SUMMARY

RESOURCE and POTENTIAL RECLAMATION EVALUATION

HORSE NOSE BUTTE STUDY AREA -DUNN CENTER LIGNITE FIELD

EMRIA REPORT #9 1977

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT
BUREAU OF RECLAMATION
GEOLOGICAL SURVEY

EMRIA

(Energy Mineral Rehabilitation Inventory and Analyses)

EMRIA is a coordinated approach to field data collection, analyses, and interpretation of overburden (soil and bedrock), water, vegetation, and energy resource data. The main objective of the effort is to assure adequate baseline data for choosing reclamation goals and establishment of lease stipulations through site-specific preplanning for surface mining and reclamation.

These reports are prepared through the efforts of the Department of the Interior, principally by the Bureau of Land Management, Bureau of Reclamation, and Geological Survey. Assistance is also provided by other Federal and State agencies.

Reports under this effort are:

EMRIA Report	Location
1	Otter Creek, Montana
2	Hanna Basin, Wyoming
3	Taylor Creek, Colorado
4	Alton, Utah
5	Bisti West, New Mexico
6	Foidel Creek, Colorado
7	Red Rim, Wyoming
8	Bear Creek, Montana
9	Horse Nose Butte, North Dakota

Published November 1977

SUMMARY AND RECOMMENDATIONS HORSE NOSE BUTTE STUDY AREA DUNN CENTER LIGNITE FIELD, NORTH DAKOTA

INTRODUCTION

This summary presents a brief nontechnical discussion of the detailed studies on the Horse Nose Butte Study Area. Backup data may be found in the main report. The study area is located in Dunn County, approximately 4 miles southeast of Dunn Center, North Dakota. The area includes about 2,560 acres in all or parts of Sections 3, 10, 11, 12, 14, and 15, T. 144 N., R. 94 W. The general location is shown on Plate 1. The area location is shown on Plate 2 and Photograph 1.

CLIMATE

The Horse Nose Butte Study Area has a continental climate with a mean average annual precipitation of about 16 inches. Over 75 percent of the precipitation is received during the April to September growing season. May and June are the wettest months, and January and February are the driest.

Soil moisture is generally adequate to supply the plants needs in the spring but consumptive use generally exceeds the available moisture by mid July. This date coincides with the maturity of small grains. Many perennial native plants become dormant or semidormant because the available moisture has been depleted. However, most native grasses mature prior to this lack of moisture-induced dormancy.

The frost-free growing season averages 121 days, with the last spring frost occurring about May 18. September 15 is the average date of the first frost in the fall. Temperature extremes range from 111° F. to -52°F.

Frost usually penetrates the ground to depths of 3 to 5 feet each winter. This action can accelerate the soil building processes in reconstructed profiles.

Normal climatic conditions are favorable for the successful establishment of a vegetative cover the first year of reclamation work. In this area, all reclamation plans should consider water short years, wind erosion, and water erosion. These hazards can be minimized by planning and management actions.

PHYSIOGRAPHY

The Horse Nose Butte Study Area lies in the glaciated portion of the Great Plains Physiographic Province. Topography in the area is characterized by gently rolling hills and poorly incised valleys. Maximum relief is about 180 feet, ranging from an elevation of 2170 feet at

Slow Creek to 2350 feet on topographic highs within the study area. Surface gradients range from nearly flat along the Slow Creek flood plain to about 15 percent along the flanks of knobs. The area is dry-farmed except for some pasturelands generally situated along steeper slopes. Drainage in the area is northward into Slow Creek which flows into Spring Creek, a tributary of the Knife River.

GEOLOGY

The Horse Nose Butte Study Area is underlain by the Sentinel Butte Formation of Paleocene Age, which consists of interbedded shale, siltstone, sandstone, limestone, and lignite. Clinker, which crops out along the valley walls of Slow Creek was produced by burning of several lignite beds. Surficial glacial, aeolian, and alluvial deposits generally mantle the Sentinel Butte Formation in the area.

Four coalbeds of economic significance underlie parts of the study area. These include the Dunn Center bed which averages 18.4 feet in thickness and three stratigraphically higher beds, averaging from 1.9 to 9.1 feet in thickness. Overburden above the Dunn Center bed varies from 10 to 200 feet.

COAL RESOURCES

The demonstrated coal resources in the Horse Nose Butte Study Area and vicinity includes 96,340,000 tons in four beds, A, B, E, and F (Dunn Center lignite). All reserves are within 200 feet of the surface.

