Shell River Watershed

Preface

Although this document focuses on information about agricultural activities and resources in the watershed, it is important to note that there are many other industries, sectors, and users of the watershed's resources that have an impact, both positively and negatively.

Agriculture is only one component, with other human activities such as industry, recreation and residences contributing to degraded riparian areas. Due to scale and accuracy limitations, this report does not replace the need for site-specific analysis; rather, it serves as a guide for general planning purposes in the Shell River River watershed.

1) Federal-Provincial Agriculture Policy and Departmental Mandates

a) Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration (PFRA) Mandate

PFRA's mission is to provide expertise and services to producers and stakeholders for the sustainable use of agricultural land and water resources. PFRA's focus is agricultural land, agricultural water, and resource analysis and interpretation.

b) Manitoba Agriculture, Food and Rural Initiatives (MAFRI) Mandate

MAFRI's mission is to assist with the compilation of a technical resource package and deliver expertise with the technical information to aid in issue identification, and to assist the proponent in completing the final Integrated Watershed Management Plan.

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Soil Associations

Detailed soil survey information is not available for the Shell River river watershed. Reconnaissance scale soil survey information is available for this area. Soil association information is available at a reconnaissance scale. Each soil association consists of a range of different soils (associates) each of which occurs in a repetitive position in the landscape.

Assiniboine Complex

The alluvial materials which form the bottom lands in the river valleys that transverse the area are collectively referred to as the Assiniboine complex. These materials occur in the U-shaped valleys of the Assiniboine, Qu'Appelle, Birdtail and Little Saskatchewan rivers. The texture of these alluvial deposits varies both within the soil profiles and from one site to another, but generally it is within the range of silty clay loam to clay. These materials are of comparatively recent origin, in fact, deposition still occurs during flood stages of the contributing rivers. For this reason, soil profile development has generally not progressed beyond the formation of layers of organic matter accumulation which may lie within the stratified material or at the present surface. Therefore, the Assiniboine complex may be said to consist of azonal, regosolic soils developed from recent alluvial sediments.

The topography is flat to very gently sloping and soil drainage is generally imperfect or poor. The native vegetation varies with the drainage. The greater portion of the imperfectly drained soils supported a lush growth of meadow-prairie grasses prior to, cultivation; while slightly better drained sites, such as river levees , were occupied by deciduous trees including species of elm, ash, maple, poplar and willow. Most of the areas of poorly drained soils still retain their native vegetative cover of willow, swamp birch, meadow grasses, reeds and sedges. Stones are a rare occurrence on these alluvial soils except where the deposition is thin and overlies stony material.

The most pronounced profile development on these alluvial materials occurs on the moderately well-drained sites under woodland vegetation. Under such conditions a weak, greyish, platy "A2" layer and a slight textural "B" horizon is sometimes in evidence. However, the stratified nature of the profile often masks the genetic development and layering represents the most prominent feature of the soil profile. The imperfectly drained soils show much variation in degree of profile development, but generally consist of 12 or more inches of dark greyish brown silty clay to clay surface material over stratified greyish brown silty clay loam to silty clay. The subsurface horizon and underlying material usually contain concretionary iron and flecks of lime carbonate. The poorly drained soils are characterized by a surface organic layer which may consist of a few inches of muck or up to two or more feet of fen peat. Below this organic layer the mineral material consists of gleyed, olive grey silty clay to clay.

Benchlands Complex

The Benchlands complex consists of all the soils occurring on the valley terraces of the Assiniboine, Birdtail and Little Saskatchewan rivers. These soils are generally developed on a thin surface mantle of medium to fine textured alluvial and outwash deposits over a substratum which may consist of cobbles, gravel, shaly gravel, sand, or modified boulder till. The surface texture varies from loam to heavy clay loam and the surface mantle of these finer sediments is usually 10 to 18 inches thick.

These soils were developed largely under mixed prairie grasses, although some woodland invasion has occurred in areas which have deep surface mantles and finer textured substrata. The soils are dominantly of the Blackearth type with some modifications due to the textural stratification of the parent material.

The topography is smooth, very gently sloping, and drainage is good to excessive due to the coarse textured subsoils. Surface stoniness is generally slight, but becomes severe in areas where the surface mantle is thin or absent and the underlying material is stony, eroded boulder till.

No representative profile descriptions can be given for the soils in this complex as the profile characteristics vary with the texture and thickness of the surface mantle and the nature of the underlying material. As a rule, the "A" horizon is restricted to the finer textured surface layer and is very dark grey, granular, friable, and neutral in reaction. The underlying material is alkaline and calcareous.

Carroll Association

The Carroll association consists of fine to medium textured soils developed on lacustrine sediments. These sediments range in texture from very fine sandy loam to silty clay. They are underlain at varying depths by a substrate of glacial till. These lacustrine sediments which formed the parent material of the Carroll soils were calcareous and saline in their original state, and the process of desalinization has had a marked influence on the development of the resultant soils. However, the well-drained member of the association can be classified as a Blackearth soil.

The Carroll soils are located in the basin of glacial LakeSouris and the Brandon glacial lake. They occur both north and south of the Assiniboine River and bear close geographical relationship with the Harding, Beresford and Souris soils.

The topography on which the Carroll soils are encountered varies considerably. Smooth topography generally associated with lacustrine deposits occurs in some areas. However, a large portion of the area of Carroll soils is undulating to rolling. This local relief pattern is due in part to severe geological erosion normal to areas bordering deeply incised drainage channels and in part to the uneven configuration of the underlying glacial till, Soil drainage is generally good in the areas of undulating topography , but large tracts of imperfectly and poorly drained soils occur where the topography is flat. The native vegetation under which these soils were developed was dominantly mixed prairie grasses. Willows and poplar occur locally surrounding some of the depressional areas, and salt-tolerant vegetative species predominate where soil salinity precludes other vegetation.

The Carroll association is divided into three phases on the basis of texture and depth of the lacustrine deposits over till. These are Carroll clay loams; Carroll loams; and Carroll till substrate phase.

Carroll clay loams

The topography varies from level to irregular , moderately sloping . Surface runoff is rapid on the sloping land, but slow on the level areas. Interna1 drainage is good, except where impeded by a finer textured substrate. A generalized description of the well-drained member is given below:

A Horizon: Very dark grey silty clay loam to clay loam (6 to 10 inches thick); blocky structure with fine granular aggregates; friable; neutral to slightly alkaline in reaction. Grades into:

B Horizon: Brown silty clay loam (6 to 8 inches thick); medium columnar structure breaks into fine granular aggregates; firm; neutral to slightly alkaline in reaction.

C Horizon: Very pale brown silty clay loam; may be stratified with finer and coarser textured layets; fine pseudocrumb structure; friable; alkaline in reaction and calcareous.
Layers of lime carbonate and gypsum accumulation often occur in the upper portion of the “C” horizon.

Associated with these well-drained soils are: intermediately drained, Blackearth-Meadow intergrade soils; Meadow soils; and saline Meadow soils. The intermediately drained soils are generally solonetzic. They resemble the well-drained member in profile characteristics but are slightly thinner, have a stronger columnar structural development in the surface horizons and have a more pronounced lime carbonate accumulation at the base of the solum. The parent material is invariably saline and iron stained. The Meadow and saline Meadow soils which are more wide-spread in areas of level topography than in the undulating areas, have thin “AC” profiles with gleyed subsoils. Soluble salts and concretionary iron are usually present throughout the profile.

Carroll Loams:

The topography varies from level to gently sloping. Drainage is generally good due to the high permeability of the parent material . Excessively drained soils occur on the knoll positions in areas of undulating topography. A generalized profile description of the well-drained member is given below:

A Horizon: Very dark grey silt loam or very fine sandy loam (12 to 16 inches thick); weakly cloddy, breaks into crumb aggregates; very friable, neutral in reaction.
Grades into: -

B Horizon: Brown very fine sandy loam (6 to 10 inches thick); weak, medium columnar structures break into fine granular aggregates; friable; slightly alkaline in reaction.

Cca Horizon: Light brownish grey very fine sandy loam horizon of lime carbonate accumulation. This horizon is ill-defined, being only slightly greyer in color than
the underlying subsoil.

C Horizon: Pale brown very fine sandy loam; weak fine pseudocrumb structure; extremely friable; alkaline in reaction and calcareous.

The excessively drained soils on the knolls have thin profiles. These soils have developed under a drier soil climate, due to the very rapid runoff of rain waters and higher evaporation rate. As a result of this drier climate the soils resemble Dark Brown - Blackearth transitional soils. The “A” horizon is 8 to 12 inches thick, dark greyish brown in color, medium columnar in structure, and slightly alkaline in reaction. The “B” horizon is only 4 to 6 inches thick and consists of brown, columnar aggregates. It is alkaline in reaction and contains some free-lime carbonate. Below the “B” horizon, a weakly-defined layer of lime carbonate accumulation occurs at the top of the very pale brown “0 horizon. Gypsum crystals are usually present in the subsoil. Under cultivated conditions, the “A” horizon of these profiles on many knolls has been removed by erosion and the knolls appear as light grey patches throughout the cultivated fields.

The intermediately drained and poorly drained associates are of limited occurrence in the Carroll loam soils due to the high permeability of the parent material. Meadow Podzol soils occur in the area south of Kenton where poplar bluffs are fairly prevalent. The poorly drained soils encountered in local depressions are usually finer in texture than the surrounding better drained soils and resemble the hydromorphic associates of the Carroll clay loam soils.

Eastbank Association

The Eastbank association consists of soils developed on water-laid sediments of medium texture underlain with undifferentiated coarse shaly drift. The water-laid deposits range in thickness from several inches on the crests of tne ridges and knolls to three or more feet in the depressional areas. The underlying drift deposits decrease in thickness toward the Assiniboine Valley, and at some sites the combined thickness of the surficial glacial sediments over the Cretaceous shale bedrock is less than two feet.

The topography of the terrace on which these soils occur is smooth gently sloping. It is marked by several continuous ridges with intervening runways and sloughs. Some dissection of the terrace by steep-banked ravines entering the Assiniboine Valley occurs, but this feature is not as conspicuous on this terrace as it is in regions where the drift sediments over the bedrock are much thicker by comparison. Drainage is good over the greater part of the area due to the moderate relief and the presence of drainage channels. Internal soil drainage also is good because of the coarseness of the substratal sediments and the gradua1 slope of the terrain toward the Assiniboine Valley. As a result of rapid infiltration and moderate runoff , the native vegetation consists principally of dryland grasses, herbs and shrubs on the uplands and wet-land vegetation in the more humid sites. On the drier uplands such plants as silver-berry, snow-berry, wormwood, sage, grama grass, and blue couch-grass are common; whereas down the slope to the wet sites a progression of plants are found that are common to the more humid conditions in the Blackearth zone.

The soils of the Eastbank association are complex in character due to the variable thickness of the finer textured surface mantle over the coarse shale drift. Most of the well-drained areas have less than fifteen inches of the finer sediments, although some local sites with good drainage have greater thicknesses of this material. The representative and dominant associate of the Eastbank association is the well-drained member and its description is given below:

A Horizon: Dark grey loam (5 to 10 inches thick); fine granular structure; friable and porous; slightly acid in reaction.

Bz Horizon: Dark greyish brown loam (4 to 10 inches thick); weakly developed fine prismatic structure, breaks into fine granular aggregates; moderately friable and porous; slightly acid in reaction.

B3u l Horizon: Brown gravel with a predominance of shale and containing some fine sediments that are slightly stained with organic matter (5 to 21 inches thick); loose mass of rubble; slightly alkaline in reaction.

D Horizon: Grey grave1 very high in shale; loose; moderately calcareous.

The profile characteristics of the genetic soil types which occur as the imperfectly and poorly drained members of -the Eastbank association bear a marked resemblance to corresponding associates in the Lenore association. They differ principally in the presence of a shale substratum below the solum of the Eastbank soils. The imperfectly drained soils in this association are chiefly Solonetzic in character. All stages in the degree of development from the Solonetz to the incipient Solods are represented, although the solodized-Solonetz is the most common type. The solodized-Solonetz soils have well developed “A2” and” B” horizons with their characteristic structures. The “B” horizon is very tough and has low porosity. A high concentration of soluble salts occurs just below the “B” horizon. The Solonetz soils found in the area differ from the solodized-Solonetz in their lack of a prominent “A2” horizon and lesser density of the prismatic “B” horizon. The Solonetz soils are higher in reaction and are more friable than the more strongly degraded types. In these soils, the salts are commonly present in the lower part of the “B” horizon as well as in the lower strata. The incipient Solod soil is a regrading type in which a friable and slightly acid “Al” horizon has developed in the upper part of the

“A2” horizon. The “B” horizon is passing through a stage of disintegration and is not as dense as in the solodized-Solonetz soil.

Most of the poorly drained soils of the Eastbank association have a 20 to 36 inch layer of heavy clay loam to clay textured sediments superimposed over the coarse shale drift. Saline soils are the most common type and in many localized areas the salt concentration is sufficient to inhibit the growth of all plants except glasswort, Salt-grass, sea blite, gumweed, wild barley and other Salt-tolerant species. In some locations where the soils are more permeable and the water table is lower, the salts have been leached to lower levels and other plants normal to wet areas are found. In this type of soil a thin layer of peat and muck is commonly present and a strong gley horizon occurs immediately below the mucky “Al” horizon.

