):

a) Deficiencies of available iron, maganese, copper or zinc may be induced.

b) Phosphate availability may decrease due to the formation of complex and insoluble calcium phosphates.

c) The uptake and utilization of boron may be hindered.

d) The high pH, in itself, may be detrimental.

Free lime cannot be readily removed from the soil. The only practical way to counteract its effect is to increase soil organic matter content.

Engineering Properties of the Soils

Engineering test data determined on representative soil samples are presented in Table 6. The samples analyzed were taken from subsoils of the map units at representative sites. Depth of sampling generally ranged between 2 and 4 feet below the surface. A brief description of the significance of each analytical parameter follows:

1. Field Moisture Percentage.

This is a determination of the natural moisture content of the soil as it occurs in the field.

For any potential borrow material, it is essential to know in advance of construction, whether, for the compaction procedure likely to be specified, the moisture content in the field is excessive or deficient with respect to the optimum value for that procedure (25).

TABLE 6. PHYSICAL ANALYSES OF SELECTED MAP UNITS *

Map Unit	Depth (feet)	Field Moisture %	Mechanical Analysis: Percentage Passing Sieve: 1 inch	3/4 inch	5/8 inch	#4 (4.7 mm.)	#10 (2.0 mm.)	#40 (0.42 mm.)	#200 (0.074 mm.)	Percentage Smaller than: 0.05 mm.	0.005 mm.	0.002 mm.	0.001 mm.	Liquid Limit	Plasticity Index	Optimum Moisture % **	Maximum Dry Density lb/ft3 **	Classification: AASHO	Unified	USDA
1	3-4	16	100	100	100	100	100	99	75	64	17	13	9	33	4	-	-	A-4 (8)	ML	SiL
12	3-4	23	100	100	100	100	100	98	98	76	45	34	27	39	16	24	96.0	A-6 (10)	CL	CL
17	2-3	12	97	95	94	93	92	86	62	58	31	24	20	33	13	20	103.5	A-6 (6)	CL	L
18	3-4	8	100	100	100	100	100	100	65	44	14	11	10	20	NP	-	-	A-4 (6)	ML	SL

* Map Units developed on similar parent material: 1, 3, 4, and 18; 12 and 11; 17, 14, 15, 16, 21, 22, and 24.

** These values are obtained from charts worked out by the Highways Testing Laboratory, Alberta Department of Highways.

2. Mechanical Analysis.

The particle size distribution within a soil is determined by laboratory tests, usually referred to as the mechanical analysis of the soil (11). The amounts of the gravel and sand fractions are determined by sieving, while the silt and clay contents are determined by sedimentation techniques. The amount of each soil separate contained in a soil determines its texture.

Where soil texture is known, approximations and estimates can be made of soil properties, such as permeability, water holding capacity, shrink-swell potential, bearing value, susceptibility to frost heave, adaptability to soil cement construction, etc.

3. Plasticity.

In soil mechanics, plasticity is defined as that property of a material which allows it to be deformed rapidly, without rupture, without elastic rebound, and without volume change (7).

Tests have been devised to determine the moisture content of a soil at which it changes from one major physical condition to another (11). These tests, conducted on the material passing the number 40 sieve (0.42 mm.), have been used as key factors in classifying soils for structural purposes.

The tests used for estimating plasticity are plastic limit, liquid limit, and plasticity index. The plastic limit is the moisture content at which the soil passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid and plastic limits. This parameter gives the range in moisture content at which a soil is in a plastic condition. A small plasticity index, such as 5, indicates that a small change in moisture content will change the soil from a semisolid to a liquid condition. A large plasticity index, such as 20, shows that a considerable amount of water can be added before a soil changes to a liquid condition.