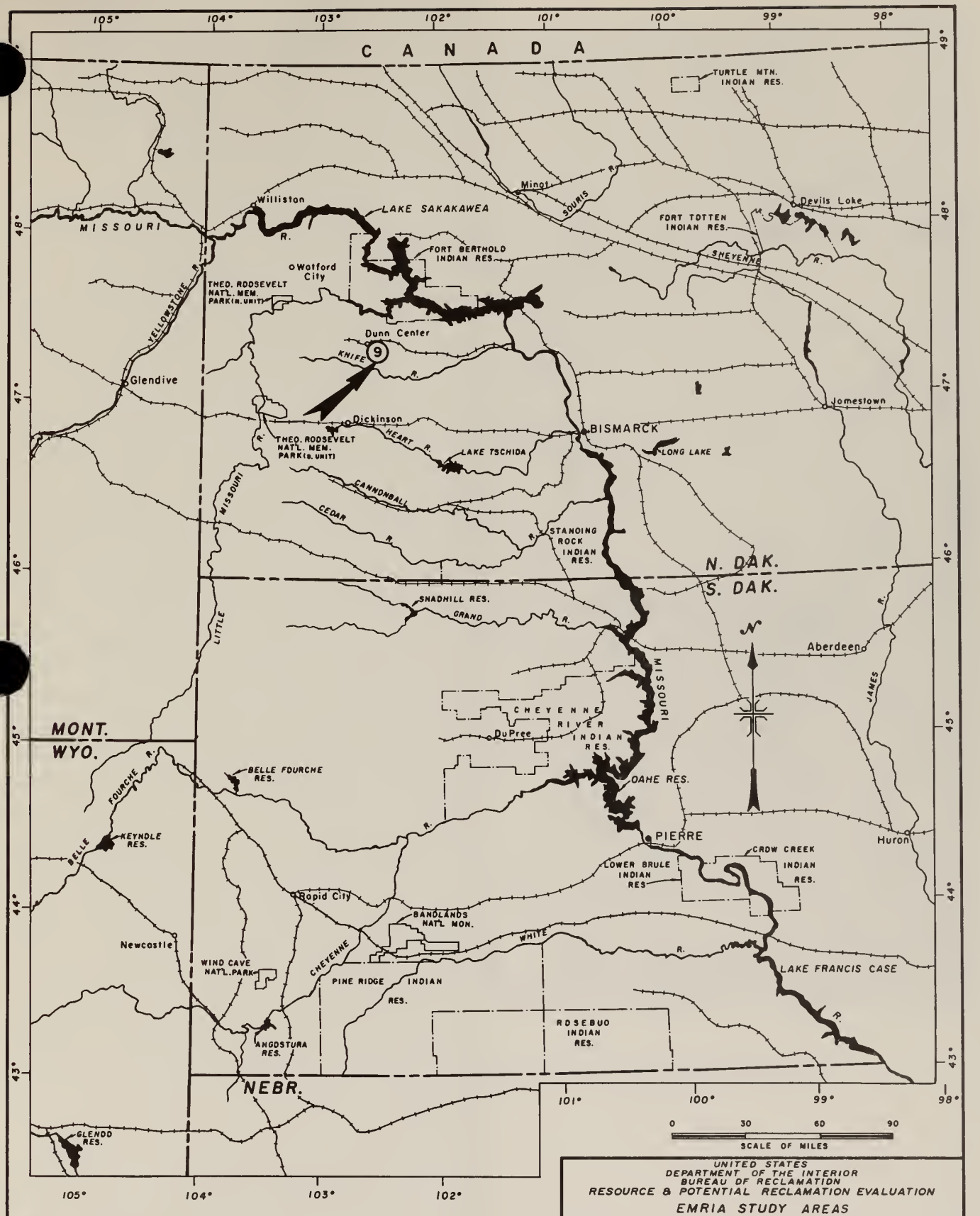
Analyses of coal samples from the Horse Nose Butte Area are not available as of this writing. However, 25 samples from surrounding uncorrelated coalbeds in Dunn County were analyzed by the U. S. Bureau of Mines. The average analysis, derived from these samples, is:

Moisture (as received)	40.6 percent
Ash (as received)	7.0 percent
Sulfur (as received)	0.6 percent
Btu (as received)	6,310

The lignite in the Horse Nose Butte Study Area is probably similar to the average cited above.

