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SOIL SURVEY

for

COMMUNITY DEVELOPMENT

LEDUC, ALBERTA

by

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LEDUC

(A) INTRODUCTION

For many years planners and engineers have used reconnaissance soil survey maps for information concerning the soils of their particular area. These maps were designed primarily as guides for determining land capability for agriculture but the scale used did not allow delineation of soil differences on small parcels of land with any reasonable accuracy. Community planners recognize the soil as an important land resource base to which their plans must be adjusted. The process of reshaping land for urban uses alters soils in many ways. Misuse of land causes drastic effects on the environment. Hence planners are now placing more emphasis on the use of larger scale detailed soil maps with soil interpretations for urban uses.

This report and map describes a detailed soil survey and soil interpretations for approximately 2,200 acres in selected areas in the vicinity of Leduc, Alberta. Leduc is located in Township 49, Range 25, west of the 4th meridian. It is about 15 miles south of Edmonton on highway 2.

The map, printed at a scale of approximately 10 inches to the mile shows the location and extent of the soil areas. The legend included with the map indicates the classification of the soils.

The report describes the cultural and physical features of the area, the classification of the soils, and some of the physical and chemical properties of the soils. A list of limiting soil properties and a table of soil interpretations are also included.

A glossary of the more commonly used terms is included in the appendix.

(B) CULTURAL AND PHYSICAL FEATURES OF THE AREA

At present, the land is being used for agricultural purposes.

The terrain is comprised of level to gently undulating areas interspersed with depressional lowlands.

The soils are developed from varying depths of clay loam till material overlying shales and sandstones of the Edmonton Formation (2). A very shallow deposition of till

overlies the bedrock in the eastern portion of the area. Many of the soils occurring in this area have a high stone content in the topsoil and upper subsoil. These soils also have characteristics that indicate the former presence of soluble sodium salts in high concentrations. However the concentration of salts is now fairly low in many of these soils indicating that they have been leached out of the soil.

The area is drained into Gwynne outlet which connects with both the North Saskatchewan and Battle River drainage systems via the Blackmud and Pipestone creeks.

(C) THE SOILS

I SOIL DEVELOPMENT

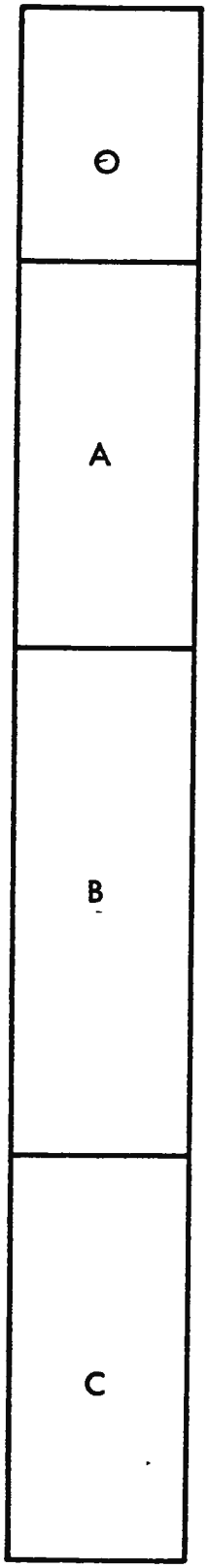
Soil is an organic or mineral layer (other than consolidated bedrock) thicker than 4 inches occurring naturally on the earth's surface and is capable of supporting plants. Soil is formed as the result of the integrated effects of climate and living matter, acting upon parent material, as conditioned by relief, over periods of time. The changes in soils as affected by these factors and their interactions are reflected in the development of a sequence of horizons as indicated in Figure 1. However, the changes are gradual because soils are in dynamic equilibrium with their environment and thus the boundaries between soils of different properties are not sharp.

II SOIL CLASSIFICATION

The soils are classified according to the System of Soil Classification for Canada (2) which is based on the study of soils in their natural environments. The legend on the soils map indicates the classification of the soils in the map area. It is the recognition of horizon differences that permits the classification of soils by this system.

Each unit in the classification system is known as a taxonomic unit (6). A taxonomic unit is a creation in the mind of man to facilitate his thoughts about objects in numbers so great that he cannot comprehend them individually. At a single site, the soil is examined vertically and horizontally. The observer digs deep enough to examine each horizon including the parent material and any

FIGURE 1. A Sketch of a Soil Profile Showing Major Soil Horizons and a brief outline of Difference in Properties.



O - an organic horizon at the surface. Typical of organic soils and peaty humic gleysols. Thin or absent in other soils.

A - a mineral horizon at or near the surface. May be a dark coloured horizon in which there is an accumulation of organic matter or a light coloured horizon from which clay and humus have been leached.

B - a mineral horizon below the A horizon in which there is no appreciable organic matter. There may be a change in colour or structure, an accumulation of clay, or dark coatings on ped surfaces. Is mottled or gleyed in Gleysols and gleyed intergrades.

C - a mineral horizon below the B horizon which is comparatively unaffected by soil-forming processes except for accumulation of salts and carbonates. Is mottled or gleyed in Gleysols and gleyed intergrades.

underlying strata that influence the genesis and behaviour of the soil. In relation to the whole three-dimensional landscape, the places examined are little more than points. The observer groups the soils examined at these points into taxonomic units that have specified limits of variation. Each unit should be thought of as consisting of (1) a central core or nucleus - a single modal profile representing the most usual condition of each property of all soils in the unit and; (2) many other closely related profiles that vary from this central nucleus within precisely defined limits. The same kinds of horizons are present in all of the profiles of the group and they occur in the same sequence. However, such properties as thickness, texture, structure, etc. vary within defined limits.

