Stillwater State Forest
Landtype Survey Report

STILLWATER STATE FOREST
LANDTYPE SURVEY REPORT

By

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DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

Division of Forestry

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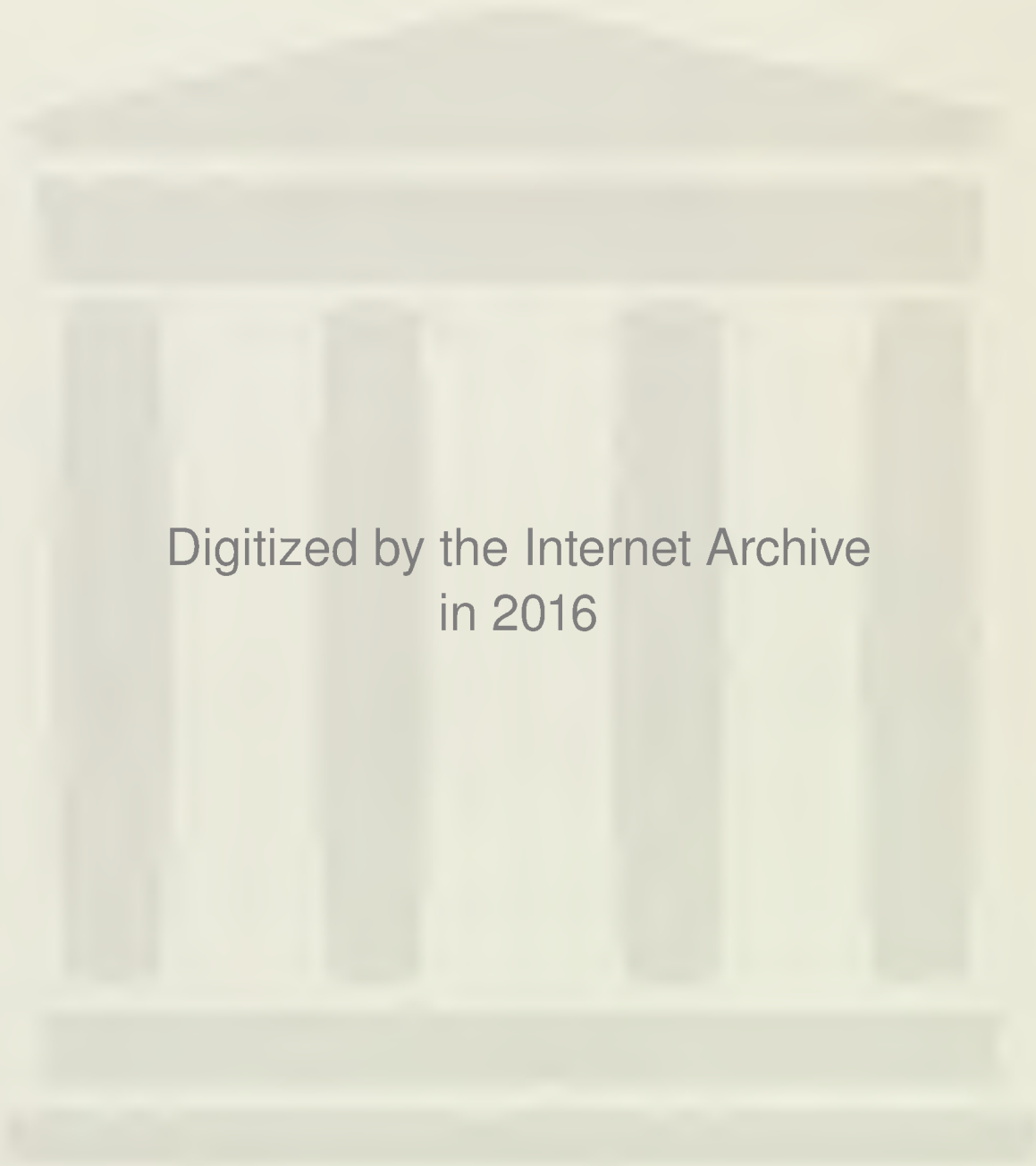

CREDITS:

Special recognition and appreciation are extended to Al Martinson, Soil Scientist, Flathead National Forest, for his aid in the completion of this report.

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INTRODUCTION

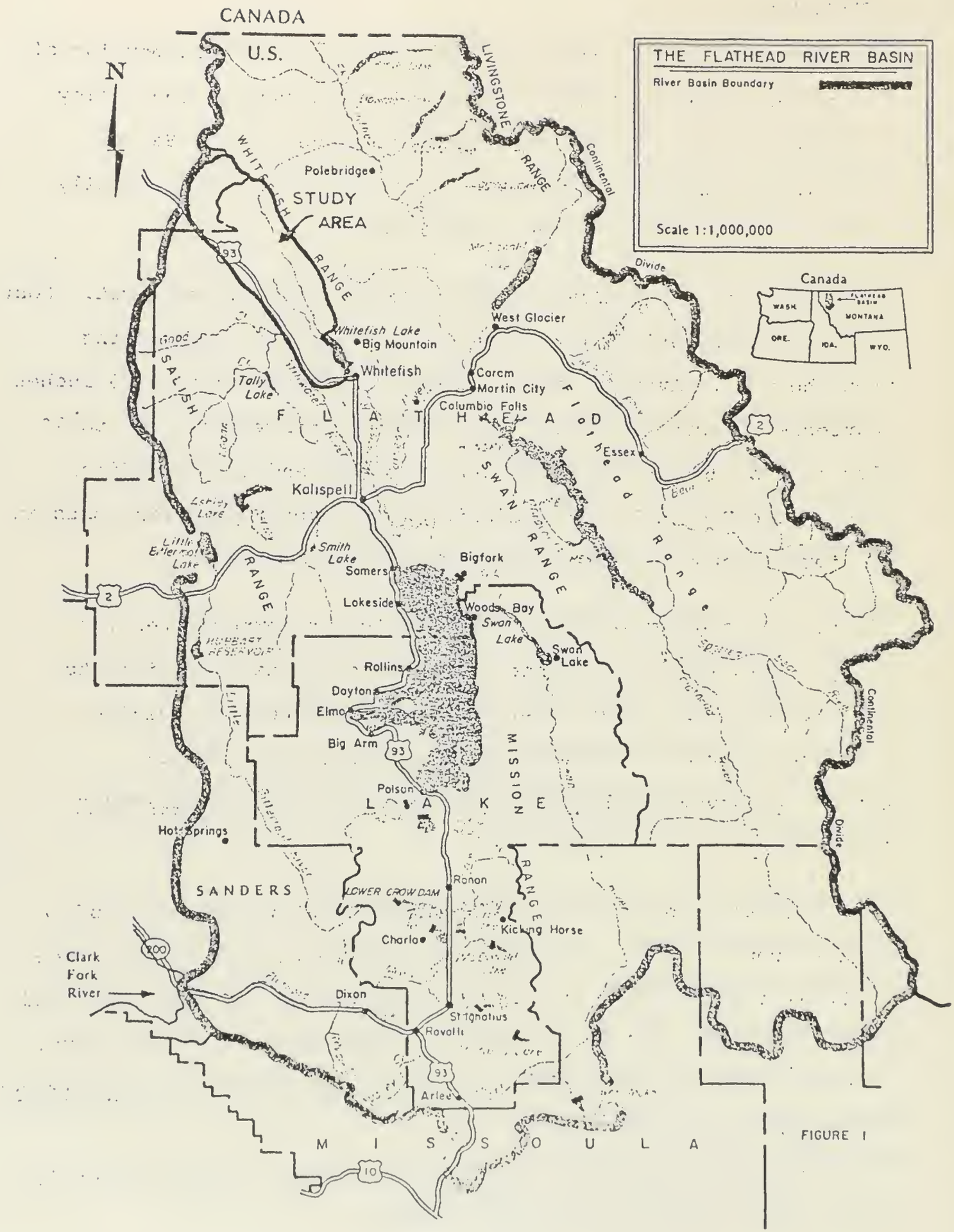
The Stillwater State Forest is located in the northern portion of the Flathead Valley, between Whitefish and Stryker. The valley is bounded on the east by the Whitefish Range and the Salish Mountains on the west. This valley is referred to geologically as the Rocky Mountain Trench. See Figure 1.

The climate of the Stillwater State Forest is relatively wet. Most of the moisture originates in maritime air masses approaching from the west. Average annual precipitation varies from 25 inches (expressed as water equivalent) along the Stillwater River to 70 plus inches at the summits of Stryker Ridge and the Whitefish Range. See Figure 2. The majority of this precipitation comes in the form of snow during late fall and winter months.

Figure 3 is a graph of the average daily air temperatures for Olney. This level of average temperatures means the Stillwater State Forest has a Cryic (very cold) soil temperature regime. For more information concerning the climate of the S.S.F., consult A Survey of the Hydrologic Resource on the Stillwater State Forest by Pete Bengefield.

The vegetation found within the Stillwater State Forest is of various conifer types, predominently within the cool-moist range of habitat types found in western Montana. The habitat types and their occurrence will be discussed further later on in the text. For more detail consult Habitat Type Descriptions of the Stillwater State Forest by Vince Frezzo.

The next several pages will discuss the general geology situation found within the Stillwater State Forest.


CANADA
U.S.
N
THE FLATHEAD RIVER BASIN
River Basin Boundary
Scale 1:1,000,000
Canada
WASH.
FLATHEAD BASIN
MONTANA
ORE.
IDA.
WYO.
LIVINGSTONE RANGE
Continental Divide
WHITEFISH RANGE
STUDY AREA
Polebridge
Whitefish Lake
Big Mountain
Whitefish
Tally Lake
West Glacier
Coram
Martin City
Columbia Falls
FLATHEAD
Flathead Range
SWAN RANGE
Essex
Kalispell
Ashley Lake
Little Bitterroot Lake
Smith Lake
Somers
Bigfork
Lakeside
Woods Bay
Swan Lake
Swan River
Hubbart Reservoir
Rollins
Dayton
Elmo
Big Arm
MISSION RANGE
Polson
LAKE
Hot Springs
SANDERS
Ronan
LOWER CROW DAM
Kicking Horse
Charlo
Clark Fork River
Dixon
St Ignatius
Ravalli
Arlee
MISSOULA
FIGURE 1

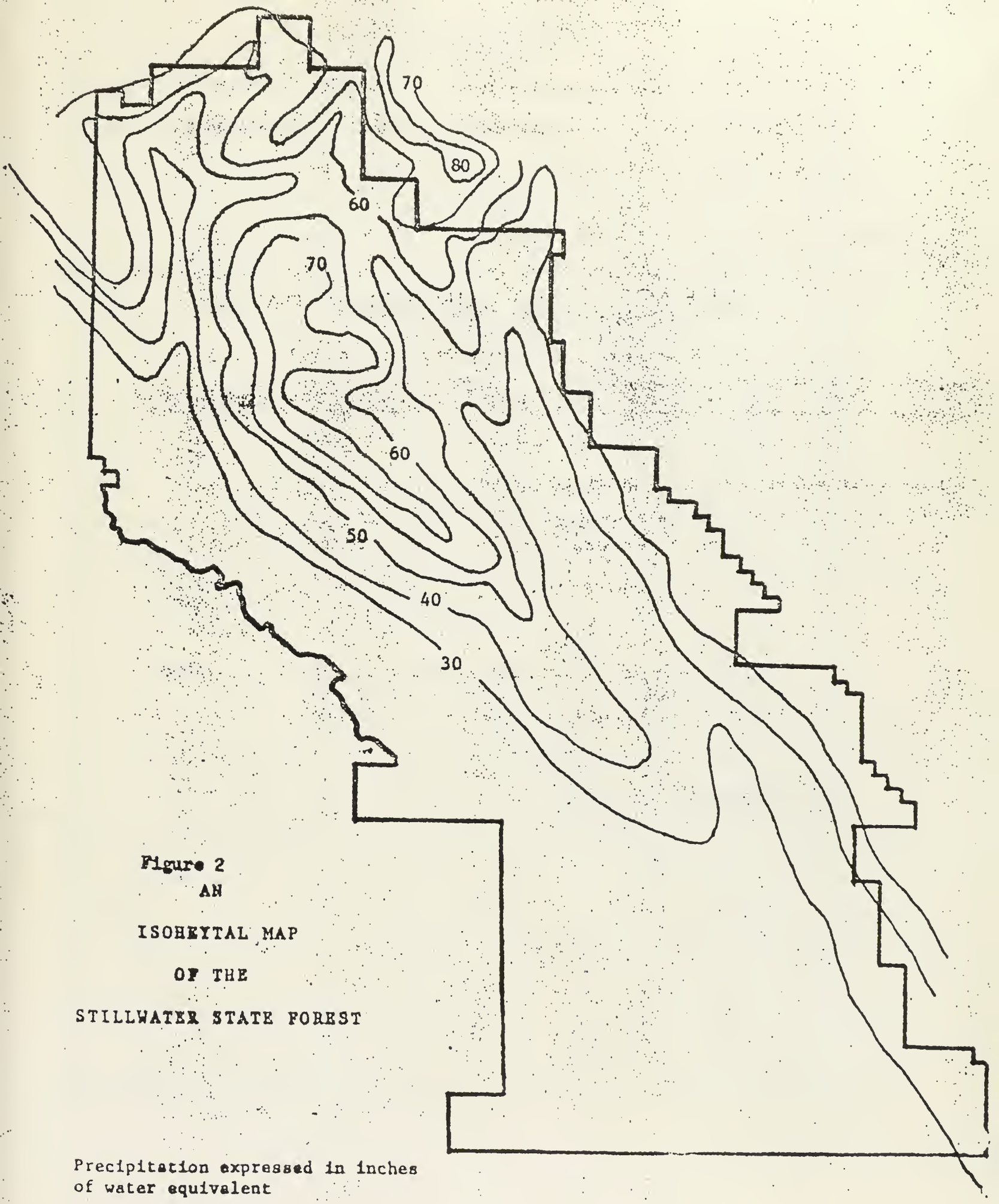


Figure 2

AN

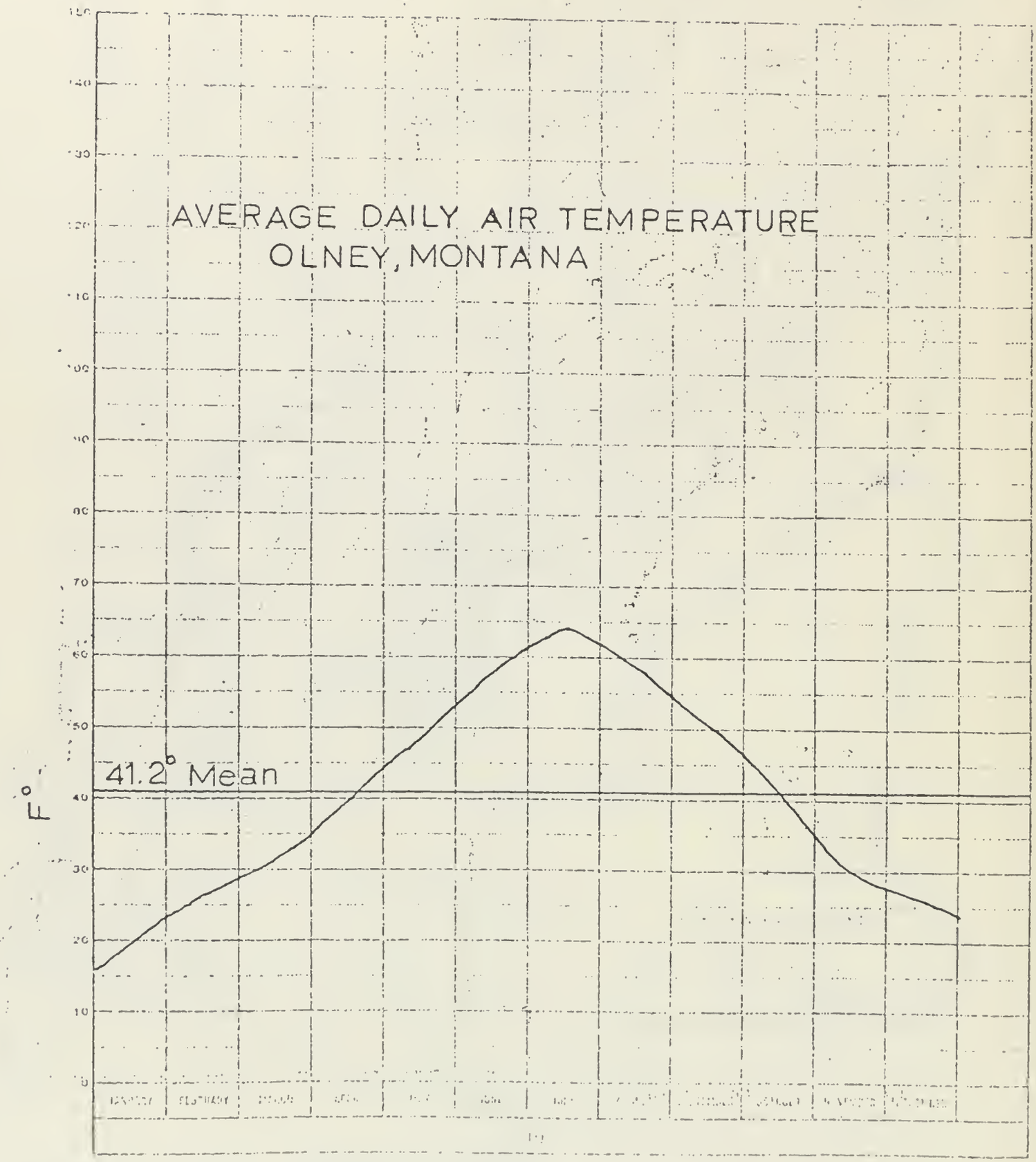
ISOHEYTAL MAP

OF THE

STILLWATER STATE FORREST

Precipitation expressed in inches
of water equivalent

FIGURE 3



HISTORICAL GEOLOGY

During the last 1,500 million years, many geologic events have taken place that directly, or indirectly, affect how the present day Stillwater State Forest looks and reacts to management actions.

The rock formations that now make up the Whitefish Range are called the Belt Series of rock formations. The individual formations will be discussed in detail later in the text. The Belt rocks are of great thickness, believed to exceed 40,000 feet. They are water-laid sediments, mainly sandstones and shales. These rocks were deposited in an ancient sea that covered a major portion of the western United States during Precambrian time from about 1,500 million years ago to about 1,150 million years ago. Since their deposition as sandstone and shale, these rocks have undergone some metamorphism and are now quartzite and argillite.

The building of the "First Rocky Mountains" was the next major geologic event in this area. The time period of this mountain building was from the late Cretaceous Period (80 million years ago) to the early part of the Tertiary Period (60 million years ago). During this 20 million year period, compressive forces, apparently from the west or southwest, causes the Belt rocks to be squeezed edgewise. The rock strata of western Montana crumpled or wrinkled into great folds, miles in width and scores of miles in length. Eventually, as the pressure continued, the rock strata broke along the trend lines of the folds and great segments of the earth moved along slipping planes upward and easterly, overriding other masses

of rock in some places for a distance of many miles. The Lewis Overthrust Fault, in Glacier National Park, which has a displacement of 8 miles eastward is an example of this mountain building period. During the next 20 million years, these mountains were eroded to a nearly level plain.

About 40 million years ago, middle Tertiary Period, the Rockie Mountains as we know them now started to be formed. The new forces causing deformation acted more or less vertically. In places the rocks were bent upward, but to a greater extent they broke (block faulted) along nearly vertical slipping plains.

During the next several million years, the faulting continued in jerky movements of 10 to 20 feet, until the displacement of the tens of thousands of feet had accumulated. The Swan-Whitefish Fault has a stratigraphic displacement of 11,000 feet. Stream erosion of these mountains slowly eroded them and in some places, filled the intermountain valleys with "valley fill" (alluvial sediments); this continued until the Pleistocene Epoch of the Quaternary Period, which began about a million years ago.

During the Pleistocene Epoch four major advances of glacial ice are known to have occurred. Only the ice of the last advance (Wisconsin) left positive evidence of its advance and retreat in the Stillwater Forest. The main lobe of the Cordilleran ice sheet from British Columbia entered Montana north of Eureka. One branch moved down the Kootenai Valley, the other, up the Tobacco Valley. The branch that moved up

the Tobacco Valley overrode the Salish Mountains south of Elk Mountain, then moved down the Stillwater Valley. As the lobe moved down the Stillwater Valley, it was crowded against the west flank of the Whitefish Range. East of the north end of Whitefish Lake, striae that tend S. 50 to 50 E. indicate that the ice diagonally overrode the south end of the range. The ice thickness was 4,000 feet at the International Boundary and at least 2,000 feet at Kalispell.

The last major geologic events that have influenced the Stillwater State Forest occurred 12,500 and 6,600 years ago. These are the approximate dates of the Glacier Peak and Mazama volcanic ashfalls respectively. The Glacier Peak volcano is located 50 miles east of Everett, Washington. This ashfall occurred during the deterioration of the last glacial ice deposit.

The Mazama Volcano (Crater Lake) is located 50 miles north-northwest of Klamath Falls, Oregon. This ashfall occurred more recently and had a longer duration. Thus, the "ash-cap" we see on the soils of the Stillwater Forest are probably more influenced by the Mazama ashfall as compared to the Glacier Peak ashfall.