Erickson Association

The Erickson association consists of medium textured soils developed on boulder till parent material of similar origin and composition to that of the Newdale and Waitville associations. These soils are located at a higher elevation than the Newdale soils and the process of degradation under woods is more advanced. They occur as a transitiona1 belt between the slightly Degrading Blackearth soils of the Newdale association and the Grey Wooded soils of the Waitville association.

This transitional belt of Grey-Black soils, which traverses the south slope of the Riding Mountain, lies approximately between the 1,900 and 2,000 foot contours and varies in width with the degree of slope. Where the change in elevation is Sharp, the transition from Black to Grey Wooded soils is abrupt; but where the slope is more gentle, the increase in degradation of the soils is gradua1 and a broad transitional zone must be recognized. The soils of the Erickson association occupy the major portion of this transitional zone.

The topography of the Erickson soils is irregular, moderately sloping. It is similar in form to that of the Newdale, undulating phase, but the slopes are generally sharper and the undulations are therefore more accentuated. The surface drainage of the Erickson soils is generally good. However, as a result of the moderately undulating topography, undrained depressions and shallow lakes are of common occurrence. The vegetation of the area is dominantly aspen with a thick undergrowth of hazel, dogwood, chokecherry, cranberry, rose, vetch, etc. Black poplar and willows predominate in the poorly drained sites.

Glacial stones are present throughout the Erickson soils; however surface stoniness is not a problem to cultivation, except where it has been accentuated by erosion of the finer materials from knoll positions. Where this has occurred, stones have become sufficiently concentrated on the eroded surface of the soil to present tillage problems. The dominant member of the Erickson association is the well-drained associate, which occurs on the crests and slopes of the undulations. A generalized description of the representative profile of this associate is given below.

Ao Horizon: Very dark brown leaf and sod mat (1 to 3 inches thick); partially decomposed; mixed with considerable minera1 matter in the lower portion; neutral in reaction.

A Horizon: Dark grey clay loam (5 to 8 inches thick); granular; friable; slight greyish blorching may be evident under dry conditions; neutral to slightly acid in reaction.

B2 Horizon: Dark greyish-brown heavy clay loam (6 to 10 inches thick); medium-sized blocky aggregates arranged in weakly developed irregular columns; hard when dry, firm when moist; neutral to slightly acid in reaction. Grades into:-

B3 Horizon: Greyish-brown clay loam (2 to 4 inches thick); fine granular aggregates; firm; contains some free lime carbonate. Grades sharply into:-

Cca Horizon: Very pale brown calcium carbonate horizon (variable in thickness, usually 8 io 12 inches thick); clay loam; pseudo-granular aggregates; weakly cemented; contains pockets of powdered concretionary iron. Fades gradually into: -

C Horizon: Light greyish brown, clay loamglacial till; psuedofragrnental; hard when dry, but plastic when moist contains concretions of calcium carbonate and powdered iron, and glacial rock fragments from limestone, shale and granitic rocks.

The intermediately drained soils are of minor importance in the Erickson association as their occurrence is restricted to narrow strips surrounding the poorly drained sites. Within these confined limits, the soil profiles vary considerably. Differences in the degree of degradation are exhibited by the character and depth of the “B” horizon. In some places this horizon has a well-developed blocky structure and is 4 to 6 inches thicker than the “A” horizon. Elsewhere the subsurface layer is granular in structure and represents a gradua1 transition between the “A” horizon and the subsoil. A bleached “AZ” subhorizon is seldom in evidence, except in some local areas where Meadow Podzol soils have been developed. These occur only in slight depressions part way up the slopes where temporary ponding of runoff waters and subsequent percolation of these waters through the soil has resulted in greater degradation.

The soils which occur in the undrained depressions are generally Peaty Meadow, Half Bog or Bog soils. The Peaty Meadow soils predominate. They consist of 3 to 12 inches of fen peat underlain by a shallow mucky “A” horizon which is generally clay in texture. The subsoil is very calcareous and iron stained and usually consists of a variable depth of clay alluvium over glacial till. These soils were not differentiated from the Half Bog and Bog soils when the area was surveyed.

Eroded Slopes

This local soil category includes all the land occupied by the eroded slopes of river valleys, ravines and other water courses. It is a land-form class rather than a unit of soil classification because mature soils do not exist on these steep slopes and the soil material that is present varies from one site to another. This material generally consists of stony, modified boulder till, except in the deep valleys of the larger rivers which have been cut into the shale bedrock.

The native vegetation on these eroded slopes is strongly influenced by the variable micro-climatic conditions which prevail on the different exposures. Except in the elevated region of the Riding Mountain where all the valley slopes are heavily wooded, the woods are generally restricted to the slopes with northern and eastern exposures, while the south and west-facing slopes are covered by grassland vegetation. The woods dominantly consist of aspen and oak with some birch, ash, elm, etc., on the lower portions. The grassland species include a dominante of xerophytic types as well as herbaceous plants common to drier areas such as: anemones, asters, goldenrod, sage, wormwood and yarrow.

Harding Association

The Harding association consists of clay textured soils developed on shallow lacustrine clay deposits. These lacustrine deposits are underlain by glacial till at varying depths below the soil profile. Where the glacial till is encountered within 3 0 inches of the surface, the soils are classified as Harding clay, till substrate phase.

The Harding soils have developed under grassland vegetation and the better drained member of the association exhibits Blackearth profile characteristics. However, the dominant soil associate in this association is the imperfectly drained member and it has been strongly influenced in its development by the processes of salinization and alkalinization. Thus, the Harding soils are dominantly intrazonal.

One large area of Harding soils lies to the north of the Assiniboine River in a broad strip of land extending southward from the town of Harding for a distance of about 10 miles. This area of Harding soils is surrounded by medium textured soils of the Carroll association, and these two soils (both developed on lacustrine sediments) grade into one another with no sharp line of demarcation. This area is bordered on the west by soils of the Carroll association, and on the east by Beresford soils. This clay deposit represents the axial portion of local glacial lakes. The topography of the Harding soils is generally flat to very gently sloping. However, within the area lying to the south of Harding, this smooth topography has been modified by a number of deeply cut drainage channels. These channels cross the area from the west to east and are bounded by long slopes of varying gradient. The presence of these deep channels is of great benefit to the drainage of the surrounding land. Where the Harding soils occur on flat topography, drainage is very slow and the soils that have developed under these conditions are generally salinized or alkalinized. However, in the vicinity of the eroded channels, the soils have developed under better drainage conditions and are more productive.

The dominant, intermediately drained Harding soils show varying degrees of alkalinization. This is reflected in the soil profile by the degree of development of a columnar structure in the “A” horizon. A generalized description of the representative virgin profile of this associate is given below:
A Horizon: Dark grey to very dark grey clay (6 to 10 inches thick medium columnar structure breaks into granular aggregates; firm, hard when dry; neutral to slightly alkaline in reaction. Tongues into:

Bg Horizon: Greyish brown clay (8 to 14 inches thick); granular aggregates; plastic; alkaline, slightly calcareous; slightly iron stained. Grades into

Cca Horizon: Very pale brown clay horizon of calcium carbonate accumulation; indistinct, variable in depth and often inseparable from the “C” horizon.

C Horizon: Light brownish grey clay; massive; plastic and sticky; alkaline in reaction and calcareous; iron stained, and contains concretionary salt crystals.

The profiles of the better drained soils, which occur in the areas influenced by the deeply cut drainage channels , reflect their more favorable moisture relationships by a granular structure in the "A" horizon and brighter colors in the " B" and " C" horizons.

The "A" horizon is dark grey, granular, friable, and neutral to slightly alkaline in reaction. It is generally 8 to 12 inches in thickness, but numerous tongues of this material extend into the lower horizons for 12 or more inches. The "B" or "A-C" horizon is a transitional layer between 'the "A" horizon and the subsoil. Xt consists of 3 to 6 inches of grayish brown clay which is granular, friable, and alkaline in reaction. The "Cca" horizon is indistinct and blends with the light brownish grey, clay texttired parent material.

A prominent feature of both the imperfectly and better drained members of this Association is the deep tonguing of the "A" horizon into the subsurface and subsoil layers. This phenomena is attributed to infiltration of surface material into cracks which result from alternate wetting and drying or freezing and thawing of these clay textured soils. It is prominently displayed in fresh road cuts where the diagonal slicing of the soil profile reveals a massive network of these dark colored tongues.

The poorly drained members of the Harding association include: Meadow, saline Meadow, and degraded Meadow or Meadow Podzol soils. The Meadow and saline Meadow soils have a 4 to 6 inch, very dark grey clay "A" horizon which is massive, plastic and sticky, alkaline, and contains free-lime carbonate and concretionary iron. This surface layer is underlain by a thick, greyish brown gley horizon which fades into the grey, strongly iron-stained, clay parent material at about 20 inches below the surface. Salt crystals appear in all horizons of the saline Meadow soils.

The degraded Meadow soils occur in the scattered, wooded depressions which dot the landscape in certain portions of the Harding soil area. These soils consist of a thin mixed leaf and sod mat over a leached, platy structured "A2" horizon which is acid in reaction and slightly iron stained. This leached layer is underlain by a very dark grey, heavy clay, massive "B" horizon which is extremely firm and also acid in reaction. The parent material shows the influence of ground water by a dark olive grey color in the moist condition and the presence of concretionary iron.

The soils of the Harding till substrate phase exhibit similar profile characteristics as the comparable members of the representative Harding soils. However they are separated from the representative soils of the association on the presence of a 'D" horizon of slightly modified glacial till within 30 inches of the surface. This horizon is generally similar in texture to the surface horizons and therefore has had little effect upon the genesis of the soils. The presence of this till substrate is often indicated by scattered small stones on the surface.

Leary Association

The Leary association consists of moderately coarse to coarse textured soils developed on sandy and gravelly sediments. These coarse textured sediments were deposited as beaches in glacial Lake Agassiz and as glacial outwash deposits in the form of kames, eskers, crevasse fillings and deltas. The well to somewhat excessively drained soils include both degraded black and dark grey wooded genetic types. The Leary soils occur as small areas at widely scattered points near the streams and river channels and as beach deposits along the eastern side of Duck Mountain. The topography is variable from one location to another. Least relief is noted in areas consisting of beach deposits and greatest in areas containing small outwash plains. Dissection of the outwash plains by glacial erosion and the presence of deep depressions, called ice-block holes, have resulted in the rough topography of these areas. Rounded hills of gravel, called kames, and several ridges of grave1 (crevasse fillings and eskers) occur at various places.

Drainage is dominantly good to excessive. Imperfect and poor drainage occurs only in depressions and in areas with thin deposits underlain with finer-textured materials. Poor drainage is common along the edges of beach ridges where the grave1 deposits are thin. The vegetation on the well-drained sites consists of prairie grasses, aspen and some spruce and jack pine. Tamarack, balsam poplar and willows are common to the depressions. The well-drained Leary soils, being of droughty character, generally do not exhibit strongly developed profiles. Degraded black and dark grey wooded soils are most common in the association, although some thin black and black soils are included. The well-drained, dark grey wooded soi1 is described below:

0 -Dark brown leaf and sod mat (1 to 2 inches thick); neutral.

A,-Dark grey to very dark grey loamy sand to sandy loam (1 to 4 inches thick); structureless; loose; neutral.

AZ-Greyish brown loamy sand to coarse Sand (1 to 4 inches thick); structureless; loose; neutral.

B -Brown to yellowish brown loamy sand to loamy fine grave1 (3 to 4 inches thick); structureless, loose; mildly alkaline.

C -Pale brown to yellowish brown stratified sand and gravel; moderately alkaline.

Other soils in this association include: gleyed black, gleyed dark grey wooded, gleyed degraded black, orthic meadow, peaty meadow and grey wooded gley.

Marringhurst Association

The Marringhurst association consists of coarse textured soils developed on coarse sandy and gravelly outwash deposits. The surface texture of these soils is generally coarse sandy loam. However, some soils which have a sandy loam surface layer and gravelly subsoil have been included with the association. Although these soils are well within the Blackearth zone, the coarse textured parent material causes a locally arid soil climate which is reflected in the native vegetation and the soil profile characteristics.

Most of the soils of the Marringhurst association occur in scattered areas adjacent to the valley of the Assiniboine River. The largest area is located at the confluence of the Qu’Appelle and Assiniboine rivers in the area known locally as the St. Lazare Plains. Other sizeable areas occur in the vicinities of Shellmouth, the Oak Lake First Nation, and Brandon.

The topography of the Marringhurst soils is generally level to gently undulating.

Almost all of the Marringhurst soils are well drained or excessively drained due to the high porosity of the grave1 parent material. Poorly drained soils occur only in local depressions or old stream channels in which the gravel deposits are very thin and are underlain by a finer textured substrate such as glacial till. The native vegetation on these gravelly soils consists of mixed prairie grasses with a predominance of xerophytic species such as: grama grass (*Bouteloua gracilis*) , and spear grass (*Stipa comata*). Surface stoniness varies with the depth of the coarse sandy mantle and the degree of sorting of the surface layers.

A generalized profile description of the well-drained member of the Marringhurst association is given below:

A Horizon: Very dark brown coarse sandy loam (3 to 7 inches thick); irregular coarse prismatic; hard when dry, very friable when moist; neutral in reaction. Grades into: -

B Horizon: Brown coarse sand and fine grave1 (3 to 7 inches thick); structureless; loose; slightly alkaline in reaction. Grades sharply into: -

Cca Horizon: Light grey coarse sand and grave1 (6 to 10 inches thick); structureless; loose but weakly cemented with lime carbonate when dry; alkaline and very calcareous.

