1-D

ADDENDUM 3.3-B

SOIL MAPPING UNIT DESCRIPTIONS and SOILS MAP

110: Bidman loam, loamy substratum, 0 to 6 percent slopes[1]

The Bidman loam, loamy substratum, map unit consists of very deep, well-drained soils that developed from alluvium derived from calcareous shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Bidman loam, loamy substratum. Within this map unit the following additional components are found: Bidman loam, Forkwood, Felix ponded, and Ulm. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bidman loam, loamy substratum soil is slow. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil due to the high clay content of the soil. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

144: Forkwood loam, 0 to 6 percent slopes[1]

The Forkwood loam map unit consists of very deep, well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Forkwood loam. Within this map unit the following additional components are found: Cambria, Ulm, and Wyotite. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Forkwood loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year the production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with the high clay content being the limiting factor. It is a fair choice for roadfill with the low strength being the limiting factor. As for reclamation material it is a fair choice for the following reasons: low organic matter content, the high clay content, and water erosion.

[1]Map unit description based on 2002 South Campbell County NRCS information.

156: Hiland fine sandy loam, 0 to 6 percent slopes[1]

The Hiland fine sandy loam map unit consists of very deep, well-drained soils that developed from alluvium and eolian deposits derived from sandstone and shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,300 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 85 percent Hiland fine sandy loam. Within this map unit the following additional components are found: Forkwood, Maysdorf, Moskee, and Vonalee. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Hiland fine sandy loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Production and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil, no limitations are found. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reason, low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

226: Ulm loam, 0 to 6 percent slopes[1]

The Ulm loam map unit consists of very deep, well-drained soils that developed from alluvium derived from calcareous shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 46 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

It map unit is approximately 85 percent Ulm loam. Within this map unit the following additional components are found: Bidman, and Forkwood. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Ulm loam soil is slow. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is moderate, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year the production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with high clay content being the limiting factor. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: high clay content, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

227: Ulm clay loam, 0 to 6 percent slopes[1]

The Ulm clay loam map unit consists of very deep, well-drained soils that developed from alluvium derived from calcareous shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 46 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

It map unit is approximately 85 percent Ulm clay loam. Within this map unit the following additional components are found: Bidman, and Forkwood. Inclusions comprise approximately 15 percent of the map unit.

Permeability within the Ulm clay loam soil is slow. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is moderate, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit. They are as follows: Green needlegrass, Western wheatgrass, Blue grama, and Skyline bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,400 lbs/acre. In a normal year the production is 1,000 lbs/acre. Also in an unfavorable (drought) year the production is approximately 600 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill and reclamation material. This unit is a poor choice for topsoil due to the high clay content of the soil. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, low organic matter content, and water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

235: Vonalee fine sandy loam, 0 to 10 percent slopes[1]

The Vonalee fine sandy loam map unit consists of very deep, well-drained soils that developed from alluvium and eolian deposists derived from calcareous sandstone. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Vonalee fine sandy loam. Within this map unit the following additional components are found: Hiland, Keeline, Terro, and areas with 10 to 15 percent slopes. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Vonalee fine sandy loam soil is moderately rapid. The Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is low and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year the production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reason, low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

111-1: Bidman loam, 0 to 6 percent slopes[1]

The Bidman loam, map unit consists of very deep, well-drained soils that developed from alluvium derived from calcareous shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Bidman loam. Within this map unit the following additional components are found: Cushman, Forkwood, Felix ponded, Parmleed, and Ulm. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bidman loam, soil is slow. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year the production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil due to the high clay content of the soil. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

111-2: Parmleed loam, 0 to 6 percent slopes[1]

The Parmleed loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from calcareous shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 48 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Parmleed loam. Within this map unit the following additional components are found: Bidman, Cushman, Forkwood, Felix ponded, and Ulm. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Parmleed loam soil is slow. The available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is slow to moderate and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 pounds. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil due to the high clay content of the soil. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, depth to bedrock, droughtiness, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

112-1: Bidman loam, 6 to 15 percent slopes[1]

The Bidman loam, map unit consists of very deep, well-drained soils that developed from alluvium derived from calcareous shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Bidman loam. Within this map unit the following additional components are found: Cushman, Forkwood, Parmleed, and Worfka. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bidman loam, soil is slow. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil due to the high clay content of the soil. It is a poor source for roadfill due to the low strength and the shrink-swell capacity, As for reclamation material it is a poor choice for the following reasons: high clay content and water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

112-2: Parmleed loam, 6 to 15 percent slopes[1]

The Parmleed loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from calcareous shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 48 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Parmleed loam. Within this map unit the following additional components are found: Bidman, Cushman, Forkwood, and Worfka. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Parmleed loam soil is slow. The available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is slow to moderate and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil due to the high clay content, slope and depth to bedrock. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, droughtiness, depth to bedrock, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

116-1: Cambria loam, 0 to 6 percent slopes[1]

The Cambria loam map unit consists of very deep, well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on alluvial fans and fan remnants are elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Cambria loam. Within this map unit the following additional components are found: Cushman, Forkwood, Kishona, poorly drained soils, Ulm and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cambria loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a fair source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

116-2: Kishona loam, 0 to 6 percent slopes[1]

The Kishona loam map unit consists of very deep well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Kishona loam. Within this map unit the following additional components are found: Cambria, Cushman, Forkwood, poorly drained soils, Ulm, and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Kishona loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

116-3: Zigweid loam, 0 to 6 percent slopes[1]

The Zigweid loam map unit consists of very deep, well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on alluvial fans and fan remnants at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Zigweid loam. Within this map unit the following additional components are found: Cambria, Cushman, Forkwood, Kishona, poorly drained soils, and Ulm. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Zigweid loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

117-1: Cambria loam, 6 to 15 percent slopes[1]

The Cambria loam map unit consists of very deep, well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Cambria loam. Within this map unit the following additional components are found: Cushman, Forkwood, Kishona, Theedle and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cambria loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a fair source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

117-2: Kishona loam, 6 to 20 percent slopes

The Kishona loam map unit consists of very deep well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on stream terraces at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Kishona loam. Within this map unit the following additional components are found: Cambria, Cushman, Forkwood, Theedle, and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Kishona association soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

122-1: Cushman loam, 6 to 15 percent slopes[1]

The Cushman loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43to 51egrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Cushman loam. Within this map unit the following additional components are found: Bowbac, Cambria, Forkwood, Worf, and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: depth to bedrock, droughtiness, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

124-1: Cushman loam, 6 to 15 percent slopes[1]

The Cushman loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,400 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43to 51egrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Cushman loam. Within this map unit the following additional components are found: Areas with 3 to 6 percent slopes, Cambria, Renohill, Samday, Shingle, Theedle, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock and slope being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: depth to bedrock, droughtiness, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

124-2: Shingle loam, 3 to 30 percent slopes[1]

The Shingle loam map unit consists of shallow, well-drained soils that developed from residuum weathered from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,400 feet

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Shingle loam. Within this map unit the following additional components are found: Areas with 3 to 6 percent slopes, Cambria, Cushman, Renohill, Samday, Theedle, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Shingle loam soil is moderate. The available water capacity is very low. Effective rooting depth is 10 to 20 inches. Surface runoff is very high and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Bluebunch wheatgrass, Western wheatgrass, Blue grama, Little bluestem, Needleandthread, Threadleaf sedge, and Green needlegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,200 lbs/acre. In a normal year that production is 900 lbs/acre. Also in an unfavorable (drought) year the production is approximately 450 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock and slope being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: droughtiness, depth to bedrock, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

127-2: Theedle loam, 0 to 30 percent slopes[1]

The Theedle map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from sandstone and shale. If occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Theedle loam. Within this map unit the following additional components are found: Cambria, Cushman, Kishona, and Shingle. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Theedle loam soil is moderate. The available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is high and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock and slope being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: depth to bedrock, droughtiness, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

140-1: Embry sandy loam, 3 to 20 percent slopes[1]

The Embry sandy loam map unit consists of very deep, well-drained soils that developed from alluvium and eolian deposits derived from sandstone. It occurs on hills and ridges at elevations between 4,200 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 50 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Embry sandy loam. Within this map unit the following additional components are found: Julesburg, Shingle, Taluce, and Turnercrest. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Embry sandy loam soil is moderately rapid. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reasons, low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

146-2: Cushman loam, 0 to 6 percent slopes[1]

The Cushman loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Cushman loam. Within this map unit the following additional components are found: Bowbac, Cambria, Forkwood, frequently ponded loamy soils, frequently ponded clayey soils, Hiland, and Theedle. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Cushman loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green Needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock being the limiting factor. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: droughtiness, depth to bedrock, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

147-1: Forkwood loam, 6 to 15 percent slopes[1]

The Forkwood loam map unit consists of very deep. Well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on hills and ridges at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Forkwood loam. Within this map unit the following additional components are found: Cambria, Cushman, Theedle, Ulm, and Zigweid. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Forkwood loam map unit is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with the high clay content and slope being the limiting factors. It is a fair source for roadfill due to the low strength. As for reclamation material it is a fair choice for the following reasons: high clay content, low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

153-1: Haverdad clay loam, 0 to 6 percent slopes[1]

The Haverdad association map unit consists of very deep, well-drained soils that developed from alluvium derived from sandstone and shale. If occurs on flood plains and stream terraces at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 52 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Haverdad association. Within this map unit the following additional components are found: Boruff, Clarkelen, Keeline and Kishona. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Haverdad association soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Note: This soil is subject to rare to occasional flooding for very brief periods during prolonged, high intensity storms from April through July.

Productivity and Reclamation Potential

There are seven plant species that are common to this map unit. They are as follows: Green needlegrass, Needleandthread, Slender wheatgrass, Western wheatgrass, and Sandberg bluegrass. Snowberry is the only shrub specie found within this unit. Cottonwood is the only tree specie found within this unit.

In a favorable year (above average moisture) the production is approximately 3,000 lbs/acre. In a normal year that production is 2,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 1,600 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

153-2: Kishona association, 0 to 6 percent slopes[1]

The Kishona association map unit consists of very deep well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on stream terraces at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Kishona association. Within this map unit the following additional components are found: Boruff, Clarkelen, Haverdad, and Keeline. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Kishona association soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a good source for topsoil as no limitations are found. It is a poor source for roadfill due to the low strength and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

157-2: Bowbac fine sandy loam, 0 to 6 percent slopes[1]

The Bowbac fine sandy loam map unit consists of moderately deep, well-drained soils that developed from alluvium and eolian deposits over residuum weathered from calcareous sandstone. It occurs on hills and ridges at elevations between 4,100 and 5,300 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Bowbac fine sandy loam. Within this map unit the following additional components are found: Cushman, Forkwood, Hiland, Terro, and Vonalee. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bowbac fine sandy loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock and the high clay content being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content, high clay content, droughtiness, and depth to bedrock.

[1]Map unit description based on 2002 South Campbell County NRCS information.

158-1: Hiland fine sandy loam, 6 to 15 percent slopes[1]

The Hiland fine sandy loam map consists of very deep, well-drained soils that developed from alluvium and eolian deposits derived from sandstone and shale. It occurs on hills, ridges, backslopes, and footslopes at elevations between 4,100 and 5,300 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Hiland fine sandy loam. Within this map unit the following additional components are found: Bowbac, Decolney, Maysdorf, Terro, Vonalee, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Hiland fine sandy loam soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope and the high clay content being the limiting factors. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reasons: high clay content, and low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

158-2: Bowbac fine sandy loam, 6 to 15 percent slopes[1]

The Bowbac fine sandy loam map unit consists of moderately deep, well-drained soils that developed from alluvium and eolian deposits over residuum weathered from calcareous sandstone. It occurs on hills, ridges, summits, and shoulders at elevations between 4,100 and 5,300 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Bowbac fine sandy loam. Within this map unit the following additional components are found: Decolney, Hiland, Maysdorf, Terro, Vonalee, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Bowbac fine sandy loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is slow and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope, the high clay content, and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: high clay content, low organic matter content, depth to bedrock, and droughtiness.

[1]Map unit description based on 2002 South Campbell County NRCS information.

170-2: Tullock loamy sand, 6 to 30 percent slopes[1]

The Tullock loamy sands map unit consists of moderately deep, excessively-drained soils that developed from alluvium and eolian deposits over residuum weathered from calcareous sandstone. It occurs on hills, ridges, summits, and shoulders at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47 to 53 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Tullock loamy sands. Within this map unit the following additional components are found: Badlands, Blowouts, Keeline, Orpha, Taluce, Terro, and Vonalee. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Tullock loamy sands soil is rapid. The available water capacity is very low. Effective rooting depth is 20 to 40 inches. Surface runoff is very low and the hazard of water erosion is slight. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Sand bluestem, Indian ricegrass, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,700 lbs/acre. In a normal year that production is 1,400 lbs/acre. Also in an unfavorable (drought) year the production is approximately 900 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with the high sand content, slope, and depth to bedrock being the limiting factors. It is a poor source for roadfill with depth to bedrock being the limiting factor. As for reclamation material it is a poor choice for the following reasons: high sand content, the wind erosion potential, low organic matter content, droughtiness, and depth to bedrock.