LITHOLOGY DESCRIPTION

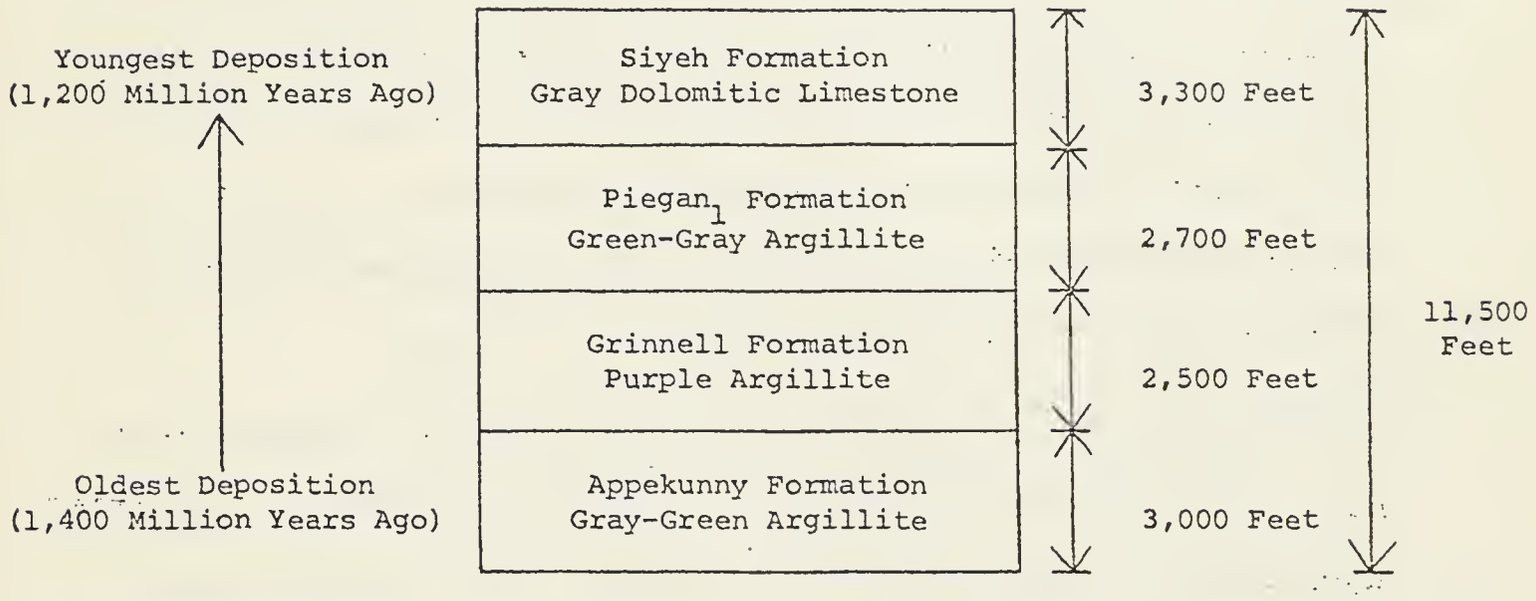
There are four major rock formations found within the Stillwater State Forest. The four formations, from oldest to youngest, are the following: the Appekunny, Grinnell, Piegan$_1$, and Siyeh. All four formations are late Precambrian in age; The Appekunny formation was deposited starting about 1,400 million years ago, with the end of the Siyeh formations deposition being about 1,200 million years ago. Therefore, during a 200 million year period, about 11,500 feet of sediment was deposited within this area in these four formations. See Figure 4 for explanation.

The Appekunny formation consists of finely laminated, gray-green argillite and gray white massive quartzitic sandstone. The Appekunny formation weathers to a yellowish-gray or rusty brown color; this is due to the oxidation of pyrite that is present. A section of this formation at Diamond Peak in the Whitefish Range exceeds 3,000 feet in thickness.

The Grinnell formation consists of grayish-red-purple to purplish-gray laminated, noncalcareous, coarse-grained argillite; with interbedded greenish-gray, coarse-grained argillite. Interlayered with both of these argillites are beds of white fine to coarse-grained quartzite as much as one foot thick. In the Whitefish Range, the thickness of the Grinnell formation is estimated at 2,500 feet.

The Piegan$_1$ formation consists of a light greenish-gray and green-gray, fine-grained, calcarious argillite, interlaminated

FIGURE 4


Youngest Deposition
(1,200 Million Years Ago)
Oldest Deposition
(1,400 Million Years Ago)
Siyeh Formation
Gray Dolomitic Limestone
Piegan Formation
Green-Gray Argillite
Grinnell Formation
Purple Argillite
Appekunny Formation
Gray-Green Argillite
3,300 Feet
2,700 Feet
2,500 Feet
3,000 Feet
11,500
Feet

with subordinate light-gray, coarse-grained argillite, producing a banded appearance. There is some gray limestone and purplish-gray argillite found in some sections of the formation. Near the Stryker Area, a 2,700 foot section of the formation is found.

The Siyeh formation consists of thin to thick bedded dark gray, bluish-gray, and light greenish-gray siliceous limestone and dolomite intercalated with gray, green-gray and yellow-gray argillite and gray-white quartzite. The formation weathers light gray, grayish-yellow, orange, yellow, brown and red, depending on the dolomite and pyrite content of the bed. The thickness of the Siyeh formation measured in the Whitefish Range is between 2,900 - 3,300 feet.

The rock formations found within the Stillwater State Forest have some characteristics that affect the management activities upon these formations. At this time, I will discuss three of these characteristics and their implication to management.

One important trait of rock formation is the stability of the formation. If a formation is unstable, a mass movement such as a rockslide or landslide may occur. In general, it can be said that the stability of the rock formations found within the Stillwater State Forest is very good. There are few mass movements that occur due to the type of bedrock. However, there are mass movement problems within the forest. These are associated with the surficial deposits on the bedrock, not the bedrock itself.

A second characteristic of the bedrock that can affect management on State land is the chemistry of the rock. The $Piegan_1$ and the Siyeh formations have a high content of calcium carbonate ($CaC0_3$) in them; therefore, the $CaC0_3$ level of the soil that developes from those formations is higher than normal also. The $CaC0_3$ level in a soil has a direct effect on the root development of some tree species and the root development of a tree will affect how well it resists blowover. Therefore, the specie selection in some cutting units should take into consideration a blowdown problem that could develop, based on $CaC0_3$ level of the soil.

The chemistry of a bedrock formation has a direct effect on the soil that develops from that formation. The fertility of a soil is especially effected by the chemical characteristics. See Appendix for a chemical analysis of the rock formations. A soil fertility analysis will come later in the text.

A major use of rock is as an aggegate in road construction. The gravel characteristics of the rock formations will be discussed here in general terms, rather than a listing of technical data.

The Appekunny formation is excellent concerning its hardness for gravel and has good durability characteristics. Overall, the Appekunny formation is a good source of gravel material.

The Grinnell formation (argillite sections) has marginal hardness and low durability, thus, making it ounly a fair gravel source. The Grinnell formation (quartite sections) has excellent hardness and durability.

The $Piegan_1$ formation has good hardness characteristics, but a low - moderate durability factor. Therefore, the $Piegan_1$ formation is a fair to good source of gravel.

The Siyeh formation has good hardness characteristics, however, the durability is moderate if it is weathered, making it only a good source of gravel. If it is not weathered, the durability is good and it makes a good gravel source.

Each source of gravel must be investigated individually in order to really evaluate how good a source is.

INVENTORY DESCRIPTION

This land inventory was accomplished using the Land System Inventory developed by U.S. Forest Service Region 1 soil scientists. The land system inventory is a hierarchical system containing seven levels. The first three levels, the province, section and subsection, are defined by climatic and geologic properties of the land. In the lowest four levels, landtype association, landtype, landtype phase and site, the classes within the categories are defined by properties of soils, landforms and climax plant communities.

The Stillwater State Forest inventory was done at a landtype level. The soils were classified to a family level and the vegetation was classified to the habitat type level. The geologic map of Flathead and Lincoln counties prepared by Willis Johns was used as a basis for the geologic information.

The mapping was done using 1:60,000 scale photographs as the base maps. During the field checking of landtypes, roadcust were used to a great extent to examine the soil and geology of the area. In addition, a number of cross-country hikes helped to verify mapping units in unroaded areas. A total of seventy-eight technical soil descriptions were done on the study area and many times that number of spot check plots.

Mapping units may contain inclusions up to 80 acres of size of similar soils. Inclusions of soils that have properties contrasting to those described for the unit are usually less than 20 acres in size. The total area of contrasting inclusions within any delineation may not exceed 15% of the total area within the delineation. A complex

of landtypes was used where the pattern of landtypes was too intricate to separate at this scale of mapping.

The next portion of this text are descriptions of the individual landtypes; explaining how they can be identified in the field and the management implications that are associated with them.

LANDTYPES OF THE STILLWATER STATE FOREST

I. Depositional Landforms

10-1: Alluvium (Recent), Excessively Well Drained
10-3 Alluvium (Recent), Poorly Drained
12: Organic Soils
14-2: Lacustrine (Non-Plastic), Well Drained
14-3: Lacustrine (Non-Plastic), Poorly Drained
16: Colluvium (Alluvium Fans)
21-8: Thin Glacial Deposition (Friable), 20-40% Slope
22-B-7: Thin Glacial Deposition (Firm, from Calcareous Argillite, 0-20% Slope
22-B-8: Thin Glacial Deposition (Firm), from Calcareous Argillite, 20-40% Slope
22-B-9: Thin Glacial Deposition (Firm), from Calcareous Argillite, 40-60% Slope
22-G-7: Thin Glacial Deposition (Firm) from Tertiary Siltstone, 0-20% Slope
22-G-8: Thin Glacial Deposition (Firm), from Tertiary Siltstone, 20-40% Slope
26-B-7: Thick Glacial Deposition (Firm), from Calcareous Argillite, 0-20% Slope
26-B-8: Thick Glacial Deposition (Firm), from Calcareous Argillite, 20-40% Slope
26-A-8: Thick Glacial Deposition (Firm), from Limestone, 20-40% Slope
27-7: Fluvial Reworked Glacial Deposition, 0-20% Slope
27-8: Fluvial Reworked Glacial Deposition, 20-40% Slope
28-1: Outwash Plain, Excessively Well Drained
28-3/10-3: Outwash Plain, Poorly Drained and Alluvium (Recent) Poorly Drained; Complex

II. Erosional Landforms

55-8: Glacial Scoured Rockland, 20-40% Slope
55-9: Glacial Scoured Rockland, 40-60% Slope
56-8: Weakly Frost Churned Glacial Scoured Lands, 20-40% Slope

III. Breakland Landforms

71: Cirque Headwalls (Early Stage)
72: Cirque Headwalls (Late Stage)
73: Glacial Trough Walls

10-1: Alluvium (Recent), Excessively Well Drained

LANDTYPE DESCRIPTION:

This landtype occurs on the floodplain and recent terraces of Swift Creek. The slopes are 1-5% typically, with up to 40% slope on the terrace escrapments. The elevation range is 3100 to 4200 feet. The annual precipitation range is between 25 and 40 inches. The soils have a thin volcanic ash surface layer over a leached, very gravelly, loamy, sand subsoil. The vegetation is a conifer timber type in the moderately cool and moist or cool and moist habitat type group.

SOILS:

The topsoil is a 6-9 inch deep yellowish brown silt loam having pH's of 5.3-6.0. The subsoil is a light gray very gravelly, loamy sand, with pH's in the 5.7 to 6.8 range. This soil is classified as an Andic Cryochrept, sandy-skeletal mixed. See pedon descriptions number 12 and 13 for a more detailed soil description of similar soils found on a different landtype.

VEGETATION:

Subalpine fir/Clintonia uniflora (AF/Clun) habitat type is found at higher elevations on this landtype and Grand fir/Clintonia uniflora (GF/Clun) at lower elevations.

INCLUSIONS:

Areas of landtype 10-3 are found in the 10-1 landtype mapping units.

INTERPRETATIONS:

Management of timber is somewhat limited on this landtype because of the close proximity of a major active stream and the seasonal flooding associated with the stream. There is a moderate windthrow hazard associated with this landtype. The major land uses are timber production, wildlife habitat and watershed.

10-3: Alluvium (Recent), Poorly Drained

LANDTYPE DESCRIPTION:

This landtype occurs near active streams with their associated flood plains and terraces. The landtype occurs in the 25 inch annual precipitation range. The elevation range is between 2980 and 3280 feet. The slope range is typically 1 to 5% with up to 40% slopes occurring on terrace escarpments associated with the landtype. The soils are weakly stratified silty deposits with some rounded coarse fragments. Vegetation is a conifer timber type with habitat types in the moderately cool and moist, and the cool and moist group.

SOILS:

The soils on this landtype are of two types, a poorly drained silt loam soil that is found on the flood plain of the active stream. Also a well drained soil is found on the older stream terraces that are in close proximity of the active stream which is a minor component of the landtype. The pH's of both soils range between 5.0-6.0. A volcanic ash layer can be found on some of the older terraces. The poorly drained soil is classified as a Typic Cryaquepts, fine silty, mixed. The well drained soils are classified as Andic Cryochrept, loamy-skeletal, mixed or Andic Cryorthent, loamy-skeletal, mixed. See pedon description number 1 for a detailed description of a well drained soil on this landtype.

VEGETATION:

The habitat types typically found on this landtype are subalpine fir/Clintonia uniflora (AF/Clun) and Spruce/Clintonia uniflora (S/Clun). Also along the active stream riparrian vegetation is present.

INTERPRETATIONS:

Due to the poorly drained soils and seasonal flooding, any management activities on this landtype are very limited. The major land uses are wildlife habitat and watershed.

12: Organic Soils

LANDTYPE DESCRIPTION:

This landtype occurs in association with glacial till ground moraine. The organic soils are formed in the depression areas of the ground moraine, where the soil is poorly drained. This landtype occurs between elevations of 3100 to 4200 feet; within a 25 to 40 inch precipitation range. The slope range is 0-2%. The soil on this landtype consists of deposit of semi-decomposed plant matter. Vegetation present is one of two types, either swamp vegetation or meadow grasses.

SOILS:

On this landtype two soil types can be found. One type is a very deep organic soil usually associated with the swamp areas. This soil is from 3 to 20 feet deep and is classified a Typic Cryosaprist. See pedon description number 2. The second type is a shallow organic soil which overlays lacustrine or marl deposits. The organic soil is from 14 to 20 inches deep and is classified a Terric Cryosaprist, fine-silty, mixed. See pedon description number 3.

VEGETATION:

Swamp vegetation is present on the deep organic soil and meadow grass is present on the shallow organic soils.

INTERPRETATIONS:

Due to the type of soil on this landtype, the best land uses are for wildlife habitat, seasonal grazing and hay production on the drier areas.

14-2: Lacustrine (Non-Plastic), Well Drained

LANDTYPE DESCRIPTION:

This landtype occurs on gently rolling to moderately steep (3 to 15%) areas within and surrounding lacustrine filled basins. Escarpments are associated with some units of this landtype; slopes on the escarpments range between 20-40%. The annual precipitation is between 25 to 40 inches. The elevation of this landtype is between 3000 and 3700 feet. The soils are a leached, layered, silt loam and silty clay loam profile. Vegetation is a conifer timber type, with habitat types in the moderately cool and moist range.

SOILS:

The topsoil is a light gray silt loam with pH's of 5.0-6.8. The subsoil is a layered silt loam and silty clay loam mixture, having pH's of 5.2-7.6. The soils are classified as either Typic Eutrochrept, coarse-silty, mixed or Typic Eutroboralf, fine-silty, mixed. See pedon descriptions numbers 4 and 5 for more detail.

VEGETATION:

The typical habitat types are Spruce/Vaccinium caespitosum (S/Vaca) or Douglas fir/Vaccinium caespitosum (DF/Vaca). The DF/Vaca is found in the lower precipitation areas and the S/Vaca in the higher precipitation areas. Grand fir/Clintonia uniflora (GF/Clun) habitat type is found on the higher elevation sites.

INCLUSIONS:

Areas within the landtype 14-2 mapping unit typically have soils that do not have a surface volcanic ash layer; however, there are inclusions where it is present.

INTERPRETATION:

The bearing capacity of the soil on this landtype is very low when the soil is moist. To minimize compaction timber harvesting should be done during a dry period or during the wintertime. Roads should not be constructed across an escarpment of landtype 14-2. The major land uses are wildlife habitat, grazing, timber production and watershed.

14-3: Lacustrine (Non-Plastic), Poorly Drained

LANDTYPE DESCRIPTION:

This landtype occurs on nearly level concave lands around intermittent lakes. Two areas of this landtype are mapped in the survey area. One is found at Skyles Lake and the other at Boyle Lake. These sites are in a 25 inch annual precipitation area and are approximately 3100 feet in elevation. The soils are deep, poorly drained, white to light gray, laminated silty clay loams. The vegetation includes wet grasses and shrubs with deciduous trees also present.

SOILS:

The topsoil is a light gray, silty clay loam, with pH's of 5-7.5. The subsoil is a white laminated silty clay loam soil. The soil is classified as an Aquic Cryorthents fine silty, mixed.

VEGETATION:

Spruce/Clintonia uniflora (S/Clun) habitat type is found surrounding this landtype. Wet grasses and shrubs are found on the landtype.

INTERPRETATIONS:

The wetness of these sites limits timber management. The major land uses are wildlife habitat and grazing.

16: Colluvium (Alluvium Fans)

LANDTYPE DESCRIPTION:

These are delta shaped fans associated with intermittent streams, that emerge from steep slopes. The slope of the landtype is from 15 to 30%. Annual precipitation is approximately 40 inches. The elevations range between 3200 and 4600 feet. Soils have a thin volcanic ash surface layer, over a very gravelly loamy sand subsoil. Vegetation is a conifer timber type in the moderately cool and moist group.

SOILS:

The topsoil is a 6-8 inch deep yellowish brown silt loam having pH's of 5.3-6.0. The subsoil is a light gray very gravelly loamy sand, with pH's in the 5.7-6.8 range. The soil is classified as an Andic Cryochrept, sandy-skeletal, mixed. See pedon description 12 and 13 for a similar soil found on a different landtype.

VEGETATION:

North aspects have a Western Red Cedar/Clintonia uniflora (WRC/Clun) habitat type. West aspects at high elevations have subalpine fir/Clintonia uniflora (AF/Clun) habitat type. At low elevations on west aspects Grand fir/Clintonia uniflora (GF/Clun) is present.

INTERPRETATIONS:

Care should be taken when locating road across this landtype because of high groundwater table that is usually present. This landtype is usually a very good source of gravel for road construction. The major land uses are wildlife habitat, grazing, timber production and watershed.

21-8: Thin Glacial Deposition (Friable), 20-40% Slope

LANDTYPE DESCRIPTION:

This landtype occurs in the bottom of the alpine basins, in association with cirque headwalls and glacial trough walls. The underlying bedrock controls the surface topography of this landtype. The elevation range is between 5600-6600 feet. The annual precipitation is between 50 and 70 inches. The soil has a volcanic ash surface layer with a friable glacial till subsoil. The vegetation is a conifer timber type with habitat types in the cool and moist range.

SOILS:

The surface layer is a 6-8 inch deep yellowish brown, silt loam, volcanic ash soil. The pH's range between 4.8-5.5 for this layer. The subsoil is a yellowish brown very gravelly silt loam, glacial till soil. The pH's range between 5.0-6.0 for this layer. The substratum is fractured limestone or calcareous argillite, which is within 2 to 6 feet of the surface. The soils are classified as Andic Cryochrept, loamy-skeletal, mixed, or Andeptic Cryoboralf, loamy-skeletal, mised. See pedon description numbers 6 and 7 for a more detailed soil description.

VEGETATION:

The predominant habitat type on this landtype is subalpine fir/Luzula hitchcockii (AF/Luhi). On the cool aspects with steeper slopes Subalpine fir/menziesia ferruginea (AF/Mefe) is the habitat type present. On the warm aspects with steeper slopes Subalpine fir/Xerophyllum texax (AF/Xete) is the habitat type.

INCLUSIONS:

Areas of landtype 56-8 may be found in mapping units of landtype 21-8.

INTERPRETATIONS:

Short growing seasons on this landtype reduce timber productivity. Frost leave of seedlings is a problem to timber management on this landtype. The major land uses are wildlife habitat, timber production and watershed.

22-B-7: Thin Glacial Deposition (Firm), from Calcareous Argillite 0-20% Slope

LANDTYPE DESCRIPTION:

This landtype occurs on gently rolling ground moraine at elevations of 3100 to 4500 feet. Annual precipitation ranges from 25 to 40 inches. Soils have a yellowish brown volcanic ash surface and a leached glacial till subsoil from 1 to 5 feet thick. The dominant rock type in the till matrix is calcareous argillite. The underlying bedrock determines the surface topography of this landtype. Vegetation is a conifer timber type usually in the moderately cool and moist range.

SOILS:

The topsoil is a 6-8 inch layer of yellowish brown silt loam soil developed from volcanic ash. The pH range is 5.7-6.2. The subsoil is a light gray very gravelly silt loam developed in glacial till. The pH range is 5.5-6.0. The substratum is fractured calcareous argillite. The soil is classified as an Andeptic Cryoboralf, loamy skeletal, mixed. See pedon description number 8 for a more detailed description.

VEGETATION:

Subalpine fir/Cluntonia uniflora (AF/Clun) is the dominant habitat type on this landtype. On sites that are somewhat warmer Grand fir/Cluntonia uniflora (GF/Clun) habitat type.

INCLUSIONS:

Within the mapping units of the 22-B-7 landtype, areas of landtype 26-B-7 may be found.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter, to minimize subsoil compaction. The windthrow hazard is moderate on this landtype depending on depth to bedrock and soil moisture regime. Depth to bedrock may require ripping for road construction in many cases. The major land uses are wildlife habitat, timber production, grazing and watershed.

22-B-8: Thin Glacial Deposition (Firm), from Calcareous Argillite, 20-40% Slope

LANDTYPE DESCRIPTION:

This landtype has the same general characteristics as those described for landtype 22-B-7 except landtype 22-B-8 occurs on steeper slopes. Also at higher elevations Subalpine fir/Menziesia ferruginea (AF/Mefe) and Subalpine fir/Xerophyllum tenax (AF/Xete) habitat types are present; the AF/Mefe on the cool slopes and AF/Xete on the warm slopes. At low elevations Douglasfir/Vaccinium caespitosum (DF/Vaca) habitat type is found.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter, to minimize subsoil compaction. The windthrow hazard is moderate on this landtype. Depth to bedrock may require ripping for most road construction. The major land uses are wildlife habitat, timber production, grazing and watershed.

22-B-9: Thin Glacial Deposition (Firm), from Calcareous Argillite 40-60% Slope

LANDTYPE DESCRIPTION:

This landtype has the same characteristics as those described for landtype 22-B-7, except landtype 22-B-9 is found on steeper slopes and only the AF/Clun habitat type is present there.

INTERPRETATIONS:

Soil erosion and moss failure hazards are greater on this landtype than 22-B-7 or 22-B-8. Timber harvesting should be done during a dry season or winter to minimize subsoil compaction. The windthrow hazard is moderate on this landtype. Depth to bedrock may require ripping for most road construction. The major land uses are wildlife habitat, timber production and watershed.

22-G-7: Thin Glacial Deposition (Firm) from Tertiary Siltstone 0-20% Slope

LANDTYPE DESCRIPTION:

This landtype occurs on gently rolling ground moraine from continental glaciation. The elevation range is between 3100 and 3400 feet. The annual precipitation is approximately 20-25 inches. The soils are a glacial till from 1 to 5 feet thick. The underlying bedrock determines the surface topography of this landtype. Vegetation is a conifer timber type in the moderately cool and moist habitat type group.

SOILS:

The topsoil is a light gray, leached, gravelly loam. The pH's are between 6.5-7.0 for this layer. The subsoil is a very gravelly silt loam, with a C_{ca} horizon at 36 inches. The pH's are between 8.0-8.3 for this layer. The substratum is fractured limestone. The soil is classified a Typic Eutroboralf, loamy-skeletal, mixed.