C Horizon: Variegated, stratified coarse sand and grave1 with a generalyellowish brown color; structureless and loose. Grave1 contains limestone, shale, and granitic rock fragments.

The excessively drained soils which occur on the elevated sites have a columnar, dark greyish brown “A” horizon and a relatively thick, dark reddish brown “B” horizon. The poorly drained soils have thin, black, crumb structured “A” horizons over a strongly carbonated and iron-stained subsoil.

Miniota Association

The Miniota association consists of sandy loam soils developed on sand and coarse sand outwash deposits. These deposits frequently become coarser with depth so that a fine gravel or gravel substrate is of common occurrence. The surface texture of the soils is generally sandy loam or loamy sand , but some soils with coarser surface and subsurface textures have been included with the soils of this association due to their intimate geographical relationship . Where the outwash material contains a high percentage of shale fragments, the soils were classified as Miniota shaly phase. The well-drained member of the Miniota association exhibits blackearth profile characteristics with some modification due to the influence of the coarse textured parent material upon the local soil climate.

The Miniota soils occur in scattered areas around the margin of the Lake Souris Basin at the points of confluence of rivers and streams with the glacial lake basin. The largest areas are located in the vicinity of Miniota, bordering the Assiniboine River, and to the south of Wheatlands, adjacent to the Little Saskatchewan River. Smaller, fan-like areas occur south of Virden. The Miniota, shaly phase soils occur interspersed with areas of Lenore soils in the strip of land between the Arrow Hills and the Assiniboine River.

The topography of the Miniota soils is level to slightly undulating. Beach-like ridges occur in some areas where the deposits were subject to wave action along the shores of the glacial lake. Elsewhere, eroded stream channels have bisected the areas giving added relief to the originally smooth plains. Soil drainage is good over almost the entire area of Miniota soils due to the high permeability of the parent material. Poorly drained soils are restricted to depressional areas in which the sandy outwash deposits are underlain by glacial till at shallow depths. The native vegetation on these sandy soils is dominantly mixed prairie grasses with a preponderance of xerophytic species on the driest sites. Surface stoniness is not a problem on these soils as the upper layers of the outwash deposits are well sorted into the finer sized grains.

Miniota Sandy Loam

A generalized profile description of the loam is given below:

A Horizon: Very dark grey sandy loam (8 to 12 inches thick); fine crumb aggregates; slightly hard when dry; neutral to slightly alkaline in reaction. Grades into: -

B Horizon: Dark greyish brown loamy sand (7 to 14 inches thick); weakly irregular columnar structures break into fine crumb aggregates; hard when dry. very friable when moist; slightly alkaline in reaction. Grades sharply into: -

Cca Horizon: Light grey, stratified sand and coarse sand (6 to 10 inches thick); structureless; often weakly cemented with lime carbonate.

C or D Horizon: Pale brown to light grey, stratified Sand, coarse sand and/ or fine gravel; structureless and loose.

The type of soil profile which occurs in the depressional areas depends upon the height of the perched layer of ground water, and therefore upon the depth of the sandy deposits over glacial till. Where the till occurs close to the surface, Meadow soils have been developed. These soils have a dark grey, sandy loam “A” horizon with a fine crumb structure, very friable consistence, and neutral to slightly alkaline reaction. This is underlain by a gley horizon of dark yellowish brown , sand and coarse Sand. The “C” horizon consists of very pale brown, sand and coarse sand which is strongly iron stained. Where the sandy deposit is thicker, the excessive surface water which collects in these local catchment basins percolates through the soil before its downward movement is arrested by the till substrate. This results in the formation of a Meadow Podzol soil with a distinct “AZ” horizon, dark colored “B” horizon, and iron-stained “C” horizon. This type of profile is usually acid in reaction down to the layer of ground-water accumulation.

Newdale Association

The Newdale association consists of medium textured soils developed on boulder till of mixed materials derived from shale, limestone, and granitic rock sediments. These soils have developed under intermixed aspen grove and grassland vegetation. The influence of woods, together with a higher precipitation-effectivity due to a slightly cooler climate than prevails to the south, has resulted in some degradation in the soils. For this reason the soils of this area have been referred to as ‘Northern Black Earths’.

The northern boundary of the association coincides roughly with the 1,900 foot contour on the southern slope of the Riding Mountain and the soils extend south-west to the Arrow Hills and southward to the Lake Souris Basin.

The topography is generally undulating (irregular gently sloping) with innumerable undrained depressions varying in size from small "potholes" and sloughs to large meadows and intermittent and shallow lakes (Figure 24). Variations from this typical, ground morainic type of topography occur, notably within a strip of land adjacent to the Assiniboine River Valley between Foxwarren and Cracknell where the relief is characterized by broad, smooth gentle slopes, and in the southeastern portion of the soil area where the terrain is smoother and marked depressions less numerous. As a result of this irregular relief pattern, surface drainage is quite variable and ranges from excessive runoff on the steeper slopes to prolonged inundation of the depressed areas. Interna1 or soil profile drainage has a corresponding range from good to very poor.

The majority of the better drained Newdale soils were developed under grassland vegetation. However, the area as a whole lies within what has been designated as the "Park Belt" and islands of aspen occur in ever-increasing size from south to north. In the southern portion of the area, aspen occurs as rings of trees around the sloughs in the depressions. Towards the north the trees have crept farther up the slopes, particularly on the northern exposures, so that only the soils on the higher positions have not been influenced by this successional change.

Although glacial stones are present in all the Newdale soils, they do not constitute a serious problem to cultivation over most of the area. The exception is in areas adjacent to the major river channels where the boulder till was subjected to severe erosion during the post-glacial period. Here, the finer material was washed out of the surface layer, leaving a stony, water-worked till as the parent material from which the soils were subsequently developed.

The Newdale association has been separated into four major divisions or phases on the basis of topography and modification of the parent material. These divisions are shown on the soils map and will be described as: the undulating phase, the broadly rolling phase, the smooth phase, and the modified phase.

Newdale Undulating Phase:

The associated soils in the Newdale undulating phase may be regarded as the representative Newdale soils. The topography varies from roughly undulating to smooth, but is characteristically moderately undulating (irregular, gently sloping) with innumerable undrained depressions. As a consequence of this irregular topography, surface drainage is variable and, due to this variation in drainage and in the amount of water that enters the soil profile, the soils may vary considerably in different parts of the same field. The representative Newdale soils, which are found in the well-drained positions and on the more gentle slopes, may be described as follows:

A Horizon: Very dark grey clay loam (6 to 10 inches thick); fine granular aggregates; friable, moderately plastic when moist; neutral in reaction.

B Horizon: Dark greyish brown coatings on fine blocky aggregates which are brown inside; clay loam to heavy clay loam texture (5 to 8 inches thick); aggregates arranged in weak columnar structures; hard, firm when moist; neutral to slightly alkaline in reaction.
Grades very sharply into: -

Cca Horizon: Very pale brown clay loam calcium carbonate horizon of vatying thickness, fading gradually into: -

C Horizon: Light brownish grey glacial till of clay loam texture; amorphous; weakly cemented when dry, plastic when moist; contains powdered iron in root channels and concretionary carbonates. Glacial rock fragments are from limestone, granitic and shale rock ‘materials.

Associated with these well-drained soils are intermediately drained, poorly drained, and degraded soils of variable character. The intermediately drained soils usually occur as narrow bands around the edge of depressions or along the margin of broad shallow draws. They are generally similar in character to the well-drained member described above. However, the “A” horizon is deeper, the “B” horizon less distinct, and the “C” horizon shows the influence of imperfect drainage by being iron stained, mottled with lime carbonate and in some cases containing gypsum crystals and pseudomycelium of other soluble salts.

The soils which occur in the numerous undrained depressions and shallow draws are of four distinct types. These types, which are often associated with one another in the poorly drained sites, are: Meadow soils; degraded Meadow soils; mucky, high-lime soils; and mucky saline soils. The Meadow and degraded Meadow soils are the common members associated with the better drained soils throughout the Newdale undulating phase area. The degraded Meadow, or Meadow Podzol, soils are more common in the northern portion of the area and the saline Meadow soils are the dominant type in the southern portion

The Meadow soils are variable in thickness and are often developed on modified parent material. The profile generally consists of two or more inches of muck or mucky material on a variable thickness of very dark grey to black clay loam. The black “A” horizon tongues into a highly carbonated and iron stained subsoil which may consist of alluvium, water-worked till, or undifferentiated till. The soil is usually alkaline throughout, but the reaction of the “A” horizon may be neutral to slightly acid if the soil is slightly degraded.

The Meadow Podzol soils are characterized by a grey, acid “A2” horizon; a thick, blocky, dark brown “B” horizon; and a carbonated and iron-stained subsoil. The surface horizon imparts a grey color to the soil when exposed by cultivation and extensive areas of these greyish soils are a characteristic of the cultivated fields in the northern portion of the Newdale soils.

The calcareous and saline Meadow soils occur most commonly in association with shallow, intermediately drained calcareous soils in large areas in the central and northern portion of the Newdale soils. These areas are quite distinctive from the Newdale undulating phase and have been separated and designated on soils maps as the calcareous and salinized associates. They are characterized by low relief; numerous sloughs, shallow draws, intermittent and shallow lakes; and a high percentage of intermediate and poorly drained, calcareous and salinized soils . Other soil associates normal to the Newdale undulating phase occur, but their presence is restricted to small isolated areas of better drained land and even they are affected to some extent by calcareous and slightly saline subsoils.

The dominant soil type in these areas of low relief is the intermediately drained, calcareous associate. It occurs in belts adjacent to the poorly drained soils and has been developed under vegetation which consists mainly of dry-land grasses and herbs and alkali-tolerant plants. The deciduous trees that do occur are less vigorous than in other areas and dry-land vegetation such as wolf willow, snow-berry, wormwood and sage, is more prevalent. The representative profile of this associate is described as follows:

A Horizon: Very dark grey clay loam (6 to 12 inches thick); fine granular structure; firm, sticky when moist; slightly alkaline and contains some free lime carbonate; occasional salt pseudomycelium also present. Grades into: -

A-C Horizon: Light brownish grey clay loam (2 to 4 inches thick); crumb structure; friable; alkaline; contains free lime carbonate and some salr L seudomycelium. Grades sharply into: -

Gca Horizon: light grey to white calcium carbonate horizon (10 to 1.5 inches thick); clay loam; contains some concretionary iron, gypsur:! and salt pseudomycelium. Grades into:-

C Horizon: Light olive grey clay loam boulder till which is massive, plastic and sticky and contains large blotches of concretionary iron, lime carbonate and gypsum crystals.

The calcareous and salinized meadow soils occur in the poorly drained positions and are usually non-arable because of inundation during the spring season or the presence of excessive amounts of soluble salts. The profiles are similar to the representative meadow soils of the Newdale undulating phase, but the “A” horizon is strongly blotched with lime carbonate and contains both salt and limonite concretions.

Newdale Broadly Rolling Phase:

This topographical phase of the Newdale association occurs in a broad belt adjacent to the Assiniboine River Valley in the vicinity of Foxwarren, Binscarth, Russell and Silverton. It represents an indistinct recessional morainic area in which the relief is characterized by relatively broad, smooth gentle slopes varying in length from one quarter to three-quarters of a mile and having summits from twenty to one hundred feet higher than the intervening depressional areas. The soils in this area have been influenced to a varying degree by a general, although somewhat erratic, higher shale content of the boulder-till parent material than is normal to the Newdale soils. In some parts of the area, particularly in the vicinity of Russell, shale bedrock frequently is close to the surface on the crests of the rolls and occasionally is encountered at depths of two to six feet.

The soils of the broadly rolling phase show modifications in profile characteristics and distribution of associates from those of the Newdale, undulating phase. These modifications result from the rolling topography, higher shale content of the parent material, and a slightly more humid climate. The well-drained soils, which occur on the heights of land and over a large portion of the gentle slopes, generally have a deeper “A” horizon and darker colored “B” horizon than the normal Newdale well-drained soils. A generalized profile description of these soils is given below:

A Horizon: Very dark grey clay loam (8 to 12 inches thick); finely granular aggregates; friable; neutral in reaction. Grades quite sharply into: -

B Horizon: Brown to dark brown clay loam to heavy clay loam (8 to 12 inches thick); fine blocky aggregates arranged in weakly developed columns; firm when moist, hard when dry; neutral to slightly alkaline in reaction. Grades into: -

Gca Horizon: Light grey lime carbonate horizon (8 to 12 inches thick); clay loam; finely granular; friable. Grades into: -

C Horizon: Light brownish grey, clay loam shaly boulder till; fine pseudo-granular; friable; moderately calcareous; contains blotches of concretionary limonite and flakes of undecomposed shale.

The greater portion of soils in the intermediately drained position have been affected to a varying extent by the influence of woods. These soils occur in the shallow depressions on the slopes and in narrow bands adjacent to the poorly drained areas. They are characterized by a textural “B” horizon with more strongly developed sub-angular blocky or fine blocky structure than the well-drained member and, in some cases, by a thin, greyish “A2” horizon which is slightly acid in reaction. Intermediately drained soils which show little or no effect of woods also occur and are similar in character to the corresponding associates in the Newdale undulating phase.