[1]Map unit description based on 2002 South Campbell County NRCS information.

171-1: Keeline, dry complex, 3 to 30 percent slopes[1]

The Keeline dry complex map unit consists of very deep, somewhat excessively drained soils that developed from alluvium and eolian deposits derived from calcareous sandstone. It occurs on hills, ridges, backslopes and footslopes at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Keeline, dry complex. Within this map unit the following additional components are found: Badland, Blowout, Niobrara, Orpha, Tullock, and Turnercrest. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Keeline, dry complex soil is moderately rapid. The available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation; topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reason, low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

194-1: Pugsley sandy loams, 6 to 15 percent slopes[1]

The Pugsley sandy loams map unit consists of moderately deep, well-drained souls that developed from alluvium over residuum weathered from calcareous sandstone. It occurs on hills, ridges, summits, and shoulders at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 46 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Pugsley sandy loams. Within this map unit the following additional components are found: Bowbac, Decolney, Hiland, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Pugsley sandy loams soil is moderate. The available water capacity is very low. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the hazard of water erosion is severe. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock and slope being the limiting factors. It is a poor source for roadfill due to the depth to bedrock. As for reclamation material it is a fair choice for the following reasons: droughtiness, depth to bedrock, and low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

194-2: Decolney sandy loams, 6 to 15 percent slopes[1]

The Decolney sandy loams map unit consists of very deep, well-drained soils that developed from alluvium and eolian deposits derived from sandstone and shale. It occurs on hills, ridges, backslopes, and footslopes at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Decolney sandy loams. Within this map unit the following additional components are found: Bowbac, Hiland, Pugsley, and Worf. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Decolney sandy loams soil is moderate. The available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a good source for roadfill as no limitations are found. As for reclamation material it is a fair choice for the following reason, low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

205-1: Samday clay loam, 3 to 15 percent slopes[1]
(Former Samsil series)

The Samday clay loam map unit consists of shallow, well-drained soils that developed from residuum weathered from calcareous shale. It occurs on hills, ridges, summits, and shoulders at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 44 to 49 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Samday clay loam. Within this map unit the following additional components are found: Heldt, Hilight, Savageton, Theedle, and Worfka. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Samday clay loam soil is slow. The available water capacity is very low. Effective rooting depth is 10 to 20 inches. Surface runoff is very high and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are five plant species that are common to this map unit. They are as follows: Western wheatgrass, Blue grama, Green needlegrass, and Bluebunch wheatgrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,000 lbs/acre. In a normal year that production is 750 lbs/acre. Also in an unfavorable (drought) year the production is approximately 450 lbs/acre.

There are three areas that are considered for reclamation; topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with depth to bedrock, slope and the high clay content being the limiting factors. It is a poor source for roadfill due to the low strength, depth to bedrock, and the shrink-swell capacity. As for reclamation material it is a poor choice for the following reasons: droughtiness, depth to bedrock, low organic matter content, high clay content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

213-1: Terro sandy loam, 6 to 30 percent slopes[1]

The Terro sandy loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum derived from calcareous sandstone. It occurs on hills, ridges, backslopes, and summits at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Terro sandy loam. Within this map unit the following additional components are found: Keeline, Orpha, Taluce, Turnercrest, Vonalee, and Badlands. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Terro sandy loam soil is moderately rapid. The available water capacity is very low. Effective rooting depth is 20 to 40 inches. Surface runoff is slow and the hazard of water erosion is severe. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are eight plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, Blue grama, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year the production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with slope and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the depth to bedrock and slope. As for reclamation material it is a fair choice for the following reasons: droughtiness, depth to bedrock, and low organic matter content.

[1]Map unit description based on 2002 South Campbell County NRCS information.

216-2: Kishona loam, 3 to 30 percent slopes[1]

The Kishona loam map unit consists of very deep well-drained soils that developed from alluvium derived from sandstone and shale. It occurs on hills, ridges, fan remnants, backslopes, and footslopes at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Kishona loam. Within this map unit the following additional components are found: Cambria, Hilight, Shingle, Taluce, Theedle, and Turnercrest. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Kishona loam soil is moderate. The available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Western wheatgrass, Blue grama, Green needlegrass, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,500 lbs/acre. In a normal year that production is 1,200 lbs/acre. Also in an unfavorable (drought) year the production is approximately 700 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with slope being the limiting factor. It is a poor source for roadfill due to the low strength, depth to bedrock, slope and the shrink-swell capacity. As for reclamation material it is a fair choice for the following reasons: low organic matter content, and the water erosion potential.

[1]Map unit description based on 2002 South Campbell County NRCS information.

221-1: Turnercrest fine sandy loam, 6 to 30 percent slopes[1]

The Turnercrest fine sandy loam map unit consists of moderately deep, well-drained soil that developed from alluvium and eolian deposits over residuum weathered from calcareous sandstone. It occurs on hills, ridges, summits, and shoulders at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 45 to 53 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Turnercrest fine sandy loam. Within this map unit the following additional components are found: Keeline, Orpha, Taluce, Terro, Tullock, and Vonalee. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Turnercrest fine sandy loam soil is moderately rapid. The available water capacity is very low. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate and the hazard of water erosion is severe. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Western wheatgrass, Little bluestem, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with slope and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the depth to bedrock. As for reclamation material it is a fair choice for the following reasons: low organic matter content, droughtiness, and depth to bedrock.

[1]Map unit description based on 2002 South Campbell County NRCS information.

221-3: Taluce fine sandy loam, 6 to 30 percent slopes[1]

The Taluce fine sandy loam map unit consists of shallow, well-drained soils that developed from residuum weathered from calcareous sandstone. It occurs on hills, ridges, summits and shoulders at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 42 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Taluce fine sandy loam. Within this map unit the following additional components are found: Keeline, Orpha, Terro, Tullock, Turnercrest, and Vonalee. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Taluce fine sandy loam soil is rapid. The available water capacity is very low. Effective rooting depth is 10 to 20 inches. Surface runoff is very rapid and the hazard of water erosion is severe. The hazard of wind erosion is severe.

Productivity and Reclamation Potential

There are six plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Bluebunch wheatgrass, Little bluestem, Blue grama, and Threadleaf sedge.

In a favorable year (above average moisture) the production is approximately 1,300 lbs/acre. In a normal year that production is 1,000 lbs/acre. Also in an unfavorable (drought) year the production is approximately 600 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with slope and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the depth to bedrock, and slope. As for reclamation material it is a poor choice for the following reasons: low organic matter content, droughtiness, and depth to bedrock.

[1]Map unit description based on 2002 South Campbell County NRCS information.

228-2: Renohill clay loam 0 to 6 percent slopes[1]

The Renohill clay loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum weathered from calcareous shale. It occurs on summits and shoulders at elevations between 4,100 and 5,200 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 43 to 47 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Renohill clay loam. Within this map unit the following additional components are found: Bidman, Parmleed, Savageton, and Ulm. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Renohill clay loam soil is moderately slow. The available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is moderate and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

Productivity and Reclamation Potential

There are four plant species that are common to this map unit. They are as follows: Green needlegrass, Western wheatgrass, Blue grama, and Cusick's bluegrass. Big sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,400 lbs/acre. In a normal year that production is 1,000 lbs/acre. Also in an unfavorable (drought) year the production is approximately 600 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a poor source for topsoil with the high clay content, and depth to bedrock being the limiting factors. It is a poor source for roadfill due to the low strength, shrink swell, and depth to bedrock. As for reclamation material it is a poor choice for the following reasons: high clay content, low organic matter content, depth to bedrock, and water erosion.

[1]Map unit description based on 2002 South Campbell County NRCS information.

236-2: Terro fine sandy loam, 2 to 10 percent slopes[1]

The Terro sandy loam map unit consists of moderately deep, well-drained soils that developed from alluvium over residuum derived from calcareous sandstone. It occurs on hills, ridges, shoulders, and summits at elevations between 4,100 and 5,000 feet.

The average annual precipitation ranges from 10 to 14 inches. The average annual air temperature is approximately 47 to 51 degrees F., and the average frost-free season is approximately 105 to 130 days.

This map unit is approximately 80 percent Terro sandy loam. Within this map unit the following additional components are found: Bowbac, Orpha, Taluce, Tullock, Vonalee, and areas with 10 to 15 percent slopes. Inclusions comprise approximately 20 percent of the map unit.

Permeability within the Terro sandy loam soil is moderately rapid. The available water capacity is low. Effective rooting depth is 20 to 40 inches. Surface runoff is slow and the hazard of water erosion is moderate. The hazard of wind erosion is severe.

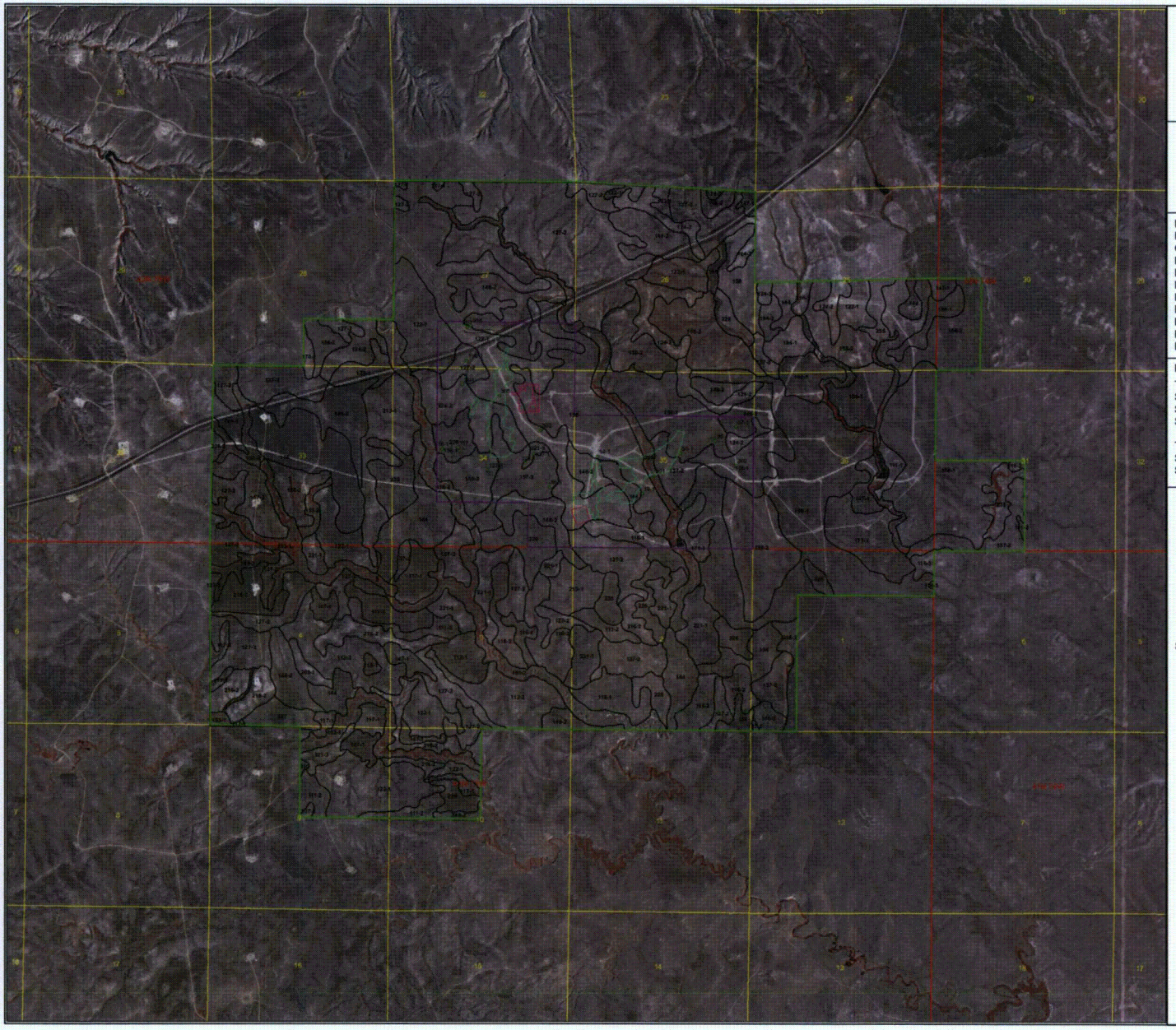
Productivity and Reclamation Potential

There are seven plant species that are common to this map unit. They are as follows: Needleandthread, Prairie sandreed, Indian ricegrass, Little bluestem, Western wheatgrass, and Threadleaf sedge. Silver sagebrush is the only shrub specie found within this unit.