4. Moisture - Density Relationships.

The purpose of every laboratory compaction test is to determine a moisture density curve comparable to that for the same material when compacted in the field by means of the equipment and procedures likely to be used (25). Most of the current

methods are derived from the procedure known as the "Standard Proctor Test". A sample of soil is dried, pulverized, and separated into two size fractions, using a number 4 sieve. The finer fraction is divided into six or eight equal portions. Each portion is mixed thoroughly with a different quantity of water so that each has a different water content, ranging from nearly 0 to about midway between the liquid and plastic limits. Each portion is compacted in a container with exactly the same compactive effort; its water content and weight of solids per cubic foot of compacted soils, usually termed the "dry density", are determined. The dry density after compaction decreases conspicuously with increasing water content and a curve is plotted showing the relation between dry density and water content. The "optimum moisture content", according to the Standard Proctor Test, is the water content at which the dry density is a maximum ("maximum dry density").

5. Soil Classification

In order that soils may be evaluated, it is necessary to devise systems or methods for identifying soils with similar properties and then to follow this identification with a grouping or classification of soils that perform in a similar manner when their densities, moisture contents, textures, etc., are similar (11). A brief descritpion of three widely used soil classification systems follows.

(a) AASHO Classification System.

The American Association of State Highway Officials system is an engineering property classification based on field performance of highways. In the AASHO system, soil material is classified into seven basic groups with each group having about the same general load carrying capacity and service. The groups are designated A-1 to A-7; the best soils for road subgrades are classified as A-1, the next best A-2 etc., with the poorest soils being classified as A-7.

In recent years these seven basic groups have been divided into subgroups with a group index that was devised to approximate within group evaluations. Group indexes range from 0 for the best subgrades to 20 for the poorest.

(b) Unified Soil Classification System.

In this system, the soils are identified according to their textures and plasticities, and are grouped according to their performance as engineering construction materials. Soil materials are divided into coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils are subdivided into eight classes; the fine grained soils into six classes; and there is one class of highly organic soils.

Coarse grained soils are those that have 50% or less of material passing the number 200 sieve; fine grained soils have more than 50% of material passing the number 200 sieve. The letters G, S, C, M, and O stand for gravel, sand, clay, silt and organic material respectively. The highly organic soils are designated by the symbol "pt". Additional letters used in the secondary division of the coarse grained soils are W and P, meaning well graded and poorly graded, respectively. Additional letters used in the secondary divisions of the fine grained soils are L and H, meaning relatively low liquid limit and relatively high liquid limit, respectively.

The designation CL for example, indicates inorganic clays of low to medium plasticity; SW indicates well graded sands; and SC indicates clayey sands and sand-clay mixtures.

(c) United States Department of Agriculture Soil Classification System.

The system of textural soil classification, used by Canadian soil scientists, is known as the USDA system. It is defined under "soil texture" in the glossary. There is some variation in the particle size limits between the USDA system and the two engineering systems just described, but the differences are not great. A comparison of the different systems is given in the PCA Soil Primer (11).

GLOSSARY

adsorption complex - The group of substances in the soil capable of adsorbing other materials.

aeolian - Related to, formed by, or deposited from wind.

aeration, soil - The process by which air in the soil is replaced by air from the atmosphere.

alluvial sediment - Material such as clay, silt, sand, and gravel deposited by modern rivers and streams.

available nutrient - The portion of any element or compound in the soil that can be readily adsorbed and assimilated by growing plants.

base saturation percentage - The extent to which the adsorption complex of a soil is saturated with exchangeable cations other than hydrogen and aluminium.

Brunisolic - An Order of soils whose horizons are developed sufficiently to exclude the soils from the Regosolic Order, but that lack the degrees or kinds of horizon development specified for soils of the other Orders.

Chernozemic - An order of well to imperfectly drained mineral soils with dark surface (Chernozemic) A horizons (Ah, Ahe, or Ap), and with B or C horizons of high base saturation with divalent cations, calcium usually being dominant. These soils are found in areas with cool semiarid to subhumid continental climates.

coarse texture - The texture exhibited by sands, loamy sands, sandy loams, and fine sandy loams.

concretion - A mass or concentration of a chemical compound, such as calcium carbonate or iron oxide, in the form of a grain or nodule of varying size, shape, hardness, and color, found in soils and in rock.

crevasse fillings - Ridges or hummocks formed from glacial sediments that were deposited in the cracks and crevasses of the ice.