The soils in the poorly drained positions are variable and may consist of meadow, meadow podzol, saline meadow, or mucky meadow soils. The small depressions which occur toward the base of the slopes, but at a slightly higher elevation than the large basinal areas, are usually occupied by Meadow Podzol soils. Meadow and mucky meadow soils predominate in the large basinal areas, and saline soils are sometimes found on the edges of sloughs and intermittent lakes. These soils are similar in profile characteristics to the corresponding associates in the Newdale undulating phase.

Newdale Smooth Phase:

The Newdale smooth phase occurs as a marginal strip at the south-east extremity of the Newdale soil area. The topography is irregular and gently undulating in some portions, but generally it is relatively smooth as compared to the area of the Newdale soils to the north and variations in relief are much less pronounced.

This area is somewhat similar to that denoted as the calcareous and salinized associates within the Newdale undulating phase. The soils in the smooth phase are generally thinner and more calcareous than is normal to the Newdale association and soluble salts commonly occur in the lower horizons of the soil profiles. However in this area, although calcareous and saline soils are common in the shallow depressions, the dominant soils are moderately well drained. These soils although similar in morphological characteristics to the representative well-drained Newdale soils have thinner profiles and less pronounced “B” horizons. This deviation from the representative type is due to the lower relief and possibly in part to a more calcareous parent material. The associated poorly drained soils are mostly saline Meadow soils of similar characteristics to those in other Newdale soil areas.

Newdale Modified Phase

Soils of the Newdale modified phase occur in scattered areas adjacent to the valleys of the Assiniboine , Birdtail and Little Saskatchewan rivers. These areas are characterized by slightly undulating (irregular, very gently sloping) topography and park-like vegetation. The soils are developed on boulder till that was eroded by glacial waters to the extent that a layer of stones or gravel of varying thickness was left as a remnant of this erosion. Where no subsequent deposition occurred, the skeletal material remained as a surface mantle, but where deposition did occur, the coarse fragments are now within the soil profile. Thus the profiles exhibit little uniformity in texture and parent material and no representative description can be given. The surface textures range from sandy loam to clay loam and the subsoil or parent material may be stony till, a mixture of gravel and stony till, or only slightly modified till. The soils resemble those of the oxbow modified phase but are separated on the basis of their relationship with the normal zonal soils.

Oxbow Association

The Oxbow association consists of loam to clay loam soils developed on light brownish grey , moderately calcareous boulder till . The well-drained member of this association is a Blackearth soil and has developed under tall prairie-grass vegetation. The parent material of the Oxbow soils, which was derived from glacial transported shale, limestone and granitic rock fragments, was variably saline throughout its extent with the soluble salt .content reaching high concentrations in some areas. The effect of these salts and their downward movement in the better drained sites has been an important factor in the genesis of the Oxbow soils.

The topography is generally undulating (irregular gently sloping). The slopes are usually short and terminate in shallow undrained depressions or eroded intermittent stream channels (Figure 6). However, in an area adjoining the Lake Souris Basin, to the west and north of Virden, this irregular land surface gives way to a smoother topography which seems to have resulted from the area being affected by shallow waters of glacial Lake Souris. Over the entire area covered by this association soil drainage is subject to much local variation and large, continuous areas of well-drained soils do not occur. In the northern portion of the area some extensive tracts of salinized meadow soils are encountered.

The native vegetation on the Oxbow soils varies considerably on the different soil members of the association. The well-drained soils , which occur on the Upper portion of the slopes , have developed under tall prairie grasses and associated herbs; while on the knoll positions, where the soils are excessively well drained, dry-land species predominate . In the depressions the vegetation also varies with the nature of the soil. Where the Meadow soils are not strongly salinized, a fringe of poplar and willow invariably occurs around their outer margin. However, in local depressions and in some extensive low areas in the northern portion of the association, where the soils are strongly carbonated, salinized or alkalinized, alkali-tolerant vegetation prevails. Thus the area presents various aspects of vegetational cover which combine to impart a Park-like appearance to the general terrain.

Rackham Association

The Rackham association consists of sandy loam to silty clay loam soils developed on lacustrine sediments of similar origin and composition to those on which the Onanole soils have been developed. These sediments range in texture from sand to silty clay loam and are underlain, at variable depths below the soil profile, by a substrate of glacial till. The soils of this association are more strongly leached than the Onanole soils and the well-drained members exhibit typical Grey Wooded profile characteristics.

The Rackham soils are located on the upper slopes of the Riding Mountain. They occur in the areas of irregular shape and size interspersed with the soils on glacial till and outwash deposits to the south and west of Clear Lake. The topography in irregular, steeply sloping and hilly and in this respect, areas of these soils are indistinguishable from the surrounding areas of Waitville soils on glacial till. The topographical relationship indicates that the sediments on which these Rackham have been developed were deposited in shallow waters temporarily ponded against the ice front. Subsequent erosion caused some modifications and removal of these sediments and resulted in the complex soil pattern which presently characterizes the area. The native vegetation on the Rackham soils is also the same as on the Waitville soils; thus, from surface appearance, the only distinguishing feature between these two associations is the absence of stones in the areas of Rackham soils.

Rackham Clay Loams

The soils of the Rackham clay loam textual phase are dominantly well-drained. Intermediately drained and poorly drained members do occur in the lower positions, but bog and halfbog soils occupy most of the depressional areas and therefore the more poorly drained member of the Rackham association are very limited in extent. The well drained soils are generally developed on the very fine sandy loam parent material; whereas, the more poorly drained soils on the lower slopes and in the depressions are finer textured. A generalized description of the representative profile of the well drained associate is given below:

A0 Horizon: Very dark brown leaf litter and partially decomposed leaf mat (2 to 3 inches thick); neutral to slightly acid in reaction.

A1 Horizon: Generally absent.

A2 Horizon: Light brownish grey very fine sandy loam (2 to 6 inches thick); weak fine platy structure breaks readily to crumb aggregates; extremely friable; slightly to moderately acid in reaction. Grades sharply into: -

B1 Horizon: Greyish brown very fine sandy clay loam (4 to 6 inches thick); fine blocky to coarse granular aggregates; firm; slightly acid in reaction. Grades into:-

B2 Horizon: Very dark greyish brown heavy clay loam (5 to 7 inches thick); blocky aggregates heavily coated with organic matter; firm; slightly acid in reaction. Grades into: -

B3 Horizon: Light yellowish brown very fine sandy clay loam to silty clay loam, (4 to 6 inches thick); fine granular structure; friable; slightly alkaline in reaction. Fades gradually into: -

Cca Horizon: Light grey; very fine sandy loam to silty clay loam calcium carbonate horizon, indistinct and variable in thickness. Fades into: -

C Horizon: Very pale brown very fine sandy loam to silty clay loam; weak pseudo-crumb structure; very friable; high calcium carbonate content.

In the intermediately drained positions, the soils are generally characterized by a dark grey “A” horizon which is 5 to 12 inches in thickness; a slightly compacted, dark greyish brown “B” horizon, which is 2 to 6 inches thick; and a subsoil which is highly calcareous, iron stained, and varies in texture from very fine sandy loam to silty clay loam. Strongly degraded soils of the Meadow Podzol type also occur but are of minor importance.

The poorly drained members of the Rackham association are restricted to small, shallow depressions and narrow strips around the edges of Bog and Half-Bog soil areas. Where they occur, the profiles generally consist of 3 to 12 inches of partially decomposed fen peat, underlain by a 4 to 8 inch mucky “A” horizon which is dark grey in color, massive, plastic and sticky, slightly alkaline in reaction, and contains some concretionary iron. The subsoil is highly mottled with calcium carbonate and iron. These soils range in texture from fine sandy clay loam to silty clay and are common to both textural phases of the Rackham association.

Souris Association

The Souris association consists of fine sandy textured soils developed on sandy lacustrine deposits in the Lake Souris Basin. These sandy sediments are underlain by finer textured deposits at varying depths below the soil profile. This finer textured substrate prevents free interna1 drainage so that the Souris soils have been developed under conditions of impeded drainage. Thus, the dominant soil in this association is a Blackearth-Meadow Intergrade.

The Souris soils occur in the basinal area of glacial Lake Souris and the Brandon glacial lake. The topography is generally level to very gently sloping. Occluded areas of sand dunes occur within the lighter textural phase of this association. Except in these areas of duned sand, soil drainage is impeded and the dominant soils are the intermediately and poorly drained associates. The native vegetation varies with the soil and substrate moisture conditions. Mixed prairie grasses thrive on the imperfectly drained SOUS, while meadow grasses, sedges and reeds occupy the lower sites. Xerophytic grass species, ground cedar and purple pin-cushion cactus occupy the drier sites in the duned area; while scrub oak and aspen grow on the north and east-facing slopes and in the small depressions. Deciduous trees including species of oak, elm, ash and maple are found on the beach-like ridge east of Oak Lake and provide a pleasant park area for summer campers.

The Souris association is divided into two textural phases. The finer textured soils have a surface texture of fine sandy loam. The coarser textural phase include well-drained and imperfectly drained soils with a surface texture of loamy fine Sand; poorly drained soils which may have finer surface textures; and lithosolic duned sand which consists dominantly of the fine sand fraction.

Souris Fine Sandy Loam:

The dominant associate of the Souris fine sandy loam soils is the imperfectly drained member . These soils generally have free-water movement in the surface horizon but impeded drainage in the subsoil. A generalized profile description of this associate is given below:

A Horizon: Dark grey fine sandy loam (8 to 12 inches thick); weak fine crumb structure; extremely friable; alkaline in reaction and contains some free lime carbonate.

AC Horizon: Greyish brown loamy fine Sand (5 to 8 inches thick); weak fine crumb structure; extremely friable; alkaline and calcareous. Contains concretionary iron.

C Horizon: Light yellowish brown to light grey fine Sand; structureless and loose; alkaline, strongly calcareous and diffusely iron stained.

Meadow soils occupy the poorly drained positions. These soils have a dark greyish brown fine sandy loam “A” horizon which is calcareous and contains concretionary iron. This surface horizon is 6 to 10 inches thick and is underlain by a strongly developed gley horizon which is light grey in color, marly, and iron stained. The parent material consists of very pale brown fine sand and is diffusely iron stained. An unconforming or “D” horizon of finer textured material is sometimes encountered within three feet of the surface. A perched ground water table commonly occurs within profile depth during wet seasons.

Souris Loamy Fine Sand

The soils of the Souris loamy fine sand phase consist predominately of four associated members. These are: moderately well drained soils in areas of micro-dune topography; imperfectly drained soils on smooth topography; poorly drained Meadow soils in flat depressional areas; and excessively drained, lithosolic soils in areas of duned Sand. Al1 of these soils occur over extensive areas and none can be said to be the dominant member.

The moderately well-drained soils are restricted to areas in which the sandy sediments were slightly duned subsequent to deposition but have been stabilized by vegetation. These soils have been leached to a varying degree due to the rapid percolation of moisture through the surface horizons. They generally have a dark grey “A” horizon seldom exceeding 15 inches in thickness. This surface horizon consists of loamy fine Sand, is extremely friable, and neutral to slightly acid in reaction. This horizon may be underlain by a weak, brown colored “B” horizon or may grade directly into a pale brown fine sand “C” horizon that is slightly calcareous and is generally iron stained.

The imperfectly drained soils are similar in profile characteristics to the imperfectly drained member of the Souris fine sandy loam soils. The dark grey loamy fine sand “A” horizon grades through a thick transitional layer of greyish brown fine sand into the pale brown “C” horizon. Iron staining usually commences in the transitional layer which also is slightly calcareous in some sites. No distinct layer of lime carbonate accumulation is perceptible. The poorly drained soils also resemble the equivalent member of the finer textured phase and often are of similar texture due to greater sedimentation in these depressional areas. The position of the gley horizon in these Meadow soil profiles varies with the average height of the groundwater table.

The skeletal soils which occur on the duned sands have very feeble profile development which consists mainly of a slight organic matter accumulation in the surface 2 to 6 inches of sandy material. These soils are generally slightly acid for a depth of 4 feet or more. Under woodland vegetation, on the north and east slopes and in the depressions, a slight “B” horizon of iron concentration usually occurs at varying depths.

Waitville Association

The Waitville association consists of medium textured soils developed on boulder till. The parent material is essentially the same as that of the Newdale and Erickson soils. The separation of these three associations is based on the degree of weathering or leaching as evidenced by the soil profile characteristics. The Waitville soils are the most strongly leached and the well-drained member of this association exhibits well-developed Grey Wooded profile characteristics.

The soils of the Waitville association occur over a large extent of land on the Riding Mountain. The southern boundary of the association coincides roughly with the 2,000 foot contour and the soils extend northward, intermixed with areas of soils developed on glacial outwash and lacustrine deposits.

The topography is irregular, steeply sloping to hilly and short slopes of 15 to 20 percent or more are common. The numerous undrained depressions, which result from this rough, irregular topography, are occupied by shallow lakes, spruce and tamarack bogs and open swamps. On the slopes and knolls, the native vegetation consists of mixed woods. Aspen predominates, but is intermixed with white birch and spruce and undergrown with hazel, dogwood, rose, cranberry, vetch, etc. Glacial stones occur throughout the soils and are concentrated on the surface in scattered areas where intense erosion occurred during glacial times.

As a result of the steeply sloping topography, most of the soils in the Waitville association are well drained. Intermediately drained soils occur only within very narrow strips around the edges of undrained depressions, and the depressional areas themselves are mainly occupied by Bog and Half Bog SOUS. The soils in these undrained depressions have not been differentiated on the soil map because they are chiefly organic
soils and are underlain by variable textured lacustrine and outwash sediments or modified glacial till.