VEGETATION:

Grand fir/Clintonia uniflora (GF/Clun) is the habitat type found on this landtype.

INCLUSIONS:

Areas within the 22-G-7 mapping units have soils with a volcanic ash surface layer. These areas occupy less than 20% of the landscape.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter, to minimize subsoil compaction. Depth to bedrock may require ripping for road construction. The major land uses are wildlife habitat, timber production, grazing and watershed.

22-G-8: Thin Glacial Deposition (Firm) from Tertiary Siltstone 20-40% Slope

LANDTYPE DESCRIPTION:

This landtype has most of the same general characteristics as those described for landtype 22-G-7. The differences are that landtype 22-G-8 occurs on steeper slopes. Also the vegetation is of drier habitat types. Douglasfir/Vaccinium caespitosum (DF/Vaca) and Douglasfir/Physocarpus malvaceus (DF/Phma) are the habitat types present on landtype 22-G-8.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter to minimize subsoil compaction. Depth to bedrock may require ripping for most road construction. The major land uses are wildlife habitat, timber production and watershed.

26-A-8: Thick Glacial Deposition (Firm) from Limestone, 20-40% Slop

LANDTYPE DESCRIPTION:

The landtype is characterized by deep deposits of alpine glacial till with a surface topography that is unrelated to the underlying bedrock. The annual precipitation is between 60 to 70 inches. The elevation is from 5600 to 6600 feet. The soils have a volcanic ash surface layer with a firm, calcareous, glacial till subsoil. The vegetation is a conifer timber type with a habitat type in the cool and moist range.

SOILS:

The surface layer is a 9-12 inch deep yellowish brown silt loam volcanic ash soil. The pH's range from 5.5 to 6.5 for this layer. The upper subsoil is a leached light gray gravelly silt loam with pH's of 6.0-6.5. The lower subsoil is a light gray garvelly to very gravelly silty clay loam, with pH's of 6.3-6.8. The substratum is a calcareous glacial till. The soil is classified as an Andeptic Cryoboralf, fine-silty, mixed, or Andeptic Cryoboralf, loamy-skeletal, mixed. The classification depends on whether or not the soil is gravelly or very gravelly. See pedon description number 10 for a more detailed soil description.

VEGETATION:

The habitat type on this landtype is Subalpine fir/Cluntonia uniflora (AF/Clun).

INTERPRETATIONS:

The soil on this landtype is more susceptible to subsoil compaction and mantle failure than the other 26 landtypes. The major land uses are timber production, wildlife habitat and watershed.

26-B-7: Thick Glacial Deposition (Firm), on Calcareous Argillite 0-20% Slope

LANDTYPE DESCRIPTION:

This landtype occurs on gently rolling ground moraine at elevations of 3200 to 4400 feet. Annual precipitation ranges from 30 to 50 inches. Soils have a yellowish brown volcanic ash surface layer and a leached glacial till subsoil. The dominant rock type in the till matrix is calcareous argillite. Vegetation is a conifer timber type with habitat types in the moderately cool and moist, and cool and moist ranges.

SOILS:

The topsoil is a 6-8 inch layer of yellowish brown silt loam soil developed from volcanic ash. The pH range is 4.7-6.2 for this layer. The subsoil is a light gray very gravelly silt loam developed in glacial till. This till subsoil has a firm to very firm, moist consistance. The pH range is from 5.5 to 6.8 for the subsoil. The soil is classified as an Andeptic Cryoboralf, loamy-skeletal, mixed. See pedon descriptions numbers 9 and 11 for more detail.

VEGETATION:

Two habitat types are present on this landtype. At lower elevations Western Red Cedar/Clintonia uniflora (WRC/Clun) is the predominant habitat type. At higher elevations Subalpine fir/Clintonia (AF/Clun) is the predominant habitat type.

INCLUSIONS:

Areas of landtype 27-7 may be found adjacent to active streams in mapping units of 26-B-7. Also small areas of greater than 20% slope.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter in order to minimize subsoil compaction. The windthrow hazard is moderate on the majority of this landtype and severe in wet areas. The major land uses are timber production, wildlife habitat and watershed.

26-B-8: Thick Glacial Deposition (Firm), from Calcareous Argillite 20-40% Slope

LANDTYPE DESCRIPTION:

This landtype occurs on moderately steep rolling ground moraine, midslope ridges and truncated spurs. The elevations range between 3400 and 6000 feet. The annual precipitation is between 40 and 60 inches. The soils have a yellowish brown volcanic ash surface layer and a leached glacial till subsoil. The dominant rock type in the till matrix is calcareous argillite. Vegetation is a conifer timber type; habitat types vary with aspect and elevation.

SOILS:

The soils are the same as those described for landtype 26-B-7.

VEGETATION:

A variety of habitat types are present on this landtype depending on elevation and aspect. At higher elevations Subalpine fir/Clintonia uniflora (AF/Clun) is present on the cool aspects and Subalpine fir/Xerophyllum tenax (AF/Xete) on the warm aspects. At lower elevations Grand fir/Clintonia uniflora (GF/Clun) and Western Red Cedar/Clintonia uniflora (WRC/Clun) habitat types are on the cool aspects. On the warm aspects Grand fir/Xerophyllum tenax (GF/Xete) and Douglasfir/Symphoricarpos albus (DF/Syal) are the habitat types.

INCLUSIONS:

Areas of landtypes 27-7 and 56-8 may be found in mapping units of 26-B-8.

INTERPRETATIONS:

Timber harvesting on this landtype should be done during a dry season or winter in order to minimize subsoil compaction. The windthrow hazard is moderate on the majority of this landtype and severe in wet areas. The major land uses are timber production, wildlife habitat and watershed.

27-7: Fluvial Reworked Glacial Deposition on 0-20% Slope

LANDTYPE DESCRIPTION:

This landtype evolves when glacial till deposits are reworked by stream action. This landtype occurs on nearly level to moderately steep terraces at elevations 3200 to 5000 feet. Annual precipitation ranges from 25 to 50 inches. Soils have a thin brown volcanic ash surface layer over a leached very gravelly loamy sand subsoil. Vegetation is a conifer timber type usually in the moderately cool and moist habitat type range.

SOILS:

The topsoil is a 6-9 inch deep yellowish brown silt loam having pH's of 5.3-6.0. The subsoil is a light gray very gravelly loamy sand with pH's in the 5.7-6.8 range. This soil is classified as an Andic Cryochrept, sandy-skeletal, mixed. See pedon description numbers 12 and 13 for descriptions of similar soils.

VEGETATION:

The habitat type found at high elevations on the north facing slopes on this landtype is Subalpine fir/Clintonia uniflora (AF/Clun). On the lower elevation north facing slopes, the Western Red Cedar/Clintonia uniflora (WRC/Clun) habitat type is found. On south or west aspects Grand fir/Clintonia uniflora (GF/Clun) is found on the moister areas and Grand fir/Xerophyllum tenax (GF/Xete) is found on the ridge tops.

INTERPRETATIONS:

The soil found on landtype 27-7 has a low water holding capacity. For this reason regeneration may be a problem on a dry habitat type. Care should be taken on this landtype not to greatly disturb the volcanic ash topsoil during timber harvesting because the majority of the plant nutrients are in that portion of the soil profile. The major land uses are timber production, wildlife habitat and watershed.

27-8: Fluvial Reworked Glacial Deposition on 20-40% Slope

LANDTYPE DESCRIPTION:

This landtype has the same characteristics as those described for landtype 27-7; except landtype 27-8 occurs on steeper slopes and Douglasfir/Symphoricarpos albus (DF/Syal) and Douglasfir/Physocarpus malvaceus (DF/Phma) habitat types are found on the very dry ridge tops.

INTERPRETATIONS:

The soil found on landtype 27-8 has a low water holding capacity. For this reason, regeneration may be a problem on dry habitat types. Care should be taken on this landtype not to greatly disturb the volcanic ash topsoil during timber harvesting because the majority of the plant nutrients are in that portion of the soil profile. The major land uses are timber production, wildlife habitat and watershed.

28-1: Outwash Plain, Excessively Well Drained

LANDTYPE DESCRIPTION:

This landtype occurs on stream terraces and gentle sloping to level outwash plains, derived from glacial debris that has been sorted and stratified by stream action. Slopes of 1-5% are associated with this landtype. Elevations range between 3200 and 4600 feet. Annual precipitation range is 25-40 inches. Soils have a thin brown volcanic ash surface layer, over a leached very gravelly loamy sand subsoil. Vegetation is a conifer timber type usually in the cool and moist habitat type group.

SOILS:

The topsoil is a 6-9 inch deep yellowish brown silt loam having pH's of 5.3-6.0. The subsoil is a light gray very gravelly loamy sand with pH's in the 5.7 to 6.8 range. This soil is classified as an Andic Cryochrept, sandy-skeletal, mixed. See pedon descriptions number 12 and 13 for a more detailed description.

VEGETATION:

Subalpine fir/Clintonia uniflora (AF/Clun) is the dominant habitat type found on this landtype. At lower elevations Western Red Cedar/Clintonia uniflora (WRC/Clun) is found on the moist areas and Picea/Vaccinium caespitosum (S/Vaca) on the drier sites.

INCLUSIONS:

Landtype 10-1 Alluvium-Recent, is found next to active streams that flow through 28-1 mapping units.

INTERPRETATIONS:

The soil found on landtype 28-1 has a low water holding capacity. For this reason regeneration may be a problem on the Spr/Vaca habitat type areas of this landtype. Care should be taken on this landtype not to greatly disturb the volcanic ash topsoil during timber harvesting because the majority of the plant nutrients are in that portion of the soil profile. The major land uses are timber production, wildlife habitat, grazing and watershed.

28-3/10-3: Outwash Plain, Poorly Drained and Alluvium (Recent), Poorly Drained; Complex

LANDTYPE DESCRIPTION:

This landtype occurs in the valley bottom north of Upper Whitefish Lake. This is an area of landtype 28 discussed earlier which has in recent time been dissected by a stream. The recent stream deposits are similar to landtype 10-3 discussed earlier in the text. The landtype is 60%-28 type and 40%-10 type. Due to the complexity of distribution of the two landtypes, they cannot be mapped individually at this scale of map. The landtype occurs at an elevation between 4400 to 4500 feet. The annual precipitation is approximately 50 inches. Soils are either recent silt deposits or older volcanic ash over outwash gravels. Vegetation is a conifer timber type in the cool and moist range.

SOILS:

The 28 landtype topsoil is a yellowish brown silt loam over a light gray, very gravelly, loamy, sand subsoil. The soil is poorly drained due to a high groundwater table. The soil is classified as an Andic Cryaquept, sandy-skeletal, mixed. The landtype 10-3 soil is a white silt loam throughout. The soil is poorly drained due to the high groundwater table. The soil is classified as a Typic Cryaquept, fine silty, mixed.

VEGETATION:

Subalpine fir/Clintonia uniflora (AF/Clun) is the habitat type found on this landtype.

INTERPRETATIONS:

Due to the groundwater table that is present on this landtype timber management is limited to dry periods and earlier winter. Blowdown is a serious problem with this landtype. The major land uses are wildlife habitat, timber production and watershed.

55-8: Glacial Scoured Rockland on 20-40% Slopes

LANDTYPE DESCRIPTION:

This landtype occurs on bedrock outcrops which have been overridden by glacial ice. The landtype occurs between elevations of 3400 to 4100 feet. The annual precipitation is 25 to 35 inches. Rock outcrop occupies 60% of the land surface with the remaining amount covered by a thin layer of volcanic ash. Vegetation is a conifer timber type having habitat types in the moderately warm and dry group; on the areas having a soil surface. The rockland areas are non-forested.

SOILS:

On the sites containing soil it is typically a yellowish brown silt loam, 8 to 10 inches deep. It has a pH level of 5.5-6.5. The substratum is glacial smoothed bedrock. The soil is classified as a Lithic Cryandept, medial. See pedon description number 14 for a more detailed soil description.

VEGETATION:

On the forested areas habitat types on the west and south aspects are Douglasfir/pinegrass (DF/Caru), Douglasfir/dwarf huckleberry (DF/Vaca), Douglasfir/Snowberry (DF/Syal); these vary with available moisture. On the north and east aspects Douglasfir/ninebark (DF/Phma) is found.

INCLUSIONS:

Included in this mapping unit are small area of landtypes 22-A-8 or 22-B-8 depending on the bedrock present. Also some areas of the mapping unit will have slopes of less than 20% and greater than 40%.

INTERPRETATIONS:

Due to the shallow soil present and amount of bedrock on this landtype, regeneration of trees is a serious problem. Road construction on this landtype vary with the type of bedrock present. If the new road is located on the Syieh Limestone formation, little or no blasting will be needed to construct a road. However, if the road is located on Piegan or Grinnell Argillite, blasting will be necessary for road construction. The major land uses of this landtype are wildlife habitat and watershed. Timber production on this landtype should be of limited extent (sanitation and salvage) due to the low productivity, regeneration problems and road construction problems.

55-9: Glacial Scoured Rockland on 40-60% Slopes

LANDTYPE DESCRIPTION:

This landtype has the same characteristics as those described for landtype 55-8; except landtype 55-9 occurs on steeper slopes.

INTERPRETATIONS:

Landtype 55-9 has a somewhat lower water holding capacity than 55-8; therefore, regeneration will be even more of a problem. For this reason timber management on this landtype is very limited. The major land uses of this landtype are wildlife habitat and watershed.

56-8: Weakly Frost Churned Glacial Scoured Lands, 20-40% Slopes

LANDTYPE DESCRIPTION:

This landtype develops on midslope ridges, upper trough walls, truncated spurs and alpine basins where glacial ice has scoured the bedrock. The landtype is found between elevations of 4600 to 6600 feet. The annual precipitation is between 45 and 60 inches. The soils are a shallow to moderately deep skeletal volcanic ash. Vegetation is a conifer timber type with habitat types in the cool and moist range.

SOILS:

The soils are a complex of moderately deep (20-40") to shallow (10-20") well drained, yellowish brown, very gravelly silt loams. The pH's range between 4.3 to 6.0. The substratum is highly fractured limestone or calcareous argillite bedrock. The soils are classified as Lithic Cryandept, medial-skeletal and Entic Cryandepts, medial-skeletal; with minor areas of Andic Cryochrepts, loamy-skeletal. See pedon description numbers 15, 16, 17 and 18 for more detailed descriptions.

VEGETATION:

Subalpine fir/Menziesia ferruginea (AF/Mefe) habitat type is on the cool aspects of this landtype. Subalpine fir/Xerophyllum tenax (AF/Xete) habitat type is on the warm aspects. At high elevations Subalpine fir/Luzula hitchcockii (AF/Luhi) habitat type is present.

INCLUSIONS:

Area of landtype 21-8 may be found in mapping units of landtype 56-8. Also some slope above 40% can be found in the mapping units.

INTERPRETATIONS:

Broadcast burning is recommended on this landtype to minimize soil disturbance. Frost heave of seedling is a problem to timber management. The major land uses are timber production, wildlife habitat and watershed.

71: Cirque Headwalls (Early Stage)

LANDTYPE DESCRIPTION:

This landtype is characterized by over-steepened slopes on alpine ridges, caused by alpine glacial ice scouring. Typically, a bowl shaped basin is found at the base of this landtype. These basins may contain small lakes. This landtype is found between the elevations of 5500 and 7500 feet. The slopes range from 55 to 120% with 65% being the average. Annual precipitation ranges from 50 to 80 inches. Rock outcrop occupies more than 50% of the surface land area. This characteristic differentiates landtype 71 from 72. The soils that are present are a thin layer of volcanic ash soil. Vegetation is an alpine and subalpine conifer timber type having habitat types in the cool and moderately dry group.

SOILS:

The soil is a shallow well drained, yellowish brown gravelly to very gravelly silt loam. The pH's range between 4.8 and 6.0. The gravel content ranges between 15 and 80%. The substratum is highly fractured limestone or argillite bedrock. The soils are classified as Lithic Cryandepts, medial-skeletal or Lithic Cryandepts, medial. See pedon descriptions 20 and 22 for more detail.

VEGETATION:

The habitat types found on this landtype are Subalpine fir/Luzula hitchcockii (AF/Luhi) and Whitebark pine-Subalpine fir (WBP-AF). The AF/Luhi habitat type is found on this landtype at elevations of less than 6400 feet and WBP-AF habitat type at elevations above 6400 feet.

INTERPRETATIONS:

Due to the severe slopes, short growing season and amount of rock outcrop, this landtype is a very poor timber management area. The avalanche hazard is severe on this landtype. The major land uses are wildlife habitat, recreation and watershed.

72: Cirque Headwalls (Late Stage)

LANDTYPE DESCRIPTION:

This landtype is characterized by over-steepened slopes on alpine ridges caused by alpine glacial ice scouring. Typically, a bowl shaped basin is found at the base of the cirque headwall. These basins often contain small lakes when they occur on north and northeast aspects. A more subdued type basin is found on the warmer western aspects of the Whitefish Range. This landtype is found between elevations of 5500 to 7500 feet. Annual precipitation ranges from 50 to 80 inches. The slope range of this landtype is 55 to 120% with 65% being the average. Rock outcrop occupies 0-30% of the land surface with the remaining area covered by a layer of skeletal volcanic ash soil. Vegetation is an alpine and subalpine conifer timber type having habitat types in the cool and moderately dry range.

SOILS:

The soils are a complex of moderately deep to very shallow well drained, yellowish brown, very gravelly silt loams. The pH's range between 4.8 and 6.0. The gravel content ranges from 40-90%. The substratum is highly fractured limestone or argillite bedrock. The soils are classified as the following: shallow phase, Lithic Cryandept, medial-skeletal. The deep phase is an Entic Cryandept, medial-skeletal. Dry south-southwest aspects are Typic Cryandept, medial-skeletal. See pedon descriptions 19, 20, 21 and 22 for more detail.

VEGETATION:

The habitat types found on this landtype are Subalpine fir/Luzula hitchcockii (AF/Luhi) and Whitebark pine-Subalpine fir (WBP-AF). The AF/Luhi habitat type is found on this landtype at elevations of less than 6400 feet and WBP-AF habitat type at elevations above 6400 feet.

INCLUSIONS:

Included in this landtype unit are small inclusions of landtype 21-8.

INTERPRETATIONS:

The short growing season limits timber growth on this landtype. The steep slopes of the landtype limit timber management. The avalanche hazard is severe on these areas. The major land uses of this landtype are recreation, wildlife habitat and watershed.

73: Glacial Trough Walls

LANDTYPE DESCRIPTION:

This landtype occurs on concave valley slopes that have been scoured by alpine and valley glaciers. The slopes are oversteepened (greater than 60%) and are a combination erosional and depositional landform. This landtype has a parallel drainage pattern associated with it. The elevation of this landtype is between 4000 to 6000 feet. The annual precipitation range is 45 to 60 inches. The soils of this landtype are a complex of glacial tills and frost churned soils. The vegetation is a conifer timber type with habitat types in the cool and moist group.

SOILS:

The soils on the lower portions of the trough walls and in the watershed drainways are compacted deep glacial till. The soil has the same characteristics as those described for landtypes 26-A-8 and 26-B-8. This type of soil is classified an Andeptic Cryoboralf, loamy-skeletal, mixed. The soils that are present on the upper portion of the trough wall and on the micro-ridges between watershed drainways are a complex of moderately deep to very shallow skeletal volcanic ash soils. These soils have characteristics as those described for landtype 72. These soils are classified as either Lithic Cryandept, medial-skeletal or Entic Cryandept, medial-skeletal, depending on the depth to bedrock.

VEGETATION:

Habitat types on this landtype vary with aspect and elevation. South aspects have Douglasfir/Syphoricarpos albus (DF/Syal) as the

main habitat type. Subalpine fir/Clintonia uniflora (AF/Clun) is the predominant mid-elevation habitat type. Subalpine fir/ Menziesia ferruginea (AF/Mefe) habitat type is found at higher elevations than the AF/Clun and Grand fir/Clintonia uniflora (GF/Clun) is found at lower elevations. On west aspects, Subalpine fir/Xerophyllum tenax (AF/Xete) habitat type is found at high elevations and Grand fir/Xerophyllum tenax (GF/Xete) at low elevations. Along the drainways Subalpine fir/Oplopanax horridum (AF/Opho) is the main habitat type.

INCLUSIONS:

Areas of bedrock outcrop may be found in mapping units of landtype 73.

INTERPRETATIONS:

The avalanche hazard is moderate on this landtype. The windthrow hazard is severe in areas of high winds. Any management activities that are to be done on this landtype should be closely scrutinized because of problems with mantle failure and soil erosion. Site preparation is limited to broadcast burning due to the steepness of this landtype. The major land uses are wildlife habitat, timber production and watershed.

LANDTYPE INTERPRETATIONS

Interpretation for the different management actions involved in managing a state forest have been formulated for the various landtypes. These interpretations are meant to be used for forest wide planning and preliminary project planning. These interpretations should not be used for specific project plans. An on-the-ground review is necessary due to specific project needs and inclusions within the landtype mapping units.

LANDTYPE HAZARD RATING

The landtype hazard ratings are an evaluation of the short and long term effects of timber removal from a given landtype. In some cases both the natural situation and the predictions of what will happen after the management action is given. For more information concerning these interpretations see Montana Division of Forestry Landtype System Handbook.

HAZARD RATING DEFINITIONS

Slight - The hazard does not exist or can easily be overcome with normal management practices.

Moderate - A hazard does exist, but can be overcome with special measures which are commonly available and economically feasible.

Severe - The hazard is difficult or practically impossible to overcome, or is economically unfeasible.