III SOIL MAPPING

Soil maps are easier to read with understanding if well-defined groups of soils are shown on them rather than a very intricate pattern of taxonomic units. The mapping units for this project consist of one or more taxonomic units and small inclusions of other soils that must be included because of the limitations imposed by the scale of mapping, soil variability, and the number of points that can be examined in the time available.

The group of mapping units that is given a place name represents a great group of soils developed on a specific kind of parent material. For example, soils of the Beaumont association are Black Chernozemic soils developed from till which is predominantly of Edmonton Formation origin. Each mapping unit is an association of one or more subgroups developed from a specific type of parent material. These subgroups represent the taxonomic units and correspond to soil series used on reconnaissance soil survey maps. The dominant subgroup represents 60 per cent or more of the soils in the mapping unit, the significant less than 40 per cent. The use of soil associations as mapping units is not regarded as a shortcoming of the mapping procedures because most of the inseparable taxonomic units are not sufficiently different in soil properties to affect urban use.

Seven major soil associations containing thirteen mapping units have been mapped in the area and are indicated in the soils legend. Three soil associations

occur on till, three on modified residual, and one on recent alluvium.

IV SOIL ASSOCIATIONS

Beaumont Soil Association

The Beaumont association consists of well to imperfectly drained, Black Chernozemic soils developed from till. They occur throughout the area on level to gently undulating topography.

The surface soil (A horizon) is slightly acidic to neutral in reaction, ranges in texture from sandy loam to loam, and is from 8 to 14 inches thick.

The upper subsoil (B horizon) has a somewhat blocky structure with occasional dark coatings on its ped faces. It is neutral to mildly alkaline in reaction, ranges in texture from loam to clay and is from 12 to 30 inches thick.

The lower subsoil (C horizon) is calcareous, mildly alkaline in reaction and ranges from loam to clay loam in texture. The B and C horizons of soils in mapping unit 3 are gleyed and mottled due to a seasonal high water table. Numerous stones occur throughout the soil profiles of the Beaumont association.

Gwynne Soil Association

The Gwynne association consists of moderately well to imperfectly drained Black Solonetzic soils developed from till. They occur in the southern portion of the area on level to gently undulating topography.

The surface soil (A horizon) is slightly acidic to neutral in reaction, ranges in texture from sandy loam to loam, and is from 4 to 8 inches thick.

The upper subsoil (B horizon) has a strong blocky to columnar structure, is extremely hard when dry and is highly organic stained. This horizon in Black Solonetz soils (Gw1 mapping unit) is more impermeable to air, water and roots than in the Black Solod soils (Gw2 mapping unit) because the upper portion is completely intact and has not broken into smaller aggregates. The B horizon is mildly alkaline in reaction, ranges in texture from loam to clay and is from 8 to 16 inches thick.

The lower subsoil (C horizon) is non to weakly saline, mildly to moderately alkaline in reaction and ranges in texture from loam to clay loam. Soils of mapping

unit 3 are gleyed and mottled in their B and C horizons.

Sandstones and shales of the Edmonton Formation often occur within 4 to 5 feet from the surface.

Stoney Soil Association

The Stoney association consists of poorly to very poorly drained soils developed from till. They are found in depressional positions throughout the area. These soils may have up to 16 inches of sedge peat at the surface.

The surface soil (A horizon) is mildly to moderately alkaline in reaction, ranges in texture from sandy loam to loam and is from 6 to 12 inches thick. It may occasionally be saline.

The subsoil (B and C horizons) is strongly gleyed and mottled due to a high water table. It is mildly to moderately alkaline in reaction and ranges in texture from loam to clay. The subsoil is weakly to moderately saline in soils of mapping units 2 and is non to weakly saline in soils of mapping unit 1.

Leduc Soil Association

The Leduc association consists of well drained Black Chernozemic soils developed from a shallow deposit of till over bedrock. These soils occur in the northeastern portion of the area on gently undulating topography.

The surface soil (A horizon) is slightly acidic to neutral in reaction, ranges in texture from sandy loam to loam and is from 6 to 10 inches thick.

The upper subsoil (B horizon) is slightly hard when dry, has a weak subangular blocky structure, is mildly alkaline in reaction, ranges from sandy loam to clay loam in texture and is from 12 to 24 inches thick.

The lower subsoil (C horizon) consists mainly of unconsolidated shales and sandstones. It is calcareous, mildly alkaline in reaction, and ranges in texture from sand to clay. The depth to consolidated bedrock varies from 2 to 6 feet.

Nisku Soil Association

The Nisku association consists of moderately well to imperfectly drained Black Solonetzic soils developed from shallow till over unconsolidated bedrock. The depth to consolidated bedrock varies from 2 to 8 feet. These soils occur in the

northeastern and eastern portions of the area on level to gently undulating topography.

The surface soil (A horizon) is slightly acid to neutral in reaction, ranges in texture from sandy loam to loam and is from 4 to 8 inches thick.

The upper subsoil (B horizon) has a strong blocky to columnar structure, is extremely hard when dry and is highly organic stained on its ped surfaces. This horizon is more impermeable to air, water and roots in Black Solonetz soils (Nsk1 mapping unit) than in Black Solod soils (Nsk2 mapping unit). The B horizon is mildly alkaline in reaction and ranges in texture from loam to clay.

The C horizon is mildly alkaline in reaction, is calcareous, non to weakly saline and consists mainly of unconsolidated shales and sandstones that vary from clay to sand in texture.

Soils of mapping unit 3 have gleyed and mottled B and C horizons. The stoney phase of mapping unit 3 has 20 to 60 per cent of its topsoil and upper subsoil volume occupied by cobbles greater than 10 inches in diameter.

Stonerock Soil Association

The Stonerock association consists of poorly to very poorly drained soils developed from a shallow deposition of till over bedrock. They occur in depressional positions in the eastern and northeastern portions of the area. These soils may have up to 16 inches of sedge peat at the surface.