The well-drained soils vary considerably in depth of profile and degree of leaching. The variation may be attributed to the irregular sloping topography and the resulting variable moisture regime. The profiles are thicker and less degraded near the base of the slopes than on the crests and the most strongly leached profiles occur in slight depressions on the face of the slopes. Cultivated soils on the crests of the slopes usually have truncated profiles due to the removal of surface material by wind and water erosion.

A generalized profile description of the typical well-drained soil which occurs on the average slopes is given below:

A0 Horizon: Reddish brown, partially decomposed leaf mat (1 to 3 inches thick); slightly acid in reaction.

A1 Horizon: Very dark grey mucky clay loam; finely granular; friable; neutral to slightly acid; very thin or absent.

A2 Horizon: Pale brown sandy loam to loam (2 to 4 inches thick); weakly developed fine platy to crumb structure; moderately hard; coarse rock fragments are largely decomposed; slightly acid in reaction. Grades sharply into: -

B1 Horizon: Brown clay loam (2 to 4 inches thick); fine to medium blocky aggregates; very hard when dry, moderately plastic when moist; aggregates have greyish coating near top and organic staining and darker color occurs with depth; slightly acid in reaction.
Blends gradually into: -

B2 Horizon: Dark brown heavy clay loam (4 to 6 inches thick); fine to medium blocky aggregates are coated with colloidal clay and organic matter and lighter in color inside; hard and strongly compacted; slightly acid in reaction. Fades gradually into:-

B3 Horizon: Brown clay loam (3 to 5 inches thick); slightly stained with organic materials; fragmenta1 structure; firm; contains some free lime carbonate. Grades sharply into: -

Cca Horizon: Light grey, calcium carbonate horizon of variable thickness; clay loam; pseudo-crumb structure; friable when moist weakly cemented when dry; contains some powdered iron concretions. Fades into -

C Horizon: Light greyish brown, clay loam glacial till; pseudofragmental; hard; strongly calcareous; contains powdered iron concretions and glacial rock fragments.

The intermediately drained soils within the narrow strips adjacent to the undrained depressions are variable in profile characteristics. The variability is chiefly in the thickness and character of the "B" horizon. The "A" horizon generally consists of 12 to 15 inches of dark grey clay loam which is finely granular in structure, friable, and neutral in reaction. However, the "B" horizon varies from a thin transitional layer between the "A" and "C" horizons to a compacted, blocky illuvial horizon of up to 15 inches in thickness. The subsoil is highly calcareous glacial till or slightly modified till and usually contains concretionary iron.

Zaporoza Association

The Seech and Zaporoza associations consist of coarse textured soils developed on shaly coarse sand and grave1 outwash deposits. The coarse textured parent material of these soils has been the dominant soil-forming factor in their development. The high porosity of these deposits has affected the local soil climate and vegetative caver under which the soils have formed and thus has altered the normal regional development of these soils.

Although they occur entirely within the Grey Wooded zone, most of the soils exhibit only slight degradation and Grey Wooded profiles occur only at the higher elevations and on the more humid north facing slopes. The soils that have developed under mixed prairie grasses and aspen vegetation and exhibit Blackearth and Degrading Blackearth profile characteristics are included in the Seech association; whereas those (occurring at higher elevations) that have developed under mixed woods and exhibit Grey Wooded profile characteristics are included in the Zaporoza association.

The Seech and Zaporoza soils, intermixed with areas of Rackham and Waitville soils, occur on the Upper slopes of the Riding Mountain.

The topography is irregular, steeply sloping to hilly and the drainage is dominantly excessive. The native vegetation varies with the soil texture, elevation, and topographical position. It is mainly mixed tall prairie grasses and associated herbs, with woods becoming prevalent in the imperfectly drained sites and at the higher elevations. The low positions are occupied by spruce and tamarack bogs or open swamps.

The soils of the Zaporoza association have been developed on similar parent material to the Seech soils but under the influence of mixed woods vegetation. The greater growth of woods in these areas than in other areas of similar outwash deposits appears to be primarily due to the cooler, more humid climate which occurs at the slightly higher elevations where the Zaporoza soils are found. The topography is steeply sloping to hilly and soil drainage is generally excessive. A generalized description of the dominant well to excessively drained associate is given below:

A0 Horizon: Dark brown leaf mat; partially decomposed; neutral to slightly acid in reaction (1 inch thick).

AI Generally absent.

A2 Light brownish grey loamy coarse sand (3 to 6 inches thick); weak platy structure; extremely friable; slightly acid in reaction. Grades into -

B1 Horizon: Brown coarse sandy loam (3 to 5 inches thick); weak granular aggregates; friable; slightly acid in reaction. Grades into: -

B2 Horizon: Yellowish brown coarse sandy loam (4 to 6 inches thick) weak blocky structure; firm; neutral in reaction. Grades into: -

B3 Horizon: Light yellowish brown coarse Sand and grave1 (2 to 5 inches thick); single grain; loose; slightly alkaline in reaction.

C Horizon: Light grey coarse Sand and grave1 and dark grey flakes of shale; single grain; alkaline in reaction. Sand and grave1 contain a high percentage of limestone material.

Small areas of intermediately drained soils of the Zaporoza association occur toward the base of the slopes as narrow bands surrounding the organic soils in the depressional areas. These intermediately drained soils are similar in general profile characteristics to the well drained Seech soils. However, these soils were developed under different moisture conditions and contain concretionary iron in the lower horizons.

Management considerations for selected soil associations

Some general management considerations can be supplied with certain soil associations. Reconnaissance scale survey cannot be used to obtain site specific information. Appropriate management is vital in all areas regardless of broad scale risk identification. Without detailed information to determine site-specific recommendations, it is preferable to consider implementing or maintaining appropriate management practices across the watershed's soil associations, realizing that although certain issues are more likely to arise in certain areas, all parts of the watershed can be affected by these issues and that proper management is vital.

Management Considerations – Assiniboine Complex

Cultivation of the Assiniboine alluvium is restricted to the better drained soils in the wider portions of the Assiniboine and Little Saskatchewan river valleys. These soils are very fertile and are highly productive under optimum moisture conditions. The chief problems concerning their cultivation arise from their slow interna1 drainage, lack of adequate runoff and susceptibility to flooding. Low porosity also is a detriment to these immature soils and cropping practices which add fibrous organic matter are recommended.

The poorly drained soils can be utilized to some extent for native hay and pasture.

Management Considerations – Benchlands Complex

The agricultural value of the Benchlands soils is variable due to the variability of the soils themselves. Where the surface mantle is a foot or more in thickness and of a clay loam or finer texture, the soils can be utilized for grain production. Even on these select sites however the soils are often susceptible to drought, due to the gravelly substrata, and should be utilized in a mixed farming enterprise. The coarser textured soils and those with very thin surface mantles are not suited to arable culture and should to be used as hay and pasture lands. The very stony areas are further restricted in their agricultural use and provide only limited pasturage for sheep or cattle.

Management Considerations – Carroll Association

The Carroll soils are highly productive, except where their fertility has been drastically lowered by the loss of the "A" horizon through water and wind erosion. Prior to cultivation, these soils represented some of the best potential agricultural land in Western Canada. They developed under a luxuriant growth of mixed prairie grasses, from parent material high in plant nutrients and of ideal texture for workability and moisture-aeration relationships. The resultant soil was a deep Blackearth of excellent fertility.

These soils were brought under cultivation early in the period of settlement of western Manitoba. Since that time the soils have been utilized almost exclusively for the production of cereal grains. This method of utilization has not appreciably affected the fertility of the soils which occur on level topography, but has been significant to soils in areas with undulating and rolling topography. Continuous grain-fallow rotations, removal of crop residues, and cultivation by rectangular fields regardless of the slope has resulted in the complete removal of the fertile top soil by water and wind erosion from a large portion of this land.

On areas of level or near level topography, these soils are ideally suited to the production of cereal grains. The use of trash caver to reduce wind erosion is necessary, especially on the Carroll loam soils, and fertilizers containing nitrogen and phosphorus will give profitable returns when applied to grain at the recommended rates. The areas of irregular sloping topography require special practises if soil fertility is to be maintained. The steeper slopes should be sown to permanent grass or grass and legume crops. Where cultivation is continued, contour farming with buffer strips of grass in rotation on the slopes will assist in reducing further erosion. Al1 crop residues should be used as trash caver and returned to the soil. Managed application of manure to eroded knolls will help to restore organic matter to these depleted soils. Eroded gullies should be filled in and seeded to grass. In short, these soils are not suited to the exclusive production of grain crops and in the future should be utilized for dairying or mixed farming with grain crops being restricted to contour strips in rotation with strips of grasses and legumes.

Management Considerations – Eastbank Association

The Eastbank soils are characterized by a thin surface mantle of medium textured material with good water retention capacity, a droughty substratum of coarse shale gravel, stoniness on the ridges , and salinity in the depressions. Most of the area is under cultivation and in years of normal rainfall fair crops of cereal grains are produced. A large part of the area however is droughty because of the proximity to the surface of the shale rubble which tends to restrict root development. Where the surface mantle is two or more feet thick, the crops are better than the average for the area. At present the stony areas and the poorly drained soils are used as native pasture lands.

Grain farming with wheat as a principal crop cannot be considered a satisfactory system for the Eastbank soils. During seasons of plentiful precipitation, good yields of grain have been obtained, but in drier years poor crops have resulted. Grain farming, without the supplementary measures of using grasses and legumes in the crop rotation, does not maintain organic matter or provide for the retention of the best soil structure.

In recent years forage crops have been grown to a greater extent in parts of the Eastbank soil area. Sweet clover and brome grass are the most important of these crops which assist both in control of wind erosion and in the maintenance of soil fertility. This increased use of forage crops is associated with livestock production. Mixed farming with emphasis on livestock production is recommended for the Eastbank soils.

Management Considerations – Erickson Association

The better drained Erickson soils are rarely equal in fertility to the corresponding members of the Newdale undulating and rolling phases. The organic matter content of the surface soil is slightly lower, due to increased leaching, but the supply of available plant nutrients other than nitrogen is about equal and the soil reaction may be more favorable for the growth of most grain and forage crops. The moisture retention capacity is equal to that of the Newdale soils and the precipitation-effectivity is higher in this area due to a somewhat cooler climate.

The same reasons that were advanced to discourage continous grain cropping of Newdale soils are even more applicable to this area of Erickson soils. The rougher topography accompanied by steeper slopes and accelerated runoff renders these soils highly susceptible to severe water erosion when unprotected by vegetative growth. This is forcibly emphasized by the exposure of greyish-brown subsurface and subsoil material on many cultivated knolls within the area, and the presence of eroded gullies wherever runoff waters are locally concentrated.

Forage crops suited to the climate produce well on these fertile soils and their utilization by means of a complementary livestock enterprise also enables use to be made of the nonarable, poorly drained soils as hay and pasture lands . The rough, irregular topography restricts the use of contour strips of grass as a means of reducing water erosion. Therefore, long-term crop rotations with a strong emphasis on grasses and legumes, together with contour cultivation and seeding down of runways and steep slopes to permanent grass is the recommended method for minimizing erosion and avoiding the rapid lowering of fertility. The use of sweet clover in the rotation as a green manure crop is very beneficial to these soils which tend to be low in available nitrogen. It also offers a method of protecting the soil and replenishing the fibre content when the production of grasses and legumes for hay and pasture is not desired by the farm operator. The use of trash caver as a surface protection and source of organic matter should be a standard practice.

Management Considerations – Eroded Slopes

The primary agricultural value of the wooded valley slopes stems from their ability to conserve moisture and aid in preventing floods rather than from direct use as farm lands. For this reason it is very important to preserve the tree cover and the underlying mat of leaf litter and decaying organic matter. This involves protection destructive grazing by livestock, and excessive removal of trees for domestic or commercial purposes. Grazing should also be limited on the steep, grass-covered slopes of these river valleys and ravines. Overgrazing of these slopes can result in severe erosion and the formation of deep gullies which may cut back into the adjoining uplands and affect good agricultural land.

Management Considerations – Harding Association

The Harding soils are highly fertile and are well adapted to grain production. They are moderately high in organic matter, and high in available plant nutrients and moisture retention capacity. Their clay texture and good aggregation renders them moderately resistant to erosion. A very high percentage of the land is arable and large fields can be farmed. The percentage of poorly drained and saline soils is low, particularly in the area north of the Assiniboine River where the surface drainage is favorably affected by the stream channels which traverse the area.

The main agricultural problems associated with these soils arise from the slow internal drainage and surface runoff in areas of flat topography. Periodic excessive wet conditions interfere with tillage operations on these heavy clay soils. Soil salinity tends to reduce yields in some areas, and poor soil aeration may retard plant growth.

The practice of returning crop residues to the soil is highly desirable on these soils. Incorporation of straw with the surface soils helps to improve workability and aeration and assists in maintaining the organic matter level. Trash cover reduces wind erosion on fallow fields and helps to control water erosion on the sloping land bordering stream channels.

Management Considerations: Leary Association

The Leary soils are best adapted to grazing.

Management Considerations – Marringhurst Association

Community pastures are an appropriate land use for Marringhurst soils.

Some grain farming is attempted on certain areas of Marringhurst soils. Fair crops of wheat and flax are occasionally obtained in years of high precipitation and even distribution of rainfall throughout the growing season. However this may be difficult to sustain as cultivation of these soils is hazardous due to their great susceptibility to drought and wind erosion. Cultivation and consequent wind erosion results in very rapid depletion of the organic matter reserve which has been built up in these soils during hundreds of years under grassland. This organic matter is the source of most of the fertility and water holding capacity of these gravelly soils. Without it, they would be of little agricultural value.