LANDTYPE HAZARD RATINGS FOR SWSF

	Mantle Failure Hazard		Water Erosion Hazard		Cutslope Vegatation Recovery Rate	Sediment Delivery Rate	Sediment Pollution Hazard	Soil Compaction Hazard
	Natural Conditions	Road Conditions	Natural Conditions	Road Conditions				
10-1	Slight	Slight	Slight	Slight	Slow	Slow	Slight	Slight
10-3	Slight	Severe	Slight	Slight	Moderate	Slow	Slight	Slight
12	Slight	Severe	Slight	Slight	Rapid	Slow	Slight	Slight
14-2	Slight-Mod	Severe	Moderate	Mod-Severe	Moderate	Slow	Moderate	Mod-Severe
14-3	Slight	Severe	Slight	Slight	Rapid	Slow	Slight	Slight
16	Slight	Moderate	Slight	Slight	Slow	Slow	Slight	Slight
21-8	Slight	Moderate	Slight	Moderate	Slow	Moderate	Moderate	Moderate
22-G-7	Slight	Slight	Slight	Slight	Moderate	Slow	Slight	Mod-Severe
22-G-8	Slight	Slight	Slight	Moderate	Moderate	Moderate	Moderate	Mod-Severe
22-B-7	Slight	Slight	Slight	Slight	Moderate	Slow	Slight	Mod-Severe
22-B-8	Slight	Slight-Mod	Slight	Moderate	Moderate	Moderate	Moderate	Mod-Severe
22-B-9	Moderate	Mod-Severe	Slight	Moderate	Moderate	Moderate	Moderate	Mod-Severe
26-A-8	Slight	Mod-Severe	Slight	Moderate	Moderate	Moderate	Moderate	Severe
26-B-7	Slight	Slight	Slight	Slight	Moderate	Slow	Slight	Mod-Severe
26-B-8	Slight	Slight-Mod	Slight	Moderate	Moderate	Moderate	Moderate	Mod-Severe
27-7	Slight	Slight	Slight	Slight	Slow	Slow	Slight	Slight
27-8	Slight	Moderate	Slight	Moderate	Slow	Slow	Moderate	Slight
28-1	Slight	Slight	Slight	Slight	Slow	Slow	Slight	Slight
28-3/10-3	Slight	Severe	Slight	Slight	Moderate	Slow	Slight	Slight
55-8	Slight	Slight	Moderate	Severe	Slow	Moderate	Severe	Slight
55-9	Slight	Slight	Severe	Severe	Slow	Rapid	Severe	Slight
56-8	Slight	Slight	Slight	Slight-Mod	Slow	Moderate	Moderate	Slight
71	Slight	Moderate	Severe	Severe	Slow	Rapid	Severe	Slight
72	Moderate	Mod-Severe	Mod-Severe	Severe	Slow	Rapid	Severe	Slight
73	Moderate	Mod-Severe	Moderate	Mod-Severe	Slow	Rapid	Severe	Moderate

iment ution zard	Soil Compaction Hazard
Slight	Slight
Slight	Slight
Slight	Slight
oderate	Mod-Severe
Slight	Slight
Slight	Slight
oderate	Moderate
Slight	Mod-Severe
oderate	Mod-Severe
Slight	Mod-Severe
oderate	Mod-Severe
oderate	Mod-Severe
oderate	Severe
Slight	Mod-Severe
oderate	Mod-Severe
Slight	Slight
oderate	Slight
Slight	Slight
Slight	Slight
Severe	Slight
Severe	Slight
oderate	Slight
Severe	Slight
Severe	Slight
Severe	Moderate

LANDTYPE USE LIMITATIONS

A limitation rating is given to each landtype for number of different major management actions that are associated with state forest lands. These management actions are: road construction, timber harvesting, fire suppression and cabin site leases.

LIMITATION RATING DEFINITIONS:

Slight - The named land use has relatively few problems or ones that can be overcome with normal management practices.

Moderate - The named land use has one or more characteristics which impose some problems, but can be overcome with special measures which are commonly available and economically feasible.

Severe - The named land use has one or more characteristics which impose serious problems which are impossible or economically unfeasible to overcome.

1) Unfavorable slopes
2) Amount of or depth to bedrock
3) Unfavorable clay and silt content
4) Unfavorable gravel or cobble content
5) Severe soil erosion hazard
6) Excess water permeability
7) Flooding or high water table
8) Unfavorable compaction characteristics
9) Safety hazard
10) Low soil shear strength

LANDTYPE USE LIMITATIONS FOR SWSF

Landtype	Road Construction: Physical Constraints	Road Construction: Road Materials Present	Building Site Limitations	Septic Tank Limitations	Timber Harvesting Limitations	Fire Suppression: Handline Construction	Fire Suppression: Catline Construction	Fire Suppression: Fire Rehabilitation
10-1	Moderate, 1	Slight	Severe, 7	Severe, 7, 6	Slight	Slight	Slight	Not Needed
10-3	Severe, 7	Slight	Severe, 7	Severe, 7	Severe, 7	Slight	Moderate, 7	Not Needed
12	Severe, 7	Severe, 8, 10	Severe, 7,10	Severe, 7	Severe, 7	Moderate, 7	Severe, 7	Not Needed
14-2	Slight	Severe, 3, 10	Moderate, 10	Moderate, 3	Moderate, 5,8	Slight	Slight	Needed Slope>10%
14-3	Severe, 7	Severe, 3, 10	Severe, 7,10	Severe, 3, 7	Severe, 7	Moderate, 7	Moderate, 7	Not Needed
16	Slight	Slight	Severe, 7	Severe, 7	Slight	Slight	Slight	Not Needed
21-8	Slight	Slight	Severe, 1	Severe, 1	Moderate, 5,8	Slight	Slight	Not Needed
22-G-7	Moderate, 2	Slight	Moderate, 3	Severe, 2	Moderate, 8	Slight	Slight	Not Needed
22-G-8	Moderate, 2	Slight	Severe, 1, 3	Severe, 1,2	Moderate, 8	Slight	Slight	Not Needed
22-B-7	Moderate, 2	Slight	Moderate, 3	Severe, 2	Moderate, 8	Slight	Slight	Not Needed
22-B-8	Moderate, 2	Slight	Severe, 1, 3	Severe, 1,2	Moderate 8	Slight	Slight	Not Needed
22-B-9	Moderate, 2	Slight	Severe, 1, 3	Severe, 1,2	Moderate, 1,8	Slight	Severe, 1,2,9	Needed
26-A-8	Slight	Moderate, 3	Severe, 1, 3	Severe, 1,3	Moderate, 5,8	Slight	Slight	Not Needed
26-B-7	Slight	Slight	Moderate, 3	Severe, 1	Moderate, 8	Slight	Slight	Not Needed
26-B-8	Slight	Slight	Severe, 1,3	Severe, 1	Moderate, 8	Slight	Slight	Not Needed
27-7	Slight	Slight	Moderate,1,4	Severe,1,4,6	Slight	Slight	Slight	Not Needed
27-8	Slight	Slight	Severe, 1, 4	Severe,1,4,6	Slight	Slight	Slight	Not Needed
28-1	Slight	Slight	Moderate, 4	Severe, 4,6	Slight	Slight	Slight	Not Needed
28-3/10-3	Severe, 7	Moderate, 3	Severe, 7	Severe, 7	Severe, 7	Slight	Moderate, 7	Not Needed
55-8	Severe, 2	Severe, 3, 4	Severe, 1,2	Severe,1,2	Severe, 5	Slight	Slight	Needed Slope>15%
55-9	Severe, 2	Severe, 3, 4	Severe, 1,2	Severe,1,2	Severe, 5	Slight	Slight	Needed
56-8	Moderate, 2	Moderate, 3	Severe, 1	Severe, 1	Moderate, 5	Slight	Slight	Not Needed
71	Severe, 1,2	Severe, 3	Severe, 1,2	Severe, 1,2	Severe, 1, 5	Severe,1,2,9	Severe,1,2,9	Needed
72	Severe, 1,2	Moderate, 3	Severe, 1,2	Severe, 1,2	Severe, 1, 5	Moderate, 1	Severe, 1, 9	Needed
73	Severe, 1	Moderate, 3	Severe, 1,2	Severe, 1,2	Mod-Severe 5,	Moderate, 1	Moderate, 1	Needed

Suppression

Catline struction	Fire Rehabilitation
Slight	Not Needed
derate, 7	Not Needed
evere, 7	Not Needed
Slight	Needed Slope>10%
derate, 7	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
ere, 1,2,9	Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
Slight	Not Needed
erate, 7	Not Needed
light	Needed Slope>15%
light	Needed
light	Not Needed
ere,1,2,9	Needed
ere, 1, 9	Needed
erate, 1	Needed

APPENDIX ONE

SOIL DESCRIPTIONS

This appendix contains twenty-two soil descriptions from the Stillwater State Forest landtype survey area. These soils are representative of the soils that are found on the different landtypes within the forest. Eighteen of the soil profiles had chemical and physical tests done on them. The chemical and physical analysis was done by the University of Idaho.

*NOTE: The ph's that are given in the soil descriptions were obtained with a field ph kit. These field ph's are higher than the ph's that were obtained in the laboratory. The field ph's were not changed in the descriptions because of the gaps in the laboratory data.

Pedon Description #	Landtype	Chem Sample #	Classification
1	10-3	None	Andic Cryorthent, loamy-skeletal, mixed
2	12	None	Typic Cryosaprist
3	12	None	Terric Cryosaprist; fine-silty, mixed
4	14-2	14-1	Typic Eutrochrept; coarse-silty, mixed
5	14-2	14-2	Typic Eutroboralf; fine-silty, mixed
6	21-8	21-1	Andic Cryochrept; loamy-skeletal, mixed
7	21-8	21-2	Andeptic Cryoboralf; loamy-skeletal, mixed
8	22-B-8	22-1	Andeptic Cryoboralf; loamy-skeletal, mixed
9	26-B-7	26-1	Andeptic Cryoboralf; loamy-skeletal, mixed
10	26-A-8	26-2	Andeptic Cryoboralf; fine-silty, mixed
11	26-B-8	26-3	Andeptic Cryoboralf; loamy-skeletal, mixed
12	28-1	28-1	Andic Cryochrept; sandy-skeletal, mixed
13	28-1	28-2	Andic Cryochrept, loamy-skeletal, mixed
14	55-8	None	Lithic Cryandept; medial
15	56-8	56-1	Andic Cryochrept; loamy-skeletal, mixed
16	56-8	56-2	Entic Cryandept; medial-skeletal
17	56-8	56-3	Lithic Cryochrept; coarse-loamy
18	56-8	56-4	Entic Cryandept; medial-skeletal
19	72	72-1	Entic Cryandept; medial-skeletal
20	72	72-2	Lithic Cryandept; medial
21	72	72-3	Typic Cryandept; medial-skeletal
22	72	72-4	Lithic Cryandept; medial-skeletal

ECOSYSTEM FACTORS

Sample	Landtype	Parent Material	Elevation	Aspect	Annual Precipitation	Habitat Type	% Slope
14-1	14-2	NA	3,160	East	25	S/Libo	20%
14-2	14-2	NA	3,620	Northeast	30	GF/Clun	3%
21-1	21-8	Limestone	6,100	Southwest	60	AF/Mefe	15%
21-2	21-8	Limestone	6,200	South	70	WBP-AF	30%
22-1	22-B-8	Argillite	5,300	Southwest	40	AF/Xete	40%
26-1	26-B-7	Argillite	3,300	NA	20	AF/Vaca	5%
26-2	26-A-8	Limestone	5,200	South	50	AF/Mefe	40%
26-3	26-B-8	Argillite	4,100	East	40	WRC/Clun	15%
28-1	28-1	Argillite	4,760	NA	50	AF/Clun	4%
28-2	28-1	Argillite	3,240	NA	20	AF/Vaca	2%
56-1	56-8	Limestone	6,200	East	60	AF/Mefe	20%
56-2	56-8	Limestone	6,580	South	70	WBP-AF	38%
56-3	56-8	Argillite	4,800	West	40	AF/Xete	50%
56-4	56-8	Argillite	6,400	South	55	AF/Luhi	35%
72-1	72	Limestone	6,900	West	70	WBP-AF	50%
72-2	72	Limestone	6,740	South	70	WBP-AF	80%
72-3	72	Argillite	6,350	West	60	WBP-AF	65%
72-4	72	Argillite	6,350	West	60	WBP-AF	65%

SOIL DESCRIPTION - 1 Landtype: 10-3

Location:	Sec. 31, T31N, R23W
Classification:	Andic Cryorthent, loamy-skeletal, mixed
Elevation:	3350 feet
Aspect:	East
Surface Runoff:	Slow
Water Holding Capacity:	Medium
Habitat Type:	AF/libo
% Slope:	1%
Soil Permeability:	Moderately rapid
Drainage Class:	Well Drained
Effective Rooting Depth:	6 feet +
Dominent Bedrock:	Piegan & Grinnell Argillites

O_1 - (1-0) inches) Dark reddish brown (5YR 2/2) moist color, undecomposed organic material

A_2 - (0-2 inches) Grayish brown (10YR 5/2) moist color, gravelly silt loam; weak fine platy structure; friable moist consistence; pH-5; 20% coarse fragments; many fine roots

B_{2ir} - (2-9 inches) Dark yellowish brown (10YR 4/4) moist color, gravelly loam; weak fine sub-anglar blocky structure; friable moist sonsistence; pH-6.0; 20% coarse fragments, many fine roots.

II C_1 - (9-28 inches) Extremely gravelly coarse sand; single grain structur pH-6.0; 90% coarse fragments by volume.

II C_2 - (28-40 inches) Pale brown (10YR 6/3) moist color, very gravelly silt loam; single grain structure; pH-6.0; 50% coarse fragments by volume.

III C_3 - (40-52 inches) Very gravelly sand; single grain structure; pH-6.0; 70% coarse fragments by volume.

IV C_4 - (52-84 inches) Pale brown (10YR 6/3) moist color, silt; massive structure; pH-6.0.

SOIL DESCRIPTION - 2 Landtype - 12

Location: NW¼, Sec. 28, T33N, R23W

Classification: Typic Cryosaprist

Elevation: 3560 feet

Aspect: Flat

Surface Runoff: Very slow

Water Holding Capacity: High

% Slope: 1%

Soil Permeability: Slow

Drainage Class: Poorly drained

O_e - (0-3 inches) Black (10YR 2.5/1) moist color, hemic material; moderate fine granular structure; pH-8.0, many fine roots present.

O_{a1} - (3-8 inches) Black (10YR 2.5/1) moist color sapric material; moderate fine granular structure; pH-7.5.

O_{a2} - (8 inches plus) Very dark gray (10YR 3/1) moist color, sapric material, moderate fine granular structure; pH-7.0.

SOIL DESCRIPTION - 3 Landtype - 12

Location: NW¼, Sec. 9, T32N, R23W

Classification: Terric Cryosaprist, coarse-silty-mixed

Elevation: 3400 feet

Aspect: Flat

Surface Runoff: Very slow

Water Holding Capacity: High

% Slope: 1%

Soil Permeability: Slow

Drainage Class: Poorly drained

O_{a1} - (0-8 inches) Very dark gray (10YR 3/1) moist color, sapric material; weak fine granular structure; pH-7.5.

O_{a2} - (8-16 inches) Very dark grayish brown (10YR 3/2) moist color, sapric material; weak medium sub-anglar blocky structure; pH-8.0.

II C - (16 inches plus) White (10YR 8/1) moist color, gravelly silt loam; massive structure; slightly hard dry consistence, firm moist consistence, slightly sticky wet consistence; 25% coarse fragments by volume; pH-8.0.

SOIL DESCRIPTION - 4 Landtype: 14-2 Sample: 14-1

Location:	SE¼, Sec. 34, T32N, R23W
Classification:	Typic Eutrochrept; coarse-silty, mixed
Elevation:	3160 feet
Aspect:	East
Surface Runoff:	Medium
Water Holding Capacity:	High
Habitat Type:	Spr/Libo
% Slope:	20%
Soil Permeability:	Moderately slow
Drainage Class:	Well drained
Effective Rooting Depth:	15 inches

A_2 - (0-4 inches) White (10YR 8/1) dry color and light yellowish brown (10YR 6/4) moist color, silt-loam; weak fine platy structure; slightly hard dry consistence, friable (moist) slightly sticky (wet); pH-7.0; many fine tubular pores, smooth abrupt boundary.

B_2 - (4-10 inches) Very pale brown (10YR 7/3) dry color and yellowish brown (10YR 5/4) moist color, silt loam; moderate medium anglar blocky structure; hard dry consistence, friable (moist) slightly sticky (wet); pH-7.5; many fine tubular pores; common, moderately thick clay films on the ped faces; smooth abrupt boundary.

B_3 - (10-13) inches) Light gray (10YR 7/2) dry color and pale brown (10YR 6/3) moist color, silt; weak fine anglar blocky structure; slightly hard dry consistence, friable (moist), slightly sticky (wet); pH-8.0; few fine tubular pores; smooth abrupt boundary.

C_{1ca} - (13-26 inches) Light gray (10YR 7/1) dry color and pale brown (10YR 6/3) moist color, silt; weak coarse platy structure; slightly hard dry consistence, friable (moist), slightly sticky (wet), pH-8.0; slightly effervescent; wavy diffuse boundary.

C_{2ca} - (26 inches plus) Light gray (10YR 7/1) dry color and pale brown (10YR 6/3) moist color, silt; strong very coarse platy structure; slightly hard dry consistence, slightly firm (moist), slightly sticky (wet); pH-8.0; slightly effervescent.

SOIL DESCRIPTION - 7 Landtype: 21-8 Sample: 21-2

Location:	SE¼, Sec. 25, T35N, R25W
Classification:	Andeptic Cryoboralf, loamy-skeletal, mixed
Elevation:	6200 feet
Aspect:	South
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	WBP-AF
% Slope:	30%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	33 inches
Dominant Bedrock:	Syieh Limestone

O_2 - (1-0 inches) Very dark gray (10YR 3/1) partially decomposed organic material, abrupt smooth boundary.

A_2 - (0-3 inches) Light gray (10YR 7/1) dry color and brown (10YR 4/3) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.8; 15% coarse fragments by volume; many fine interstitial pores, common fine roots; abrupt smooth boundary.

B_{2ir} - (3-6 inches) Brownish yellow (10YR 6/6) dry color and yellowish brown (10YR 5/6) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-6.3; 20% coarse fragments by volume; many fine interstitial pores, common fine roots; abrupt smooth boundary.

II A_2 - (6-12 inches) Very pale brown (10YR 8/3) dry color and light yellowish brown (10YR 6/4) moist color, very gravelly silt loam; weak fine sub-anglar blocky structure; loose dry consistence, friable (moist), non-sticky (wet); pH-5.5; 60% coarse fragments by volume; many fine interstitial pores, common fine roots; clear wavy boundary.

II B_{2t} - (12-24 inches) Light gray (2.5YR 7/2) dry color and light yellowish brown (2.5YR 6/4) moist color, very gravelly silt loam; weak fine anglar blocky structure; loose dry consistence, friable (moist) sticky (wet); pH-5.5; 60% coarse fragments by volume; common fine interstitial pores, few thin clay flows on ped faces, diffuse wavy boundary.

II C - (24-33 inches) Light gray (2.5YR 7/2) dry color and light gray (2.5YR 7/2) moist color, extremely gravelly loam; weak fine sub-anglar blocky structure; loose dry consistence, friable (moist), non-sticky (wet); pH-5.5; 80% coarse fragments by volume; abrupt wavy boundary.

R - (33 inches plus) Fractured Syieh Limestone.

SOIL DESCRIPTION - 8 Landtype: 22-B-8 Sample: 22-1

Location:	SW¼, Sec. 22, T33N, R23W
Classification:	Andeptic Cryoboralf; loamy-skeletal, mixed
Elevation:	5300 feet
Aspect:	Southwest
Surface Funoff:	Medium
Water Holding Capacity:	Medium
Habitat Type:	AF/Xete
% Slope:	40%
Soil Permeability:	Moderate
Drainage Class:	Well drained
Effective Rooting Depth:	40 inches
Dominant Bedrock:	Piegan Argillite

O_2 - (1-0 inches) Very dark gray (10YR 3/1) dry color partially decomposed organic material; smooth abrupt boundary.

B_{2ir} - (0-7 inches) Brown (7.5YR 4/4) moist color and yellowish brown (10YR 6/4) dry color, silt loam; weak fine sub-anglar blocky structure; soft dry consistence, very friable (moist), non-sticky (wet); 10% coarse fragment by volume; pH-7.0; many fine interstitial pores, few medium roots; wavy abrupt boundary.

II A_2 - (7-25 inches) Light brownish gray (10YR 6/2) moist color and light gray (10YR 7/1) dry color, very gravelly coarse sandy loam; weak sub-anglar blocky structure; slightly hard dry consistence, friable (moist), non-sticky (wet); pH-7.0; 40% coarse fragments by volume; many fine interstitial pores, few medium roots; wavy clear boundary.

II B_{2t} - (25-40 inches) Light gray (10YR 7/1) moist color and white (10YR 8/1) dry color gravelly silt loam; moderate medium sub-anglar blocky structure; hard dry consistence, firm (moist), sticky (wet); pH-7.5; 30% coarse fragments by volume; common medium pores; common thick clay films on ped faces; wavy abrupt boundary.

R - (40 inches plus) Fractured weathered Piegan Argillite.

SOIL DESCRIPTION - 9 Landtype: 26-B-7 Sample: 26-1

Location:	NE¼, Sec. 23, T32N, R24W
Classification:	Andeptic Cryoboralf, laomy-skeletal, mixed
Elevation:	3300 feet
Aspect:	Flat
Surface Funoff:	Slow
Water Holding Capacity:	Medium
Habitat Type:	AF/Vaca
% Slope:	5%
Soil Permeability:	Moderate
Drainage Class:	Well drained
Effective Rooting Depth:	40 inches +
Dominant Bedrock:	Grinnell Argillite

B_{2irp} - (0-5 inches) Light yellowish brown (10YR 6/4) dry color and yellowish brown (10YR 5/4) moist color; gravelly silt loam; weak fine sub-anglar blocky structure; loose (moist), non-sticky (wet); pH-6.5; 30% gravel by volume; many fine interstitial pores, few coarse roots; clear wavy boundary.

II A_{21} - (5-14 inches) White (5YR 8/1) dry color and gray (10YR 6/1) moist color, gravelly silt loam; weak fine sub-anglar blocky structure; loose dry consistence, friable (moist), non-sticky (wet); pH-6.5; 30% coarse fragments by volume; many fine interstitial pores, few coarse roots; clear wavy boundary.

II A_{22} - (14-19 inches) White (5YR 8/1) dry color and gray (10YR 6/1) moist color, very gravelly silt loam; weak medium sub-anglar blocky structure; slightly hard dry consistence, friable (moist), non-sticky (wet); pH-6.5; many fine interstitial pores; clear wavy boundar

II B_{21t} - (19-29 inches) Light gray (5YR 7/1) dry color and pinkish gray (7.5YR 6/2) moist color, very gravelly silt loam; moderate medium sub-anglar blocky structure; hard dry consistence, firm (moist) slightly sticky (wet); pH-6.5; 40% coarse fragments by volume; common fine interstitial pores; few thin clay films on pore walls; smooth clear boundary.

II B_{22t} - (29-41 inches) Light gray (5YR 7/1) dry color and pinkish gray (7.5YR 6/2) moist color, very gravelly silt loam (heavy); moderate medium sub-anglar blocky structure; hard dry consistence, firm (moist) slightly sticky (wet); pH-6.5; 50% coarse fragments by volume; many medium interstitial pores, many moderately thick clay films on pore walls and ped faces; clear wavy boundary.