HYDROLOGY

The Horse Nose Butte site is located in a recharge area for the shallow local ground water flow system. Due to the low permeability and small thickness of sandstone beds in the recharge area, the study area contains only minor shallow aquifers. Fracture zones in the lignite will supply small amounts of water to farm wells, but the lignite beds generally are not significant aquifers. Ground water flow from the study area is toward lowland areas along Spring Creek and its tributaries.



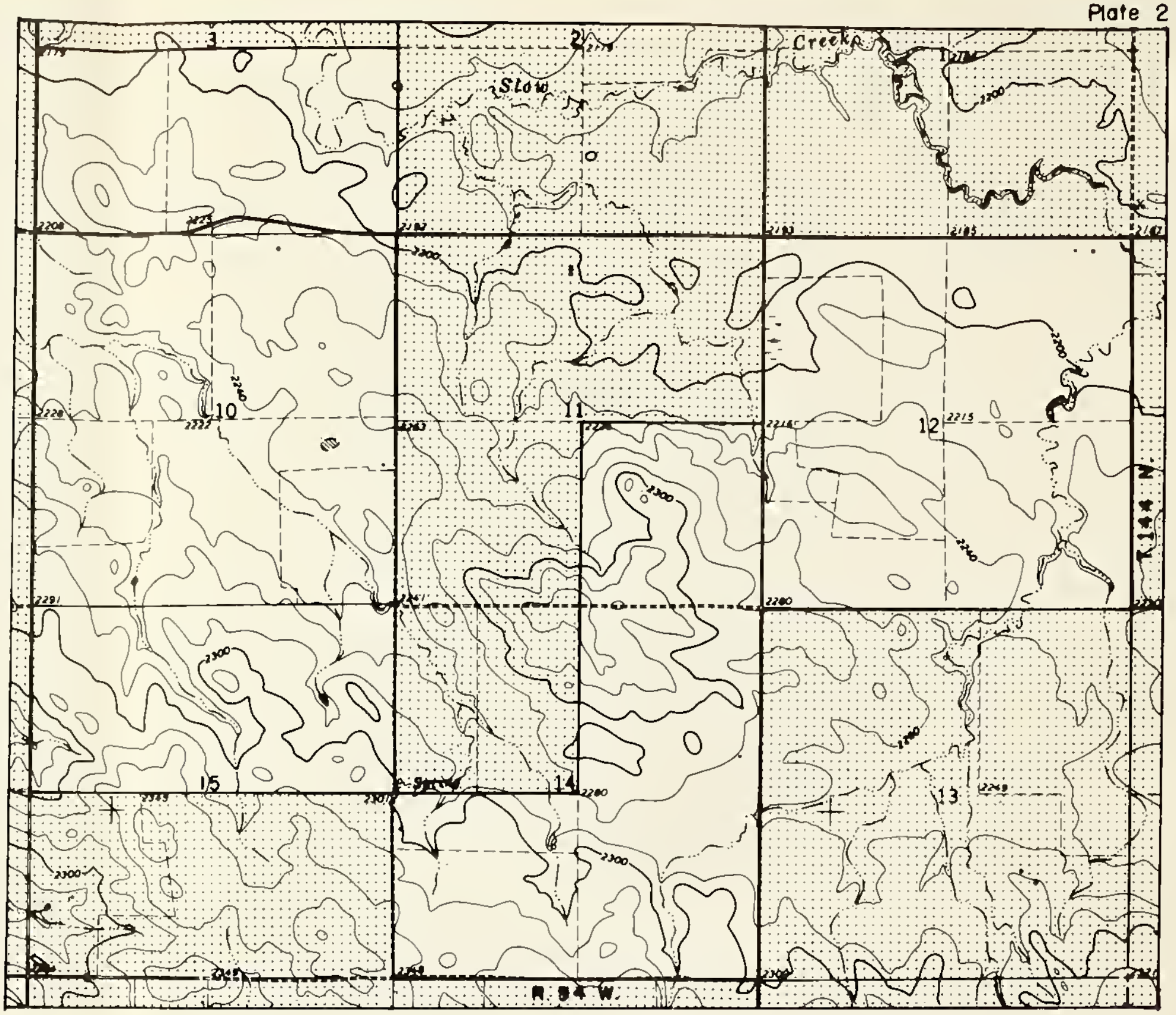
(9) HORSE NOSE BUTTE STUDY AREA—EMRIA NO. 9