Dark Gray Chernozem - A Chernozemic soil having significant characteristics indicative of degradation or other modification resulting from the accumulation and decomposition of forest vegetation, including leaf mats (L-H horizons).

Dark Gray Luvisol - A Luvisolic soil with an Ah or Ahe horizon, or both, more than 5 cm. (2 inches) thick; and the total thickness of the Ah and Ae is greater than 15 cm. (6 inches).

degraded - A leached and weathered state of a soil, usually indicated by morphological features such as an eluviated, light colored A (Ae) horizon.

deposition - Material being left in a new position by a natural transporting agent such as water, wind, ice, or gravity, or by the activity of man.

eluvial horizon - A soil horizon that has been formed by the process of eluviation.

eluviation - The transportation of soil material in suspension or in solution within the soil by the downward or lateral movement of water.

escarpment - A steep slope or cliff separating gently sloping areas.

esker - A winding ridge of irregularly stratified sand, gravel, and cobbles deposited under the ice by a rapidly flowing glacial stream.

Eutric Brunisol - A great group of soils in the Brunisolic Order. The soils may have Ah horizons less than 2 inches thick, and they have Bm horizons in which the base saturation is 100%.

exchangeable cation - A cation that is held by the adsorption complex of the soil and is easily exchanged with other cations of neutral salt solutions.

fibric - Composed of organic soil material containing large amounts of weakly decomposed fiber whose botanical origin is readily identifiable.

fine texture - The texture exhibited by sandy clay loam, silty clay loam, clay loam, sandy clay, clay, silty clay, and heavy clay.

firm consistence - The consistence at which a moist soil offers distinctly noticeable resistance to crushing, but can be crushed with moderate pressure between the thumb and forefinger.

floodplain - The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

fluvial deposits - All sediments past and present, deposited by flowing water.

forb - A broadleaf seed producing plant, other than grass, that does not develop persistent woody tissue, but dies down at the end of a growing season.

friable consistence - Consistence at which a moist soil crushes easily under gentle to moderate pressure between the thumb and forefinger, and coheres when pressed together.

gleying (of soil) - Characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic reducing conditions.

Gleysolic - An Order of soils that are saturated with water and are under reducing conditions continuously or during some period of the year, unless they are artificially drained. They have developed under hydrophytic vegetation and may be expected to support hydrophytic vegetation if left undisturbed.

Gray Luvisol - A Luvisolic soil in which the Ah horizon, if present, is less than 5 cm. (2 inches) thick.

Great Group - The fifth category in the Canadian system of soil classification. It is a taxonomic group of soils having certain morphological features in common, and a similar pedogenic environment.

green manure - Plant material incorporated with the soil, while the plant material is still green. The purpose is to improve the soil.

hard consistence - Consistence at which a dry soil mass is moderately resistant to pressure; it can be broken in the hands without difficulty, but is rarely breakable between the thumb and forefinger.

humic - Composed of highly decomposed organic soil material containing little fiber.

Humic Gleysol - Gleysolic soils that, when virgin, have Ah horizons more than 8 cm. (3 inches) thick.