II C - (41 inches plus) Light gray (5YR 7/1) dry color and pinkish gray (7.5YR 6/2) moist color, very gravelly silt loam; massive structure; hard dry consistence, firm (moist), slightly sticky (wet); pH-6.5; 50% coarse fragments by volume; few medium interstitial pores.

SOIL DESCRIPTION - 10 Landtype: 26-A-8 Sample: 26-2

Location:	NW¼, Sec. 13, T34N, R24W
Classification:	Andeptic Cryoboralf; fine-silty, mixed
Elevation:	5200 feet
Aspect:	South
Surface Runoff:	Medium
Water Holding Capacity:	High
Habitat Type:	AF/Mefe
% Slope:	40%
Soil Permeability:	Moderately slow
Drainage Class:	Moderately well drained
Effective Rooting Depth:	18 inches

A_1 - (0-10 inches) Dark brown (10YR 3/3) moist color, silt loam; weak fine granular structure; very friable moist consistence; pH-6.5; 5% coarse fragments by volume; a clear wavy boundary.

B_{2ir} - (10-12 inches) Yellowish-brown (10YR 5/6) moist color, silt loam; weak fine granular structure; very friable moist consistence; pH-7.0; 5% coarse fragments by volume; a clear broken boundary.

II A_2 - (12-18 inches) Very pale brown (10YR 7/4) moist color, gravelly silt loam; moderate, medium sub-anglar blocky structure; friable moist consistence; pH-715; 20% coarse fragments by volume; a clear wavy boundary.

II B_{2t} - (18-40 inches) Light yellowish-brown (10YR 6/4) moist color, very gravelly clay laom; moderate, medium anglar blocky structure; firm moist consistence; pH-7.5; 30% coarse fragments by volume; a clear wavy boundary.

II B_3 - (40-46 inches) Light yellowish-brown (10YR 6/4) moist color, very gravelly silty clay loam; moderate, medium sub-anglar blocky structure; firm moist consistence; pH-7.5; 30% coarse fragments by volume; a clear wavy boundary.

II C - (46 inches plus) Very pale brown (10YR 7/4) moist color, very gravelly silt loam; massive structure; firm moist consistence; pH-7.5; 30% coarse fragments by volume.

SOIL DESCRIPTION - 11 Landtype: 26-B-8 Sample: 26-3

Location:	NW¼, Sec. 23, T33N, R23W
Classification:	Andeptic Cryoboralf; loamy-skeletal, mixed
Elevation:	4100 feet
Aspect:	East
Surface Runoff:	Slow
Water Holding Capacity:	Medium
Habitat Type:	WRC/Clun
% Slope:	15%
Soil Permeability:	Moderate
Drainage Class:	Well drained
Effective Rooting Depth:	24 inches
Dominant Bedrock:	Grinnell Agrillite & Piegan Argillite

O_2 - (1-0 inches) Partially decomposed organic material; abrupt smooth boundary.

A_2 - (0-2 inches) Light gray (10YR 7/1) dry color and dark gray (10YR 4/1) moist color, silt loam; single grain structure; soft dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 10% coarse fragments by volume; many fine interstitial pores, common fine roots; abrupt smooth boundary.

B_{2ir} - (2-6 inches) Brownish yellow (10YR 6/8) dry color and dark brown (7.5YR 4/4) moist color, silt loam; single grain structure; soft dry consistence, very friable (moist), non-sticky (wet); pH-5.8; 10% coarse fragments by volume; many fine interstitial pores, common fine roots; abrupt wavy boundary.

II A_2 - (6-17 inches) Light gray (10YR 7/1) dry color and light brownish gray (2.5Y 6/2) moist color, very gravelly loam; weak fine sub-anglar blocky structure; slightly hard dry consistence, very friable (moist), slightly sticky (wet); pH-6.5; 60% coarse fragments by volume, few fine interstitial pores; clear wavy boundary.

II B_{21t} - (17-23 inches) Light gray (10YR 7/2) dry color and light brownish gray (2.5Y 6/2) moist color, very gravelly silt loam (heavy); moderate medium sub-anglar blocky structure; slightly hard dry consistence, firm (moist), sticky (wet); pH-6.5; 40% coarse fragments by volume; common medium interstitial pores; few thin clay films on pore walls; diffuse wavy boundary.

II B_{22t} - (23-40 inches) Light gray (10YR 7/2) dry color and light brownish gray (2.5Y 6/2) moist color very gravelly silt loam (heavy); moderate medium anglar blocky structure; hard dry consistence, firm (moist), sticky (wet); pH-6.8; 40% coarse fragments by volume; common medium interstitial pores; common thin clay films on pore walls and ped faces, clear wavy boundary.

II C - (40 inches plus) Light gray (10YR 7/2) dry color and light brownish gray (2.5Y 6/2) moist color very gravelly silt loam; massive structure, hard dry consistence, friable (moist), slightly sticky (wet); pH-7.0; 60% coarse fragments by volume; common medium interstitial pores.

SOIL DESCRIPTION - 12 Landtype: 28-1 Sample: 28-1

Location:	SE¼, Sec. 8, T34N, R23W
Classification:	Andic Cryochrept; sandy-skeletal, mixed
Elevation:	4760 feet
Aspect:	Flat
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	AF/Clun
% Slope:	4%
Soil Permeability:	Moderately Rapid
Drainage Class:	Somewhat excessively drained
Effective Rooting Depth:	6 feet +
Dominant Bedrock:	Piegan Argillite & Grinnell Argillite

O_2 - (1-0 inches) Dark brown (10YR 3/3) moist color, partially decomposed organic material; smooth abrupt boundary.

A_2 - (0-1 inches) Light brownish gray (10YR 6/2) dry color and brown (10YR 4/3) moist color; silt loam; weak fine granular structure; loose dry consistence, friable (moist), non-sticky (wet); pH-6.5; many fine interstitial pores, common fine roots; 12% coarse fragments by volume; smooth clear boundary.

B_{2ir} - (1-13 inches) Brown (7.5 YR 4/4) dry color and yellowish brown (10YR 5/6) moist color, gravelly silt loam; weak medium sub-anglar blocky structure; loose dry consistence, friable (moist), non-sticky (wet); pH-6.0; 20% coarse fragments by volume; many fine interstitial pores, common fine roots, smooth clear boundary.

B_3 - (13-19 inches) Light yellowish brown (10YR 6/4) dry color and dark yellowish brown (10YR 4/4) moist color, very gravelly silt loam; weak medium sub-anglar blocky structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 35% coarse fragments by volume; many fine interstitial pores, wavy clear boundary.

II B_2 - (19-29 inches) Gray (10YR 6/1) very gravelly coarse sandy loam; singl grain structure; loose dry consistence, loose (moist), non-sticky (wet); pH5.5; 85% coarse fragments by volume; many medium interstitial pores; wavy clear boundary.

II B_3 - (29-38 inches) Gray (7.5YR 6/0) extremely gravelly loamy coarse sand; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); pH-6.0; 95% coarse fragments by volume; many coarse interstitial pores, wavy diffuse boundary.

II C - (38 inches plus) Gray (5YR 6/1) extremely gravelly coarse sand; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); pH-6.5; 98% coarse fragments by volume; many coarse interstitial pores.

SOIL DESCRIPTION - 13 Landtype: 28-1 Sample: 28-2

Location:	SE¼, Sec. 13, T32N, R24W
Classification:	Andic Cryochrept; loamy-skeletal, mixed
Elevation:	3240 feet
Aspect:	Flat
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	AF/Vaca
% Slope:	2%
Soil Permeability:	Moderately rapid
Drainage Class:	Somewhat excessively drained
Effective Rooting Depth:	6 feet +
Dominant Bedrock:	Piegan Argillite & Grinnell Argillite

A_2 - (0-3 inches) Light gray (10YR 7/2) dry color and very dark grayish brown (10YR 3/2), silt loam; weak fine granular structure; loose dry consistence, loose (moist), and non-sticky (wet); pH-5.5; 10% coarse fragments by volume; many fine interstitial pores, common medium roots; smooth clear boundary.

B_{2ir} - (3-11 inches) Light yellowish brown (10YR 6/4) dry color and dark yellowish brown (10YR 4/4), silt loam; weak fine sub-anglar blocky structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-7.0; 10% coarse fragments by volume; many fine interstitial pores, common medium roots; smooth clear boundary.

II B_{21} - (11-19 inches) Light gray (10YR 7/1) dry color and yellowish brown (10YR 5/4) moist color, very gravelly loam; weak fine sub-anglar blocky structure; slightly firm dry consistence, friable (moist), non-sticky (wet); pH-6.5; 80% coarse fragments by volume; many medium interstitial pores; wavy clear boundary.

II B_{22} - (19-31 inches) Light gray (10YR 7/1) dry color and pale brown (10YR 6/3) moist color, very gravelly loam; weak fine sub-anglar blocky structure; slightly firm dry consistence; friable (moist), non-sticky (wet); 80% coarse fragments by volume; pH-7.0; many medium pores; wavy clear boundary.

II C - (31-80 inches) Light gray (10YR 7/1) dry color and pale brown (10YR 6/3) moist color, extremely gravelly loamy coarse sand; single grain consistence, loose (moist) non-sticky (wet); 90% coarse fragments by volume; pH-8.0; many medium pores.

SOIL DESCRIPTION - 14 Landtype: 55-8

Location:	SW¼, Sec. 31, T33N, R23W
Classification:	Lithic Cryandept, medial
Elevation:	3360 feet
Aspect:	Southwest
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	DF/Vaca
% Slope:	5%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	5 inches
Dominant Bedrock:	Grinnell Argillite

O_2 - (1/2-0 inches) Black (10YR 2.5/1) partially decomposed organic material; smooth abrupt boundary.

A_1 - (0-1 inches) Dark yellowish brown (10YR 4/4) dry color and brown (10YR 4/3) moist color, silt loam; weak fine granular structure; loose dry consistence, very friable moist consistence, non-sticky wet consistence; pH-6.5; many fine interstitial pores, common fine roots; smooth abrupt boundary.

B_{21ir} - (1-2 inches) Yellowish brown (10YR 5/6) dry color and (10YR 5/6) moist color, silt loam; weak fine sub-anglar blocky structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-6.5; many fine interstitial pores, common fine roots; smooth clear boundary.

B_{22ir} - (2-5 inches) Yellowish brown (10YR 5/6) dry color and (10YR 5/6) moist color, silt loam; single grain structure, loose dry consistence, very friable (moist), non-sticky (wet); pH-6.5; many fine interstitial pores, common fine roots; wavy abrupt boundary

R - (5 inches plus) Glacial polished Grinnell Argillite.

SOIL DESCRIPTION - 15 Landtype: 56-8 Sample: 56-1

Location:	NW¼, Sec. 11, T34N, R24W
Classification:	Andic Cryochrept; loamy-skeletal, mixed
Elevation:	6200 feet
Aspect:	East
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	AF/Mefe
% Slope:	20%
Soil Permeability:	Moderate
Drainage Class:	Well drained
Effective Rooting Depth:	30 inches
Dominant Bedrock:	Syieh Limestone

O_2 - (2-0 inches) Partially decomposed organic material; abrupt smooth boundary.

A_2 - (0-3 inches) Light gray (10YR 7/2) dry color and brown (10YR 5/3) moist color, silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-6.0; 10% coarse fragments by volume; clear smooth boundary.

B_{2ir} - (3-9 inches) Strong brown (7.5YR 5/6) dry color and yellowish red (5YR 4/6) moist color, silt loam; weak medium sub-anglar blocky structure; loose dry consistence, very friable (moist), non-sticky (wet) pH-5.5; 10% coarse fragments by volume; abrupt smooth boundary.

II B_2 - (9-16 inches) Yellowish brown (10YR 5/6) moist color, gravelly loam; weak fine sub-anglar blocky structure; soft dry consistence, friable (moist), slightly sticky (wet); pH-6.5; 20% coarse fragments by volume; gradual wavy boundary.

II B_3 - (16-24 inches) Light yellowish brown (2.5Y 6/4) moist color, very gravelly loam; massive structure; slightly hard dry consistence, friable (moist), non-sticky (wet); pH-6.0; 40% coarse fragments by volume; diffuse wavy boundary.

II C - (24 inches plus) Pale yellow (2.5Y 7/4) moist color, very gravelly loam; massive structure; slightly hard dry consistence, friable (moist), non-sticky (wet); pH-6.0; 50% coarse fragments by volume.

SOIL DESCRIPTION - 16 Landtype: 56-8 Sample: 56-2

Location:	SW¼, Sec. 25, T34N, R25W
Classification:	Entic Cryandept; medial-skeletal
Elevation:	6580 feet
Aspect:	South
Surface Funoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	WBP-AF
% Slope:	38%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	22 inches
Dominant Bedrock:	Syieh Limestone

A_2 - (0-2 inches) Light gray (10YR 7/1) dry color and brown (10YR 5/3) moist color, very gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.0; 30% coarse fragments by volume; many fine interstitial pores, many fine roots; abrupt smooth boundary.

B_{2ir} - (2-10 inches) Brownish yellow (10YR 6/6) dry color and dark brown (7.5 YR 4/4) moist color, very gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 50% coarse fragments by volume; many fine interstitial pores, many fine roots; clear smooth boundary.

B_3 - (10-18 inches) Very pale brown (10YR 7/4) dry color and light yellowish brown (10YR 6/4) moist color, extremely gravelly silt loam; weak fine sub-anglar blocky strucutre; loose dry consistence, friable (moist), non-sticky (wet); pH-8.0; 70% coarse fragments by volume; clear wavy boundary.

C - (18-22 inches) Very pale brown (10YR 7/4) dry color and light yellowish brown (10YR 6/4) moist color, extremely gravelly silt loam; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); pH-8.0; 80% coarse fragments by volume; diffuse wavy boundary.

R - (22 inches plus) Anglar fractured fragments of Syieh limestone with 10% loam soil in rock fissures.

SOIL DESCRIPTION - 17 Landtype: 56-8 Sample: 56-3

Location:	NW¼, Sec. 21, T34 N. R23W
Classification:	Lithic Cryochrept; coarse-loamy, mixed
Elevation:	4800 feet
Aspect:	West
Surface Funoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	AF/Xete
% Slope:	50%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	12 inches
Dominant Bedrock:	Appegunney Argillite

A_1 - (0-3 inches) Dark brown (10YR 3/3) moist color, coarse sandy loam; moderate fine granular structure; soft dry consistence, very friable (moist), non-sticky (wet); pH-6.5; 5% coarse fragments by volume; common coarse roots, many fine interstitial pores; abrupt smooth boundary.

B_{2ir} - (3-9 inches) Yellowish brown (10YR 5/6) moist color, coarse sandy loam; weak medium sub-anglar blocky strucutre; soft dry consistence, very friable (moist), non-sticky (wet); pH-6.5; 10% coarse fragments by volume; common coarse roots, many fine interstitial pores; clear smooth boundary.

B_3 - (9-12 inches) Yellowish brown (10YR 5/4) moist color, gravelly coarse sandy loam; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); pH-6.5; 15% coarse fragments by volume.

R - (12 inches plus) Fractured Appengunny Argillite.

SOIL DESCRIPTION - 18 Landtype: 56-8 Sample: 56-4

Location:	NW¼, Sec. 5, T32N, R22W
Classification:	Entic Cryandept; medial-skeletal
Elevation:	6400 feet
Aspect:	South
Surface Runoff:	Slow
Water Holding Capacity:	Low
Habitat Type:	AF/Luhi
% Slope:	35%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	32 inches
Dominant Bedrock:	Piegan Argillite

A_1 - (0-3 inches) Very dark grayish brown (10YR 3/2) dry color and very dark gray (10YR 3/1) moist color, silt loam, weak fine granular structure; loose dry consistence, loose (moist), non-sticky (wet); 15% coarse fragments by volume; pH-7.0; many fine roots; clear wavy boundary.

B_{21} - (3-20 inches) Light yellowish brown (10YR 6/4) dry color and yellowish brown (10YR 5/6) moist color, very gravelly silt loam; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); 60% coarse fragments by volume; pH-7.0; common fine roots; clear wavy boundary.

B_{22} - (20-32 inches) Very pale brown (10YR 7/4) dry color and yellowish brown (10YR 5/4) moist color, extremely gravelly silt loam; single grain structure; loose dry consistence, loose (moist), non-sticky (wet); 75% coarse fragments by volume; pH-6.5; few fine roots; clear wavy boundary.

R - (32 inches plus) Very pale brown (10YR 7/4) dry color and yellowish brown (10YR 5/4) moist color, anglar gravel fragments of Piegan Argillite with 10% silt loam soil in rock fissures.

SOIL DESCRIPTION - 19 Landtype: 72 Sample: 72-1

Location:	NE¼, Sec. 1, T33N, R24W
Classification:	Entic Cryandept; medial-skeletal
Elevation:	6900 feet
Aspect:	West
Surface Funoff:	Medium
Water Holding Capacity:	Medium
Habitat Type:	WBP-AF
% Slope:	50%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	4 feet
Dominant Bedrock:	Syieh Limestone

O_2 - (1/2 - 0 inches) Black (10YR 2.5/1) partially decomposed organic material; smooth abrupt boundary.

A_1 - (0-3 inches) Black (10YR 2.5/1) moist and dry color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable moist consistence, non-sticky wet consistence; pH-5.5; 30% coarse fragments by volume; few coarse roots, many fine interstitial pores; smooth clear boundary.

A_2 - (3-4 inches) Brown (10YR 5/3) dry and moist color, very gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 35% coarse fragments by volume; few coarse roots, many fine interstitial pores; smooth clear boundary.

B_{21ir} - (4-10 inches) Light yellowish brown (10YR 6/4) dry color, yellowish brown (10YR 5/6) moist color, very gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-7.0; 50% coarse fragments by volume; few coarse roots, many fine interstitial pores; smooth clear boundary.

B_{22ir} - (10-17 inches) Light yellowish brown (10YR 6/4) dry color, yellowish brown (10YR 5/6) moist color, very gravelly silt loam; single grain structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-7.0; 60% coarse fragments by volume; smooth diffuse boundary.

B_3 - (17-20 inches) Light yellowish brown (10YR 6/4) dry color, yellowish brown (10YR 5/6) moist color, extremely gravelly silt loam; single grain structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-7.5; 80% coarse fragments by volume; smooth diffuse boundary.

C - (20 inches plus) Light yellowish brown (10YR 6/4) dry color, brownish yellow (10YR 6/6) moist color, extremely gravelly silt loam; single grain structure; loose dry consistence, very friable (moist) non-sticky (wet); pH-7.0; 90% coarse fragments by volume.

SOIL DESCRIPTION - 20 Landtype:72 Sample: 72-2

Location:	SE¼, Sec. 1, T33N, R24W
Classification:	Lithic Cryandept, medial
Elevation:	6740
Aspect:	South
Surface Funoff:	Medium
Water Holding Capacity:	Low
Habitat Type:	WBP-AF
% Slope:	80%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	20 inches
Dominant Bedrock:	Syieh Limestone

O_2 - (1-0 inches) Black (10YR 2.5/1) partially decomposed organic material; smooth abrupt boundary.

A_2 - (0-5 inches) Yellowish brown (10YR 5/4) dry color and brown (10YR 5/3) moist color, silt loam; weak fine granular structure; loose dry consistence, very friable moist consistence, non-sticky wet consistence; pH-5.5; 10% coarse fragments by volume; few coarse roots, many fine interstitial pores; smooth abrupt boundary.

B_{2ir} - (5-17 inches) Light brownish yellow (10YR 6/4) dry color and yellowish brown (10YR 5/6) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 30% coarse fragments by volume; few coarse roots, many fine interstitial pores; wavy abrupt boundary..

R - (17 inches plus) Fractured weathered Syieh limestone.

SOIL DESCRIPTION - 21 Landtype: 72 Sample: 72-3

Location:	NE¼, Sec. 27, T32N, R22W
Classification:	Typic Cryandept; medial-skeletal
Elevation:	6350 feet
Aspect:	West
Surface Runoff:	Medium
Water Holding Capacity:	Medium
Habitat Type:	WBP-AF
% Slope:	65%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	6 feet +
Dominant Bedrock:	Piegan Argillite

A_{11} - (0-3 inches) Very dark grayish brown (10YR 3/2) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable moist consistence, non-sticky wet consistence; pH-7.0; 20% coarse fragments; few coarse roots, many fine interstitial pores; smooth clear boundary.

A_{12} - (3-14 inches) Dark brown (10YR 3/3) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-7.0; 20% coarse fragments by volume; few coarse roots, many fine interstitial pores; wavy diffuse boundary.

A & B - (14-18 inches) Dark brown (10YR 3/3) moist color, very gravelly silt loam; weak medium granular structure; loose dry consistence, friable (moist), non-sticky (wet); pH-6.5; 35% coarse fragments; many fine interstitial pores; wavy diffuse boundary.

B_{2ir} - (18-36 inches) Yellowish brown (10YR 5/4) moist color, very gravelly silt loam; moderate medium sub-anglar blocky structure; slightly firm dry consistence, friable (moist), non-sticky (wet); ph-6.0; 40% coarse fragments by volume; many fine interstitial pores; wavy diffuse boundary.

C - (36 inches plus) Yellowish brown (10YR 5/4) moist color, very gravelly silt loam; single grain structure; loose dry consistence, very friable (moist), non-sticky (wet); pH-5.5; 40% coarse fragments by volume.

SOIL DESCRIPTION - 22 Landtype: 72 Sample: 72-4

Location:	NE¼, Sec. 27, T32N, R22W
Classification:	Lithic Cryandept; medial-skeletal
Elevation:	6350 feet
Aspect:	West
Surface Runoff:	Medium
Water Holding Capacity:	Low
Habitat Type:	WBP-AF
% Slope:	65%
Soil Permeability:	Moderately rapid
Drainage Class:	Well drained
Effective Rooting Depth:	6 feet +
Dominant Bedrock:	Piegan Argillite

A_1 - (0-3 inches) Very dark grayish brown (10YR 3/2) moist color, gravelly silt loam; weak fine granular structure; loose dry consistence, very friable moist consistence, non-sticky wet consistence; pH-7.0; 20% coarse fragments; few coarse roots, many fine interstitial pores; wavy clear boundary.

B_{2ir} - (3-14 inches) Yellowish brown (10YR 5/4) moist color, very gravelly silt loam; weak fine sub-anglar blocky structure; slightly firm dry consistence, friable (moist), non-sticky (wet); pH-6.0; 40% coarse fragments by volume; many fine interstitial pores.

R - (14 inches plus) Fractured Piegan Argillite.

APPENDIX TWO

LANDTYPE LABORATORY DATA

This appendix contains laboratory data on the various soils found in the Stillwater State Forest. The samples were collected for a given landtype to characterize the landtype not a given "soil series". The analysis was done at the University of Idaho Soils Lab. This data would not have been possible without the cooperation of Burlington Northern, Timber and Lands Department; for their help I am very grateful.