The surface soil (A horizon) is neutral to mildly alkaline in reaction, ranges in texture from sandy loam to loam and is from 6 to 10 inches thick.

The subsoil (B and C horizons) is mildly alkaline in reaction and ranges in texture from sand to clay.

Galahad Soil Association

The Galahad association consists of imperfectly drained Regosolic soils developed from recent alluvium. A small area of these soils occurs in the vicinity of a small tributary of Whitemud creek in the south central portion of the area.

The topsoil (A horizon) is neutral in reaction, ranges in texture from sandy loam to silt loam and is from 4 to 6 inches thick. The subsoil (C horizon) is neutral to mildly alkaline in reaction and ranges in texture from sandy loam to silt loam.

The soil profile is gleyed and mottled.

ENGINEERING CLASSIFICATION OF THE SOILS

The engineer has named the different particle sizes of soils and set definite limits for the size of each. By this naming and defining of sizes of soil particles, all soil tests are placed on a common ground for comparison. The amounts of each particle size group in a soil, as determined by sieve and sedimentation tests, is referred to as the mechanical analysis of soil.

Engineers also recognize certain moisture contents referred to as Atterberg limits - liquid limit, plastic limit and plasticity index. The mechanical analysis and Atterberg limit determinations allow the engineer to classify the soil in relation to its performance for structures such as highways or buildings. From these determinations the engineers can give reasonable estimates of other important engineering properties such as bearing value, optimum moisture content, maximum moisture content for compaction, shrink-swell potential, susceptibility to frost heave, etc.

The natural or taxonomic classification of soils as indicated on a detailed soil survey map is used by the engineer to identify the soils he is concerned about and enables the engineer to place soil boundaries between soils that have different engineering properties. By using the mapping unit for the identification of the soils, the engineer is assured that a structure on a particular mapping unit, horizon and grain size will perform the same wherever it occurs since such important factors as rainfall, freezing, groundwater table level, etc. are part of the identification system.

The American Association of State Highway Officials (4) system of classifying soils is an engineering property classification based on field performance of highways. Grouping soils with about the same general load carrying capacity results in the formation of seven basic groups that are designated A1 to A7. The best soils for road subgrades are classified as A1 with the poorest soils classified as A7. In recent years these groups have been divided into subgroups with a group index to approximate within group evaluations. Group indices range from 0 for the best subgrades to 20 for the poorest. Increasing value of the index reflects the reduction of the load carrying capacity of subgrades and the combined effect of increasing liquid limits and plasticity indices and decreasing percentages of coarse materials.

The Unified Soil Classification System (4) groups soils according to their texture and plasticity with respect to their performance as engineering construction materials. Soil materials are divided into coarse-grained, fine grained and organic soils. The coarse-grained soils are subdivided into 8 classes, the fine-grained into 6 classes and the organic into one class.

Coarse-grained are those having 50 per cent or less of material passing the no. 200 sieve; fine-grained having 50 per cent or more. The letters G,S,C,M and O stand for gravel, sand, clay, silt and organic material respectively and the letters L and H stand for low or high liquid limits. CL, for example, indicates clays with low liquid limits; SC indicates sands with an appreciable amount of clay.

The system of textural classification used by Canadian soil scientists is known as the U.S.D.A. system. There is some variation in grain size between this system and the two engineering systems but the differences are not great. A comparison is given in the P.C.A. Soil Primer (4).

SOIL SURVEY INTERPRETATIONS

Soil maps, with interpretations for urban use, usually indicate that different mapping units have different potential for typical urban development. If the soil properties are interpreted with the idea of designing the urban development to the land capability, it is possible to achieve an urban environment that is harmonious with the physical environment. It is also less likely that misuse of land will result in severe damage to the environment.

Soil survey interpretations are included with the report so that soils information may be more easily understood. These interpretations should be treated as evaluations of performance of soils not as recommendations for the use of soils. Many other factors are involved in the recommended use of soils. Also, because soil lines are not precise, soil survey interpretations do not eliminate on-site investigations. They are, however, intended as an aid in planning further investigations, to reduce the amount of investigation and minimize cost.

For each use, the soils are rated in terms of degree of limitation - slight, moderate or severe or in terms of suitability as a source of material - good, fair or poor.