Humisol - A Great Group of soils in the Organic Order. The diagnostic layer is composed dominantly of humic material.

humus - (1) The fraction of the soil organic matter that remains after most of the added plant and animal residues have been decomposed. It is usually dark colored. (2) Humus is also used in a broader sense to designate the humus forms referred to as forest humus. (3) All the dead organic material on and in the soil that undergoes a continuous breakdown, change, and synthesis.

illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension as a layer of accumulation.

kame - An irregular ridge or hill of stratified glacial drift deposited by glacial meltwater.

lacustrine - Material deposited in lakewater and later exposed either by lowering of the water level or by uplifting of the land. These sediments range in texture from sands to clays.

leaching - The removal from the soil of materials in solution.

lime (in soil) - A soil constituent consisting principally of calcium carbonate, and including magnesium carbonate and perhaps other materials.

lithic layer - Bedrock under the control section of a soil.

loess - Material transported and deposited by wind and consisting of predominantly silt sized particles.

loose consistence - Consistence at which a moist or dry soil is noncoherent.

Luvisolic - An Order of soils that have developed under climatic conditions ranging from mild humid to very cold humid. The soils have developed under deciduous, mixed deciduous-coniferous, or boreal forests, or under mixed forest in the forest-grassland transitional zones. These soils have eluviated light colored surface (Ae) horizons, brownish illuvial B (Bt) horizons in which silicate clay is the main accumulation product, and parent materials that are generally neutral to alkaline in reaction.

marsh - Periodically flooded or continually wet area having the surface not deeply submerged. It is covered dominantly with sedges, cattails, rushes, or other hydrophytic plants.

matrix (of soil) - The soil material that encloses other soil features, for example, concretions embedded in a fine grained matrix.

medium texture - Intermediate between fine texture and coarse texture. It includes the following textural classes: very fine sandy loam, loam, silt loam and silt.

Melanic Brunisol - A great group of soils in the Brunisolic Order. The soils have Ah horizons thicker than 5 cm. (2 inches) and base saturated Bm horizons.

mesic - Composed of organic soil material at a stage of decomposition between that of fibric and humic materials.

Mesisol - A great group of soils in the Organic Order. The diagnostic layer is composed dominantly of mesic material.

mottling - Spotting or blotching of different colors or shades of color interspersed with the dominant color.

nodule - A rounded unit within the soil matrix, that differs from the surrounding material because of the concentration of some constituent.

Order, soil - The highest category in the Canadian system of soil classification. All the soils within an Order have one or more characteristics in common.

Organic - An order of soils that have developed dominantly from organic deposits that are saturated for most of the year, or are artificially drained, and contain 30% or more organic matter to certain specified depths.

Orthic - Refers to the modal or central concept in the definition of a soil Order.

particle size distribution - The amounts of the various soil separates in a soil sample, usually expressed as weight percentages.

peat - Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed organic matter.

peaty phase (of soil) - Soil having 6 to 16 inches (15 to 40 cm.) of mixed peat or 6 to 24 inches (15 to 60 cm.) of fibric moss peat on the surface.

Rego - A modifying adjective used to indicate a soil that lacks any B horizon.

Regosolic - An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other Orders.

sandstone - A sedimentary rock composed of sand sized grains of minerals and rock fragments cemented together.

scarp - An escarpment or cliff.

sedimentary rock - Rock derived from the waste products of older rocks.

shale - A sedimentary rock in which the particles are predominantly of clay size.

slightly hard consistence - Consistence of a dry soil at which it is weakly resistant to pressure, and easily broken between the thumb and forefinger.

soft consistence - Consistence at which a dry soil is weakly coherent and fragile, and breaks to a powder or individual grains under very slight pressure.

soil aggregate - A group of soil particles cohering so as to behave mechanically as a unit.

soil horizon - A layer of soil or soil material approximately parallel to the land surface; it differs from adjacent genetically related layers in physical properties such as color, structure, texture, and consistence; and chemical, biological, and mineralogical composition. Soil horizons are designated by letters according to the following definitions.

1) Master Organic Horizons - These are organic layers containing more than 30% organic matter. Organic layers designated as L-F-H, commonly abbreviated to L-H, have developed under imperfectly to well-drained conditions, often forest litter. They are defined as follows:
L - The original structures of the organic material are easily recognized.
F - The accumulated organic material is partly decomposed.
H - The original structures of the organic material are unrecognizable.