The following statements are interpretations I have made from the analytical data. In most cases more research is needed to prove or disprove these interpretations; therefore, they should not be used as fact.

1. The percent organic matter range was between 4.78% and 11.50% for the volcanic ash soils. These are relatively high organic matter percentages for forest soils.

2. The percent organic matter in the non-volcanic ash soils was between .5% and 7.3%. Most of these percentages were in the expected range for forest soils.

3. The levels of exchangeable copper and zinc are moderately low to low, when compared to other soils in western Montana. A growth response may be seen with fertilization of these elements.

4. The levels of exchangeable iron and manganese are relatively high as compared to other western Montana soils.

5. The levels of phosphate are low in all soil samples. Phosphate, I believe, is the growth limiting element in these soils. Phosphate fertilization may be an economic alternative. However, this needs more research to be proven.

6. Phosphate is absorbed very fast and in high quantities by the volcanic ash. Whether or not this is available or unavailable, phosphate cannot be determined from this date, but this is a very important fact which should be researched.

7. The levels of potassium are moderate to low compared to other western Montana soils. The levels of potassium are higher in the volcanic ash than in the other soil materials. I believe a growth response would be seen with potassium fertilization.

8. The percent total nitrogen, like the percent organic matter, was relatively high in the volcanic ash layers and moderate in the other soil horizons. The available nitrogen was not measured; therefore, it is not possible to determine how much of the total nitrogen is available nitrogen.

9. The levels of calcium and magnesium are moderate to moderately low compared to other western Montana soils.

10. There is a good calcium magnesium ratio in most of the soil horizons.

11. The levels of sodium are moderate to low compared to other soils in western Montana.

12. The levels of sulfate are moderate in most cases, when compared to other soils in western Montana. A growth response may be seen with sulfate fertilization.

13. Landtypes 56 and 21 do not have to be phased by bedrock. This is apparently due to the high precipitation levels masking the chemical differences of the bedrock.

14. The overall fertility of the various soils decreased with increased elevation and precipitation, as would be expected. There was a sharp break in the fertility at a 40-50 inch annual precipitation range.

* One sample of clay from II B_{21t} horizon of sample site 26-3 was tested for x-ray diffraction patterns. The tests showed the sample contained the following clay minerals: kaolinite, illite, cholorite, and a trace of montmorillonite.

Ident #	Soil Fraction	% Gravel	pH	NaF pH	Exchangeable CEC	Exchangeable Ca	Exchangeable Mg	Exchangeable Na	Exchangeable K	Soluble Ca	Soluble Mg	Soluble Na	Soluble K	Soluble CO_3	Soluble HCO_3	Soluble Cl
					meq/100 g					meq/1000 g						
14-1-A1	1.00	None	6.85			7.26	1.42	0.04	0.32	0.36	0.09	0.12	0.03	Nil	0.50	0.4
B2	1.00	None	7.20		8.08	10.93	0.73	0.08	0.90	0.66	0.09	0.24	0.01	0.12	0.88	0.4
C	1.00	None	7.60		4.62	9.46	0.48	0.03	0.05	0.43	0.08	0.16	0.01	Nil	0.84	0.4
14-2-A1	0.73	27.33	5.00			1.58	0.32	0.04	0.13	0.20	0.08	0.10	0.03	Nil	0.38	0.4
B2t	0.68	32.06	5.20		12.15	5.38	1.27	0.04	0.15	0.21	0.05	0.13	0.01	Nil	0.52	0.4
C	trace	trace	5.90		11.05	6.60	1.12	0.03	1.60	0.98	0.16	0.17	0.02	0.12	1.16	0.3
28-1-A2	0.57	43.52	5.30	8.80						0.23	0.07	0.09	0.02	Nil	0.71	0.6
Bir	0.48	51.61	5.50		39.80	1.57	0.16	0.02	0.13	0.28	0.07	0.11	0.03	Nil	0.72	0.3
IIB2	0.20	79.66	5.20		3.69	0.20	0.27	0.03	0.05	0.03	0.02	0.04	0.01	Nil	0.20	0.1
IIC	0.47	52.75	5.15							0.06	0.02	0.04	0.01	Nil	0.17	0.1
28-2-A2	0.42	57.63	5.95	9.50						0.40	0.16	0.20	0.18	Nil	0.77	0.4
Bir	0.64	36.35	6.30		15.45	2.78	0.53	0.03	0.61	0.24	0.06	0.20	0.07	Nil	0.56	0.6
IIB2	0.43	57.27	5.75		11.70	6.63	1.22	0.04	0.18	0.24	0.05	0.10	0.02	Nil	0.24	0.2
IIC	0.22	78.48	6.70							0.30	0.04	0.09	0.01	Nil	0.43	0.3
21-1-Bir	0.47	53.18	5.70	11.00	28.00	1.28	0.43	0.03	0.40	0.16	0.07	0.16	0.09	Nil	0.69	0.6
IIA2	0.64	35.66	5.30		23.65	4.39	0.98	0.18	0.78	0.60	0.18	0.24	0.27	Nil	0.91	0.8
IIB2	0.29	70.67	6.10		7.05	2.78	0.45	0.09	0.11	0.15	0.05	0.12	0.01	Nil	0.50	0.3
IIC	0.38	62.27	5.90	9.80						0.20	0.07	0.14	0.03	Nil	0.36	0.3
21-2-A2	0.67	32.92	4.85	9.00	19.70	1.78	1.19	0.03	0.24	0.16	0.13	0.16	0.04	Nil	0.56	0.3
Bir	0.63	36.80	5.30	11.20	26.55	0.29	0.25	0.03	0.11	0.11	0.09	0.19	0.02	Nil	0.65	0.3
IIA2	0.64	36.29	5.30		9.99	0.29	0.30	0.04	0.06	0.05	0.04	0.10	0.01	Nil	0.33	0.1
IIB2t	0.68	32.41	5.20		9.19	0.74	0.69	0.04	0.06	0.05	0.03	0.08	0.01	Nil	0.24	0.2
IIC	0.38	61.59	5.50	10.30						0.08	0.06	0.14	0.01	Nil	0.38	0.2
22-1-Bir	0.59	40.66	5.70		20.10	1.34	0.41	0.03	0.20	0.13	0.06	0.16	0.03	Nil	0.68	0.49
IIA2	0.36	64.12	5.60			1.39	0.52	0.09	0.07	0.10	0.04	0.10	0.01	Nil	0.29	0.2
IIB2t	0.57	42.73	5.80		4.56	1.79	0.73	0.05	0.06	0.07	0.04	0.03	0.01	Nil	0.24	0.2
26-1-Bir	0.66	33.78	6.15	9.90	17.60	4.18	0.87	0.04	0.59	0.20	0.08	0.06	0.09	Nil	0.53	0.4
IIA2	0.66	34.19	5.9[illegible]		4.33	2.20	0.72	0.15	0.08	0.04	0.02	0.03	0.01	Nil	0.38	0.3
IIB2t	0.53	47.29	5.[illegible]		8.15	3.99	1.60	0.10	0.11	0.06	0.04	0.03	0.01	Nil	0.24	0.
IIC	0.60	39.76	5.[illegible]	8.80						0.03	0.03	0.03	0.01	Nil	0.19	0.

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Ident #	% N	Exchangeable H+ meq/100 g	$CaCO_3$ Equiv. %	Gypsum %	% OM*	% OM	1:5 NaOAC P ppm	1:5 NaOAC K meq/l	Fe ppm	Zn ppm	Cu ppm	Mn ppm	SO_4
14-1-A1	0.050					1.44	2.3	99.5	36.50	0.30	1.00	11.10	
B2	0.040	None				1.70	7.0	29.5	17.00	0.24	1.00	6.60	4
C	0.025					1.08	6.0	26.0	10.50	0.24	0.40	5.30	0
14-2-A1	0.039					2.80	1.9	52.5	132.00	0.44	0.50	17.50	
B2t	0.044	2.46				2.14	10.8	49.0	62.00	0.48	0.80	12.50	7
C	0.039	1.03	None	None		1.85	6.9	51.0	54.00	0.48	0.80	16.50	0
28-1-A2									100.00	1.68	0.40	88.00	
Bir	0.275					6.80	6.9	49.0	45.00	1.58	1.20	4.20	21
IIB2	0.030					0.50	4.4	21.5	12.00	0.26	1.50	3.60	11
IIC													
28-2-A2									100.00	6.15	0.60	66.00	
Bir	0.093					1.85	3.5	179.5	40.50	0.16	0.40	3.60	9
IIB2	0.039					0.75	1.8	72.0	45.50	0.46	1.00	18.00	0
IIC													
21-1-Bir	0.159				6.93		2.9		100.00	1.45	0.60	12.00	18
IIA2	0.240					7.30	6.5	332.5	184.00	9.30	0.80	116.00	31
IIB2	0.043					1.38	0.9	51.0	23.50	0.34	0.40	6.40	7
IIC													
21-2-A2							3.0		360.00	1.66	0.50	2.40	21
Bir	0.170				7.08		12.0		160.00	0.87	0.40	3.60	21
IIA2	0.038					2.20	1.0	27.5	65.00	0.27	0.30	6.60	18
IIB2t	0.031					2.14	1.5	26.0	37.00	0.27	0.20	5.00	9
IIC													
22-1-Bir	0.136					6.20	3.0	74.0	260.00	0.80	0.60	86.00	26
IIA2						0.85	3.5	39.0	74.00	0.18	0.30	28.50	60
IIB2t	0.028					1.50	1.0	31.5	90.00	0.18	0.40	28.50	9
26-1-Bir	0.124				5.48		8.9		300.00	1.36	0.60	100.00	9
IIA2						0.75	1.9	41.0	58.00	0.21	0.20	16.00	4
IIB2t	0.023					1.08	5.1	49.0	31.00	0.25	0.40	6.40	0
IIC			None						26.00	0.46	0.40	9.80	

lent #	Soil Fraction	% Gravel	pH	NaF pH	Exchangeable CEC	Ca	Mg	Na	K	Soluble Ca	Mg	Na	K	CO_3	HCO_3	Cl
					meq/100 g					meq/1000 g						
5-2-A1	0.65	35.09	5.90			5.94	0.93	0.05	0.87	0.56	0.14	0.04	0.34	Nil	0.87	0.88
IIA2	0.69	31.46	6.20			5.43	0.55	0.05	0.16	0.24	0.04	0.02	0.02	Nil	0.35	0.35
IIB2t	0.55	45.31	6.40		10.45	7.93	0.75	0.01	0.16	0.23	0.04	0.42	0.01	Nil	0.37	0.39
IIC	0.54	45.78	6.60	9.40						0.25	0.07	0.02	0.01	Nil	0.36	0.30
5-3-A2	0.63	37.14	4.70	8.00		2.27	0.80	0.09	0.46	0.30	0.18	0.12	0.17	Nil	0.69	0.67
Bir	0.65	34.76	5.40		27.00	0.94	0.23	0.04	0-23	0.12	0.04	0.08	0.06	Nil	0.53	0.82
IIA2	0.54	46.49	5.45		6.10	1.04	0.46	0.05	0.10	0.06	0.04	0.04	0.02	Nil	0.21	0.21
IIB2t	0.53	47.44	5.70		4.99	3.05	1.15	0.05	0.14	0.04	0.03	0.01	0.01	Nil	0.21	0.21
IIC	0.57	42.88	5.90	9.00						0.06	0.04	0.02	0.01	Nil	0.28	0.24
6-1-A2	0.62	37.77	4.30	8.00		0.53	0.48	0.04	0.19	0.21	0.19	0.13	0.08	Nil	0.63	0.85
Bir	0.44	56.51	5.30		33.70	0.19	0.06	0.02	0.07	0.14	0.05	0.10	0.01	Nil	0.63	0.48
IIB2	0.60	39.76	5.40		7.35	0.20	0.07	0.04	0.06	0.04	0.03	0.06	0.01	Nil	0.30	0.30
6-2-A2	0.58	41.77	4.50	7.90						0.18	0.15	0.06	0.05	Nil	0.42	0.42
Bir	0.53	47.40	5.80		17.45	1.69	0.35	0.04	0.17	0.07	0.04	0.07	0.01	Nil	0.53	0.35
B3	0.42	58.46	5.80		8.87	1.50	0.49	0.05	0.08	0.04	0.02	0.04	0.00	Nil	0.33	0.19
C	0.49	50.80	5.55							0.13	0.05	0.07	0.01	Nil	0.22	0.42
6-3-A1	0.33	66.66	5.40		20.30	0.89	0.26	0.04	0.31	0.12	0.04	0.08	0.10	Nil	0.69	0.61
B2ir	0.35	65.13	5.50		10.53	0.14	0.06	0.05	0.11	0.05	0.02	0.02	0.02	Nil	0.34	0.34
B3	0.45	55.12	5.40		8.63	0.20	0.06	0.10	0.11	0.02	0.01	0.02	0.02	Nil	0.30	0.20
6-4-A1	0.41	59.39	5.00	8.80						0.25	0.17	0.05	0.16	Nil	0.76	1.02
B21	0.47	53.51	5.30		19.10	0.19	0.12	0.04	0.22	0.11	0.04	0.07	0.04	Nil	0.67	0.71
B22	0.42	58.43	5.10		6.72	0.19	0.17	0.24	0.07	0.05	0.02	0.05	0.01	Nil	0.27	0.36
72-1-A2	0.68	32.03	4.80			2.08	0.89	0.04	0.43	0.19	0.16	0.10	0.13	Nil	0.99	0.97
Bir	0.46	54.18	5.75		24.60	0.80	0.28	0.05	0.20	0.04	0.04	0.04	0.03	Nil	0.68	0.43
72-2-A2	0.49	51.28	5.10			4.64	0.84	0.04	0.43	0.63	0.20	0.05	0.26	Nil	1.21	1.13
Bir	0.58	41.73	5.25			5.99	0.17	0.03	0.19	0.06	0.04	0.03	0.04	Nil	0.44	0.44
72-3-A1	0.51	49.19	5.60			7.08	0.94	0.05	0.34	0.17	0.05	0.02	0.04	Nil	0.34	0.30
Bir	0.49	51.53	5.95		12.15	3.24	0.60	0.05	0.30	0.11	0.04	0.02	0.01	Nil	0.34	0.34
72-4-A2	0.42	57.82	5.50			3.86	0.78	0.04	0.49	0.36	0.12	0.05	0.14	Nil	0.79	0.51
Bir	0.49	51.72	5.40			1.29	0.31	0.03	0.21	0.06	0.03	0.02	0.03	Nil	0.32	0.32

Analysis by: Soil and Plant Analytical Laboratory University of Idaho

December 1977

Ident #	% N	Exchangeable H+ meq/100 g	$CaCO_3$ Equiv. %	Gypsum %	% OM*	% OM	1:5 NaOAC P ppm	1:5 NaOAC K meq/l	Fe	Zn	Cu	Mn	SO_4
									ppm				
26-2-A1	0.300					11.50	4.8	302.5	46.00	0.54	0.60	8.60	
IIA2						2.30	0.5	62.5	25.00	0.26	0.40	4.60	9
IIB2t	0.049					1.64	1.2	49.0	39.00	0.16	0.60	20.00	7
IIC			None						35.00	0.30	0.80	20.50	
26-3-A2							5.1		500.00	0.42	0.40	1.60	33
Bir	0.158					5.75	4.2	84.0	160.00	1.19	0.80	24.00	26
IIA2						1.58	2.5	45.0	78.00	0.42	0.40	10.60	18
IIB2t	0.035					1.58	2.9	47.0	59.50	0.28	0.70	26.00	0
IIC			None						110.00	0.24	0.80	51.00	
56-1-A2					7.47				380.00	5.50	0.60	9.60	
Bir	0.139						6.0	27.5					28
IIB2	0.038						1.9	27.5					23
56-2-A2					4.78								
Bir	0.079												23
B3	0.044												11
C													
56-3-A1	0.096												16
B2ir	0.107												23
B3	0.095												14
56-4-A1					11.16								
B21	0.204												31
B22	0.194												9
72-1-A2	0.249												11
Bir	0.246												28
72-2-A2	0.241												16
Bir	0.143												23
72-3-A1	0.195												4
Bir	0.278												21
72-3-A2	0.124												21

*Walkley-Black modified method

Burlington Northern

Pedon: Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	vol.	Textural Classes
cm	%								%		
14-1-A1	0.67	0.93	0.33	0.77	0.68	3.38	73.75	22.87	NONE	--	Silt Loam
B2	0.05	0.11	0.03	0.12	1.02	1.33	82.77	15.90	NONE	--	Silt Loam
C	0.08	0.08	0.02	0.18	3.58	3.94	89.46	6.60	NONE	--	Silt
14-2-A1	2.78	3.72	2.56	4.22	2.90	16.18	68.85	14.97	27.33	--	Gr. Silt Loam
B2t	0.37	0.51	0.23	0.39	0.50	2.00	70.87	27.13	32.06	--	Gr. Silty Clay Loa
C	0.05	0.21	0.11	0.27	0.48	1.12	71.65	27.23	TRACE	--	Silty Clay Loa

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
14-1-A1					30.31	17.74				
B2					36.04	14.13	31.98	25.83		6.15
C					32.68	7.23	25.63	23.70		1.93
14-2-A1					29.77	17.34			--	
B2t					31.00	21.80	32.05	24.11		7.94
C					32.77	20.65	32.48	23.03		9.45

Remarks: Centrifuge method, Carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Burlington Northern
Pedon: Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	>2 mm vol.	Textural Classes
cm	%								%		
21-1-Bir	3.27	5.39	2.08	4.20	8.99	23.93	68.15	7.93	53.18	--	V.Gr. Silt Loam
IIA2	2.02	2.51	1.23	3.11	7.72	16.59	72.21	11.19	35.66	--	Gr. Silt Loam
IIB2	10.34	13.86	5.79	8.89	6.61	45.49	46.89	7.63	70.67	--	V.Gr. Loam
IIC	13.78	14.09	5.95	10.35	6.80	50.97	41.32	7.70	62.27	--	V.Gr. Loam
21-2-A2											
Bir	2.01	3.32	1.82	4.69	8.44	20.28	68.86	10.87	36.80	--	Gr. Silt Loam
IIA2	3.57	3.73	1.91	5.50	8.89	23.60	62.28	14.12	36.29	--	Gr. Silt Loam
IIB2t	4.11	5.45	2.55	6.11	7.68	25.90	54.70	19.41	32.41	--	Gr. Silt Loam
IIC	6.51	9.89	4.84	7.73	6.88	35.85	48.41	15.74	61.59	--	V.Gr. Loam

-06-

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
21-1-Bir						48.37	24.21			
IIA2										
IIB2						21.74	12.22	NDNP	NDNP	NDNP
IIC								NDNP	NDNP	NDNP
21-2-A2										
Bir						44.23	22.59			
IIA2										
IIB2t						24.12	16.72	NDNP	NDNP	NDNP
IIC								NDNP	NDNP	NDNP

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Burlington Northern
Pedon: Montana Forest Service

Date: December. 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	>2 mm vol.	Textural Classes
cm	%								%		
22-1-Bir	8.53	8.74	3.72	6.07	7.43	34.49	58.40	7.11	40.66	--	Gr. Silt Loam
IIA2	23.70	19.14	6.27	6.46	4.24	59.81	36.32	3.88	64.12	--	V.Gr. Coarse Sandy loam
IIB2t	7.31	7.63	3.65	6.16	4.98	29.73	61.74	8.53	42.73	--	Gr. Silt Loam
26-1-Bir	7.56	7.66	3.81	5.78	8.03	32.84	58.35	8.80	33.78	--	Gr. Silt Loam
IIA2	4.32	5.58	3.58	8.28	9.84	31.60	61.62	6.78	34.19	--	Gr. Silt Loam
IIB2t	0.54	1.68	1.17	4.19	9.20	16.78	72.72	10.49	47.29	--	Gr. Silt Loam
IIC	0.85	2.24	1.07	3.21	6.79	14.16	74.64	11.19	39.76	--	Gr. Silt Loam

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc		%			%	
22-1-Bir						37.57	17.36			
IIA2										
IIB2t						20.00	3.70	NDNP	NDNP	NDNP
26-1- Bir						34.56	9.51	NDNP	NDNP	NDNP
IIA2										
IIB2t						24.37	4.04	24.45	22.68	1.77
IIC						25.42	5.57	25.10	21.78	3.32

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Burlington Northern
Pedon: Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	>2 mm vol.	Textural Classes
cm	%								%		
26-2-A1	4.07	5.30	2.90	5.84	5.19	23.30	54.79	21.92	35.09	--	Gr. Silt Loam
IIA2	3.86	6.66	3.56	5.84	5.05	24.97	53.84	21.18	31.46	--	Gr. Silt Loam
IIB2t	4.76	5.64	2.84	5.43	2.30	20.97	51.51	27.52	45.31	--	Gr. Clay Loam
IIC	3.51	5.43	2.83	5.50	5.01	22.28	51.79	25.94	45.78	--	Gr. Silt Loam
26-3-A2											
Bir	4.34	6.12	3.39	5.47	10.85	30.17	63.52	6.31	34.76	--	Gr. Silt Loam
IIA2	11.91	11.26	5.96	9.77	6.18	45.08	46.16	8.76	46.49	--	Gr. Loam
$IIB2_t$	3.21	4.44	2.37	5.12	5.07	20.21	58.67	21.13	47.44	--	Gr. Silt Loam
IIC	4.05	5.26	3.05	5.39	5.07	22.82	56.62	20.56	42.88	--	Gr. Silt Loam

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
26-2-A1										
IIA2										
IIB2t						24.62	10.07	28.40	21.02	7.38
IIC						41.01	9.14	29.45	19.51	9.94
26-3-A2										
Bir						23.94	12.48			
IIA2										
IIB2t						23.89	6.56	24.04	20.08	3.96
IIC						40.80	6.00	22.70	19.44	2.26

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Burlington Northern
Pedon: Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm)								Gravel & Stone		
	VCS	CS	MS	FS	VFS	TS	TSi	TC	> 2 mm		Textural
	2-1.0	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	2-0.05	0.05-0.002	< 0.002	wt.	vol.	Classes
cm	%								%		
28-1- A2											
Bir	7.85	10.68	5.16	6.06	7.87	37.62	56.34	6.02	51.61	--	V.Gr. Silt Loam
IIB2	29.82	31.77	12.07	9.65	2.69	86.00	13.38	0.63	79.66	--	V.Gr. Loamy Coarse Sa
IIC	33.03	38.98	12.08	6.65	0.96	91.70	7.25	1.06	52.75	--	V.Gr. Coarse Sand
28-2-A2											
Bir	7.49	6.48	2.29	4.28	7.93	28.47	65.33	6.21	36.35	--	Gr. Silt Loam
IIB2	11.90	12.14	4.63	8.87	9.22	46.76	46.05	7.18	57.27	--	V.Gr. Loam
IIC	34.66	24.07	6.29	7.38	4.97	77.37	19.20	3.45	78.48	--	V.Gr. Loamy Coarse Sa