Management Considerations – Miniota Association

The soils of the Miniota association are fair in agricultural value. The problems associated with their utilization are those common to all sandy textured soils in the Blackearth zone; Under native conditions these soils are moderately high in fertility and, except during periods of severe drought, support a good growth of native grasses. However, when brought under continuous cultivation for the production of grain, this fertility is rapidly lowered by the loss of organic matter and the finer soil particles through wind erosion.

During the pioneer period of settlement in Manitoba, these soils were highly valued as the land most suited to the production of wheat. Thus the name Wheatlands was given to a village situated on these sandy soils. The main reason for this pioneer concept was that the varieties of wheat available at that time required a much longer growing period than those raised today and the more rapid maturity obtained on the sandy lands was often the critical factor in crop production. However the productivity of these soils declined rapidly and prolonged drought conditions have caused the periodic abandonment of much of the land.

These soils can not withstand exposure to the wind. Several inches of the “A” horizon have been lost from all cultivated fields and the dust storms which may occur are evidence of further depletion. If grain production is continued, measures should be adopted which will help to control this severe loss of top soil. These measures may include: reduced tillage strip farming, trash cover, field shelterbelts, and green manure crops.

Management Considerations – Newdale Association

The representative better-drained Newdale soils are highly fertile and productive. They are characterized by a high organic matter content, moderate supply of plant nutrients, favorable texture and structure, excellent moisture retention and aeration relationship, and very good tilth and workability. Thus, in areas where these better drained associates comprise a large portion of the soils on individual farms, capable farm operators rewarded with consistent high yields of grain or forage crops and consequent prosperity relative to the times. However, the productivity of these fertile Newdale soils is considerably reduced over a large portion of this area by the occurrence of a high proportion of poorly drained calcareous and salinized, or stony soils. Some of these soils are not suited for grain production and their extent, largely dependent on the local topography, has rendered the area as a whole more suited to mixed farming than to the exclusive production of grain crops.

The practice of mixed farming as a means of utilizing extensive areas of nonarable soils which characterize portions of the Newdale soil area is further supported by climatic conditions of the area which favor the production of coarse grains.

A complementary livestock enterprise for farms on Newdale soils is not only desirable from the standpoint of suitability of the area to feed crops, but also is highly desirable as an integral part of a stable farm program. Soil erosion is an ever-increasing problem on this undulating and rolling topography. The use of trash cover and windbreaks to reduce wind erosion, are necessary practices on all the soils if fertility is to be maintained.

Local soil areas within the Newdale association which present special management problems are those occupied by salinized, degraded, and stony soils. The salinized soils are usually located in poorly drained areas which are often too wet for cultivation.

These are best suited for native hay and pasture land. The degraded soils under cultivation and seeded to grain are indicated by short crops and reduced yields. These soils are low in organic matter and available plant nutrients and are benefitted by applications of manure and commercial fertilizers and the growth of grasses and legumes. The stony soils are restricted to areas of Newdale modified phase and within these areas surface stoniness is variable. Where the soils are too stony for cultivation, the land is best suited for native hay and pasture. Thus it may be seen that the agricultural value of Newdale soils varies from high to very low and the value of any individual parce1 of land is largely dependent on the local topography which governs the distribution of the various soil associates. For this reason, the Newdale broadly rolling phase with its characteristic long gentle slopes, together with certain portions of the undulating phase where the intervening sloughs and potholes are at a minimum, constitute the best agricultural land in the Newdale association. These soils are highly fertile and very productive, but the same topographical features which are responsible for the high percentage of well-drained, fertile soils are also those features most conducive to loss of this fertility through soil erosion. Therefore, judicious management of these soils is of paramount importance.

Management Considerations – Rackham Association

The Rackham soils are extremely susceptible to erosion and the loss of fertility through the effects of wind and water erosion is the primary consideration in land use recommendations. The characteristic features of these soils, namely; fine sandy and silty textures, low organic matter content, feeble structure, and steeply sloping to hilly topography combine to render prolonged cultivation very hazardous.

The soils of the finer textured phase are moderately high in natural fertility. The available nitrogen and phosphorus supply is medium to low, due to soil development under forest vegetation, but the soils are friable, have a good moisture retention capacity, and they are located in an area of high precipitation-effectivity. Grass and legume crops will produce well on these soils, especially if the deficiencies in natural fertility are offset by the application of manure or appropriate commercial fertilizers. The growth of grass-legume mixtures for hay and pasture or suitable grasses for the production of seed should constitute the major portion of the cropping system on these very erosive soils. Grain crops should be grown in rotation with improvement crops on slopes of the lowest gradient. Sharp slopes and eroded knolls should be permanently retired to grass or left under forest vegetation.

Management Considerations – Souris Association

The soils of the Souris association possess features which render them almost unique in their agricultural problems and potentialities. Like all sandy textured soils in the dry farming belt of Western Canada, their utilization must be tempered by their high susceptibility to soil drifting. Also they have the low moisture retention capacity characteristic of sandy soils and are subject to drought. However, the feature that sets them apart from most other soils of like texture and modifies their potential value is the moist substrate which occurs throughout the area.

In the past this natural sub-irrigation feature of these soils has been largely neglected. Wherever drainage and topography permitted, the soils have been generally utilized by the continuous growing of grain crops alternated with black summerfallow. This has resulted in severe loss of fertility through the removal by wind erosion of much of the organic matter and finer soil separates from the surface soil. Wherever poor surface drainage or rough, duned topography prohibited cultivation, the soils have been used to a limited extent for livestock grazing (Figure 19). The native vegetation on these soils provide pasturage of poor quality. This pattern of land use has been wasteful of the potential productivity of the Souris soils.

In recommending methods of improving the utilization of these soils a distinction must be made between the two textural phases of the association and the duned areas. The soils of the Souris fine sandy loam phase can be used for limited grain production in a mixed farming program. Their susceptibility to soil drifting and surface drought must be recognized and counteracted by special management practices. Field shelterbelts do well on this soil and should be utilized for surface protection. The trees tap the underground water supply and thus can survive periods of prolonged surface drought. Additional surface protection can be provided by strip cropping and avoidance of black summerfallow through the use of trash caver and fallow substitutes such as corn. Deep rooted, perennia1 legume crops should be included in the rotation as they also will tap the substrate moisture and provide forage during dry seasons. Thus, a system of landuse is envisioned in which grasses and legumes are grown in rotation with cereal crops and corn on elongated fields perpendicular to the prevailing winds and surrounded by field shelterbelts. It is suggested that through practices such as these the soils of the Souris fine sandy loam phase can be utilized for mixed farming, and it is further emphasized that continuation of the present system of grain growing, alternated with fallow, will eventually ruin these soils for any type of agricultural production.

The wet meadow and sandy imperfectly drained soils of the Souris loamy fine sand phase are not suited to arable culture. They must be utilized for the production of feed for livestock. For this purpose they have a good potentiality. The sand dunes which occur interspersed with the coarser textured Souris soils should always be kept under a vegetative caver. These duned sands will support the growth of adapted trees and commercial forests can be attained through the planting of suitable coniferous trees. This has been demonstrated in other areas of similar character in Manitoba and should be extended to include all areas of sand dunes on which it is feasible.

Management Considerations – Waitville Association

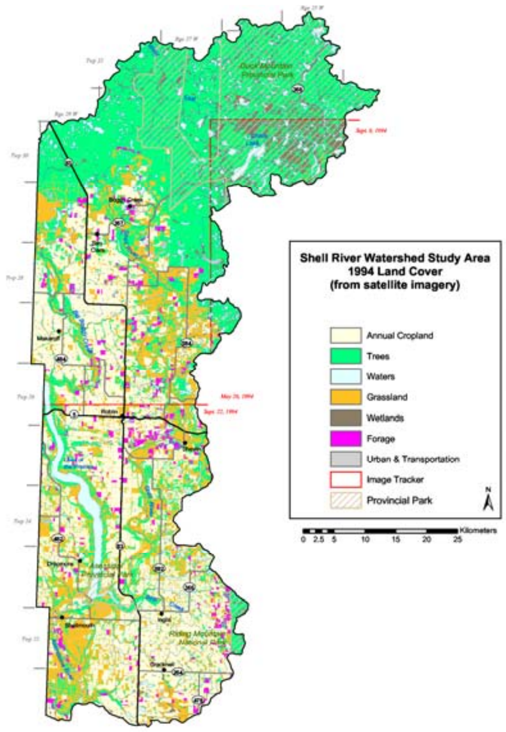
The normal, well-drained Waitville soils are medium in natural fertility. Compared to the Erickson and Newdale soils they are lower in organic matter; lower in available plant nutrient supply, particularly nitrogen and phosphorus; slightly lower in moisture retention capacity; and they occur at a higher elevation where frost hazard is a definite problem in the production of grain crops. However, the most important aspect of these soils in relation to their agricultural utilization is the very steep slopes which characterize their topography.

The Waitville soils are highly susceptible to erosion if unprotected by vegetative cover. Many of the steeper slopes which are at present under cultivation should be permanently retired to grass or forest and those which have not been cleared should be left in their native state. On the more gentle slopes where cultivation is practical, the cropping program should be designed to provide some protective cover and to build up the organic matter content of the soils. The growth of grasses and legumes for hay and pasture or seed production is the best method by which these aims may be accomplished. If grain crops must be grown, they should be produced in rotation with grasses and legumes, and crop residues should be utilized as trash cover and a source of organic matter. Cultivation should always be done on the contour. Exposure of bare soils through summerfallowing should be avoided.

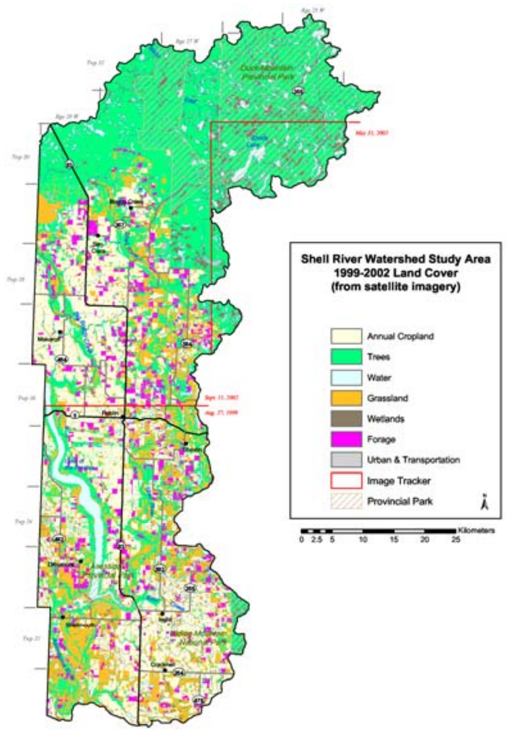
Management Considerations – Zaporoza Association

With the exception of the small areas of Seech sandy loam, deep phase, the soils in these associations are not suited to arable culture for the growth of field crops. They have a very low moisture retention capacity, low organic matter and available plant nutrient supply, and are very susceptible to wind and water erosion if unprotected by native vegetation. These soils should be utilized through controlled grazing or for forestry and the preservation of wildlife.

Land Use/Land Cover in the Shell River Watershed



1993-94 Land Cover



1999-2000 Land Cover

Land Cover (1999-2000) and general trend over a 5- to 7-year period (1993-4 to 1999-2000)in the Shell River Watershed area

Class	Area (2000) (ha)	% of Watershed	Change in Area (ha)	% Change Since 1993	% Change in Class
Annual Crop Land	66,003.3	22	-8,984.3	**-3.0**	**- 14**
Trees	133,842.2	44.7	7,455.8	**2.5**	**5.5**
Water	15,930.3	5.3	710.2	**.2**	**4**
Grassland	44,015.9	14.7	-10,031.8	**-3.3**	**- 13**
Wetlands	18,330	6.1	1,427.4	**.5**	**7**
Forages	16,423.95	5.5	9,253.3	**3.1**	**56**
Urban/Transportation	5,017.15	1.7	169.8	**.1**	**3**
Total	276,146.2	100	--	--	

The changes in the landuse/landcover show trends that are occurring in land management on the landscape of the watershed, both positive and negative. These changes will ultimately provide insight to some of the later resource trends that are being witnessed in the watershed.