2) Master Mineral Horizons - These are mineral soil layers containing less than 30% organic matter. They are defined as follows:
A - A mineral horizon formed at or near the surface in the zone of removal of materials in solution and suspension or maximum in situ accumulation of organic matter or both.

B - A mineral horizon characterized by one or more of the following:

a) An enrichment in silicate clay, iron, aluminum or humus.
b) A prismatic or columnar structure that exhibits pronounced coatings or staining associated with significant amounts of exchangeable sodium.
c) An alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below or both.

C - A mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, except gleying, and the accumulation of carbonates and more soluble salts. Roman numerals are prefixed to horizon designations to indicate unconsolidated lithologic discontinuities in the profile. Roman numeral I is understood for the uppermost material and therefore is not written. Subsequent contrasting materials are numbered consecutively in the order in which they are encountered downward, that is II, III and so on.

3) Lowercase Suffixes - These indicate a secondary or subordinate feature or features, in addition to those characteristic of the defined master horizon. They are defined as follows:

ca - A horizon of secondary carbonate enrichment where the concentration of lime exceeds that in the unenriched parent material.

e - A horizon characterized by removal of clay, iron, aluminum, or organic matter, alone or in combination, and lighter colored when dry than an underlying B horizon. It is used with A (Ae).

g - A horizon characterized by gray colours, or prominent mottling indicative of permanent or periodic intense reduction, or both, and caused by conditions of imperfect or poor drainage. Examples are Aeg, Btg, Bg, and Cg.

h - A horizon enriched with organic matter. Ah - An A horizon of organic matter accumulation. It contains less than 30% organic matter. It is darker than the layer immediately below, or has at least 1% more organic matter than the IC or both. Ahe - This horizon has been degraded, as evidenced by streaks and splotches of light and dark material and often by platy structure.

j - This is used as a modifier of suffixes e, g, and t to denote an expression of but failure to meet the specified limits of the suffix it modifies, for example Aej is an eluvial horizon that is thin, discontinuous or faintly discernible.

k - Presence of carbonate.

m - A horizon slightly altered by hydrolysis, oxidation, or solution or all three, to give a change in color, structure or both.

p - A layer disturbed by man's activities, that is, by cultivation or pasturing, or both.

t - A horizon enriched with silicate clay as indicated by a higher clay content (by specified amounts) than the overlying eluvial horizon, a thickness of at least 2 inches (5 cm.), and usually a higher ratio of fine (less than 0.2 micron) to total clay than the IC horizon.

soil morphology - The color, structural, and textural characteristics of the soil or any of its parts.

soil ped - A unit of soil structure such as a prism, block, or granule, which is formed by natural processes.

soil profile - A vertical section of the soil through all its horizons and extending into the parent material.

soil separate - Mineral particles, less than 2.0 mm. in equivalent diameter, ranging between specified size limits. The names and size limits of separates recognized in Canada and the United States are very coarse sand, 2.0 to 1.0 mm; coarse sand, 1.0 to 0.5 mm; medium sand, 0.5 to 0.25 mm; fine sand, 0.25 to 0.10 mm; very fine sand, 0.10 to 0.05 mm; silt, 0.05 to 0.002 mm; and clay, less than 0.002 mm.

soil solum - The upper horizons of a soil, in which the parent material has been modified and in which most plant roots are found. It usually consists of A and B horizons.

subgroup, soil - The fourth category in the Canadian soil classification system. These soils are subdivisions of the Great Groups, and therefore each soil is defined more specifically.

terric layer - An unconsolidated mineral substratum underlying organic soil material.

till - Unsorted and unstratified materials deposited by glacial ice.

very firm consistence - Consistence at which moist soil crushes under strong pressure, and is barely crushable between the thumb and forefinger.

very friable consistence - Consistence at which moist soil is crushed under very gentle pressure, but coheres when pressed together.