In a favorable year (above average moisture) the production is approximately 1,600 lbs/acre. In a normal year that production is 1,300 lbs/acre. Also in an unfavorable (drought) year the production is approximately 750 lbs/acre.

There are three areas that are considered for reclamation: topsoil, roadfill, and reclamation material. This unit is a fair source for topsoil with depth to bedrock being the limiting factor. It is a poor source for roadfill due to the depth to bedrock. As for reclamation material it is a fair choice for the following reasons: low organic matter content, droughtiness, and depth to bedrock.

[1]Map unit description based on 2002 South Campbell County NRCS information.



Moore Ranch Uranium Project
Soils Mapping
Figure 3.3-26

Designed by: BKS (Brenda Schladweiler)
Drawn by: C. Robinson
Checked by: J. Eberly, BKS
Date Drawn: 2/26/07
Date Modified: 4/11/07
Date Modified: 5/11/07
Date Modified: 6/12/07
Date Modified: 7/30/07
Date Modified: 9/6/07
Date Modified: 1/21/08
Date Modified: 3/16/10

Scale: 1" = 1500'
Projection: NAD 1983, UTM Zone 13
Year of CIR photo: 2001
Sheet: 1 of 1
File: Moore_Ranch_Soils_Final_Map_v3.mxd

Legals

T42N R75W
Sections 26-27, 33-36
S1/2 Sec. 25
S1/2, SE1/4 of Sec. 28

T42N R74W
SW1/4 of Sec. 31
SW1/2, SW1/4 of Sec. 30

T41N R75W
Sections 2, 3, 4
N1/2, N1/2 of Sec. 1
W1/2, W1/2 of Sec.1
NE1/4 of Sec. 9
NW1/4 of Sec. 10

Legend

- 2007 Soil Sample Location Waypoints
- Well Field Areas
- Central Plant Facility and Compressor Station
- Disturbance Boundary
- Permit Boundary
- Soil Map Units
- Township/Range Lines
- Sections

N
W E
S

Soil Map Unit Legend

Soil Symbol	Map Unit Description	Permit Acreage	Salvage Depth (ft)
110	Bidman loam, loamy substratum, 0 to 6 percent slopes	1.81	n/a
144	Forkwood loam, 0 to 6 percent slopes	349.08	1.7
156	Hiland fine sandy loam, 0 to 6 percent slopes	297.58	2.6
226	Ulm loam, 0 to 6 percent slopes	211.59	1.8
227	Ulm clay loam, 0 to 6 percent slopes	29.69	n/a
235	Vonalee fine sandy loam, 0 to 10 percent slopes	216.75	1.3
111-1	Bidman loam, 0 to 6 percent slopes	108.97	2.3
111-2	Parmleed loam, 0 to 6 percent slopes	138.37	n/a
112-1	Bidman loam, 6 to 15 percent slopes	40.82	n/a
112-2	Parmleed loam, 6 to 15 percent slopes	170.57	n/a
116-1	Cambria loam, 0 to 6 percent slopes	61.82	n/a
116-2	Kishona loam, 0 to 6 percent slopes	193.13	0.2
116-3	Zigweid loam, 0 to 6 percent slopes	74.21	1.7
117-1	Cambria loam, 6 to 15 percent slopes	71.51	n/a
117-2	Kishona loam, 6 to 20 percent slopes	13.22	n/a
122-1	Cushman loam, 6 to 15 percent slopes	734.28	0.1
124-2	Shingle loam, 3 to 30 percent slopes	272.28	0.2
127-2	Theedle loam, 6 to 30 percent slopes	1050.01	0.2
140-1	Embry sandy loam, 3 to 20 percent slopes	41.15	n/a
146-2	Cushman loam, 0 to 6 percent slopes	493.61	1.2
147-1	Forkwood loam, 6 to 15 percent slopes	90.39	n/a
153-1	Haverdad clay loam, 0 to 6 percent slopes	141.42	n/a
153-2	Kishona clay loam, 0 to 6 percent slopes	155.7	n/a
157-2	Bowbac fine sandy loam, 0 to 6 percent slopes	211.56	1.7
158-1	Hiland fine sandy loam, 6 to 15 percent slopes	829.03	1.7
158-2	Bowbac fine sandy loam, 6 to 15 percent slopes	493.1	2.3
170-2	Tullock loamy sand, 6 to 30 percent slopes	8.49	n/a
171-1	Keeline, dry complex, 3 to 30 percent slopes	106.75	3.7
194-1	Pagsley sandy loams, 6 to 15 percent slopes	53.65	n/a
194-2	Deconey sandy loams, 6 to 15 percent slopes	12.99	n/a
205-1	Samday clay loam, 3 to 15 percent slopes	14.03	n/a
213-1	Terro sandy loam, 6 to 30 percent slopes	142.49	n/a
216-2	Kishona loam, 6 to 30 percent slopes	42.22	n/a
221-1	Turnercrest fine sandy loam, 6 to 30 percent slopes	168.96	n/a
221-3	Taluce fine sandy loam, 6 to 30 percent slopes	22.55	0.2
228-2	Renohill clay loam, 0 to 6 percent slopes	5.28	n/a
236-2	Terro fine sandy loam, 2 to 10 percent slopes	25.65	n/a
Total		7,094.72	1.4

ADDENDUM 3.3-C

SAMPLED SOIL SERIES DESCRIPTIONS

HILAND SERIES

SOIL MAPPING UNIT: 156 Hiland fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 14-1
TYPICAL PEDON: Hiland silty loam on flat area utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 5 inches; silty loam, non effervescent, very slightly acidic (pH 6.8)

Bt1--5 to 16 inches; loam, non effervescent, slightly acidic (pH 6.5)

Bt2--16 to 31 inches; clay loam; non effervescent, very slightly acidic (pH 6.8)

Bt3--31 to 42 inches; sandy clay loam, non effervescent, very slightly alkaline (pH 7.2)

Btk --42 to 51 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

Ck -- 51 to 60 inches; sandy clay loam, strongly effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 14-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized

dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

HILAND SERIES

SOIL MAPPING UNIT: Hiland fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 19-1
TYPICAL PEDON: Hiland loam on northeast facing slope of 3 percent; utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, non effervescent, slightly acidic (pH 6.2)

Bt--3 to 20 inches; silty loam, non effervescent, very slightly acidic (pH 7.1)

Btk--20 to 24 inches; silty loam; strongly effervescent, slightly alkaline (pH 7.6)

C1k--24 to 32 inches; clay, strongly effervescent, moderately alkaline (pH 8.2)

C2k --32 to 44 inches, clay-clay loam, strongly effervescent, moderately alkaline (pH 8.2)

C3k -- 44 to 60 inches; clay loam, strongly effervescent, slightly alkaline (pH 7.9)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 19-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 24 to 44 inches. Marginal selenium and SAR values were found at 44 to 60 inches. Estimated stripping depth is 44 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized

dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

KEELINE SERIES

SOIL MAPPING UNIT: 171-1 Keeline, dry complex
SOIL SAMPLE LOCATION: 33-1
TYPICAL PEDON: Keeline sandy loam on east facing midslope of 4 percent utilized as rangeland

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

A--0 to 3 inches; sandy loam, non effervescent; slightly acidic (pH 6.4)

AC--3 to 15 inches; sandy loam, non effervescent; slightly acidic (pH 6.5)

C1--15 to 34 inches; sandy clay loam, non effervescent, neutral (pH 7.0)

C2k—34 to 44 inches; sandy clay loam, non effervescent, very slightly alkaline (pH 7.1)

C2k--44 to 60 inches; sandy clay loam, strongly effervescent, slightly alkaline (pH 7.8)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 33-1 on map included in this report.

RANGE IN CHARACTERISTICS: Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6 inches. The control section averages fine sandy loam or sandy loam with 5 to 18 percent clay. Rock fragments range from 0 to 15 percent. Some thin strata of coarser material may occur. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 4 mmhos throughout the profile. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING: Keeline soils are on terraces, benches, alluvial fans, fan remnants, ridgetop and hillslope positions. Slopes are 0 to 40 percent. These soils formed in moderately coarse alluvium or eolian deposits derived from calcareous sandstone. Elevations are 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over one-half of the annual

precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 15 inches. The mean annual temperature is about 46 degrees F. but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 36-1
TYPICAL PEDON: Cushman sandy clay loam on south facing slope of about 3 percent under native grass vegetation

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A-- 0 to 3 inches; sandy clay loam, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

Bt--3 to 12 inches, clay, moist, weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic, common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; very slightly acidic (pH 6.5); clear smooth boundary

Btk--12 to 17 inches, clay, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

Ck--17 to 42 inches, silty clay, strongly effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 36-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal textures (clay to silty clay) were found at 3 to 42 inches. Estimated stripping depth is

42 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash, alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 37-1
TYPICAL PEDON: Cushman loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

AB--3 to 7 inches; clay loam, non effervescent, slightly acidic (pH 6.2)

Bt--7 to 15 inches; clay; moist, weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic, common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; very slightly acidic (pH 6.7); clear smooth boundary

Btk--15 to 18 inches; clay, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; strongly effervescent, slightly alkaline (pH 7.8); clear smooth boundary

Ck --18 to 28 inches, clay, strongly effervescent, slightly alkaline (pH 7.8)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 37-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for atleast 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal soil texture (clay) was found at 7 to 28 inches. Course fragment percentage was marginal (31 %) at 7-15 inches. Saturation percentage was marginal (80.7) at 15-28 inches. Estimated stripping depth is 28 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash, alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the

annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to130 days depending upon elevation, aspect, and air drainage.

BOWBAC SERIES

Soil Mapping Unit: 157-2 Bowbac fine sandy loam 0 to 6 percent slopes
Soil Sample ID: 80-1
Typical Pedon: Bowbac sandy loam on a northeast facing slope of 1 percent under native vegetation

Taxonomic Class: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A-0 to 3 inches, sandy loam, weak fine and very fine granular structure; soft, very friable, nonsticky nonplastic; many fine and very fine roots; non effervescent, slightly acidic (pH 6.4), abrupt wavy boundary.

BC-3 to 20 inches; sandy loam, non effervescent, very slightly acidic (pH 6.6)

C1-20 to 28 inches; sandy loam, non effervescent, very slightly alkaline (pH 7.1)

C2-28 to 37 inches; sandy loam, strongly effervescent, very slightly alkaline (pH 7.3)

Type Location: Campbell County, Wyoming; refer to waypoint 80-1 on map included in this report.

Range in Characteristics (according to official series description): Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable parameters were found. The estimated stripping depth is 37 inches.

GEOGRAPHIC SETTING (according to official series description): Bowbac soils are on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May,

and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

SHINGLE SERIES

SOIL MAPPING UNIT: 124-2 Shingle loam, 3 to 30 percent slopes
SOIL SAMPLE LOCATION: 107-1
TYPICAL PEDON: Shingle clay loam on a toeslope of 6 percent in rangeland

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents.

A--0 to 2 inches; clay loam, moderate effervescent, slightly alkaline (pH 7.5)

C--2 to 14 inches; clay loam, strongly effervescent, neutral (pH 7.0)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 107-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft bedrock and paralithic contact ranges from 4 to 20 inches. The mean annual soil temperature is 47 to 53 degrees F. The soils commonly are calcareous throughout, but some pedons are leached to 6 inches The particle size control section averages 20 to 35 percent clay and has more than 15 percent but less than 35 percent fine or coarser sand. The soil is usually dry. The moisture control section is usually moist in April, May and early June. It is dry for 60 consecutive days or more during the 90 day period following the summer solstice. EC is 0 to 2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 14 inches.

GEOGRAPHIC SETTING (according to official series description): The Shingle soils occur on all hillslope positions. Slopes are 0 to 80 percent. These soils formed in colluvium and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone. Elevation is 3,200 to 6,500 feet. The mean annual precipitation is about 10 to 14 inches, most of which falls in April, May, and June. The mean annual temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

KISHONA SERIES

Soil Mapping Unit: 116-2 Kishona fine sandy loam, 0 to 6 percent slopes
Soil Sample ID: 108-1
Typical Pedon: Kishona clay loam in rangeland

Taxonomic Class: Fine loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

A--0 to 3 inches; clay loam, non effervescent, neutral (pH 7.0)

Bk--3 to 24 inches; silty clay loam, strongly effervescent, slightly alkaline (pH 7.5)

C1--24 to 30 inches; silty clay, strongly effervescent, slightly alkaline (pH 7.8)

C2--30 to 44 inches; silty clay, strongly effervescent, moderately alkaline (pH 8.0)

C3--44 to 46 inches; silty clay loam, strongly effervescent, moderately alkaline (pH 8.0)

Type Location: Campbell County, Wyoming; refer to waypoint 108-1 on map included in this report

Range in Characteristics (according to official series description): Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F. or more. The soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal texture (silty clay) was found at a depth of 24 to 44 inches. Estimated stripping depth is 24 inches.