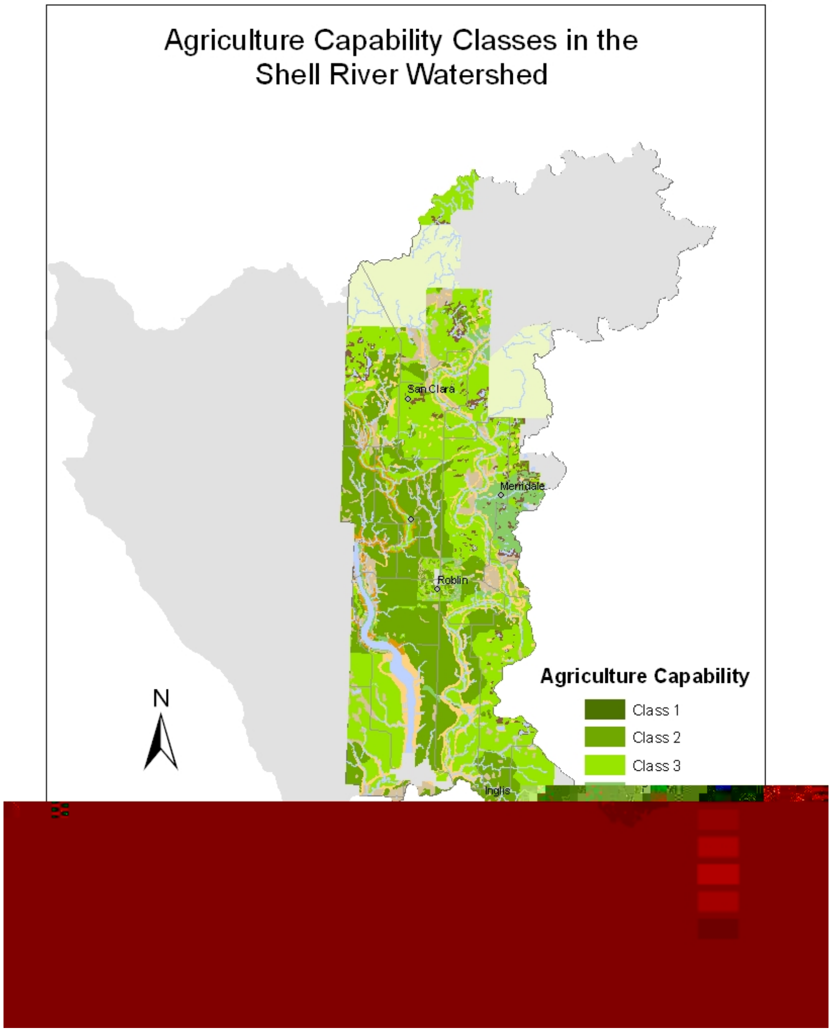
The land cover classification of the watershed has been interpreted from LANDSAT imagery (with a 30 metre resolution), using computerized classification techniques. Individual spectral signatures were classified and grouped into the seven land coever classes: annual crop land, forage, grassland, trees, wetlands, water, urban and transportation. Land cover information for the 1994 satellite imagery was taken May 26th, 1994 for the northern part of the watershed, September 22,1994 for the southern portion, and September 6th, 1994 for the eastern edges. For the 1999-2002 land cover data, the northern part of the watershed was analyzed using imagery taken September 11, 2002, the southern portion with imagery taken August 27 , 1999, and the eastern edges with imagery taken May 31, 2002. It has also been noted that imagery was to be available for 2005-2006 year but not ready for the time of this report.

Trends

Over the span of 5-8 years, there has been a substantial change in forage cover; a 54% increase in land converted to forages (see Table). Annual Crop land decreased by 14%, likely coverted to forages. Wetlands and open water classifications may be slightly over estimated due to the fact that the 1994 image classification concentrated specifically on annual cropland to aid in the delivery of the Western Grains Transportation Payment Program. Greater attention was paid to all classification categories on the 1999-2002 image classification.

Due to the small size, and tightly integrated nature of wetlands with other land cover categories such as grasslands and shrubs, they can be very difficult to quantify using course resolution imagery. A Prairie Habitat Joint Venture Habitat Monitoring Program coordinated by the Canadian Wildlife Service provides a detailed evaluation of wetland habitat trends in targeted areas of the prairies. Preliminary analysis indicated that there has been a net change of 4% in wetland areas from 1985-2000.

Agricultural Capabilities in the Shell River Watershed



Agriculture capability can best be described as the ability of the land to support the appropriate type of crops and agriculture management techniques. Not all land can be used in the same manner and it varies according to soil type, topography, stoniness, soil moisture deficiency and low fertility, to name only a few of the limitations. Classes have been established and range from 1 to 7 with each class having its own characteristics (See Table below).

Within each of the agricultural capability classes, there is a subclass to identify the soil properties or landscape conditions that may limit use, such as: adverse climate (C); dense subsoils (D); erosion damage (E); inundation or flooding by streams or lakes (I); lack of soil moisture (M); salinity (N); stones (P); shallow depth to bedrock (R); topography or slopes (T); excess water other than from flooding (W); or two or more minor limitations in combination (X).

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

Source: Natural Resources Canada 2000

Within the Shell River watershed the majority of the land is classified as CLI class 2, 3 and 6 with 141,111, 198,269, and 46,523 acres, respectively. Unclassified areas represent the Riding Mountain National Park and Provincial Park areas. The amount of land within each CLI class for each sub-watershed is displayed in the table below and is shown geographically within the map.

Area (acre and hectares) and percent (%) of land in each class for CLI agriculture land capability in the Shell River watershed.

	Shell River Watershed		
Canada Land Inventory Class	Area (acres)	Acre (hectares)	Percent (%)
Water	17,575	7,112	1.3
Unclassified	10,895	4,409	0.8
1	110	44	0.0
2	141,111	57,106	10.7
3	198,269	80,237	15.0
4	19,941	8,070	1.5
5	33,540	13,573	2.5
6	46,523	18,827	3.5
7	9,174	3,712	0.7
Organic	11,206	4,535	0.9
Total	488,343	197,626	36.9

Data Gaps

The Agricultural capability system is based on livestock capability, and does not recognize any environmental considerations/implications for land development.

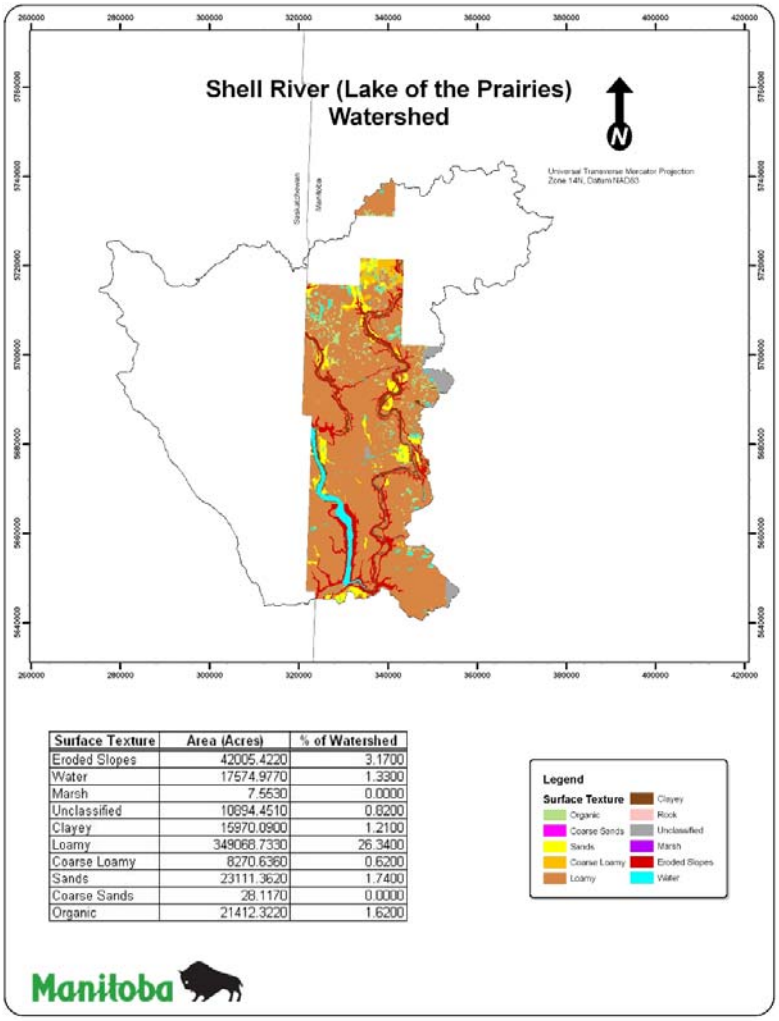
Management Considerations

Efforts should be taken to understand the soil limitations and to specific land within the watershed Encourage sound beneficial management practices to those lower soil classes where needed.

Shell River Watershed - Soil Surface Texture

Soil surface texture strongly influences the soil's ability to retain moisture, its general level of fertility, and the ease or difficulty of cultivation. For example, water moves easily through coarse-textured (sandy) soils, so little moisture is retained and these soils dry out more quickly than fine-textured (clayey) soils. Sandy soils are often characterized by a loose or single-grained structure which is very susceptible to wind erosion. On the other hand, clay soils have a high proportion of very small pore spaces which hold moisture tightly. Clay soils are usually fertile because they are able to retain plant nutrients better than sandy soils. However, they transmit water very slowly and are therefore susceptible to excess moisture conditions.

There is only 37 % of the watershed that has been classified for the Shell River Valley, as the remainder is located in the province of Saskatchewan or in federal and provincial parks. Of the classified portion, the predominant soil surface texture within the watershed is loamy (26 %). Eroded slopes account for 4% of the watershed, predominantly occurring along the Assiniboine River valley walls and associated waterways. Sands account for 1.7 % of the soils in the study area and Clayey soils account for just over 1% of lands in the watershed.



Surface Texture	Area (Acres)	% of Watershed
Eroded Slopes	42005.4220	3.1700
Water	17574.9770	1.3300
Marsh	7.5530	0.0000
Unclassified	10894.4510	0.8200
Clayey	15970.0900	1.2100
Loamy	349068.7330	26.3400
Coarse Loamy	8270.6360	0.6200
Sands	23111.3620	1.7400
Coarse Sands	28.1170	0.0000
Organic	21412.3220	1.6200

Efforts should be taken to understand soil texture with respect to groundwater table depths, riparian area vegetation, and landuse activity within, wind and water erosion risks, and adoption of soil conservation practices within the watershed.

Management Considerations

Soil Texture appears to be a low concern for this watershed. However, where there are **sandy, coarse sandy, or clayey soils**, the following considerations should still be initiated:

- Encourage or support the adoption of soil conservation practices (permanent cover, shelterbelts, etc.),

- Longterm monitoring (soil testing) should be encouraged for leaching movement within the subsurface where current land management support such practices as nutrient/pesticide/insecticide applications,

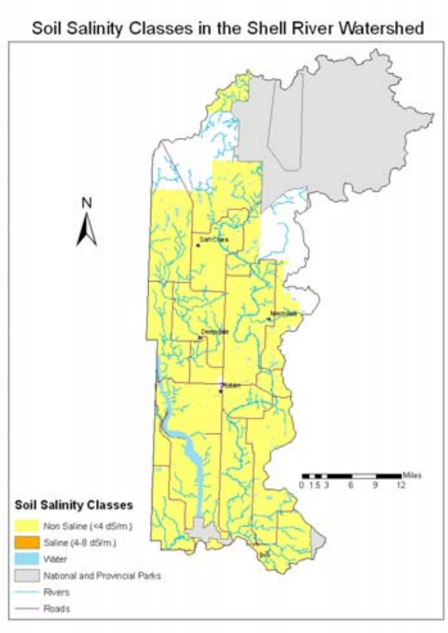
- Encourage new beneficial management practices such as Variable Rate Fertilizer application associated with soil testing applications,

- Encourage incentives toward permanent cover land management where there is significant slope exist and significant precipitation amounts are recorded,

- Where livestock grazing is involved, incentives should be offered to encourage that adequate growth is maintained for soil stabilization,

- Encourage or offer incentives to maintain adequate riparian buffer that accounts for vegetative cover and slope.

Salinity in the Shell River Watershed



Soil salinity is a limitation where plant growth is reduced due to the presence of soluble salts in soil which holds water more tightly than the ability of plants to extract water from the soil. As a result, many plants will exhibit symptoms of droughtiness, but the soil is often relatively moist.

For soil salinity to occur, there must be the presence of soluble salts in the subsoil, groundwater or in both, and the presence of wet conditions, either as a shallow water table or frequently saturated conditions that can result in soluble salts moving into the root zone of the soil through the upward movement of water.

Almost the entire watershed is considered **non-saline**, due to a lack of salts present in the bedrock and subsoil, or due to the absence of a shallow water table or shallow bedrock with salts present. What little salinity does occur is only weakly saline, significantly affecting only the most sensitive crops, such as pulse crops and vegetables, and these areas are mostly confined to locations adjacent to watercourses and drainage ditches. There is a small area that is Individual aerial photos, soil testing and producer experience would give more detail of the salinity status of specific fields in the watershed.

Data Gaps

Information presented within the maps is from Reconnaissance Mapping Level and details salinity information from a very general scale for a majority of the watershed.

Local stakeholder input could provide more detailed information to degree of salinity occurrences in the watershed.

The degree of salinity changes with fluctuating moisture conditions year to year.

Management Considerations

- Information collected appears to indicate that soils and characteristics within the watershed do not create conditions favourable to salinity development.
- Management considerations should include local stakeholder input to determine if salinity management should be a priority.