Depth	Silt Size Distribution (mm)			Bulk	Water Content		Liquid	Plastic	Plastic
	CoSi	MSi	FSi	Density	1/10 Bar	1/3 Bar	15 Bar	Limit	Limit	Index
	0.05-0.02	0.02-0.005	0.005-0.002							
cm	%			g/cc	%			%		
28-1- A2										
Bir						41.77	23.97			
IIB2						6.78	3.49			
IIC										
28-2- A2										
Bir						42.23	16.27			
IIB2						19.66	9.12			
IIC										

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Burlington Northern
Pedon: Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	vol.	Textural Classes
cm	%								%		
56-1- A2											
Bir	2.38	2.60	1.03	2.43	10.70	19.14	70.68	10.19	56.51	--	V.Gr. Silt Loam
IIB2	10.58	11.40	5.27	9.60	7.31	44.16	46.75	9.09	39.76	--	Gr. Loam
56-2- A2											
Bir	4.33	3.97	2.04	5.19	9.73	25.26	64.16	10.58	47.40	--	Gr. Silt Loam
B3	2.36	4.30	2.37	7.37	11.26	27.66	62.30	10.06	58.46	--	V.Gr. Silt Loam
C	1.78	3.33	2.00	6.92	11.60	25.63	63.33	11.04	50.80	--	V.Gr. Silt Loam

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
56-1-A2										
Bir										
IIB2										
56-2-A2										
Bir						28.97	10.52			
B3							5.20			
C										

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Pedon: Burlington Northern
Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	>2 mm vol.	Textural Classes
cm	%								%		
56-3-A1											
B2ir	12.59	17.71	7.88	9.79	4.25	52.22	36.49	11.30	65.13	--	V.Gr.Coarse Sandy Loam
B3	14.11	18.48	8.62	11.56	5.15	57.92	29.34	12.72	55.12	--	V.Gr.Coarse Sandy Loam
56-4-A1											
B21	7.94	9.60	4.23	5.98	6.24	33.99	55.55	10.46	53.51	--	V.Gr. Silt Loam
B22	6.28	10.11	5.34	8.18	5.86	35.77	50.34	13.88	58.43	--	V.Gr. Silt Loam

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
56-3-A1										
B2ir						25.34	6.11			
B3						20.03	5.75			
56-4-A1										
B21										
B22										

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

Pedon: Burlington Northern Montana Forest Service

Date: December 1977

Depth	Particle Size Distribution (mm) VCS 2-1.0	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	TSi 0.05-0.002	TC <0.002	Gravel & Stone >2 mm wt.	vol.	Textural Classes
cm	%								%		
72-1-A2 Bir	7.13	4.88	1.79	3.66	9.55	27.01	64.57	8.43	54.18	--	V. Gr. Silt Loam
72-2-A2 Bir											
72-3-A1 Bir	7.94	8.54	4.16	6.09	2.87	29.60	55.25	15.15	51.53	--	V. Gr. Silt Loam
72-4-A2 Bir											

Depth	Silt Size Distribution (mm) CoSi 0.05-0.02	MSi 0.02-0.005	FSi 0.005-0.002	Bulk Density	Water Content 1/10 Bar	1/3 Bar	15 Bar	Liquid Limit	Plastic Limit	Plastic Index
cm	%			g/cc	%			%		
72-1-A2 Bir					41.57	12.85	NDNP	NDNP	NDNP	
72-2-A2 Bir					29.55	8.55				
72-3-A1 Bir					33.16	7.88	NDNP	NDNP	NDNP	
72-4-A2 Bir					25.83	7.91				

Remarks: Centrifuge method, carbonates removed if present.
5% Sodium Hexametaphosphate added.

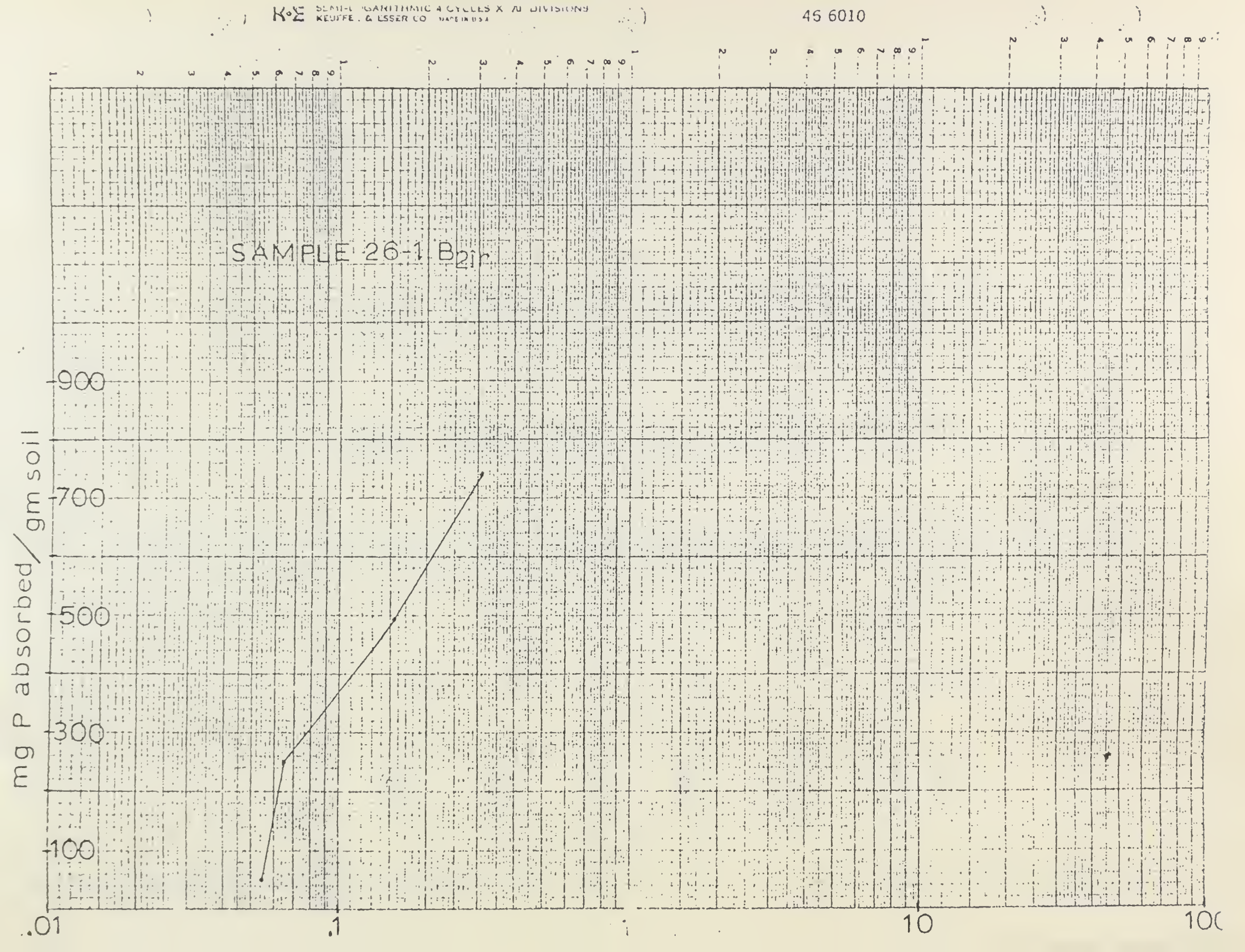
Analysis by: Debbie Hall
1/3 & 15 - Anita Falen

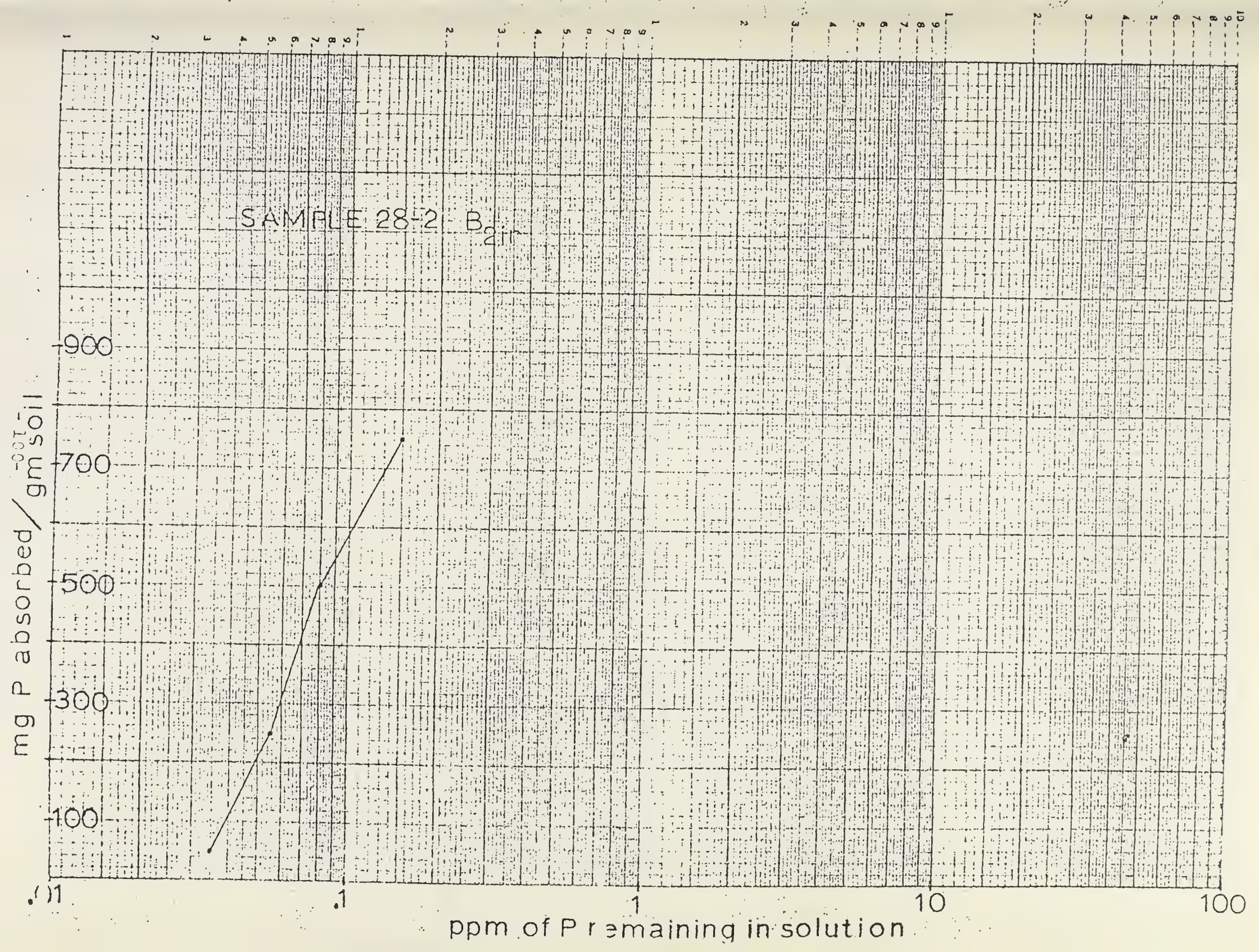
Burlington Northern
Missoula, Montana Forest Service

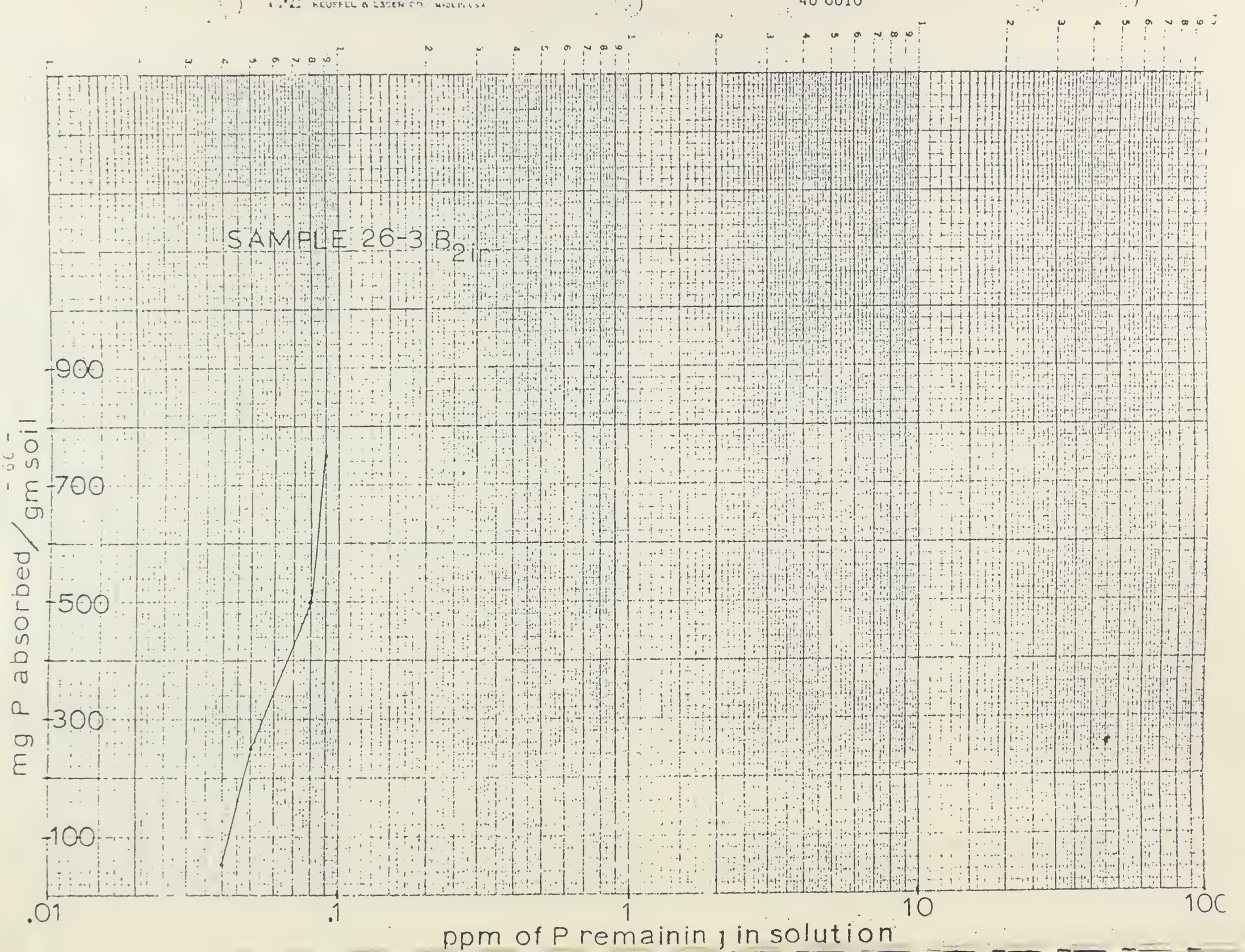
Phosphorus Isotherm
12/13/77

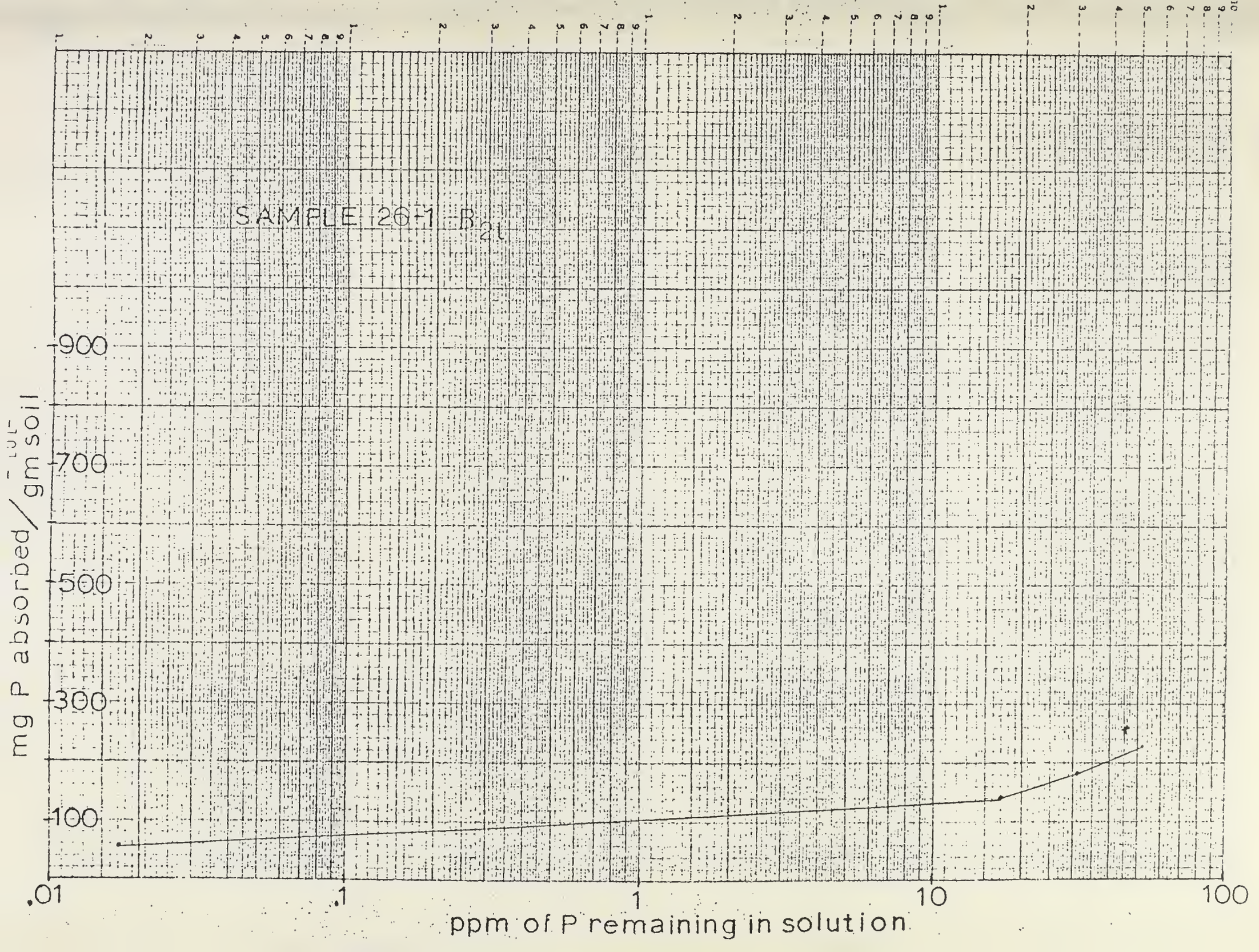
Ident #	Lab #	Equilibrium Solution	P PPM	mg P Absorbed Per Grams Sol
28-2 (B_{2ir})	12	5	.035	49.70
		25	.055	250.00
		50	.08	500.00
		75	.15	750.00
26-1 (B_{2ir})	27	5	.055	49.50
		25	.065	249.50
		50	.155	498.50
		75	.31	740.70
26-1 (IIB_{2t})	29	5	.17	48.30
		25	10.71	142.80
		50	31.86	181.40
		75	52.20	228.00
26-2 (IIB_{2t})	33	5	.35	49.70
		25	1.73	232.70
		50	11.88	381.20
		75	26.46	485.40
26-3 (B_{2ir})	36	5	.04	49.60
		25	.05	250.00
		50	.08	500.00
		75	.09	750.00
26-3 (IIB_{2t})	38	5	.03	49.70
		25	2.87	221.30
		50	16.20	338.00
		75	35.64	393.60

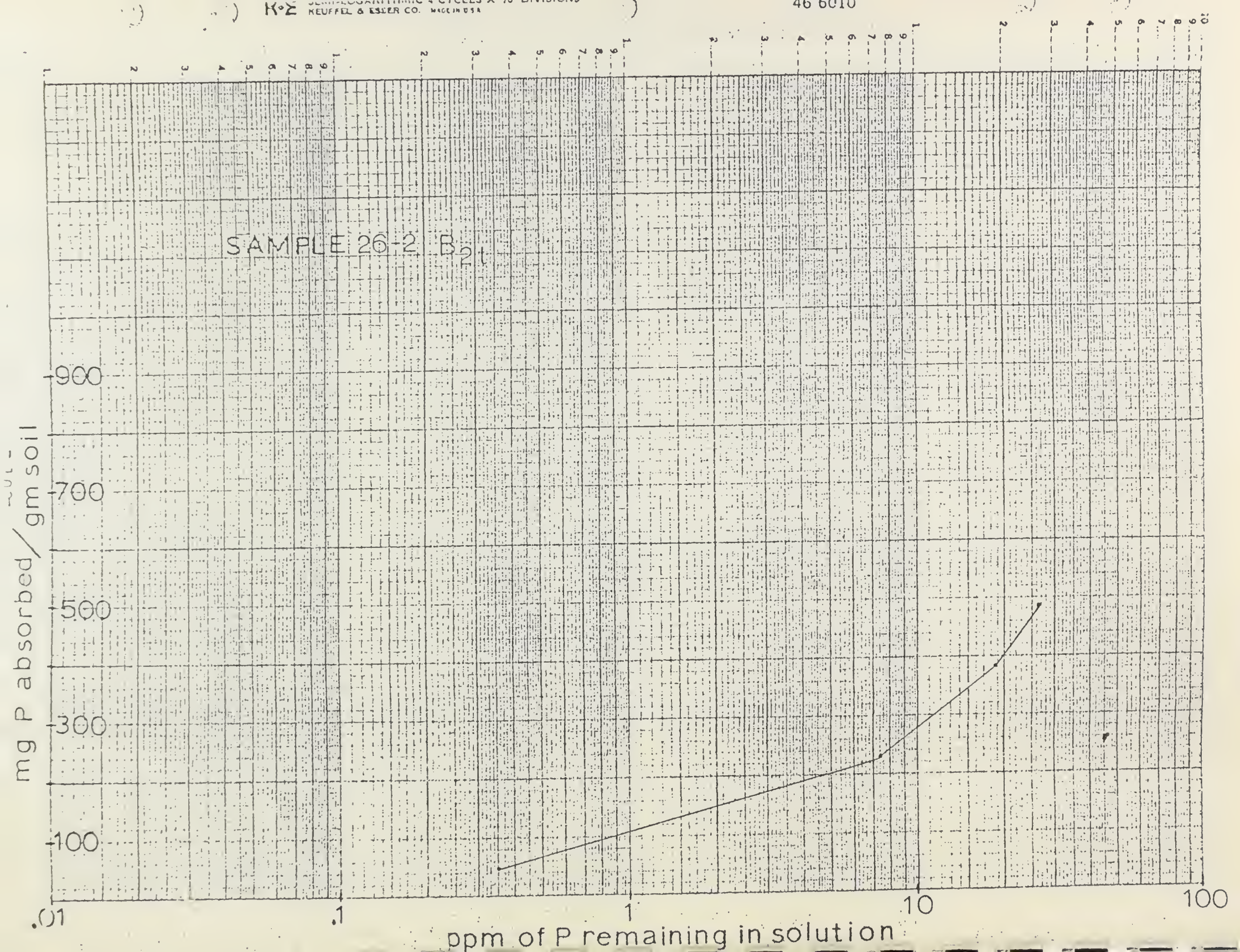
Analysis by: Soil and Plant
Analytical Laboratory
University of Idaho