Geographic Setting (according to official series description): Kishona soils are on dissected

alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges form 10 top 14 inches with over one-half falling in April May and June and less than one inch falling in each month of July, August, September and October. The mean annual air temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

BOWBAC SERIES

SOIL MAPPING UNIT: 157-2 Bowbac fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 116-1
TYPICAL PEDON: Bowbac sandy loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; sandy loam, slightly acidic (pH 6.3).

Bt1--3 to 12 inches; sandy clay loam, slightly acidic (pH 6.5).

Bt2--12 to 20 inches; sandy clay loam, very slightly acidic (pH 6.8).

Bk-- 20 to 24 inches; sandy clay loam, slightly alkaline (pH 7.3).

Cr— 24 to 36 inches; sandy clay loam, slightly effervescent, moderately alkaline (pH 8.0).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 116-1 on map included in this report.

RANGE IN CHARACTERISTICS: Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded gravel. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 36 inches.

GEOGRAPHIC SETTING: Bowbac soils are on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 105 to

130 days.

ULM SERIES

SOIL MAPPING UNIT: 226 Ulm loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 117-1
TYPICAL PEDON: Ulm clay loam-rangeland

TAXONOMIC CLASS: Fine, smectitic, mesic Ustic Haplargids

A-0 to 3 inches, clay loam, moist; strong fine granular structure; slightly hard, friable, sticky and plastic; many fine and few medium roots; slightly acidic (pH 6.1); clear smooth boundary

Bt1-3 to 10 inches, clay loam, moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; very slightly acidic (pH 6.6); clear wavy boundary.

Btk-21 to 32 inches, clay, moist; moderate medium prismatic parting to strong medium angular blocky structure; very hard, firm, very sticky and very plastic; common fine and few medium roots; common distinct clay films on faces of peds; slightly effervescent; calcium carbonate mostly disseminated with few prominent masses; moderately alkaline (pH 8.1);clear wavy boundary.

Ck1-32 to 40 inches, clay loam, strongly effervescent, moderately alkaline (pH 8.4)

Ck2-42 to 50 inches, sandy clay loam, violently effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 117-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to calcareous material ranges from 12 to 33 inches. Rock fragments range from 0 to 15 percent channers. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at 10 to 32 inches. Estimated stripping depth is 50 inches.

GEOGRAPHIC SETTING (according to official series description): Ulm soils are on relict alluvial terraces, alluvial fans, fan remnants, plateaus and footslopes and toeslopes of hills. Slopes are 0 to 18 percent. The soils formed in fine and medium textured alluvium derived from interbedded shales and agrillaceous sandstone. Elevations are 3,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature ranges from 46 to 51 degrees F. The frost-free season is 105 to 130 days.

ZIGWEID SERIES

SOIL MAPPING UNIT: 116-3 Zigweid loam, 0 to 6 percent slopes
Soil Sample ID: 123-1
TYPICAL PEDON: Zigweid clay- on a 3 percent southwest facing slope utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplocambids

A--0 to 3 inches; clay, non effervescent; slightly acidic (pH 7.6).

Bw--3 to 14 inches; clay, non effervescent, very slightly acidic (pH 7.3).

BC--14 to 20 inches; clay, strongly effervescent, slightly alkaline (pH 7.8).

C1k--20 to 32 inches; clay, violently effervescent; moderately alkaline (pH 8.2).

C2k--32 to 44 inches; clay, violently effervescent; moderately alkaline (pH 8.3).

C3k—44 to 54 inches; clay, violently effervescent, moderately alkaline (pH 8.2).

C4k—54 to 60 inches; clay, violently effervescent, moderately alkaline (pH 8.1).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 123-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to carbonates ranges from 0 to 8 inches. Depth to the Bk horizon and the base of the cambic horizon ranges from 10 to 22 inches. The particle-size control section and the soil profile are clay loam or loam. Clay ranges from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with more than 15 percent but less than 35 percent fine sand or coarser. Rock fragments range from 0 to 15 but are typically less than 5 percent and are mostly soft shale chips. The moisture control section is usually dry in all parts for 90 cumulative days following the summer solstice and for 60 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F. The soil temperature at a depth of 20 inches is 41 degrees F. or warmer for 175 to 192 days.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): These soils are on fan aprons, alluvial fans, fan remnants, terraces, fan piedmonts, ridges and hills. In many areas they are dissected. Slopes range from 0 to 20 percent. These soils formed in calcareous, moderately

fine textured sediments derived from interbedded shale and soft sandstone. Elevations are 3,500 to 6,600 feet. The mean annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F., and ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

TALUCE SERIES

SOIL MAPPING UNIT: 221-3 Taluce fine sandy loam, 6 to 30 percent slopes
Soil Sample ID: 126-1
TYPICAL PEDON: Taluce sandy loam-on a convex north-facing slope, used as rangeland

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

A- 0 to 2 inches, sandy loam, moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; slightly effervescent, calcium carbonate disseminated; very slightly acidic (pH 6.8); clear smooth boundary.

Ck-2 to 10 inches, sandy loam to sandy clay loam, moist; weak medium platy rock structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; slightly effervescent, calcium carbonate disseminated; slightly alkaline (pH 7.6)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 126-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to bedrock ranges from 6 to 20 inches. Typically, these soils are calcareous throughout, but some pedons are leached to a depth of as much as 4 inches. Rock fragments range from 0 to 15 percent. The particle-size control section has 10 to 18 percent clay. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable parameters were found. Estimated stripping depth is 10 inches.

GEOGRAPHIC SETTING (according to official series description): Taluce soils are on ridges and hills. Slope ranges from 3 to 70 percent. They formed in residuum and slope alluvium derived from sandstone. The mean annual precipitation ranges from 10 to 17 inches with over half of the precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 42 to 51 degrees F. Elevation is 3,500 to 6,500 feet. The frost-free season is 100 to 130 days.

FORKWOOD SERIES

SOIL MAPPING UNIT: 144 Forkwood loam, 0 to 6 percent slopes
Soil Sample ID: 127-1
TYPICAL PEDON: Forkwood loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, non effervescent; slightly acidic (pH 6.1).

Bt--3 to 20 inches; clay loam, non effervescent, very slightly acidic (pH 6.9).

Btk--20 to 27 inches; clay loam, strongly effervescent; slightly alkaline (pH 7.8).

C1k--27 to 45 inches; clay, violently effervescent; moderately alkaline (pH 8.1).

C2k--45 to 51 inches; clay loam, violently effervescent; moderately alkaline (pH 8.2).

C3k—51 to 60 inches; clay loam, moderate effervescent, moderately alkaline (pH 8.2).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 127-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to the base of the argillic horizon is 10 to 33 inches, and depth to continuous horizons of carbonate accumulation is 10 to 33 inches. Rock fragments range from 0 to 15 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature ranges from 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 4 mmhos/cm throughout the profile. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at 27 to 45 inches. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Forkwood soils are on terraces, alluvial fans, fan remnants, hills, ridges and pediments. Slopes are 0 to 15 percent. The soils formed in slopewash alluvium derived from interbedded shales and argillaceous sandstone. Elevations are 3,500 to 6,000 feet. The average annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in

each month of July, August, September, and October. The mean annual air temperature ranges from 43 to 51 degrees F. The estimated frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

BIDMAN SERIES

Soil Mapping Unit: 111-1 Birdman loam 0 to 6 percent slopes
Soil Sample ID: 300
Typical Pedon: Bidman loam-grassland

Taxonomic Class: Fine, smectitic, mesic Ustic Paleargids

A-0 to 4 inches: clay loam, non effervescent; very slightly acidic (pH 6.7)

Bt1-4 to 20 inches: clay, moist; strong medium prismatic structure that parts to strong medium angular blocky; hard, very sticky and very plastic, many prominent clay films on faces of peds, in channels and pores: very slightly acidic (pH 6.8); clear wavy boundary

Bt2-20 to 28 inches: clay, non effervescent; slightly alkaline (pH 7.5)

Btk-28 to 40 inches: clay loam to clay, moist; weak coarse prismatic structure that parts to moderate coarse angular and subangular blocks; extremely hard, very friable; sticky and plastic; few distinct clay films on faces of peds; strongly effervescent; moderately alkaline (pH 8.0): gradual wavy boundary

Ck- 40 to 49 inches: clay loam, moist; massive; hard, very friable, sticky and slightly plastic, violently effervescent, slightly alkaline (pH 7.9)

Type Location: Campbell County, Wyoming; refer to waypoint 300 on map included in this report

Range in Characteristics (according to official series description): Depth to calcareous material ranges from 8 to 26 inches, Depth to the base of the argillic horizon range from 15 to 36 inches. Organic carbon ranges from .6 to 1.5 percent in the surface horizons and decreases uniformly with increasing depth. Cation exchange capacity ranges from 60 t0 90 millequivalents per 100 grams of clay. Rock fragments are typically less than 2 percent but ranges from 0 to 15 percent. This soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is never moist in some or all parts for as long as 60 consecutive days during this same period. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or warmer for 175 to 195 days. The mean summer soil temperature at depth of 20 inches ranges from 59 to 65 degrees F.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal Texture (clay) was found at 4 to 49 inches. Estimated stripping depth is 49 inches.

Geographic Setting (according to official series description): The Bidman soils are on alluvial fans, fan remnants, terraces, ridges and hills. Elevation is 2,600 to 6,000 feet. Slopes range from 0 to 25 percent. These soils formed in thick, calcareous alluvial sediments derived from sedimentary rock. At the type location the mean annual temperature is 47 degrees F., and the mean summer temperature is 66 degrees F. The average annual precipitation is about 12 inches with about half the precipitation in April, May, and June. Precipitation ranges from 10 to 14 inches. The frost-free season is 100 to 130 days.

VONALEE SERIES

Soil Mapping Unit: 235 Vonalee fine sandy loam, 0 to 10 percent slopes
Soil Sample ID: 301
Typical Pedon: Vonalee fine silty clay loam-on north facing hill slope of 6 percent utilized as rangeland.

Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Ustic Haplargids

A-0 to 2 inches, silty clay loam, moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots throughout and common medium throughout; non effervescent: very slightly acidic (pH 6.7) clear smooth boundary

Bt-2 to 15 inches, clay loam to loam, moist, moderate medium subangular blocky structure, soft, very friable, nonsticky and nonplastic; many very fine and fine roots throughout and common medium throughout; strongly effervescent, very slightly alkaline (pH 7.4)

C1-15 to 24 inches, sandy clay loam, moderate to strongly effervescent, moderately alkaline (pH 8.2)

C2-24 to 38 inches, sandy loam, strongly effervescent, slightly alkaline (pH 7.9)

C3-38 to 50 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

C4-50 to 60 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

Type Location: Campbell County, Wyoming; refer to waypoint 301 on map included in this report

Range in Characteristics (according to official series description): Rock fragments are typically less than 5 percent but may range to 15 percent. Depth to continuous carbonate accumulation ranges from 11 to 40 inches, but the soils are typically calcareous above 30 inches. Depth to bedrock is greater than 60 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The average annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F., or more for 175 to 192 days.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal saturation percentage (83.6) was found at 0 to 2 inches. The estimated stripping depth is 60 inches.

Geographic Setting (according to official series description): Vonalee soils are on ridges, hills, alluvial fans, fan remnants and high terraces. Slopes are 0 to 30 percent. The soils formed in coarse and moderately coarse alluvium or eolian deposits derived largely from calcareous sandstone. Elevations are 3,500 to 6,500 feet. Precipitation ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The average annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

HILAND SERIES

SOIL MAPPING UNIT: 158-1 Hiland fine sandy loam, 6 to 15 percent slopes
SOIL SAMPLE LOCATION: 302
TYPICAL PEDON: Hiland sandy loam on northeast facing slope of 3 percent; utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; sandy loam, non effervescent, very slightly acidic (pH 6.8).

BA--3 to 12 inches; sandy loam, non effervescent, slightly acidic (pH 6.3).

Bt--12 to 20 inches; sandy clay loam; non effervescent, very slightly acidic (pH 6.6).

Btk--20 to 30 inches; sandy clay loam, strongly effervescent, very slightly alkaline (pH 7.2).

C1k--30 to 48 inches, clay loam, violently effervescent, moderately alkaline (pH 8.0).