Water Erosion:

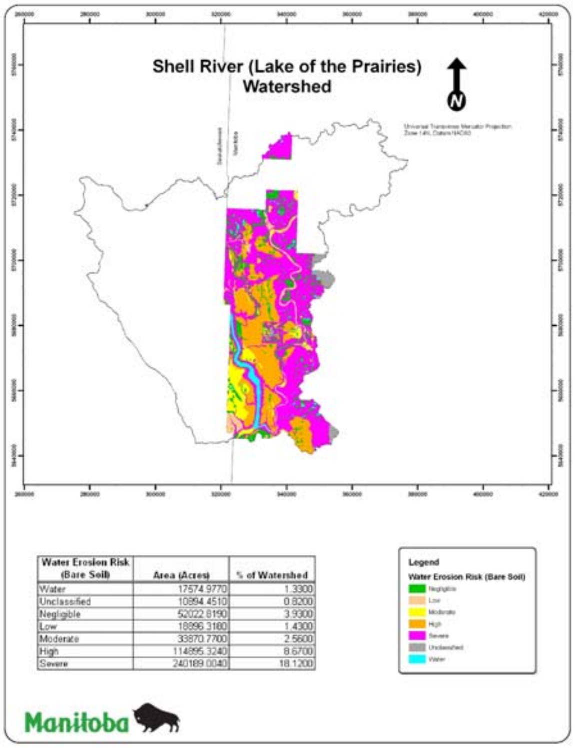
Water erosion, or more properly the erosion of soil by water, is the removal of soil particles by water. Water erosion often removes topsoil, the soil layer best fitted to support life. Any reduction in the quantity of topsoil reduces the soil's ability to produce a crop by reducing its fertility and its ability to accept and store water and air. Water laden with eroded soil or sediment has negative consequences for aquatic life. The eventual deposition of eroded soil may occur in areas unsuited for this deposition. Each further loss of soil may compound the concern.

The risk of water erosion was estimated using the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith (1965). The USLE predicted soil loss (tonnes/hectare/year) was calculated for each soil component in each soil map polygon. Water erosion risk factors used in the calculation include mean annual rainfall, slope length, slope gradient, vegetation cover, management practices, and soil erodibility (Eilers et al. 2002). Erosion risk classes were assigned based on the weighted average soil loss for each map polygon. The five classes of soil erosion risk (ranging from negligible to severe) are based on soils that are a bare, unprotected soil condition. These practices can significantly reduce this risk depending on crop rotation, soil type, and landscape features. Basing the soil erosion risk on the bare soil case helps to identify areas dominated by sensitive, erosive soils which may otherwise be masked if a land use or surface vegetation cover factor was considered (Eilers et al. 2002).

Identification of water erosion risk areas for the Shell River River Watershed is based on reconnaissance level soil mapping. Detailed soil survey information is not available for this watershed. As a result, the mapping cannot be used to obtain site specific information. Areas of high risk will exist in areas of land generally considered to be low risk. Areas of low risk will exist in areas of land considered to be high risk.

According to the interpreted water erosion risk classification for bare soils, water erosion can be a concern within this watershed. There are approximately 27% of the lands in the watershed that have been classified as either high or severe erosion risk under bare soil conditions. Areas with severe risk are found along waterways of the watershed, as well as in the northern and eastern regions. About 3% of the land base has been estimated to be a moderate erosion risk, while approximately 5% is of low to negligible risk (Figure 1).

Figure 1 Water Erosion Risk



Water Erosion Risk (Bare Soil)	Area (Acres)	% of Watershed
Water	17574.9770	1.3300
Unclassified	10894.4510	0.8200
Negligible	52022.8190	3.9300
Low	18896.3180	1.4300
Moderate	33870.7700	2.5600
High	114895.3240	8.6700
Severe	240189.0040	18.1200

However, most of the watershed is covered by some type of vegetation for at least part of the year. Generally speaking, the shorter the length of time soil is left bare, the less the water erosion risk will be. In this analysis, the grassland and forage land cover types reduces the risk of water erosion (provided the grassland or forage cover is not removed). Areas in grassland or forage, even if considered to be at high or severe risk for water erosion, are considered to be lower risk for water erosion, because of the mitigating management practice. Of the 2.6% of the watershed with moderate risk, 34% of this area with moderate risk (0.88% of the watershed) is considered to be mitigated due to appropriate land use. Of the 27% of the watershed with high or severe risk, 30% of this area with high or severe risk (7.9% of the watershed) is considered to be mitigated due to appropriate land use (Figure 2).

Other practices which are not captured by land use data including grassed waterways are effective at reducing water erosion and are employed in the watershed.

Obviously, water erosion risks can only be mitigated if the areas remain in grassland and forage. If the vegetation is removed, erosion is more likely.

Approximately 11% of the watershed is considered cropland on areas with high to severe risk for water erosion. It is important to realize that practices such as the establishment of grassed watershed can significantly reduce the erosion area in these areas. Just over 1% of the watershed is in cropland with a moderate risk of water erosion, these being the lands that are rolling with imperfect drainage. Another 1.2% of the watershed is classified as being in cropland and having a low to negligible risk for water erosion (Figure 3).

Figure 2 Water Erosion Risk on Grassland and Forage

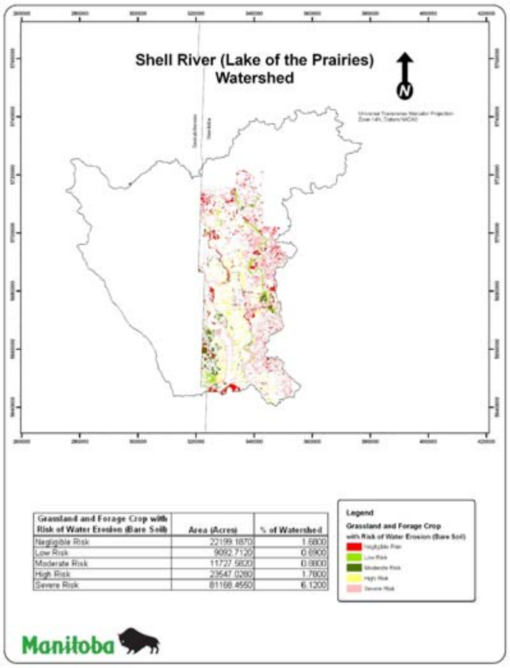
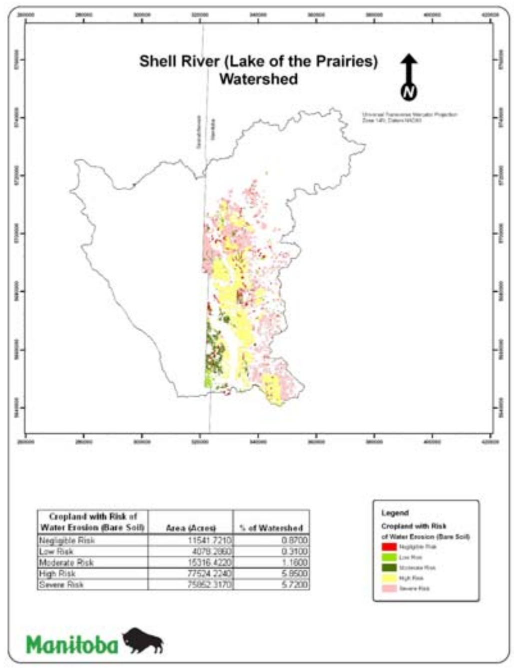


Figure 3 Water Erosion Risk on Cropland



Management Considerations

Appropriate management is vital in all areas regardless of broad scale risk identification. All areas must be monitored for water erosion. Factors including appropriate surface water management, ephemeral wetland retention, maintenance and enhancement of grassed waterways, and appropriate riparian management are important in all areas of the watershed. Areas considered to be of higher risk may be more sensitive to water erosion, but all areas are subject to water erosion, especially if appropriate management practices are changed.

Without detailed information to determine site-specific recommendations, it is preferable to consider implementing or maintaining appropriate management practices across the watershed, realizing that although issues are more likely to arise in risk prone areas, all parts of the watershed can be affected by water erosion and that proper management is vital.

Surface water management and ephemeral wetland retention is important in reducing flood peaks and streambank and streambed erosion. Overly rapid land drainage may result in downstream flooding and erosion.

Consider establishing grassed runways in areas where water erosion has been noted or significant slope exists. Grassed runways should have side slopes of 25% or less, be at least 16 feet (4.8 metres) wide, and at least 6 inches (15 cm) deep. Grassed runways will reduce gully erosion in sensitive areas.

Manage riparian areas appropriately in order to minimize streambank erosion.

Adopt conservation tillage practices (i.e. any tillage and planting system that leaves at least 30% of the soil surface covered by the previous year's crop residue after planting). Conservation tillage protects the soil surface and reduces the erosive force of rain and may slow sheet erosion.

Consider the establishment of permanent cover – sensitive areas may be taken out of annual crop production for forage production, pasture production, or as a set aside for non-agricultural uses. It may be most beneficial to establish permanent cover on headlands or at points where soil and water are likely to exit the property.

Data Gaps

Site specific information would be valuable in establishing the location of area prone to erosion. Reconnaissance level soil survey is not appropriate for site specific analysis. Detailed soil survey would be valuable.

Better monitoring of wind erosion would be beneficial.

Wind Erosion:

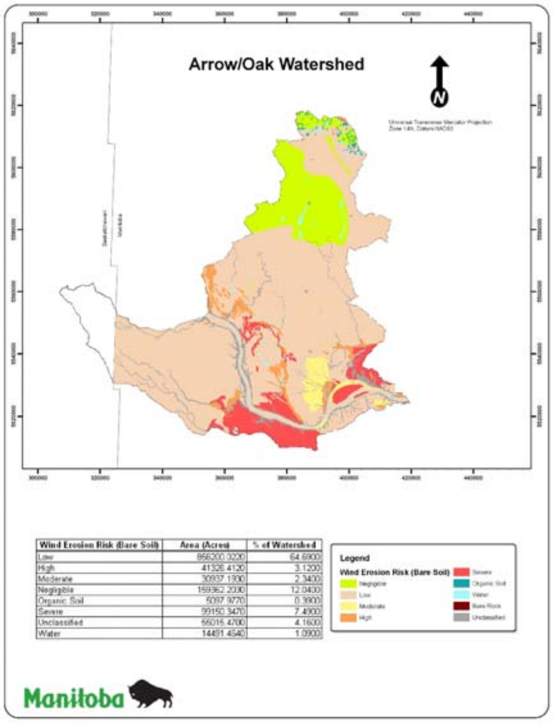
Wind erosion, or more properly the erosion of soil by wind, is the removal of soil particles by wind. Wind erosion removes topsoil, the most layer most exposed to wind and the soil layer best fitted to support life. Any reduction in the quantity of topsoil reduces the soil's ability to produce a crop by reducing its fertility and its ability to accept and store water and air. The eventual deposition of eroded soil may occur in areas unsuited for this deposition. Each further loss of soil may compound the concern.

The wind erosion risk data was provided by Agriculture and Agri-Food Canada (PFRA) by using the Manitoba soils layer and the Soil Landscapes of Canada. Wind erosion risk is based on bare soil conditions and is dependant on surface texture, structure, soil erodibility, sheltered distance and wind velocity. As a means of determining areas with potential wind erosion risks a grading system was established and a map created to illustrate where the varying wind erosion risk areas are within the SR watershed (Figure 4). The grading system includes five classes, which have been based on bare unprotected soil; Negligible, Low, Moderate, High and Severe.

Identification of wind erosion risk areas for the Shell River River Watershed is based on reconnaissance level soil mapping. Detailed soil survey information is not available for this watershed. As a result, the mapping cannot be used to obtain site specific information. Areas of high risk will exist in areas of land generally considered to be low risk. Areas of low risk will exist in areas of land considered to be high risk.

The majority of the SR watershed falls in the low wind erosion risk category or negligible categories. Some areas of high or moderate wind erosion risk occur along the Shell and Assiniboine Rivers. (Figure 4). Appropriate management practices are especially important on these soils.

Figure 4 Wind Erosion Risk



Management Considerations

Appropriate management is vital in all areas regardless of broad scale risk identification. All areas must be monitored for wind erosion. Factors including the maintenance of adequate crop residue, the establishment of cover crops, and the establishment of shelterbelts are important in all areas of the watershed. Areas considered to be of higher risk may be more sensitive to water erosion, but all areas are subject to water erosion, especially if appropriate management practices are changed.

Without detailed information to determine site-specific recommendations, it is preferable to consider implementing or maintaining appropriate management practices across the watershed, realizing that although issues are more likely to arise in risk prone areas, all parts of the watershed can be affected by wind erosion and that proper management is vital.

Maintain adequate crop residue cover (at least 35% cover just after seeding for most soils, and at least 65% cover for soils highly susceptible to soil erosion) - standing stubble is 1.6 times more effective at controlling wind erosion than flat stubble.

Establish cover crops, such as fall rye. These crops should be solid seeded at the appropriate time and seeding rate. For fall rye, the crop should be seeded between August 15th and September 12th at a rate of 11-23 lbs/ac. If it is not feasible to plant a cover crop on the entire field, plant on headlands (field perimeter), or on/beside the most susceptible areas

Establish shelterbelts to reduce wind erosion to reducing wind velocity in the area. Shelterbelts can reduce wind velocity in the area up to 30 times the height of trees. Plant shelterbelts perpendicular to prevailing winds. If planting shelterbelts in the middle of a field is not feasible due to equipment access, consider planting shelterbelts on the north and west edges of the field perimeter to reduce the effects of prevailing winds. Contact Prairie Farm Rehabilitation Administration for more information on shelterbelt design and establishment.

In emergency situations, consider applying crop residues to highly erodible soils (1700-2000 lb/ac (1910-2247 kg/ha) of cereal straw). The straw may have to be wet or anchored to the soil by packing. Potential drawbacks include the introduction of weed seeds and the immobilization of nitrogen due to high C:N ratios in the straw.

Data Gaps

Site specific information would be valuable in establishing the location of area prone to erosion. Reconnaissance level soil survey is not appropriate for site specific analysis. Detailed soil survey would be valuable.

Better monitoring of wind erosion would be beneficial.