SOILS MAP OF BOW VALLEY PROVINCIAL PARK AND ADJACENT KANANASKIS AREA

Tp. 24, R. 8, W-5th

MAP 1.

Soil Classification:

MAP UNIT	SOIL ORDER	SOIL SUBGROUP	SOIL PARENT MATERIAL
1	Regosolic	Orthic Regosol	loess overlying gravel
2	Brunisolic	Orthic Eutric Brunisol	thin deposit of loess overlying gravel
3	Regosolic	Orthic Regosol	loess overlying coarse textured alluvial sediment
4	Regosolic	Gleyed Orthic Regosol	loess overlying gravel
5	Regosolic	Orthic Regosol	sand
6	Gleysolic	Rego Gleysol	medium to coarse textured alluvial sediment
7	Regosolic	Lithic Orthic Regosol	gravel overlying rock
8	Regosolic	Orthic Regosol	coarse textured alluvial sediment overlying gravel
9	Gleysolic	Rego Gleysol	gravel
10	Luvisolic	Orthic Gray Luvisol	gravel
11	Luvisolic	Orthic Gray Luvisol	fine textured lacustrine overlying gravel
12	Chernozemic	Orthic Dark Gray	fine textured lacustrine overlying gravel
13	Brunisolic and Luvisolic	Degraded Eutric Brunisol and Orthic Gray Luvisol	medium to coarse textured alluvial sediment overlying gravel
14	Chernozemic	Gleyed Rego Dark Gray	medium textured till overlying gravel
15	Regosolic	Orthic Regosol	medium to fine textured till overlying gravel
16	Luvisolic	Orthic Gray Luvisol	medium to fine textured till
17	Brunisolic	Degraded Eutric Brunisol and Orthic Eutric Brunisol	medium to fine textured till
18	Luvisolic and Brunisolic	Orthic Gray Luvisol and Degraded Eutric Brunisol	loess overlying medium textured till
19	Brunisolic and Regosolic	Orthic Eutric Brunisol and Orthic Regosol	gravel
20	Brunisolic and Regosolic	Degraded Eutric Brunisol and Orthic Regosol	sand overlying gravel
21	Brunisolic	Orthic Eutric Brunisol and Orthic Melanic Brunisol	medium textured till
22	Luvisolic	Lithic Orthic Gray Luvisol	medium textured till overlying sandstone
23	Luvisolic and Brunisolic	Lithic Orthic Gray Luvisol and Lithic Orthic Eutric Brunisol	medium textured residual sandstone till overlying sandstone
24	Luvisolic and Brunisolic	Lithic Orthic Gray Luvisol and Lithic Degraded Eutric Brunisol	medium textured residual shale till overlying shale
M.	Organic	undifferentiated Mesisol	peat
H.	Organic	undifferentiated Humisol	peat
T.H.	Organic	Terric Humisol	peat overlying mineral soil
T.H.- G.	Organic and Gleysolic	Terric Humisol and Rego Gleysol - peaty phase	peat overlying gravel

Legend:

Map Symbol

2 ← map unit
d3 ← surface stoniness rating
topographic class

- Er. — steep eroded slopes
- R. — bare rock outcrops
- Gv. — alluvial gravel bar
- S.L.F. — sanitary land fill site
- G.P. — gravel pit
- R. F. — rock fill
- B. P. — borrow pit
- D. O. — dugout (reservoir)
- Q — open water
- steep escarpment
- sandstone outcrop
- soil line
- boundary of mapped area
- direction of slope

APPROXIMATE SCALE:

660 0 660 1320 1980 2640 3300

FEET

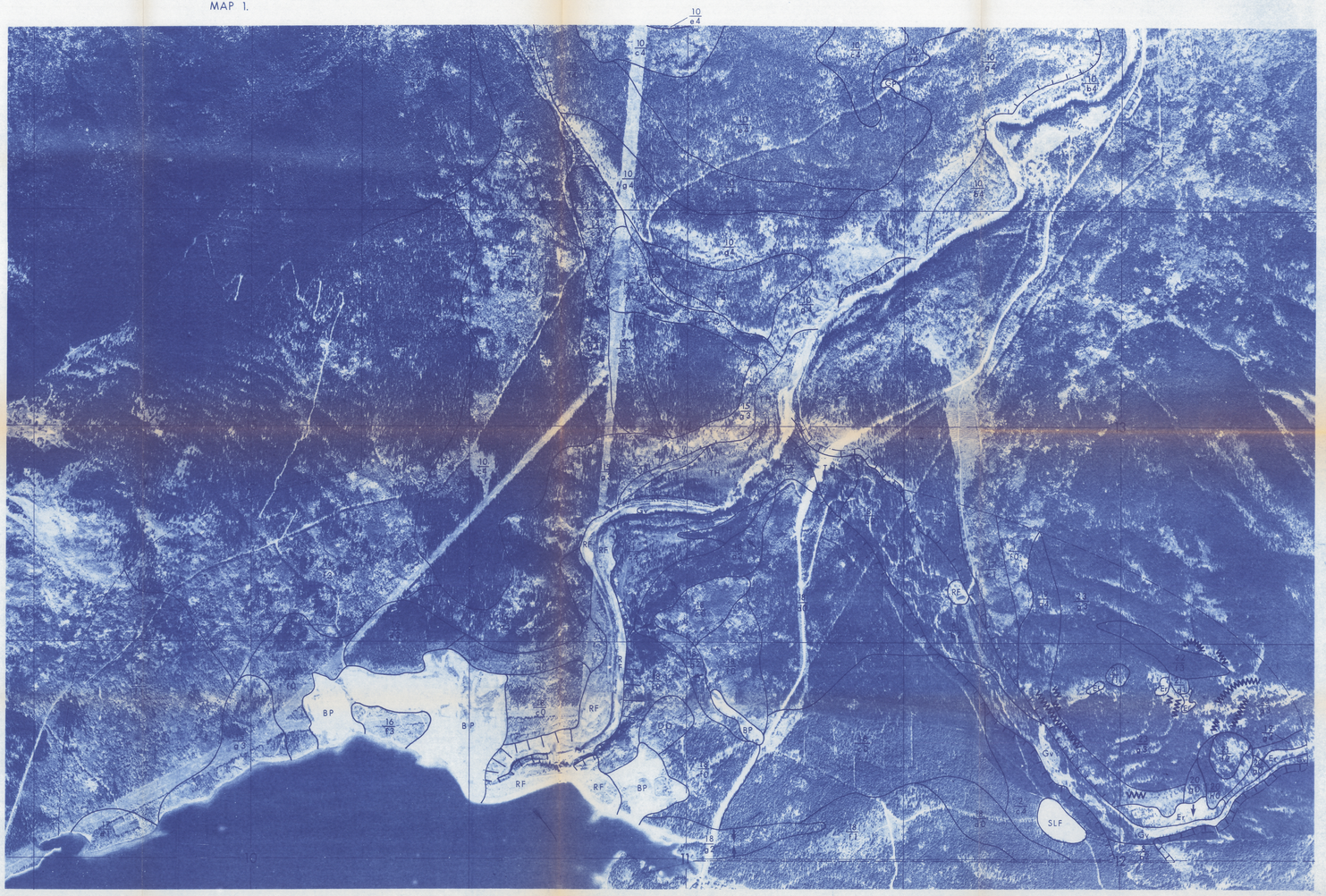
Compiled from uncontrolled mosaic.