C2k—48 to 60 inches; clay loam, violently effervescent, moderately alkaline (pH 8.3).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 302 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized

dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

SHINGLE SERIES

SOIL MAPPING UNIT: 124-2 Shingle loam, 3 to 30 percent slopes
SOIL SAMPLE LOCATION: 303
TYPICAL PEDON: Shingle clay loam

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents.

A--0 to 3 inches; clay loam, non effervescent, slightly alkaline (pH 7.6).

AC--3 to 10 inches; clay loam, strongly effervescent, slightly alkaline (pH 7.8).

Cr--10 to 18 inches; silty clay loam; strongly effervescent, slightly alkaline (pH 7.9).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 303 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft bedrock and paralithic contact ranges from 4 to 20 inches. The mean annual soil temperature is 47 to53 degrees F. The soils commonly are calcareous throughout, but some pedons are leached to 6 inches The particle size control section averages 20 to 35 percent clay and has more than 15 percent but less than 35 percent fine or coarser sand. The soil is usually dry. The moisture control section is usually moist in April, May and early June. It is dry for 60 consecutive days or more during the 90 day period following the summer solstice. EC is 0 to 2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 18 inches.

GEOGRAPHIC SETTING (according to official series description): The Shingle soils occur on all hillslope positions. Slopes are 0 to 80 percent. These soils formed in colluvium and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone. Elevation is 3,200 to 6,500 feet. The mean annual precipitation is about 10 to 14 inches, most of which falls in April, May, and June. The mean annual temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

THEEDLE SERIES

SOIL MAPPING UNIT: 127-2 Theedle loam, 0 to 30 percent slopes
SOIL SAMPLE LOCATION: 304
TYPICAL PEDON: Theedle clay loam- on west facing hill footslope of 6 percent-rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents.

A--0 to 3 inches; clay-clay loam, strongly effervescent, slightly alkaline (pH 7.6)

C--3 to 20 inches; clay loam, violently effervescent, neutral (pH 8.1)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 304 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft, gray, calcareous sandstone or sandy whale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 0 to 3 inches. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): Theedle soils are on rock-controlled fans aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hill slope p[profile but typically are on the lower shoulder, foot slope, and toe slope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 305
TYPICAL PEDON: Cushman clay loam- on south facing slope of about 3 percent under native grass vegetation

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 2 inches; clay loam, strongly effervescent,) moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly alkaline (pH 7.5); clear smooth boundary

Btk1--2 to 12 inches; clay loam, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly alkaline (pH 7.8); clear smooth boundary

Btk2--12 to 20 inches; clay loam; strongly effervescent, moderately alkaline (pH 8.2)

Bk--20 to 26 inches; clay loam, moist; weak coarse subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic, violently effervescent; calcium carbonated as common prominent irregularly shaped masses and many fine filaments and masses; moderately alkaline (pH 8.2)

Cr --26 to 36 inches, clay loam, strongly effervescent

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 305 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for atleast 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 36 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

THEEDLE SERIES

SOIL MAPPING UNIT: 127-2 Theedle loam, 0 to 3 percent slopes
SOIL SAMPLE LOCATION: 306
TYPICAL PEDON: Theedle clay loam- on west facing hill footslope of 6 percent-rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents.

A--0 to 2 inches; clay loam, non effervescent, slightly alkaline (pH 7.7)

BCk-- 2 to 20 inches; clay, strongly effervescent, moderately alkaline (pH 8.1)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 304 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft, gray, calcareous sandstone or sandy whale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 2 to 20 inches. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): Theedle soils are on rock-controlled fans aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hill slope p[profile but typically are on the lower shoulder, foot slope, and toe slope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

ADDENDUM 3.3-D

LABORATORY RESULTS

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-001	WP 116-1	0-3	0.52	33.6	6.3	3.2	1.8	0.10	0.06	0.011	< 0.20	55	26	19	SL
C07051219-002	WP 116-1	3-12	0.32	38.1	6.5	2.2	1.1	0.14	0.11	0.009	< 0.20	54	21	25	SCL
C07051219-003	WP 116-1	12-20	1.68	48.1	6.8	10	4.9	0.22	0.08	0.005	< 0.20	57	19	24	SCL
C07051219-004	WP 116-1	20-24	3.85	48.9	7.3	23	11	0.40	0.10	< 0.005	< 0.20	53	19	28	SCL
C07051219-005	WP 116-1	24-36	0.63	51.9	8.0	2.8	3.1	0.31	0.18	< 0.005	< 0.20	54	17	29	SCL
C07051219-006	WP 117-1	0-3	0.67	48.5	6.1	3.7	3.1	0.14	0.07	0.011	< 0.20	35	35	30	CL
C07051219-007	WP 117-1	3-10	0.42	48.8	6.6	2.3	2.1	0.39	0.26	0.005	< 0.20	34	34	32	CL
C07051219-008	WP 117-1	10-21	0.34	69.0	7.1	1.4	1.6	0.95	0.79	< 0.005	0.25	24	33	43	C
C07051219-009	WP 117-1	21-32	0.57	64.5	8.1	1.7	2.2	2.0	1.44	< 0.005	0.34	28	31	41	C
C07051219-010	WP 117-1	32-42	0.52	55.4	8.4	1.2	1.7	2.8	2.37	0.006	0.45	40	28	32	CL
C07051219-011	WP 117-1	42-50	1.04	44.4	8.2	2.3	3.8	4.6	2.64	0.011	0.44	49	19	32	SCL
C07051219-012	WP 123-1	0-3	0.65	45.7	7.6	5.9	2.0	0.12	0.06	0.015	< 0.20	38	32	30	CL
C07051219-013	WP 123-1	3-14	0.67	55.0	7.3	4.2	3.1	0.40	0.21	0.016	< 0.20	32	30	38	CL
C07051219-014	WP 123-1	14-20	0.67	46.9	7.8	3.6	3.1	0.69	0.38	0.011	< 0.20	42	26	32	CL
C07051219-015	WP 123-1	20-32	0.62	53.2	8.2	2.1	3.0	1.6	0.97	0.020	0.22	26	37	37	CL
C07051219-016	WP 123-1	32-44	1.34	49.9	8.3	2.6	5.8	5.2	2.57	0.137	0.37	29	37	34	CL
C07051219-017	WP 123-1	44-54	3.56	56.1	8.2	7.4	19	13	3.57	1.37	1.0	40	29	31	CL
C07051219-018	WP 123-1	44-54								2.31					
C07051219-018	WP 123-1	54-60	7.12	57.1	8.1	28	51	19	3.06	2.06	0.93	32	33	35	CL
C07051219-019	WP 126-1	0-2	0.94	48.6	6.8	9.1	2.0	0.07	0.03	0.006	0.20	69	12	19	SL
C07051219-020	WP 126-1	2-10	0.53	41.8	7.6	4.8	1.1	0.10	0.06	0.011	< 0.20	62	18	20	SL - SCL
C07051219-021	WP 127-1	0-3	0.48	49.1	6.1	3.3	1.9	0.07	0.04	0.010	< 0.20	47	32	21	L
C07051219-022	WP 127-1	3-20	0.52	54.4	6.9	3.8	2.4	0.16	0.09	0.007	< 0.20	44	24	32	CL
C07051219-023	WP 127-1	20-27	0.80	56.9	7.8	4.6	3.5	0.47	0.23	< 0.005	< 0.20	31	31	38	CL
C07051219-024	WP 127-1	27-45	0.44	55.7	8.1	1.4	1.5	2.0	1.68	0.014	0.29	20	37	43	C
C07051219-025	WP 127-1	45-51	0.56	54.3	8.2	1.5	1.5	3.6	2.95	0.042	0.78	36	25	39	CL
C07051219-026	WP 127-1	51-60	1.11	50.4	8.2	3.4	3.4	5.7	3.08	0.049	1.0	35	28	37	CL
C07051219-027	WP 300	0-4	0.56	48.0	6.7	3.9	3.0	0.25	0.14	0.010	< 0.20	35	31	34	CL
C07051219-028	WP 300	4-20	0.32	74.6	6.8	1.5	1.5	0.83	0.68	0.005	0.23	24	26	50	C
C07051219-029	WP 300	20-28	0.66	68.7	7.5	2.9	3.0	1.9	1.12	< 0.005	0.31	25	31	44	C
C07051219-030	WP 300	28-40	0.77	59.8	8.0	2.4	2.8	3.1	1.94	0.010	0.55	34	26	40	C - CL
C07051219-031	WP 300	40-49	2.61	51.7	7.9	14	14	6.9	1.86	0.037	0.86	38	26	36	CL
C07051219-032	WP 301	0-2	1.68	83.6	6.7	14	5.8	0.22	0.07	0.018	0.29	20	51	29	SICL
C07051219-033	WP 301	2-15	1.04	46.3	7.4	6.9	4.3	0.78	0.33	0.019	0.34	45	28	27	CL - L
C07051219-034	WP 301	15-24	1.09	37.1	8.2	2.1	3.3	6.6	4.04	0.010	0.26	50	24	26	SCL
C07051219-035	WP 301	24-38	0.99	41.6	7.9	2.6	2.8	5.3	3.25	0.007	< 0.20	67	14	19	SL
C07051219-036	WP 301	38-50	0.74	39.7	8.1	2.0	1.4	4.7	3.57	< 0.005	< 0.20	47	25	28	SCL
C07051219-037	WP 301	50-60	0.42	34.1	8.1	1.0	0.44	3.5	4.11	< 0.005	< 0.20	55	20	25	SCL
C07051219-038	WP 302	0-3	0.73	46.4	6.8	6.3	2.3	0.11	0.05	0.009	< 0.20	61	23	16	SL
C07051219-039	WP 302	3-12	0.27	37.5	6.3	2.3	1.1	0.09	0.07	0.008	< 0.20	62	20	18	SL
C07051219-040	WP 302	12-20	0.28	39.3	6.6	2.0	1.0	0.13	0.11	0.006	< 0.20	54	21	25	SCL