TABLE 1. ENGINEERING TEST DATA OF REPRESENTATIVE SOIL SAMPLES FROM THE LEDUC AREA

Map-ping Unit	Depth from surface in inches	Elect. cond. mmhos/cm.	% SO_4	Mechanical Analysis: Percentage Passing Sieve: 1 inch	3/4 inch	5/8 inch	#4	#10	#40	#200	Percentage Smaller than: .05 mm	.005 mm	.002 mm	.001 mm	Atterberg Limits: Liquid Limit	Plastic Limit	Plas-ticity Index	Textural Classification: AA SHO	Uni fied	USDA
mt 2	36-92	0.7	0.00	100	100	100	98	97	93	63	59	35	29	25	35	21	14	A6(8)	CL	CL
	0-14	0.0	0.00	100	100	100	100	100	97	80	60	24	15	10	48	41	7	A5(10)	ML	L
mt 2	14-46	0.0	0.00	100	100	100	98	98	84	68	68	42	36	33	47	23	24	A7-6(16)	CL	CL
	46-78	0.6	0.00	100	100	100	100	99	95	59	59	37	30	25	34	20	14	A6(7)	CL	CL
	78-106	1.9	0.00	100	100	100	100	99	94	54	54	33	27	23	31	18	13	A6(5)	CL	L
mt 2 b	60-96	0.2	0.00	100	100	100	99	98	96	68	61	27	19	16	26	18	8	A4(8)	ML-CL	L
Gw 2	27-57	1.2	0.06	100	100	100	100	99	95	66	64	37	31	29	45	20	25	A7-6(13)	CL	CL
b	57-93	2.0	0.08	100	100	100	100	100	100	96	93	58	43	33	61	30	31	A7-5(20)	CH	SiC
	0-6	0.1	0.00	100	100	100	100	99	96	79	69	23	16	13	30	25	5	A4(8)	ML	SiL
Gw 2	6-12	0.1	0.00	100	100	100	100	100	96	85	70	26	19	16	23	18	5	A4(8)	ML	SiL
	12-32	0.2	0.00	100	100	100	99	98	92	57	57	40	34	28	44	23	21	A7-6(8)	CL	CL
	32-66	0.6	0.02	100	100	100	98	98	94	64	61	37	28	22	38	19	19	A6(10)	CL	L-C
Gw 3	12-54	2.2	0.17	100	100	100	98	98	93	65	65	42	31	27	39	19	20	A6(10)	CL	CL
	0-6	0.1	0.00	100	100	100	100	100	99	91	67	13	9	7	57	48	9	A5(12)	MH	SiL
Usk 1	6-14	0.1	0.00	100	100	100	100	100	99	86	84	48	42	38	57	33	24	A7-6(17)	MH	SiC
	26-56	0.8	0.05	100	100	100	100	100	100	77	74	37	32	30	71	30	41	A7-6(20)	CH	CL
	56-86	1.4	0.10	100	100	100	100	100	100	68	68	36	29	25	65	31	34	A7-6(20)	CH	CL
Usk 3	20-40	2.4	0.21	100	100	100	100	100	100	92	88	55	42	34	59	28	31	A7-6(20)	CH	SiC
	48-72	1.7	0.15	100	100	100	100	100	100	83	73	49	41	32	52	28	24	A7-6(18)	CH	C

A slight soil limitation is the rating given soils that have properties favourable for the use. Good performance and low maintenance can be expected.

A moderate soil limitation is the rating given soils that have properties moderately favourable for the use. This limitation can be overcome or modified by special planning, design or maintenance.

A severe soil limitation is the rating given soils that have one or more properties that are seriously unfavourable for the use. This limitation generally requires major soil reclamation, special design or intensive maintenance. In most situations, it is difficult and costly to alter the soil or to design a structure so as to compensate for the severe degree of limitation but using these soils without employing corrective measures could result in failure.

The decision as to whether or not a soil will be utilized for a specific use, regardless of the soil limitation, is beyond the scope of this report.

The five components of community development selected for interpretation for this project are: (1) suitability as a source of topsoil; (2) suitability for sewage lagoons; (3) suitability for dwellings with basements and underground conduits; (4) suitability as a source of road fill and (5) suitability for agricultural cropland.

Soil properties that appear to be important in affecting the designated uses of the soils in the Leduc area are presented in Table 2 and are included at the bottom of Table 7.

TABLE 2. LIMITING SOIL PROPERTIES

1. Depth to a seasonal high water table.
2. Susceptibility to flooding.
3. Percent by volume of stones > 10 inches in diameter.
4. Depth of topsoil.
5. Low permeability of the upper subsoil.
6. High percentage of organic matter.
7. Shallow depth to bedrock.
8. Texture of subsoil.
9. Shrink-swell potential.
10. Potential frost action.
11. Potential concrete corrosion.

1. Suitability as a Source of Topsoil

Soil properties considered in rating soils for this use are surface texture and permeability as they relate to trafficability; topsoil salinity; topsoil thickness; depth to a seasonal high water table; per cent coarse fragments greater than 10 inches in diameter; steep slopes; and the natural fertility of the material or the response of plants when fertilizer is applied. Consideration is given to the damage to the borrow area and features that determine the ease or difficulty of excavating such as slope, wetness and thickness of suitable material. Some damage to borrow areas is expected but if the damage is great enough that major revegetation and erosion control is needed to rectify the problem, as in Black Solonetz soils, then the soil should be given a rating of poor.

Soils of the Beaumont association (mapping unit 2) are considered to be good sources of topsoil while soils of the Nisku, Gwynne, Stoney and Stonerock associations are poor sources due to such properties as low permeability of the upper subsoil and a seasonal high water table.

Table 3 is used for determining the suitability ratings and Table 7 indicates the suitability ratings for each mapping unit in the area.

2. Suitability for Sewage Lagoons

Sewage lagoons require consideration of soils for two functions: (1) as a vessel for the impounded area and (2) as soil material for the enclosing embankment. When finished the lagoon must be capable of holding water with minimum seepage.

Soil rating properties considered for this use are depth to a seasonal high water table, soil texture, flooding, soil permeability, the amount of organic matter and the amount of coarse fragments that interfere with compaction. Depth to a seasonal high water table is disregarded if the lagoon floor is more than two feet thick of impermeable material after compaction. Moderate to high amounts of organic matter promotes growth of plants that are detrimental to the functioning of the lagoon.

Soils of mapping unit 2 of the Beaumont association are considered to have slight limitations for sewage lagoons. Soils of the Nsk3 st. mapping unit are considered to have severe limitations due to a combination of factors: a seasonal high water table, a high percentage of coarse fragments greater than 10 inches in diameter and a shallow depth to moderately permeable unconsolidated bedrock. Soils of the

TABLE 3. SUITABILITY RATINGS OF SOILS AS SOURCES OF TOPSOIL.