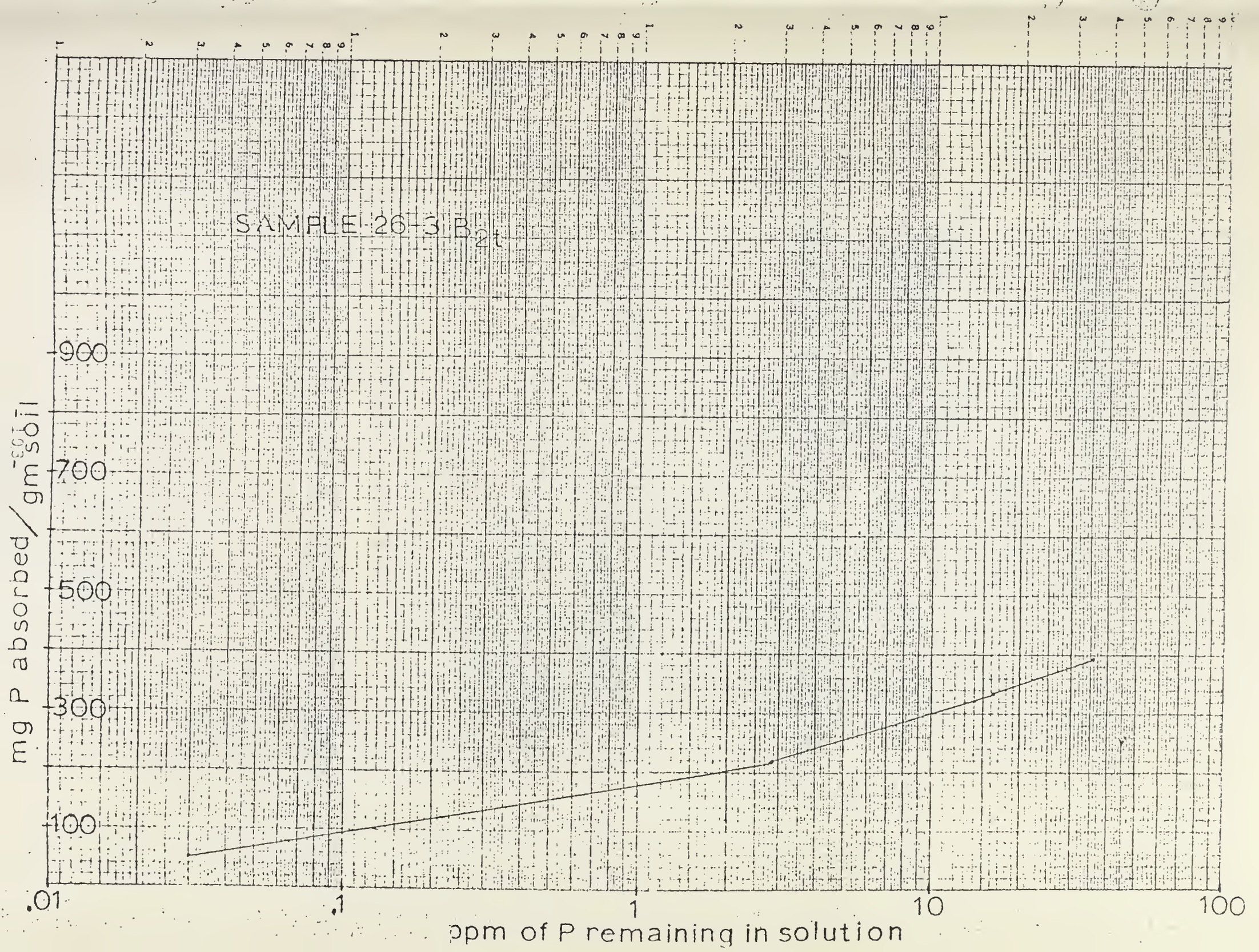

K•Σ SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO MADE IN U.S.A.
46 6010
SAMPLE 26-1 B2ir
mg P absorbed/gm soil
900
700
500
300
100
.01
.1
10
100


SAMPLE 28-2 B21
900
700
500
300
100
mg P absorbed / gm soil
.01
.1
1
10
100
ppm of P remaining in solution


SAMPLE 26-3 B_{2i}
900
700
500
300
100
mg P absorbed / gm soil
.01
.1
1
10
100
ppm of P remaining in solution


SAMPLE 26-1 B_{21t}
900
700
500
300
100
mg P absorbed / gm soil
.01
.1
1
10
100
ppm of P remaining in solution


K•E KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6010
SAMPLE 26-2 B21
900
700
500
300
100
mg P absorbed / gm soil
.01
.1
1
10
100
ppm of P remaining in solution


SAMPLE 26-3 B2t
900
700
500
300
100
mg P absorbed / gm soil
.01
.1
1
10
100
ppm of P remaining in solution

1. Warm and Dry

Pinus ponderosa/Agropyron spicatum h.t. - PP/Agsp
Pinus ponderosa/Festuca idahoensis h.t. - PP/Feid
a. Festuca idahoensis
b. Festuca scabrella phase
Pinus ponderosa/Symphoricarpos albus h.t. - PP/Syal
a. Symphoricarpos albus phase
Pseudotsuga menziesii/Agropyron spicatum h.t. - DF/Agsp
Pseudotsuga menziesii/Festuca idahoensis h.t. - DF/Feid
Pseudotsuga menziesii/Festuca scarbrella h.t. - DF/Fesc

2. Moderately Warm and Dry

Pseudotsuga menziesii/Spiraea betulifolia h.t. - DF/Spbe
Pseudotsuga menziesii/Calamgrostis rubescens h.t. - DF/Caru
a. Agropyron spicatum phase
b. Arctostaphylos uva-ursi phase
c. Calamagrostis rubescens phase
Pseudotsuga menziesii/Symphoricarpos albus h.t. - DF/Syal
a. Agropyron spicatum phase
b. Calamagrostic rubescens phase
c. Symphoricarpos albus phase
Pseudotsuga menziesii/Physocarpus malvaceus h.t. - DF/Phma
a. Physocarpus malvaceus phase
b. Calamagrostis rubescens phase
Pseudotsuga menziesii/Linnaea borealis h.t. - DF/Libo
a. Symphoricarpos albus phase
b. Calamagrostis ruvescens phase
Pseudotsuga menziesii/Xerophyllum tenax h.t. - DF/Xete
a. Vaccinium globulare phase
b. Arctostaphylos uva-ursi phase
Pseudotsuga menziesii/Vaccinium globulare h.t. - DF/Vagl
b. Arctostaphylos uva-ursi phase

3. Moderately Cool and Moist

Picea/Vaccinium caespitosum h.t. - S/Vaca
Picea/Linnaea borealis h.t. - S/Libo
Picea/Clintonia uniflora h.t. - S/Clun
a. Vaccinium caespitosum phase
b. Clintonia uniflora phase
Picea/Equisetum arvense h.t. - S/Eqar
Abies grandis/Xerophyllum tenax h.t. - GF/Xete
Abies grandis/Clintonia uniflora h.t. - GF/Clun
a. Clintonia uniflora phase
b. Aralia nudicaulis phase
Thuja plicata/Clintonia uniflora h.t. - WRC/Clun
a. Clintonia uniflora phase
b. Aralia nudicaulis phase
c. Menziesia ferruginea phase

3. Moderately Cool and Moist (continued)

Thuja plicata/Oplopanax horridum h.t. - WRC/Opho
Tsuga heterophylla/Clintonia uniflora h.t. - WH/Clun
a. Clintonia uniflora phase
b. Aralia nudicaulis phase

4. Cool and Moist

Abies lasiocarpa/Vaccinium caespitosum h.t. - AF/Vaca
a. Vaccinium caespitosum phase
b. Calamagrostis canadensis phase
Abies lasiocarpa/Linnaea borealis h.t. - AF/Libo
a. Linnaea borealis phase
b. Xerophyllum tenax phase
Abies lasiocarpa/Xerophyllum tenax h.t. - AF/Xete
a. Vaccinium globulare phase
Abies lasiocarpa/Galium triflorum h.t. - AF/Gatr
a. Galium triflorum phase
Abies lasiocarpa/Clintonia uniflora h.t. - AF/Clun
a. Clintonia uniflora phase
b. Aralia nudicaulis phase
c. Xerophyllum tenax phase
d. Menziesia ferruginea
Abies lasiocarpa/Calamagrostis canadensis h.t. - AF/Caca
Abies lasiocarpa/Oplopanax horridum h.t. - AF/Opho
Abies lasiocarpa/Alnus sinuata c.t.
Abies lasiocarpa/Menziesia ferruginea h.t. - AF/Mefe
Abies lasiocarpa/Luzula hitchcockii h.t. - AF/Luhi
b. Menziesia ferruginea phase

5. Cool and Moderately Dry

Abies lasiocarpa/Lusula hitchcockii h.t. - AF/Luhi
a. Vaccinium scoparium phase
Abies lasiocarpa/Xerophyllum tenax h.t. - AF/Xete
b. Vaccinium scoparium phase
Abies lasiocarpa/Vaccinium scoparium h.t. - AF/Vasc
b. Vaccinium scoparium phase
Abies lasiocarpa (Pinus albicaulis)/Vaccinium scoparium h.t. - AF (WBP) Vasc
Pinus albicaulis-Abies lasiocarpa h.t. - WBP-AF
Larix lyallii-Abies lasiocarpa h.t. - AL-AF

Done By: Danny On, Flathead National Forest, 1975

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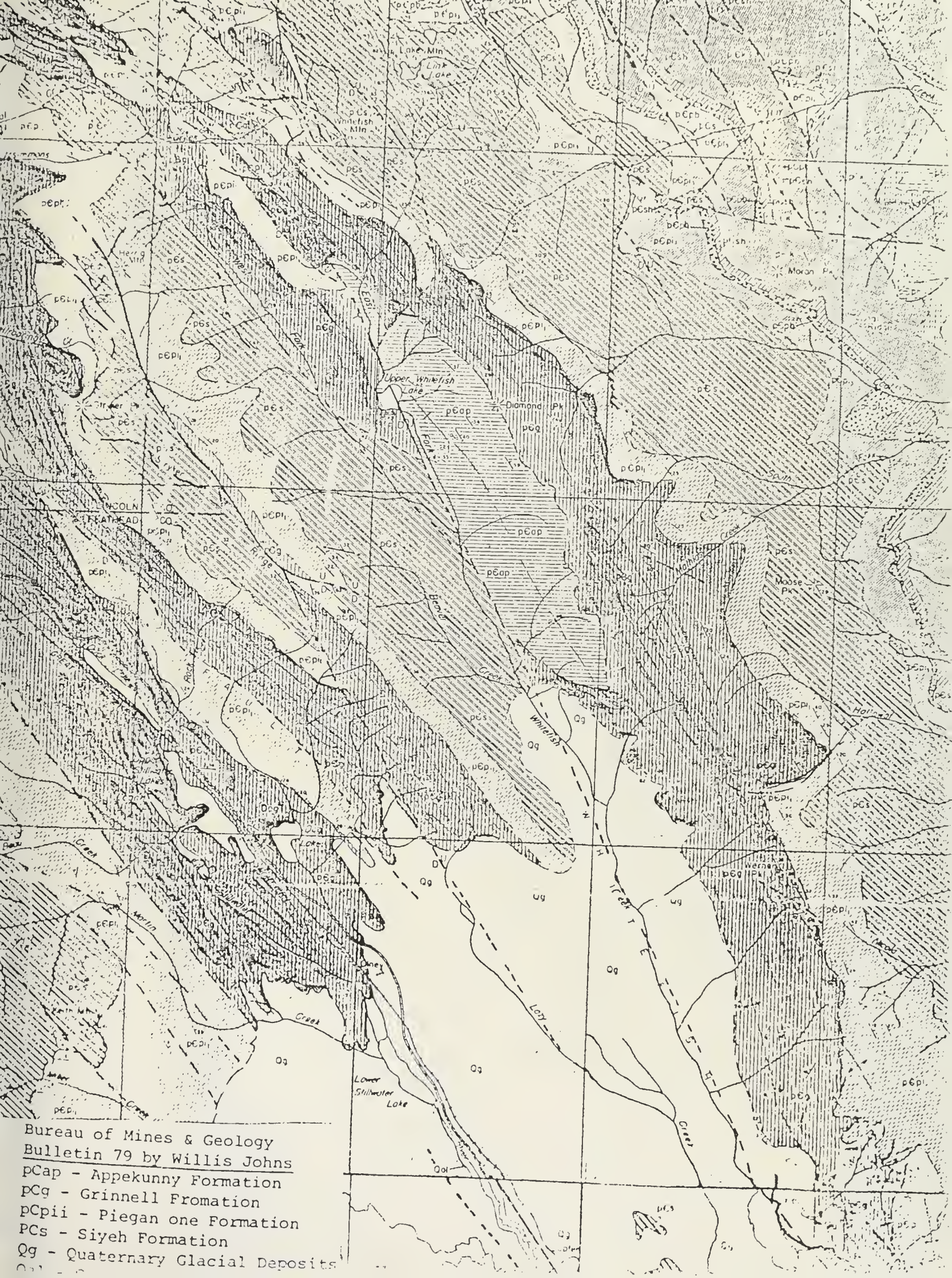
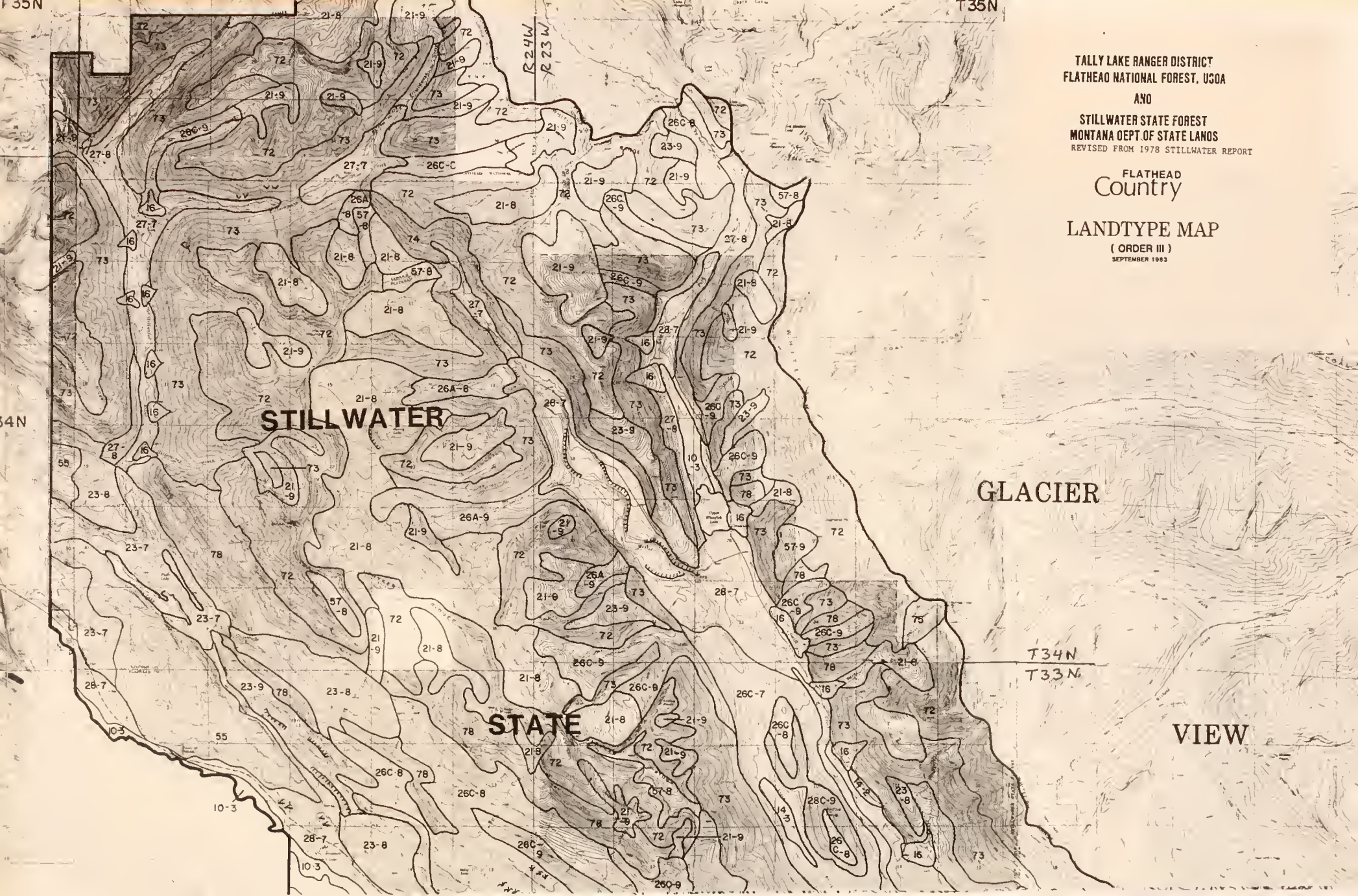
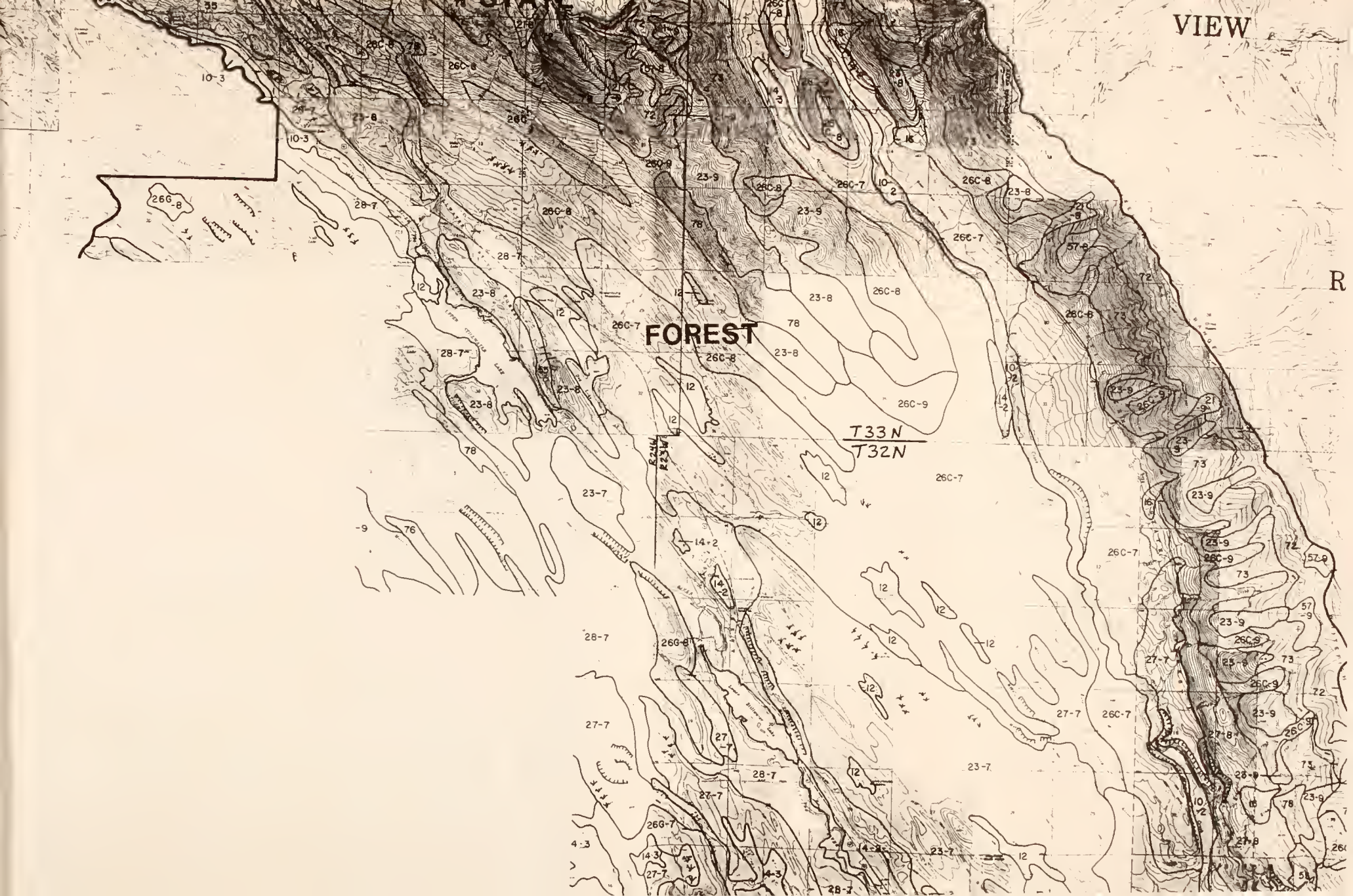

Bureau of Mines & Geology
Bulletin 79 by Willis Johns
pCap - Appekunny Formation
pCg - Grinnell Fromation
pCpii - Piegan one Formation
PCs - Siyeh Formation
Qg - Quaternary Glacial Deposits
Lake Mtn
Link Lake
Whitefish Mtn
Upper Whitefish Lake
Diamond Pk
Moose Pk
Whitefish
Lower Stillwater Lake
Loop
Creek
Fork


TALLY LAKE RANGER DISTRICT
FLATHEAD NATIONAL FOREST, USDA
AND
STILLWATER STATE FOREST
MONTANA DEPT OF STATE LANDS
REVISED FROM 1978 STILLWATER REPORT
FLATHEAD
Country
LANDTYPE MAP
(ORDER III)
SEPTEMBER 1983
STILLWATER
STATE
GLACIER
VIEW
T35N
T34N
T33N
R24W
R23W


VIEW
FOREST
T33N
T32N
R24W
R23W