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
RESOURCE & POTENTIAL RECLAMATION EVALUATION

EMRIA STUDY AREAS
NORTH DAKOTA, SOUTH DAKOTA, MONTANA & WYOMING

GENERAL LOCATION MAP

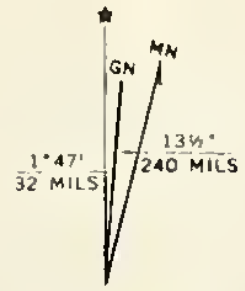
DESIGNED V. LINDSEN	SUBMITTED
DRAWN V. LINDSEN	RECOMMENDED
CHECKED G.J.T.	APPROVED
BILLINGS, MONTANA MARCH 1976	1305-600-77



1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

NOTE: STUDY AREA NOT STIPPLED

CONTOUR INTERVAL 20 FEET

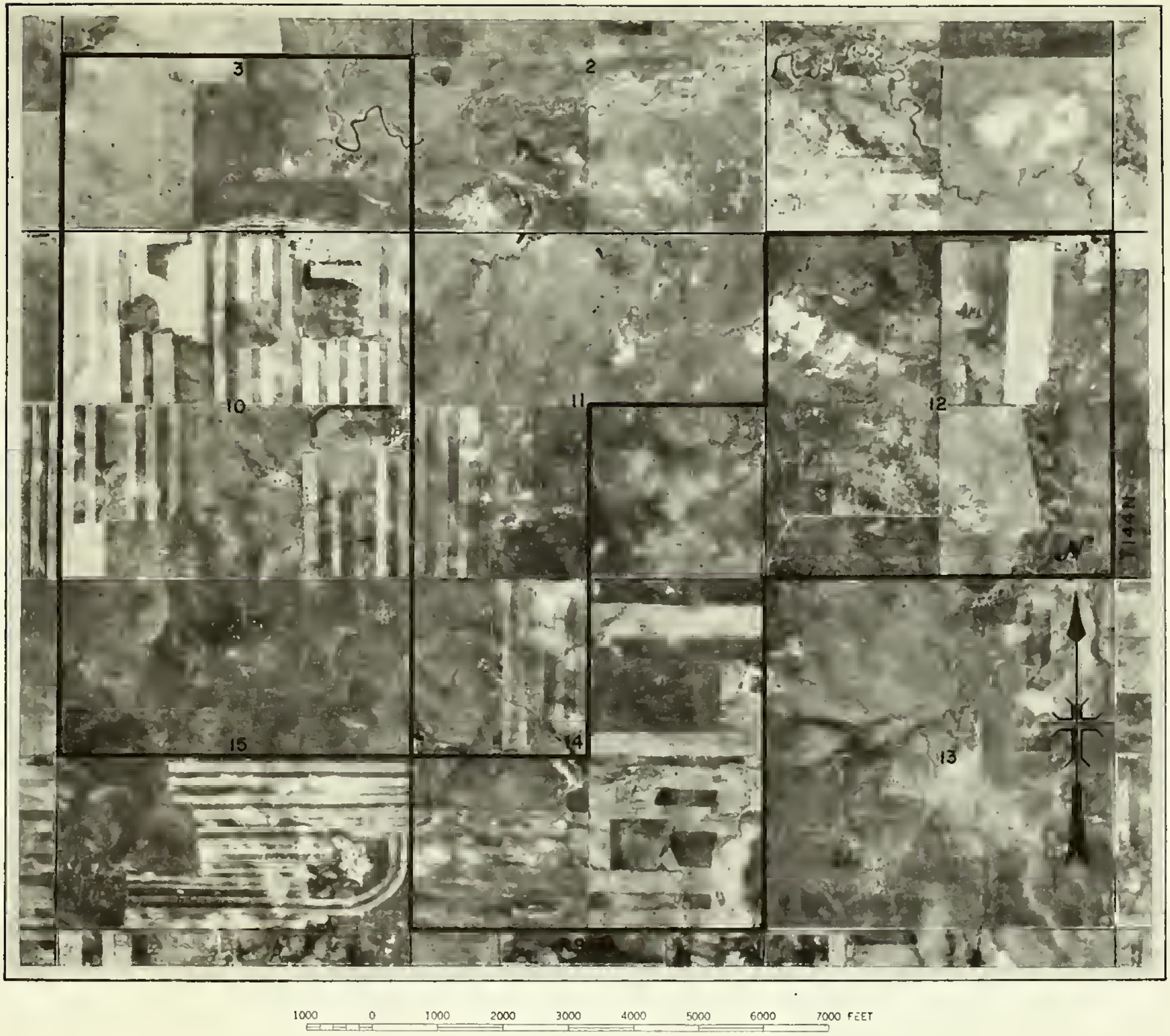


UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION
PORTION OF U.S.G.S. DUNN CENTER QUADRANGLE

RESOURCE & POTENTIAL RECLAMATION EVALUATION
HORSE NOSE BUTTE STUDY AREA
DUNN CENTER LIGNITE FIELD

TOPOGRAPHY



Photograph 1 - Aerial view of the Horse Nose Butte Study Area. This photograph is a portion of the Bureau of Land Management Photograph MDAD 9-33-93 (8/18/75).

Short-term geochemical effects will be limited to mine ponds and lakes at the mine site. If these surface-water sources are discharged to tributaries of Spring Creek, an increase in dissolved solids will occur at low flow. The long-term geochemical effect will be an increase in dissolved solids in water from the local flow system downgradient from the mine site.

Deep aquifers are protected from direct contamination from the mining by the relatively impervious Cannonball Member in the Fort Union Formation and by confining beds in the Hell Creek Formation.

Small quantities of water are available from ground and surface water sources in the Dunn Center area; however, the only reliable water source for extensive reclamation is from the Little Missouri River area of Lake Sakakawea.

VEGETATION, SOIL WATER, AND SOIL DETACHABILITY

The native vegetation is predominantly mixed prairie, a mixture of mid and short grasses, and a few tall grasses. The most abundant mid grasses are western wheatgrass, junegrass, and needle-and-thread. Blue grama is the most abundant short grass, but buffalograss and sandberg bluegrass are present in minor amounts. Sloughgrass, little bluestem, and prairie sandreed are the only tall grasses of importance and these occur on sandy soils or sites that receive run-in moisture. Saline lowlands cover considerable area and have mixed strands of western wheatgrass, alkali-grass, sloughgrass and saltgrass. Native vegetation covers about 65 percent of the area and occupies the steeper slopes, nearly level tracts on upland divides, and on moderately undulating hilly terrain.