	Degree of Suitability		
LIMITING SOIL PROPERTY	GOOD	FAIR	POOR
Flooding	None	May flood occasionally for short periods	Frequently or constantly flooded
Depth to a seasonal high water table	Well and moderately[1] well drained soils not subject to ponding	Well and moderately well drained soils subject to ponding. Imperfectly drained soil not subject to ponding	Poorly and very poorly drained soils Imperfectly drained soils subject to ponding.
Stoniness[2]	none to slightly stony	moderately stony	very to excessively stony.
Coarse fragments percent by volume	Less than 3%	3 to 15%	more than 15%
Surface soil texture	SL, FSL, VFSL, L, SiL	CL, SCL,S,CL	LS, S, SC, SiC, C, Organic soils
Depth of topsoil	More than 6 inches	3 to 6 inches	Less than 3 inches
Slope	Less than 8%	8 to 15%	More than 15%
Salinity of topsoil	E.C.[3] 0 to 1	E.C. 1 to 3	E.C. greater than 3
Permeability of upper subsoil	Moderate	Moderately low	Very low

1 See glossary.

2 Refers to limitations of stoniness for agriculture or for hindrance to cultivation.

3 Electrical Conductivity in mmhos/cm.

Stoney and Stonerock associations are also considered to have severe limitations for sewage lagoons due to a seasonal high water table and a high percentage of organic matter.

Table 4 is used for determining the suitability ratings and Table 7 indicates the suitability ratings for each mapping unit in the area.

3. Suitability for Dwellings with Basements and Underground Conduits

In rating soils for dwellings with basements the properties that affect foundations and those that affect ease of excavation must both be considered.

Properties affecting bearing strength and settlement of the soil are wetness, flooding, plasticity, texture and shrink-swell potential. Those affecting the ease of excavation are wetness and slope.

Potential concrete corrosion is another property that may affect foundations in this area. About 25 samples of the parent materials of Gwynne and Nisku soils were found to contain from 0.0 to 0.4% soluble sulphate with the average being about 0.15. This indicates that on-site investigation may be necessary.

The Concrete Manual of the United States Bureau of Reclamation (7) recognizes the following concrete corrosion categories: negligible attack - less than 0.10%; mild but positive attack - 0.10 to 0.20%; considerable attack - 0.20 to 0.50%; severe attack - greater than 0.50%. Preventive measures should include the following; use of sulphate resisting cement, low water-cement ratio, high cement content, waterproof coatings, drainage and reinforcing cover.

Soils of the Beaumont association (mapping unit 2) are considered to have slight limitations for dwellings with basements and underground conduits. Soils of the Stoney and Stonerock associations are considered to have severe limitations due to a seasonal high water table.

Table 5 is used for determining the suitability ratings and Table 7 indicates the suitability ratings for each mapping unit in the area.

4. Suitability as a Source of Road Fill

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soils after they have been placed in the embankment properly compacted and provided with adequate drainage and (2) the relative ease

TABLE 4. SUITABILITY RATINGS OF SOILS FOR SEWAGE LAGOONS.

	Degree of Limitation		
LIMITING SOIL PROPERTY	SLIGHT	MODERATE	SEVERE
Depth to Seasonal High Water Table (depends on thickness of slowly permeable layer)	more than 72 in.	48 to 72 in.	less than 48 in.
Flooding[1]	none	none	Subject to flooding once in 50 years
Percent Organic Matter	less than 2	2 - 10	greater than 10
Percent Coarse Fragments Greater than 10 in. in diameter (by volume)	less than 10	10 - 30	greater than 30
Depth to Bedrock[2]	more than 72 in.	48 to 72 in.	less than 48 in.
Thickness of Slowly Permeable Layer	more than 48 in.	24 to 48 in.	less than 24 in.
Unified Soil Texture Classification	GC, SC, CL and CH	GM, ML, SM and MH	GP, GW, SW, SP, OL, OH and Pt.

1 If floodwaters are less than 5 feet deep and the embankment material is impermeable the limitation rating is not severe.

2 The bedrock in this area is mostly unconsolidated or weathered bedrock with occasional consolidated bedrock above 72 inches.

TABLE 5. SUITABILITY RATINGS OF SOILS FOR DWELLINGS WITH BASEMENTS AND UNDERGROUND CONDUITS.

LIMITING SOIL PROPERTY	Degree of Limitation SLIGHT	MODERATE	SEVERE
Seasonal High[1] Water Table (For 1 month or more)	Below a depth of 60 inches or rapidly and well drained soils.[2]	Below a depth of 48 inches or moderately well drained soils.	Above a depth of 48 inches or imperfectly, poorly and very poorly drained soils.
Shrink-Swell[3] Potential	SM, SP, SC, CL and ML with P.I.[4] less than 15.	CL and ML with P.I. greater than 15.	CH, MH, OL, OH
Potential Frost Action[5]	GW, GP, SW, SP depending on drainage	GM, GC, SC, CH, OH. depending on drainage	ML, CL, OL, MH, SM. depending on drainage
Potential Concrete Corrosion[6]	Less than 0.15% soluble sulphate in soil	from 0.15 to 0.50	more than 0.50
Flooding	none	none	rare to frequent
Stoniness[7]	none to slightly	moderately stony	very to excessively stony
Depth to bedrock[8]	more than 60 inches	40 to 60 inches	less than 40 inches

1 This rating does not consider the installation of storm drains.

2 See glossary.

3 According to Unified Classification System.

4 P.I. means plasticity index.

5 According to Unified Classification System. The formation of ice lenses depends on capacity of soil to deliver water to a freezing front. This water is more available in poorly drained soils and in soils of the indicated texture classes.

6 According to Concrete Manual. Moisture is also an important factor because it is needed to move sulphate through concrete.

7 Refers to stoniness as it affects hindrance to cultivation.

8 Refers to consolidated bedrock. Most of the bedrock in the area is highly weathered but on-site investigation may be necessary.

of excavating the material at borrow areas.