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-041	WP 302	20-30	0.60	42.5	7.2	4.1	2.4	0.18	0.10	0.006	< 0.20	50	20	30	SCL
C07051219-042	WP 302	30-48	0.41	47.5	8.0	2.2	2.1	0.20	0.14	< 0.005	< 0.20	41	24	35	CL
C07051219-043	WP 302	48-60	0.25	51.1	8.3	0.69	1.8	0.36	0.31	< 0.005	< 0.20	29	34	37	CL
C07051219-044	WP 303	0-3	0.74	55.4	7.6	7.4	1.4	0.11	0.05	0.012	< 0.20	31	37	32	CL
C07051219-045	WP 303	3-10	0.90	62.2	7.8	6.6	2.2	0.23	0.11	0.016	< 0.20	39	30	31	CL
C07051219-046	WP 303	10-18	1.24	57.8	7.9	6.9	4.5	0.63	0.27	0.014	< 0.20	4.0	64	32	SICL
C07051219-047	WP 304	0-3	0.92	57.4	7.6	8.6	1.8	0.08	0.04	0.012	0.26	26	34	40	C - CL
C07051219-048	WP 304	3-20	0.40	59.4	8.1	2.4	1.6	0.23	0.16	0.005	< 0.20	38	27	35	CL
C07051219-049	WP 305	0-2	1.09	48.0	7.5	11	1.8	0.13	0.05	0.010	< 0.20	30	39	31	CL
C07051219-050	WP 305	2-12	0.90	58.4	7.8	7.3	2.0	0.16	0.07	0.015	< 0.20	31	34	35	CL
C07051219-051	WP 305	12-20	0.42	55.5	8.2	2.2	1.8	0.35	0.25	0.007	< 0.20	36	34	30	CL
C07051219-052	WP 305	20-26	0.81	53.8	8.2	3.2	4.0	0.98	0.52	0.008	< 0.20	30	37	33	CL
C07051219-053	WP 306	0-2	0.78	59.6	7.7	7.0	1.8	0.15	0.07	0.008	0.21	29	32	39	CL
C07051219-054	WP 306	2-20	0.84	72.2	8.1	3.4	2.5	2.7	1.55	0.008	< 0.20	24	25	51	C
C07051219-055	WP 14-1	0-5	0.78	46.0	6.8	6.2	2.7	0.11	0.05	0.015	< 0.20	26	53	21	SIL
C07051219-056	WP 14-1	5-16	0.30	50.8	6.5	2.0	1.2	0.13	0.10	0.011	< 0.20	48	28	24	L
C07051219-057	WP 14-1	16-31	0.36	51.8	6.8	2.1	1.5	0.17	0.13	0.008	< 0.20	37	27	36	CL
C07051219-058	WP 14-1	31-42	0.41	41.2	7.2	2.1	1.7	0.23	0.17	< 0.005	< 0.20	49	26	25	SCL
C07051219-059	WP 14-1	42-51	0.36	42.8	8.1	1.9	1.8	0.32	0.24	< 0.005	< 0.20	51	18	31	SCL
C07051219-060	WP 14-1	51-60	0.31	40.4	8.2	1.4	1.7	0.36	0.29	< 0.005	< 0.20	59	19	22	SCL
C07051219-061	WP 19-1	0-3	0.76	42.8	6.2	4.3	2.8	0.12	0.06	0.014	< 0.20	42	37	21	L
C07051219-062	WP 19-1	3-20	0.28	51.9	7.1	0.98	0.86	0.99	1.04	0.007	0.29	26	51	23	SIL
C07051219-063	WP 19-1	20-24	1.53	64.6	7.6	0.11	0.14	0.14	0.39	0.005	0.31	22	53	25	SIL
C07051219-064	WP 19-1	24-32	0.50	59.7	8.2	1.0	1.1	2.8	2.78	0.049	0.60	17	38	45	C
C07051219-065	WP 19-1	32-44	0.79	58.3	8.2	1.5	1.6	4.5	3.59	0.077	1.2	23	37	40	C - CL
C07051219-066	WP 19-1	44-60	5.35	48.6	7.9	27	25	65	12.8	0.224	0.77	44	26	30	CL
C07051219-067	WP 33-1	0-3	0.60	39.4	6.4	3.9	1.6	0.06	0.04	0.011	< 0.20	73	13	14	SL
C07051219-068	WP 33-1	3-15	0.78	34.5	6.5	5.2	2.0	0.09	0.05	0.010	< 0.20	73	12	15	SL
C07051219-069	WP 33-1	15-34	0.32	45.8	7.0	2.5	0.72	0.10	0.08	0.007	< 0.20	63	16	21	SCL
C07051219-070	WP 33-1	34-44	0.82	44.2	7.1	5.6	1.7	0.19	0.10	0.006	< 0.20	59	19	22	SCL
C07051219-071	WP 33-1	44-60	0.98	43.0	7.8	5.3	2.7	0.27	0.13	< 0.005	< 0.20	57	19	24	SCL
C07051219-072	WP 36-1	0-3	0.74	43.3	6.2	4.0	3.3	0.13	0.07	0.011	< 0.20	46	24	30	SCL
C07051219-073	WP 36-1	3-12	0.56	64.6	6.5	2.7	2.5	0.29	0.18	0.010	0.23	34	25	41	C
C07051219-074	WP 36-1	12-17	0.80	63.4	7.8	3.3	3.5	1.1	0.58	0.005	0.21	18	37	45	C
C07051219-075	WP 36-1	17-36	0.72	67.6	8.2	1.7	2.5	2.8	1.91	0.025	0.32	9.0	42	49	SIC
C07051219-076	WP 36-1	36-42	0.79	68.0	8.2	1.4	2.4	3.9	2.66	0.060	0.61	11	43	46	SIC
C07051219-077	WP 37-1	0-3	0.78	43.6	6.2	18	17	0.71	0.17	0.011	< 0.20	52	29	19	L
C07051219-078	WP 37-1	3-7	0.45	39.0	6.2	1.8	2.4	0.47	0.33	0.020	< 0.20	45	22	33	CL
C07051219-079	WP 37-1	7-15	0.79	79.9	6.7	2.5	4.3	1.1	0.61	0.015	0.25	13	36	51	C
C07051219-080	WP 37-1	15-18	1.20	80.7	7.8	3.4	7.0	2.7	1.18	0.007	0.31	12	32	56	C
C07051219-081	WP 37-1	18-28	0.50	80.7	7.8	22	42	6.1	1.08	0.044	0.73	13	30	57	C

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s_u_	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-062	WP 80-1	0-3	0.51	40.9	6.4	3.3	1.4	0.19	0.13	0.008	< 0.20	62	22	16	SL
C07051219-063	WP 80-1	3-20	0.52	34.0	6.6	3.8	1.4	0.17	0.11	0.009	< 0.20	64	17	19	SL
C07051219-064	WP 80-1	20-28	0.84	29.1	7.1	5.6	1.8	0.27	0.14	< 0.005	< 0.20	80	9.0	11	SL
C07051219-065	WP 80-1	28-37	0.75	29.5	7.3	5.1	1.7	0.26	0.14	< 0.005	< 0.20	80	9.0	11	SL
C07051219-066	WP 107-1	0-2	0.90	59.7	7.5	6.0	2.9	0.18	0.09	0.015	< 0.20	26	41	33	CL
C07051219-067	WP 107-1	2-14	1.54	58.3	7.0	14	2.8	0.07	0.03	0.025	0.29	33	39	28	CL
C07051219-068	WP 108-1	0-3	1.20	60.0	7.0	11	1.9	0.07	0.03	0.011	< 0.20	21	43	36	CL
C07051219-069	WP 108-1	3-24	0.76	67.1	7.5	5.4	1.9	0.21	0.11	0.007	< 0.20	19	44	37	SICL
C07051219-090	WP 108-1	24-30	0.42	79.9	7.8	2.6	1.9	0.22	0.15	0.010	< 0.20	13	45	42	SIC
C07051219-091	WP 108-1	30-44	0.55	58.7	8.0	2.3	2.8	0.35	0.22	< 0.005	< 0.20	14	45	41	SIC
C07051219-092	WP 108-1	44-60	0.66	61.4	8.0	2.3	3.7	0.83	0.48	0.006	< 0.20	17	46	37	SICL

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C07051219-001	WP 116-1	0-3	4.3	2.9
C07051219-002	WP 116-1	3-12	4.1	
C07051219-003	WP 116-1	12-20	3.1	
C07051219-004	WP 116-1	20-24	6.9	
C07051219-005	WP 116-1	24-36	2.8	
C07051219-006	WP 117-1	0-3	2.9	4.4
C07051219-007	WP 117-1	3-10	3.7	
C07051219-008	WP 117-1	10-21	21	
C07051219-009	WP 117-1	21-32	8.9	
C07051219-010	WP 117-1	32-42	4.5	
C07051219-011	WP 117-1	42-50	4.2	
C07051219-012	WP 123-1	0-3	1.8	2.5
C07051219-013	WP 123-1	3-14	4.8	
C07051219-014	WP 123-1	14-20	4.6	
C07051219-015	WP 123-1	20-32	4.0	
C07051219-016	WP 123-1	32-44	3.9	
C07051219-017	WP 123-1	44-54	4.3	
C07051219-018	WP 123-1	44-54		
C07051219-018	WP 123-1	54-60	5.0	
C07051219-019	WP 126-1	0-2	2.2	4.2
C07051219-020	WP 126-1	2-10	3.5	
C07051219-021	WP 127-1	0-3	1.5	3.1
C07051219-022	WP 127-1	3-20	3.3	
C07051219-023	WP 127-1	20-27	6.3	
C07051219-024	WP 127-1	27-45	5.1	
C07051219-025	WP 127-1	45-51	3.5	
C07051219-026	WP 127-1	51-60	3.1	
C07051219-027	WP 300	0-4	1.0	2.9
C07051219-028	WP 300	4-20	8.3	
C07051219-029	WP 300	20-28	6.7	
C07051219-030	WP 300	28-40	4.1	
C07051219-031	WP 300	40-49	2.4	
C07051219-032	WP 301	0-2	1.6	6.8
C07051219-033	WP 301	2-15	1.6	
C07051219-034	WP 301	15-24	< 1.0	
C07051219-035	WP 301	24-38	< 1.0	
C07051219-036	WP 301	38-50	1.1	
C07051219-037	WP 301	50-60	< 1.0	
C07051219-038	WP 302	0-3	< 1.0	3.4
C07051219-039	WP 302	3-12	< 1.0	
C07051219-040	WP 302	12-20	1.8	

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C07051219-041	WP 302	20-30	2.6	
C07051219-042	WP 302	30-48	1.7	
C07051219-043	WP 302	48-60	2.4	
C07051219-044	WP 303	0-3	2.1	3.4
C07051219-045	WP 303	3-10	6.2	
C07051219-046	WP 303	10-18	7.7	
C07051219-047	WP 304	0-3	1.8	3.8
C07051219-048	WP 304	3-20	4.9	
C07051219-049	WP 305	0-2	1.7	3.5
C07051219-050	WP 305	2-12	2.0	
C07051219-051	WP 305	12-20	4.7	
C07051219-052	WP 305	20-26	9.0	
C07051219-053	WP 306	0-2	1.4	3.0
C07051219-054	WP 306	2-20	18	
C07051219-055	WP 14-1	0-5	< 1.0	3.5
C07051219-056	WP 14-1	5-16	1.7	
C07051219-057	WP 14-1	16-31	2.6	
C07051219-058	WP 14-1	31-42	2.3	
C07051219-059	WP 14-1	42-51	1.4	
C07051219-060	WP 14-1	51-60	< 1.0	
C07051219-061	WP 19-1	0-3	< 1.0	3.8
C07051219-062	WP 19-1	3-20	10	
C07051219-063	WP 19-1	20-24	18	
C07051219-064	WP 19-1	24-32	4.4	
C07051219-065	WP 19-1	32-44	3.5	
C07051219-066	WP 19-1	44-60	6.7	
C07051219-067	WP 33-1	0-3	< 1.0	2.4
C07051219-068	WP 33-1	3-15	2.4	
C07051219-069	WP 33-1	15-34	1.8	
C07051219-070	WP 33-1	34-44	2.2	
C07051219-071	WP 33-1	44-60	2.7	
C07051219-072	WP 36-1	0-3	1.9	2.9
C07051219-073	WP 36-1	3-12	13	
C07051219-074	WP 36-1	12-17	12	
C07051219-075	WP 36-1	17-36	6.4	
C07051219-076	WP 36-1	36-42	6.1	
C07051219-077	WP 37-1	0-3	< 1.0	2.9
C07051219-078	WP 37-1	3-7	5.6	
C07051219-079	WP 37-1	7-15	31	
C07051219-080	WP 37-1	15-18	24	
C07051219-081	WP 37-1	18-28	14	

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C07051219-082	WP 80-1	0-3	1.6	2.6
C07051219-083	WP 80-1	3-20	1.5	
C07051219-084	WP 80-1	20-28	4.1	
C07051219-085	WP 80-1	28-37	2.5	
C07051219-086	WP 107-1	0-2	3.4	2.1
C07051219-087	WP 107-1	2-14	2.5	
C07051219-088	WP 108-1	0-3	2.7	4.1
C07051219-089	WP 108-1	3-24	4.2	
C07051219-090	WP 108-1	24-30	20	
C07051219-091	WP 108-1	30-44	4.1	
C07051219-092	WP 108-1	44-60	3.9	

ADDENDUM 3.3-E

PRIME FARMLAND DESIGNATION

Jamie Eberly
Plant Ecologist
BKS Environmental Associates, Inc.
P.O. Box 3467
Gillette, WY 82717

RE: Prime Farmland for Moore Ranch

Jamie,

I looked over the area for the Energy Metals Moore Ranch Corporation.

There is no prime farmland.

Douglas A. Gasseling

Douglas A. Gasseling, CPAg, CPESC, CCA
Conservation Agronomist
11221 East Highway 30
Cheyenne, WY 82009

3.4 WATER RESOURCES

3.4.1 Water Use

3.4.1.1 Regional Groundwater Use

The license area is located at the southwestern edge of the Northern Great Plains aquifer system, which underlies most of the Dakotas and parts of Montana and Wyoming (USGS 1996). The major aquifers of the Northern Great Plains aquifer system are sandstones of Tertiary and Cretaceous age and carbonate rocks of Paleozoic age. These are overlain by unconsolidated deposits of Quaternary age, some of which are locally highly permeable and underlain by crystalline rocks that yield little water (USGS 1996).

Regional movement of water in the Northern Great Plains aquifer system comes from recharge areas at high altitudes, down the dip of the aquifers and then upward to discharge into shallower aquifers or to the land surface. The regional direction of flow in the deep, confined aquifers follows long flow paths and trends from southwest to northeast. Most of the recharge to the aquifer system is either from precipitation or snowmelt. Much of the discharge from the aquifer system is by upward leakage of water into shallower aquifers where the hydraulic head in the shallower aquifer is less than that of a deeper aquifer (USGS 1996).

The water-bearing units in the Northern Great Plains aquifer system can be divided into six major aquifer systems. From shallowest to deepest, these include:

- Quaternary Aquifers
- Middle Tertiary Aquifers
- Lower Tertiary Aquifers
- Upper Cretaceous Aquifers
- Lower Cretaceous Aquifers
- Paleozoic Aquifers

Table 3.4.1-1 shows these units along with the corresponding geologic formation, general transmissivity and water yields, and general water quality for the Northern Great Plains

aquifer systems. Units younger than Lower Tertiary are typically not present within the vicinity of Moore Ranch and therefore are of no significance with respect to groundwater supply. Aquifer systems and geologic formations applicable to the Moore Ranch Project are discussed in greater detail in Section 3.4.3.