These grasslands are generally in good to excellent condition with little evidence of deterioration due to grazing. Estimated carrying capacities are 0.7 to 1.8 acres per animal unit month.

All of the soils in this area interact similarly with water, so a single family of linear relationships between moisture content and moisture-retention force can be used to define the vegetation-soil-water relationship.

About 3 feet of the extensively occurring medium-textured (silt loam) soil are required to store the accumulated moisture from normal amounts of winter and spring precipitation under low runoff conditions.

On the uplands, highest yields of grasses occur where about 3 feet of relatively coarse soils overlie finer-textured soils. This causes part of the soil water to be "perched" and thus more readily available to plants. Appreciable depths of sandy loam materials that occur in some lowland areas could provide a source of relatively coarse material.

SEDIMENT YIELDS

Present source-area sediment yields on and near the study area are low. They range from none to about 0.4 acre-foot per square mile per year. Highest sediment yields are from the cultivated areas. Differences in the slope of the land appears to cause some of the variation in source-area sediment yields. Sediment discharges from small drainage basins in this area are low, ranging from 0.1 to 0.2 acre-foot per square mile. There is an insignificant amount of channel erosion on the study area.

Source-area sediment yields probably will be increased slightly to moderately above present rates during mining and during the rehabilitation period. After rehabilitation and when vegetation cover is fully established and the soil is stabilized, sediment-yield rates should approximate the present rates, under the same land uses.

SOIL

Soil and Bedrock Material

The soils of Horse Nose Butte Study Area developed on and from three types of material: (1) residual, (2) alluvial/colluvial, and (3) glacial. Residual soils have the greatest areal distribution. They occupy 63 percent of the area. Three characteristics common to these soils are their variability in depth to parent material and their chemical and physical properties. Alluvial/colluvial soils occupy 19 percent of the area. These soils are usually high quality material with little difference attributed to mode of deposition. Glacial deposits have produced 8 percent of the soils and the remaining soil types include aeolian influenced soils that are intricately intermixed in the major soil areas.