Soil properties that affect this use are those that affect load supporting capacity, stability of the subgrade and the workability and quantity of the cut and fill material available. The texture and the shrink-swell potential indicate the load supporting capacity; wetness, flooding and potential frost action indicate the stability; and slope, wetness, depth to bedrock and stoniness affect the ease of excavation and the amount of cut and fill material needed to reach an even grade.

Soil survey interpretations for suitability ratings of soils as a source of roadfill are oriented to local roads and streets where embankments are less than 6 feet high. The rating is given for the whole soil profile down to 6 feet because soil horizons will be mixed in loading, dumping and spreading. Since surface soils are generally removed during road construction their properties are disregarded.

Damage from frost action is most prevalent in soils low in clay, high in silt or very fine sand and in poorly drained locations. These soils have the highest capacity for delivery of water to a freezing front. If the roadbed is properly compacted and adequate drainage is provided the danger of frost action is considerably reduced.

The bedrock in this area is generally fairly soft relative to consolidated bedrock. However, consolidated sandstones and shales occasionally may be found at fairly shallow depths and the ratings given do not consider this situation. This indicates that on-site investigations are needed. Stones that are larger than 10 inches in diameter interfere with compaction.

Soils of the Bmt 2 mapping unit are considered to be good sources of roadfill. They have good bearing capacity when compacted to maximum practical density but lose this bearing capacity when moisture is absorbed. Hence these soils are not suitable for use as subgrades under thin flexible base courses and require insulating courses of A1 or A2 soils in poorly drained soils such as in the Stoney association.

Soils of the Nisku association are classified as A7-6 soils and are subject to extremely high volume change, have low bearing value when wet, and are elastic and rebound when a load is removed which makes them difficult to compact properly. The addition of A1 and A2 soils is necessary for flexible pavements. They are considered to be poor sources of roadfill. The extreme variation in the texture of these soils, however, indicates that on-site investigation may be necessary.

Table 6 is used for determining the suitability ratings and Table 7 indicates the suitability ratings for each mapping unit in the area.

5. Suitability as Agricultural Cropland

Table 7 indicates the ratings of the different mapping units as agricultural cropland. These correspond to the classes and subclasses given in the Canada Land Inventory - Soil Capability for Agriculture for the Edmonton Sheet (83-H).

The classes are: Class 1 - Soils in this class have no significant limitations in use for crops. Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices. Class 4 - Soils in this class have severe limitations that restrict the range of crops. Class 5 - Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. Class 6 - Soils in this class are capable of only producing perennial forage crops and improvement practices are not feasible. Class 7 - Soils in this class have no capability for arable culture or permanent pasture.

The subclasses are as follows: i - flooding by streams or lakes; p - stones interfere with tillage and harvesting; r - bedrock less than 3 feet from the surface; s - adverse soil characteristics that include one or more of the following: undesirable structure, low permeability, a restricted rooting zone, low fertility, low moisture-holding capacity, salinity; w - excess water other than from flooding or poor drainage.

TABLE 6. SUITABILITY RATINGS OF SOILS AS SOURCES OF ROAD FILL.

LIMITING SOIL PROPERTY		Degree of Soil Suitability GOOD	FAIR	POOR
Seasonal High Water Table		Rapidly to Moderately Well Drained[1]	Imperfectly Drained	Poorly and very poorly drained
Engineering Soil Class	Unified Soil Groups	GW, GP, SW, SP, GC, SM, SC[2]	ML, CL with P.I.[3] less than 15	CH, MH, OL, OH, Pt. and CL with P.I. less than 15
	AASHO Group Index	0-4	5-8	Greater than 8
Stoniness[4]		none to moderately stony	very stony	exceedingly stony
Shrink-Swell Potential		SM, SP, SC, CL & ML with P.I. less than 15	CL & ML with P.I. more than 15	CH, MH, OL, OH
Potential Frost Action[5]		GW, GP, SW, SP	GM, GC, SC, CH, OH	ML, CL, OL, MH

1 See glossary.

2 Downgrade to fair if fines more than 30%.

3 P.I. means plasticity index.

4 See glossary.

5 Depends on drainage or moisoure content.

TABLE 7. SOIL SUITABILITY AND LIMITATIONS FOR SELECTED USES.

Mapping Unit	Suitability as a Source of Topsoil	Degree of Limitation for Sewage Lagoons	Degree of Limitation for Dwellings with Basements and Underground Conduits	Suitability as a Source of Roadfill	Suitability for Agricultural Cropland
Bmt 2	G	S	S	G	1
Bmt 3	F1	M1	M1	F1,8	2W
Bmt 2/b	G	M7*	M7*	G*	1
Bmt 3/b	F1	M1,7*	M1,7*	F1,7,8*	2W
Gw1	P4,5	S	M11*	G	3s,
Gw2	F4	S	M11*	G	3s,
Gw3	P1,4,5	M1	V1,10,11*	F1,8	4^{s}_{w},
Sy1	P1	V1,6	V1,10	P1,10	5W
Sy2	P1,11*	V1,6	V1,10,11*	P1,10	5W
Sy2p	P1,11*	V1,6	V1,10,11*	P1,10	6W
Ldc 1	G	S	M7,9*	P7,9*	1
Nsk 1	P4,5	M7*	M7,9,11*	P7,9*	3s
Nsk 2	F4	M7*	M7,9,11*	P7,9*	3s
Nsk 3	P1,4,5	M1,7*	V1,7,9,11*	P1,7,9,10*	4^{s}_{w}
Nsk 3 st.	P1,3,4,5	V1,3,7*	V1,3,7,9,11*	P1,3,7,9,10*	4^{s}_{p}
Stk 1	P1	V1,6	V1,7,9,10*	P1,7,9,10*	5W
Stk 1 p	P1	V1,6	V1,7,9,10*	P1,7,9,10*	6W
Gld 1	F2	V2	V2	F2	3i

G - Good, F - Fair, P - Poor, S - Slight, M - Moderate, V - Severe
/b - over bedrock, st. - stony phase, p - peaty phase
* Indicates need for on-site investigations.