Mapped and Compiled by G.M. Greenlee

Soils Division

Alberta RESEARCH

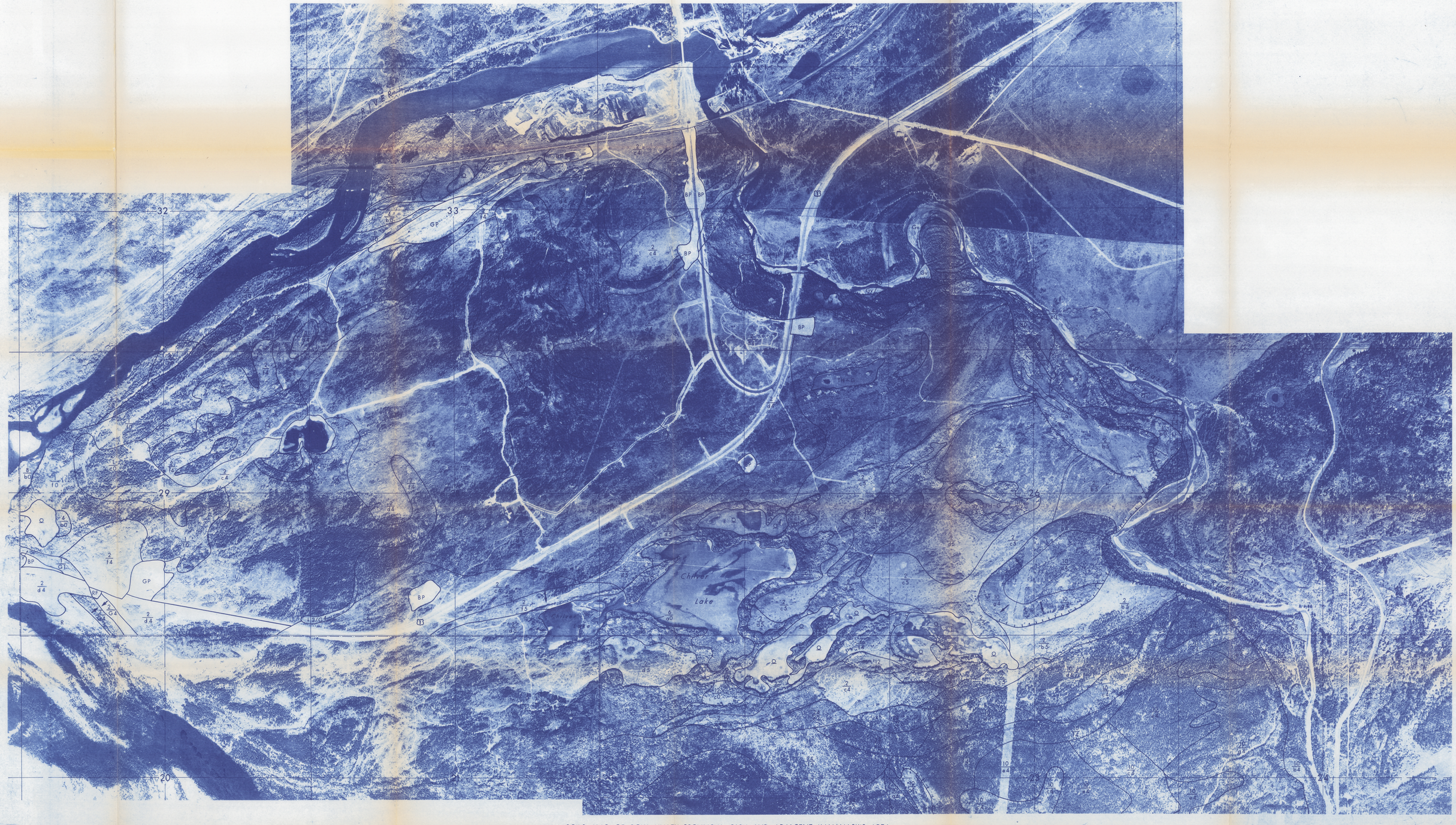
1973



map 1 of 2

OFR 1974-2

MAP 2.



SOILS MAP OF BOW VALLEY PROVINCIAL PARK AND ADJACENT KANANASKIS AREA

map 2
of 2

OFR 1974-2