The residual soils formed on material weathered from intertonguing soft shale, siltstone, and sandstone of the Sentinel Butte Formation. These soils form a complex pattern and range from shallow to deep. The surface relief consists largely of gently rolling hills. In most locations, selective stripping 1/ of the best material for plant media can be accomplished.

Sandy residual soils in the area have a few minor but manageable limitations if used as plant media. The two principal deficiencies are susceptibility to wind erosion, which can be controlled in part with cover crops and low moisture retention of the subsoil which can be minimized by placement below adequate topdressing material. These soils occur on the steeper slopes, but selective stripping can be accomplished.

The silty residual soils occur on rolling hills with surface gradients ranging from 3 to 9 percent. Surface layers of these soils are best

1/ Selective stripping is used in tracts with complex land conditions. The good quality material is stripped for surface use, suitable material for subsurface use and adverse material is left for removal and placement with the spoils.

for topdressing shaped spoils. The subsoil is lower quality, but may be used on or near the surface. The substratum generally should not be used near the surface.

Clayey residual soils in this study area occur on relatively flat uplands. These soils have an incomplete cover of a few inches of material suitable for use as topdressing. However, this material should be stripped and stockpiled to reduce the amount of borrow material required for successful reclamation. It can be used separately or mixed with borrowed topdressing material for use on the surface. Subsoils and substrata are often saline and sodic and should be placed 36 inches or more below the surface.

The alluvial/colluvial soils are the most valuable source of the topdressing material for use in revegetating mined land in the study area. These soils are good-to-high quality and include silty soils with well developed profiles and sandy soils with less profile development on old alluvial terraces. Also included are recent alluvial/colluvial soils on terraces, fans and footslopes. They have very high quality surface soil. The subsoil and substratum are usually suitable for use on or near the surface. This readily available source should be considered as potential borrow material for improvement of tracts with minimal suitable material for plant media.

Glacial soils will provide adequate good quality topdressing material from the surface layers. The subsoil and substratum are suitable for use in their natural position, but should not be used on the surface.

Land Suitability

A land classification survey was made to determine the suitability of the overburden (soil and bedrock) for use in revegetating the study area if it is surface mined. This land classification survey was performed using specifications developed specifically for use in this study area. Field, laboratory and greenhouse data were used to evaluate the quality and quantity of material in the soil mantle and bedrock portions of the overburden. This work was finalized by delineating the land in Classes 1, 2, 3, and 6 on field maps. Map symbols show the location, quality, and thickness of the soil and substratum.

Class 1 lands provide the most desirable and plentiful source of material for use at or near the surface of reconstructed profiles. This material has few limitations for use as plant media. Class 2 and 3 are less desirable because of soil deficiencies. Typical deficiencies of the lower classes are erosiveness, salinity, and sodicity. Protection from wind erosion will be necessary if coarse-textured material is used on the surface and surface manipulations may be required to leach soluble salts from medium- and fine-textured material. These and other minor deficiencies are manageable. The lower class land may also lack adequate material for profile improvement. Class 6 land is deficient in suitable topdressing material for the successful revegetation of mined land. Additional suitable material must be borrowed from nearby deep soil areas or from the bedrock for successful revegetation of these tracts.

Bedrock Suitability

A systematic evaluation was made of the drill core material using data from laboratory analyses, greenhouse studies and weathering tests.

The weathered bedrock immediately below a shallow soil mantle is usually suitable for use near the surface of reconstructed profiles. However, the deeper bedrock layers are quite sodic and should not be used near the surface. If this more adverse material is placed below 36 inches of permeable material, the downward movement of moisture will be restricted. This may increase the effective use of precipitation.

There is more than adequate supply of good and high quality soil material in the study area. Therefore, bedrock material will not usually be needed for use at or near the surface. Although the bedrock should be placed below 36 inches because better material is available, there is no indication of toxicity to plants. Plant growth was observed in tracts with shale exposures.

The highly sodic material from deep bedrock layers could be toxic to seedlings if used on the surface. It is also very unstable, erosive, and very slowly permeable. In this area, it will not be needed for planting media on or near the surface.

Soil Inventory

A soil inventory was made in the Horse Nose Butte Study Area to obtain soil and environmental data. Data from the inventory will be used to develop multiple resource management plans. Interpretation will be made by the BLM related to management of the lands before mining.