1. Depth to a seasonal high water table
2. Susceptibility to flooding
3. Percent by volume of stones
4. Depth of topsoil
5. Low Permeability
6. High percentage of organic matter
7. Shallow depth to bedrock
8. Texture
9. Shrink-swell potential
10. Potential frost action
11. Potential concrete corrosion

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APPENDIX

Aeolian material - material deposited by wind.

Alluvial material - material deposited by water.

Association, Soil - a group of soils geographically associated in a characteristic repeating pattern in the landscape.

Calcareous material - material containing free carbonates which effervesce visibly when treated with dilute hydrochloric acid.

Cation - an ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, potassium, sodium and hydrogen.

Eluviation - the removal of soil material in suspension or in solution from a layer or layers of a soil.

Field capacity - the amount of moisture held in a soil after the free water has been drained away into drier soil material below.

Gleying - a reduction process that takes place in soils that are saturated with water for long periods of time.

Horizon - a layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil-forming processes.

Illuviation - the process of deposition of soil material from an upper to a lower horizon in the soil profile.

Intergrade - a soil that possesses moderately well-developed distinguishing characteristics of two or more soil Orders.

Lacustrine materials - material deposited in lake water and later exposed by a lowering of the water or uplift of the land.

Liquid limit - the water content at which a pat of soil, cut by a groove of standard dimensions, will flow together for a distance of 12 mm. under the impact of 25 blows in a standard liquid limit apparatus.

Peat - unconsolidated soil material consisting largely of undecomposed to partially decomposed organic matter accumulated under conditions of excessive moisture.

Ped - a unit of soil structure such as a prism, block or granule formed by natural processes (in contrast to a clod which is formed artificially).

Pedology - those aspects of soil science involving the constitution, distribution, genesis and classification of soils.

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

pH - a notation used to designate the relative acidity or alkalinity of soils and other materials. A pH of 7.0 indicates neutrality, high values indicate alkalinity, lower values acidity.

Plastic limit - water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm. in diameter.

Plasticity index - the numerical difference between the liquid and plastic limits.

Profile - a vertical section of the soil throughout all its horizons and extending into the parent material.

Saline material - material whose saturated extract has an electrical conductivity greater than 4 mmhos/cm. The grades of salinity are: weakly saline - 4 to 8 mmhos/cm, moderately saline - 8 to 15 mmhos/cm, and strongly saline - over 15 mmhos/cm.

Soil moisture classes - defined in terms of (a) actual moisture in excess of field capacity and (b) the extent of the period during which excess water is present in the plant root zone.

(1) Rapidly drained - soil moisture content seldom exceeds field capacity except immediately after water additions.

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

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

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

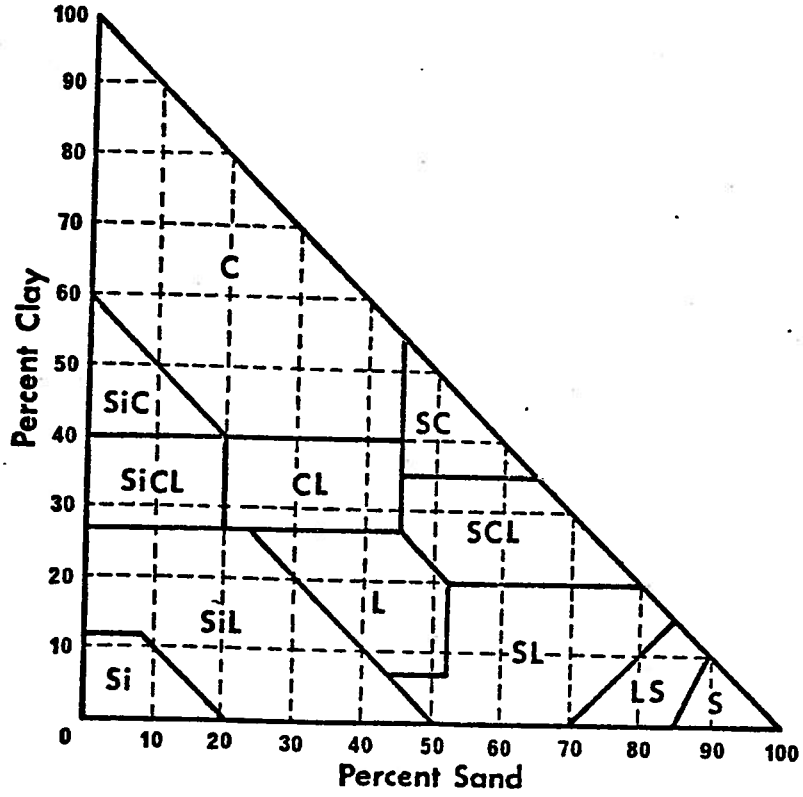
(5) Poorly drained - soil moisture in excess of field capacity remains in all horizons for a large part of the year.

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

Texture - the composition of the soil on the basis of the per cent of the different soil separates. The soil separates or particle sizes on which textural classes are based are:

Separates	Diam. in mm.*
Gravel (G)	more than 2.0
Very coarse sand (VCS)	2.0 - 1.0
Coarse sand (CS)	1.0 - 0.5
Medium sand (MS)	0.5 - 0.25
Fine sand (FS)	0.25 - 0.10
Very fine sand (VFS)	0.10 - 0.05
Silt (Si)	0.05 - 0.002
Clay (C)	less than 0.002
Fine clay (FC)	less than 0.0002

* USDA Classification



The various textures are grouped as follows: coarse textured - sands (S) and loamy sands (LS); moderately coarse textured - sandy loams (SL) and fine sandy loams (FSL); medium textured - loams (L), very fine sandy loams (VFSL), silt loams (SiL), and silts (Si); moderately fine-textured-sandy clay loam (SCL), clay loam (CL), and silty clay loams (SiCL); fine textured - sandy clays (SC), clays (C), and silty clays (SiC); very fine textured - heavy clays (HC).