Water use estimates for Campbell County for different water use types are presented in Table 3.4.1-2.

Table 3.4.1-1 Northern Great Plains Aquifer Systems and Formations General Characteristics

Aquifer System	Formations	General Transmissivity (gpd/ft).	General Water Yields (gpm)
Quaternary Aquifers	Alluvium, Terrace, and Eolian Deposits	15 to 64,000	Up to 1,000
Middle Tertiary Aquifers	Arikaree Formation	Up to 77,000	Up to 1,000
Lower Tertiary Aquifers	Wasatch and Fort Union Formations	1 to 5,000	1 to 60
Upper Cretaceous Aquifers	Lance and Fox Hills Formations	76 to 2,100	Up to 350 gpm (Lance) and 700 gpm (Fox Hills)
Lower Cretaceous Aquifers	Dakota Sandstone Formation	220-810	Up to 150
Paleozoic Aquifers	Madison Limestone Formation	1,000 to 300,000	Up to 1,000

(HKM et al. 2002).

Table 3.4.1-2 Estimated Water Use in Campbell County, Wyoming

Water Use Type	Withdraws (MGD)
Public Supply	1.88
Domestic GW	0.01
Industrial GW	0.25
Industrial SW	0.15
Irrigated Acres, sprinkler	0.00184
Irrigated Acres, surface flood	0.01096
Irrigated Acres, total	0.01280
Irrigation GW	1.26
Irrigation SW	40.85
Irrigation, total	42.11
Mining GW	56.67
Mining SW	13.29
Mining, total	69.96
Thermoelectric, total	0.41
Total GW, fresh	41.26
Total GW, saline	18.97
Total GW	60.22
Total SW, fresh	54.55
Total SW, saline	0
Total SW	54.55

Source: Hutson et al. 2000
Notes: GW = Groundwater
SW = Surface water
MGD = Million gallons per day

3.4.1.2 Site Area Groundwater Use

The License Area is situated in the southwestern part of the Powder River Basin. The surface unit in the area is Wasatch Formation which is underlain by Fort Union Formation. The Wasatch Formation is further divided into sand layers interbedded with coal and mudstone. The target production zone is referred to as the 70 Sand. The thickness of 70 Sand is normally in the range of 60 to 80 feet and the dip is generally less than one degree toward the northwest. Recharge to the 70 Sand occurs mainly in the outcrop area located southeast of the License Area. The first water bearing formation above the 70 Sand is the 72 Sand (overlying) and first water bearing stratum below is represented by the 68 Sand (underlying). A shallow water bearing stratum, identified as the 80 Sand, is present above the 72 sand as a localized

discontinuous unit. Deeper water bearing strata, identified as the 40 and 50 Sands extend areally and are locally considered significant aquifers (Conoco 1980).

Groundwater rights in Wyoming are permitted on a well by well basis through the Wyoming State Engineers Office (SEO). Groundwater rights within the review area are listed in Addendum 3.4-A. To the extent the data are available, the well yield, well depth, static water level and completion interval associated with each groundwater right (well) is included in Addendum 3.4.A. The date the permit was issued is also included. The yields listed in the Addendum are simply the yields that were reported to the SEO and are not a permit limit. However, domestic and stock wells are limited to 25 gpm per well. There are no minimum heads entitled with the rights listed in the Addendum. Priority of the rights is as listed in the Addendum based on the date of issuance. Not all available groundwater rights have been granted in the area of the facility as permits are granted on a well by well basis and for the completion interval of the specific well. Conceivably, several wells could be placed in the same general vicinity, but could be screened across different intervals. The vast majority of the water rights permitted in the vicinity of Moore Ranch are for CBM activities within the Fort Union Formation, at depths exceeding 800 feet.

According to the SEO, there are 559 active wells located within the 2-mile radius of the License Area boundary as of June 2009. Of those wells, 465 are indicated as CBM or stock-CBM wells. All of the CBM and stock-CBM wells for which records are available are over 700 feet deep, deeper than the 60 through 72 sands would be projected within the two mile radius. The CBM and stock-CBM wells which have no records of completion depth are unlikely to have been completed in shallow Wasatch Sands as the target for CBM in the area of Moore Ranch is the Fort Union Formation. The Fort Union is encountered at depths exceeding 800 feet within the area of Moore Ranch.

In general, groundwater supplies in the vicinity of the License Area include shallow alluvial sediments and sandstone layers within the Wasatch aquifer typically encountered from surface up to depth of 1,100 feet below ground surface (bgs) in this area (Conoco 1980). Groundwater rights within 2 miles of the License Area are summarized in the following table.

Table 3.4.1-1 Groundwater Rights within 2 Miles of the Moore Ranch License Area

Category	No. Wells in Category	No. Wells with TD <700 ft,	No. Wells With TD >700 ft,	No. Wells with No Completion Interval Listed	No. Non-Monitor Wells Probably Completed in 60 68, 70 or 72 Sands
Cancelled	125	NA	NA	NA	NA
CBM	162	0	125	37	0
Stock, CBM	303	0	119	184	0
Stock	27	25	2	0	25
Monitor	57	57	0	0	0
Domestic, Irr, Indust, Misc	10	4	3	3	4
Total	684	86	147	235	31

Groundwater rights within the review area are in Addendum 3.4-A.

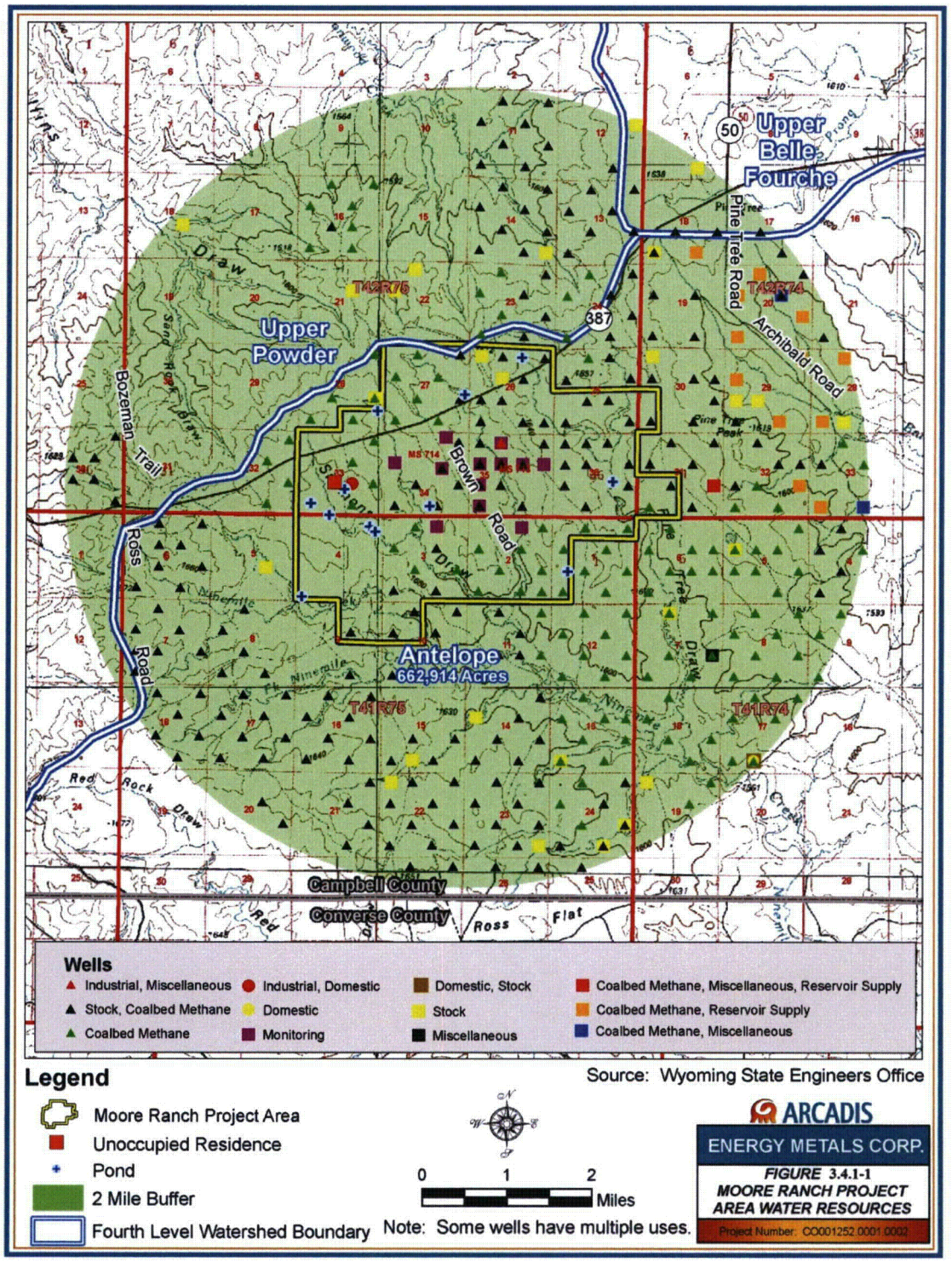
Figure 3.4.1-1 shows the locations of all water wells in the License Area and the 2-mile radius review area. Within this area, there are three domestic water wells ranging from 137 to 440 feet in depth. Licensed yields for these wells vary between 15 and 40 gpm, and static water level ranges between 60 to 90 feet below ground surface (ft bgs). While these wells are licensed for domestic use, there are no current occupied residences within the License Area and 2-mile radius. Therefore, these wells are not being primarily utilized for human consumption. There are no irrigation wells located within the surveyed 2-mile radius of the License Area boundary. There are 27 permitted stock wells within 2 miles of the License Area. Stock water wells depths range between 2 and 800 feet bgs, with static level depth from 0 to 320 feet bgs and yields between 2 and 40 gpm. CBM and stock-CBM wells are up to 1,410 feet deep and generally deeper than 700 feet. Static water levels range from 188 to over 1000 ft bgs. Water levels from 57 monitoring wells within the License Area boundary range between 65 and 330 feet bgs. Depth of these monitoring wells ranges between 66 to 630 feet bgs (WSEO 2009).

Additionally, there are four stock wells located within the License Area that are older and as a result not licensed through the State Engineers Office. There is also a windmill and a shallow well located in the License Area. However, it is not functional.

In summary, there are three water wells licensed for domestic use and no irrigation groundwater wells within the 2-mile radius review area. Based on population projections, future water use within the 2-mile radius review area would likely be a continuation of present use

3.4.1.3 Operational Water Use

Based on a bleed of 0.5% to 1.5% which has been successfully applied at other ISR operations, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 99%) of groundwater used in the mining process will be treated and re-injected (Figure 2.2-4). Potential impacts on groundwater quality due to consumptive use outside the license area are expected to be negligible. Impacts from operational water consumption are described in detail in Section 4 of this Environmental Report.


Upper Belle Fourche
Pine Tree Road
Archibald Road
Upper Powder
Bozeman Trail
Ross Road
Brown Road
Antelope
662,914 Acres
T42R75
T42R74
T41R75
T41R74
Campbell County
Converse County
Ross Flat
Wells
Industrial, Miscellaneous
Industrial, Domestic
Domestic, Stock
Coalbed Methane, Miscellaneous, Reservoir Supply
Stock, Coalbed Methane
Domestic
Stock
Coalbed Methane, Reservoir Supply
Coalbed Methane
Monitoring
Miscellaneous
Coalbed Methane, Miscellaneous
Legend
Moore Ranch Project Area
Unoccupied Residence
Pond
2 Mile Buffer
Fourth Level Watershed Boundary
Source: Wyoming State Engineers Office
0 1 2
Miles
Note: Some wells have multiple uses.
ARCADIS
ENERGY METALS CORP.
FIGURE 3.4.1-1
MOORE RANCH PROJECT
AREA WATER RESOURCES
Project Number: CO001252.0001.0002

3.4.2 Surface Water

The Moore Ranch License Area, as well as the western, southern, and eastern portions of the 2-mile radius review area (located in Campbell County, Wyoming) are drained by Ninemile Creek, an intermittent stream which flows through the far southern portion of the property in a southeasterly direction, within the Antelope Basin, Hydrologic Unit Code (HUC) 10120101 (US EPA 2007) (Figure 3.4.2-1). Simmons Draw, an intermittent stream, flows through the License Area from the northwest to the southeast and joins with Ninemile Creek just south of the License Area near the Van Gordon Ranch. as shown in Figure 3.4-1-1b. The second tributary to Simmons Draw, another unnamed intermittent stream flows through the center of the License Area from north to south and converges with Ninemile Creek on the south side near the Van Gordon Ranch. Pine Tree Draw and its tributaries are intermittent streams located in the eastern portion of the License Area, and flows from north to south joining with Ninemile Creek southeast, just upstream from Ninemile Ranch. Pine Tree Draw is composed of three distinct branches within the License Area. The most easterly branch of Pine Tree Draw is fed by Pine Tree Spring, which is located at an elevation of 5,244 feet above mean sea level (amsl). Ninemile Creek joins with Antelope Creek southeast of the License Area in Converse County, WY about 8 miles downstream. Antelope Creek eventually flows easterly through Thunder Basin National Grassland to its confluence with the Cheyenne River in eastern Wyoming (USGS 1977). The Antelope Basin drains a total of 1,036 square miles and is part of the greater Cheyenne River Basin, which is part of the Northeastern Wyoming River Basin area (US EPA 2007 and HKM et al. 2002).