The soil inventory of the Horse Nose Butte Study Area was performed by the Soil Conservation Service in cooperation with the North Dakota Agricultural Experiment Station. The survey identifies a total of 31 soil series and 1 land type. Mapping units in the study area total 40. Each soil series is recognized as having characteristics differentiating it from other soils. Soil texture, color, thickness, parent material, physical and chemical properties, as well as climate and topography, influence and characterize each soil. Soils are generally evaluated to a 40-inch depth.

The 31 series consist of Entisols and Mollisols. The areal distribution of the Mollisols is much greater. In the 1938 USDA Soil Classification System, the majority of the soils were placed in the Chestnut great soil group.

All taxinomic soil mapping units are described in the report as to general characteristics, landform position, and technical evaluation related to management.

ALTERNATE OBJECTIVES OF RECLAMATION

Three reclamation objectives and nonmining were considered as possible alternatives for the Horse Nose Butte Study Area. Because of the need for energy and indications that the area could be reclaimed if surface-mined, the nonmining option was considered unacceptable.

Objective No. 1 would return the area to its present condition. Because of the difficulty and impracticability of restoring an area to its exact premining conditions, this objective is not acceptable for the Horse Nose Butte Area.

Objective No. 2 would provide a relatively thin uniform layer of suitable material spread on spoils reshaped to the desired topographic relief. This would provide adequate potential for revegetation with native grasses and satisfy most environmental requirements. The agricultural potential of some lands would be degraded but some would be improved.

Objective No. 3 is similar to No. 2 but where possible most areas deficient in surfacing material would be improved by borrowing material from deep soil areas. The idealized objective would reconstruct profiles in most areas that would be capable of maximum agricultural productivity attainable in this climatic area. Legal limitations on transporting material across ownership lines, distance from deficient tracts to available material, and overall economic limitations will prevent attainment of the idealized conditions.

Reclamation and revegetation plans for the Horse Nose Butte Area should consider combination of Objectives Nos. 2 and 3. Present productive capacity of the better dryfarmed land would be retained and many tracts of many low quality rangeland would be improved.

RECOMMENDATIONS FOR RECLAMATION

Reclamation plans must conform to the North Dakota State law which requires that reconstructed land surfaces be graded to a rolling topography traversable by machines necessary for maintenance in accordance with planned use. Slopes should have no more than a 20 percent grade except final cuts and end walls which must be backsloped to an angle not exceeding 35 degrees from horizontal. Successful revegetation of the Horse Nose Butte Area must consider the long periods of moisture stress in the summer and frost hazards in the fall and spring. Even though the mean annual precipitation appears to be adequate, drouthy years occur and may delay or prevent successful revegetation during these years.

Revegetation of surface-mined areas requires: (1) stockpiling material, (2) shaping and placement of material, (3) planting and seedbed preparation, and (4) management of the revegetated area until the vegetation has been permanently reestablished.

The land classification survey indicates there is an adequate amount of suitable material for revegetation in the Horse Nose Butte Area. The surface soil is generally the best material available because of its high organic content, natural fertility, and more stable structure. An abundant amount of this material exists to supply several inches of topdressing to all disturbed lands. Bedrock material will normally not be needed for use at or near the surface.

A surface gradient of 4 percent or less would be the ideal slope for revegetation and management. However, the surface relief must be designed to accommodate runoff from adjacent higher elevations. Temporary reservoirs, and/or water spreaders may be necessary to prevent increased sediment discharges to Slow Creek. A well vegetated drainage system should be established during rehabilitation of the mined area. Grassed drainageway, if needed, should be constructed sufficiently wide to prevent channel erosion and to promote uniform deposition of sediment. This should maintain the designed gradients of the drainageways.

Surface preparation and planting procedures presently being used successfully in reclamation work should be selected for compatibility with the material in the reconstructed profile. This may include disking, ripping, contour planting, pitting, gouging basins, or a combination of these and other practices.

Both spring and fall planting are successful in this area but fall planting on fallow land reduces plant competition and the hazard from wind and water erosion. Species for planting and planting rates should be determined locally by the agency that will administer the land during the reclamation period.

Management practices after a stand of native plants is established should include a 3-year delay in grazing or other agricultural uses. Conservation practices to attain desired land use goals can be developed with the assistance of the State Extension Service and the Soil Conservation Service.

Irrigation as a development goal should not be considered for this area. However, temporary irrigation may be required on newly seeded tracts in times of drouth. Water for this purpose should be selected with care and irrigation should be discontinued as soon as possible.