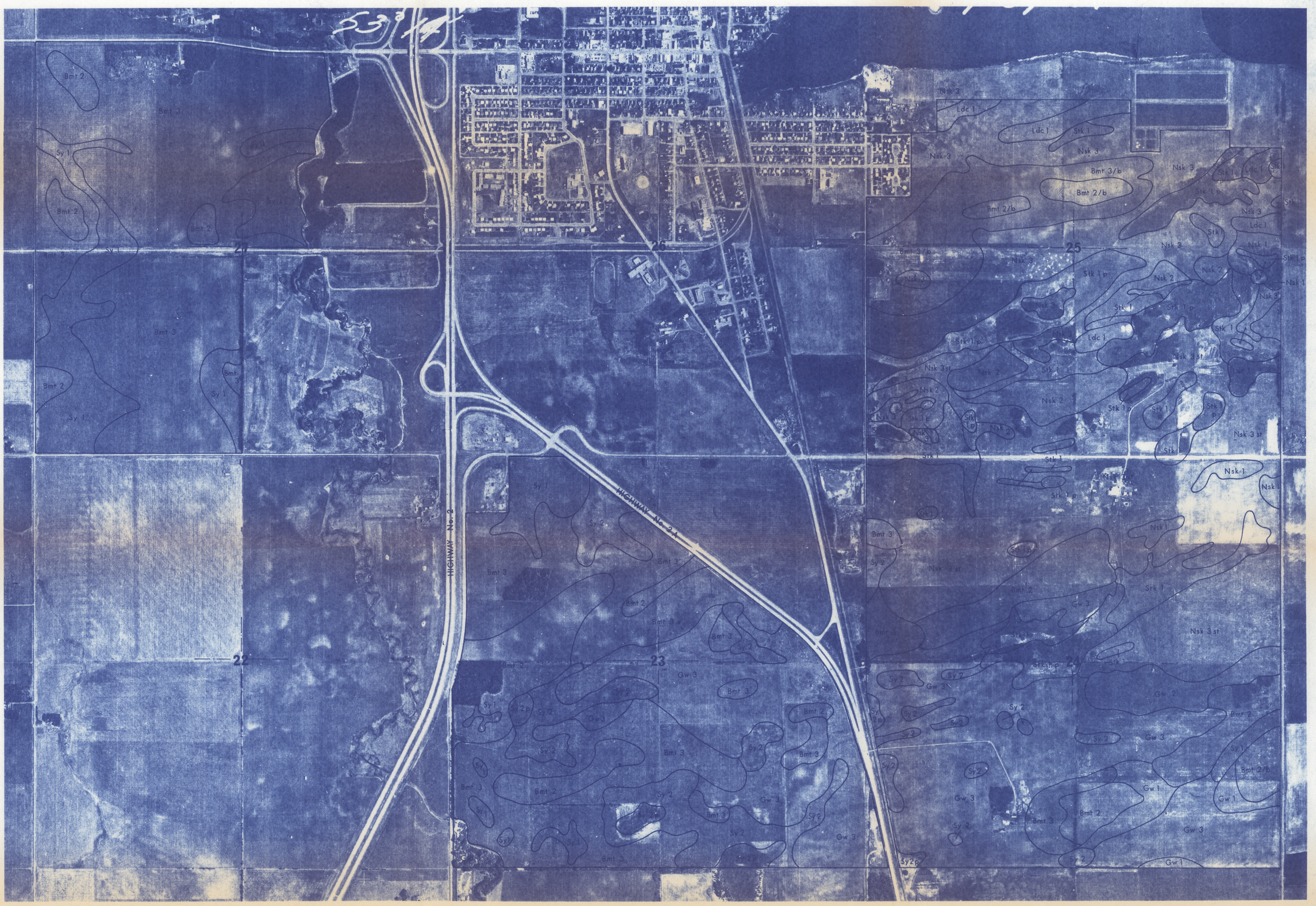
Water holding capacity - the ability of a soil to hold water.

Water table - the upper limit of that part of the soil that is wholly saturated with water.

SOIL SURVEY OF SELECTED AREAS ADJACENT TO THE TOWN OF LEDUC

Tp - 49, R - 25, W - 4

1973



Soils Legend:

Parent Material	Soil Association	Mapping Unit	Dominant Subgroup	Significant Subgroup
Till	Beaumont	Bmt 2	Solodic Black	Black Solod
		Bmt 3	Gleyed Solodic Black	Gleyed Black Solod
	Gwynne	Gw 1	Black Solonetz	Black Solod
		Gw 2	Black Solod	Black Solonetz
		Gw 3	Gleyed Black Solod	Gleyed Black Solonetz
	Stoney	Sy 1	Orthic Humic Gleysol	
		Sy 2	Saline Humic Gleysol	
Modified Residual	Leduc	Ldc 1	Orthic Black	
	Nisku	Nsk 1	Black Solonetz	Black Solod
		Nsk 2	Black Solod	Black Solonetz
		Nsk 3	Gleyed Black Solonetz	Gleyed Black Solod
	Stonerock	Stk 1	Orthic Humic Gleysol	
Recent Alluvium	Galahad	Gld 1	Gleyed Orthic Regosol	Gleyed Calcareous Regosol

p - peaty phase
/b - overlying bedrock
st - stony phase

APPROXIMATE SCALE:

670 0 670 1340 2010 2680 3350 FEET

Mapped and Compiled by: M. D. Scheelar
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RESEARCH

OFR 1974-10