About nine small ponds are located within the License Area (Figure 3.4.1-1). The ponds are located on intermittent streams including Ninemile Creek, Simmons Draw, an unnamed stream, and Pine Tree Draw. Ponds are used to supply range and pasture animals with drinking water or may be used for holding water discharged from coal bed methane and other oil and gas mining operations.

The northern/northwestern portion of the 2-mile review area drains to the Upper Powder River Basin (HUC 10090202) via Collins Draw and Cottonwood Creek (Figure 3.4.2-1). Collins Draw and Cottonwood Creek flow northward and join with the Dry Powder River in Johnson County, WY northwest of the License Area. The Dry Powder River flows northwesterly to its confluence with the Powder River just north of Sussex, WY. The total drainage area of the Upper Powder Basin is 2,518 square miles (US EPA 2007).

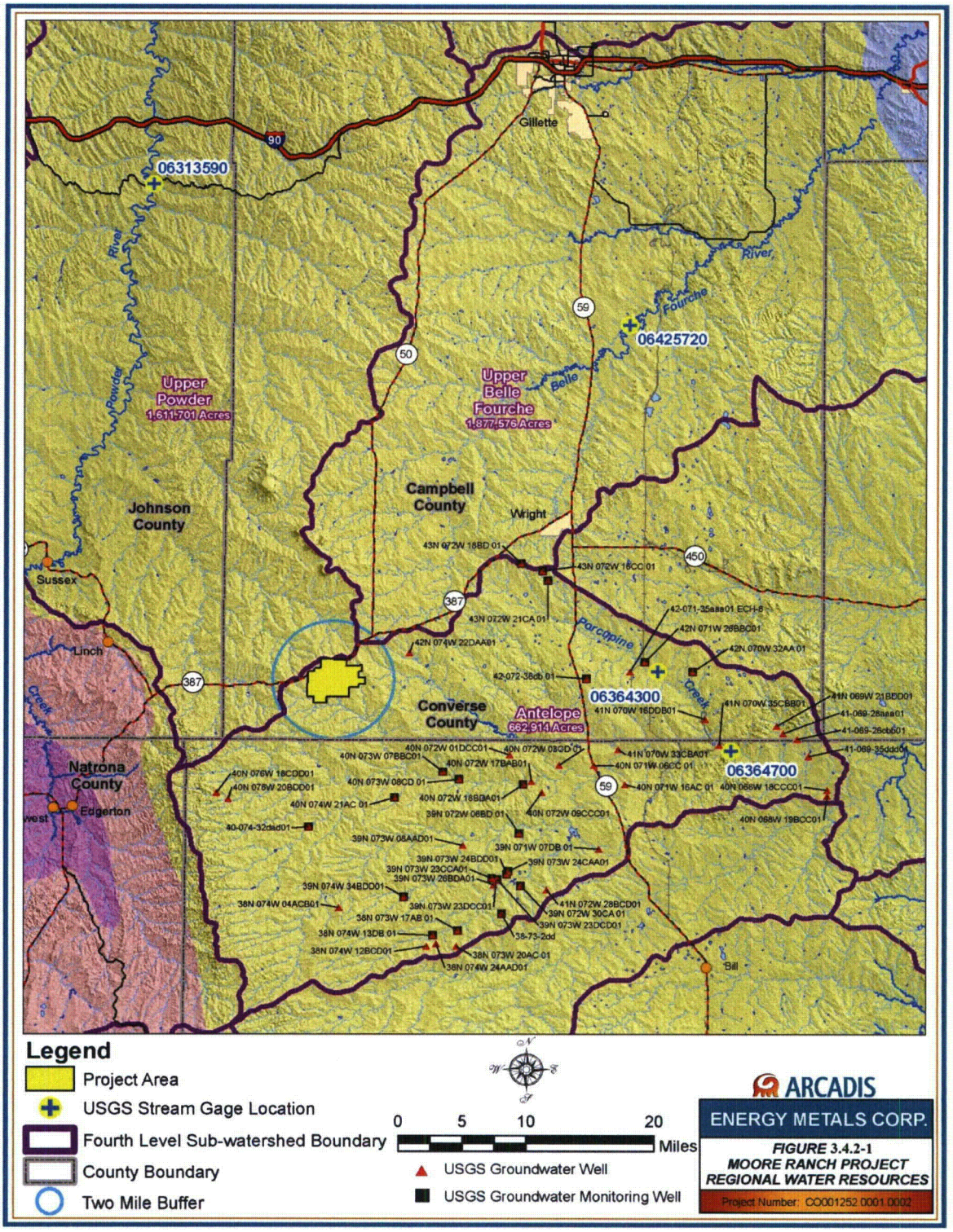
The northeastern most portion of the 2-mile review area drains to the Belle Fourche River and the Upper Belle Fourche Basin, HUC 10120201, which has a drainage area of 2,934 square miles (Figure 3.4.2-1) (US EPA 2007). In the upper portion of the Belle Fourche River is an intermittent river which eventually joins with the Cheyenne River east of the South Dakota boundary. The Cheyenne River joins the Missouri River in South Dakota.

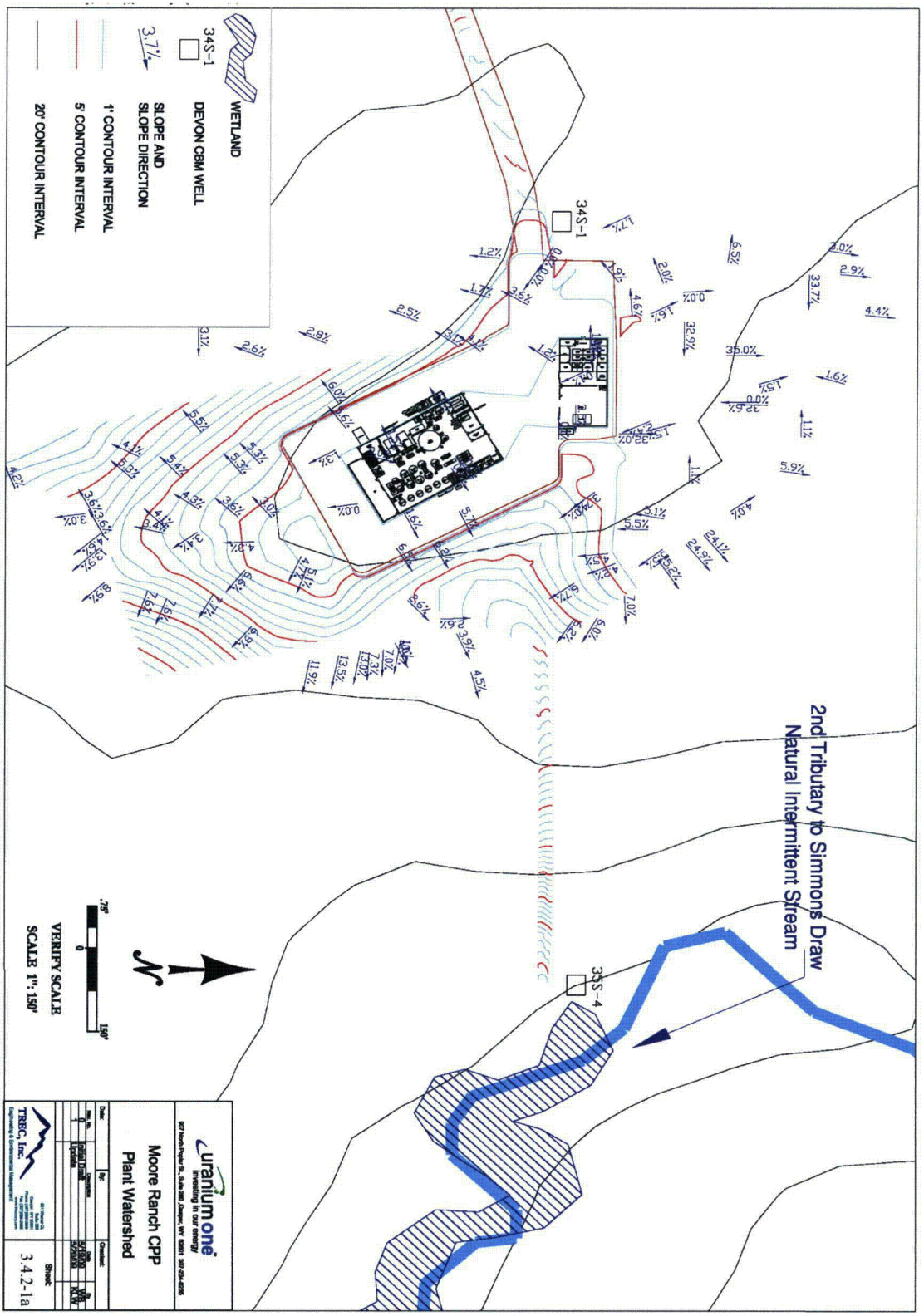
Elevations near the License Area and its surrounding 2-mile review area are approximately 5,500 feet. Climate in the area is arid, typical of a high desert area, with low annual precipitation (13 inches/year) and high evaporation rates. Hydrographs for streams in the upper portions of the Antelope, Upper Belle Fourche, and Upper Powder River watersheds peak during snowmelt in the late spring/early summer. Summer thunderstorms also influence smaller hydrograph peaks.

3.4.2.1 Surface Water Quantity and Runoff

Surface water data for the Antelope Creek Basin (HUC 10120101) are scarce. No stream flow data are available for drainages located within the License Area or within the 2-mile review area. One U.S. Geological Survey (USGS) stream gage on Antelope Creek near Teckla, WY (USGS 06364700) is located southwest and downstream of the License Area (Figure 3.4.2-1). In the Upper Powder River Basin (HUC 10090202), which receives drainage from the northwest portion of the 2-mile review area, a USGS stream gage (USGS 06313590) is located above Burger Draw near Buffalo, WY. The Upper Belle Fourche River Basin (HUC 10120201), which receives a small portion of the drainage from the northeastern tip of the 2-mile review area, has a USGS stream gage located below Rattlesnake Creek near Piney, WY. Streamflow data from these USGS gage sites were analyzed to describe water quantities that may be influenced from activities within the License Area (USGS 2007).

Available daily mean discharge data for Antelope Creek is limited to September of 1977 through September of 1981. Analysis of daily mean discharge for Antelope Creek near Teckla, WY (USGS 06364700) during this period revealed an average of 9.8 cubic feet per second (cfs) and a median of 0.3 cfs. The maximum daily mean discharge of 2,560 cfs was recorded on May 18, 1978. Analysis of annual instantaneous peak discharge recorded from August 17, 1979 through August 5, 1981 revealed a peak flow of 1,760 cfs measured on August 17, 1979. Average peak flows were 836 cfs, ranging from 70 to 1,760 cfs, and the median peak flow was 836 cfs (USGS 2007) (Figure 3.4.2-2). Flood frequency data analysis was not possible due to the limited record of annual peak instantaneous data.


Gillette
90
06313590
River
Powder
Upper Powder 1,611,701 Acres
Johnson County
Sussex
Linch
387
Natrona County
Edgerton
Campbell County
Converse County
Wright
50
59
06425720
Fourche
Upper Belle Fourche 1,877,576 Acres
Belle
450
Parcupine
Creek
Antelope 662,914 Acres
06364300
06364700
Bill
Legend
Project Area
USGS Stream Gage Location
Fourth Level Sub-watershed Boundary
County Boundary
Two Mile Buffer
0 5 10 20
Miles
USGS Groundwater Well
USGS Groundwater Monitoring Well
ARCADIS
ENERGY METALS CORP.
FIGURE 3.4.2-1
MOORE RANCH PROJECT
REGIONAL WATER RESOURCES
Project Number: CO001252.0001.0002


WETLAND
34S-1
DEVON CBM WELL
3.7%
SLOPE AND SLOPE DIRECTION
1' CONTOUR INTERVAL
5' CONTOUR INTERVAL
20' CONTOUR INTERVAL
2nd Tributary to Simmons Draw
Natural Intermittent Stream
35S-4
.75'
0
150'
VERIFY SCALE
SCALE 1": 150'
uranium one
Moore Ranch CPP
Plant Watershed
TREC, Inc.
3.4.2-1a