NORTH DAKOTA
PUBLIC SERVICE COMMISSION

RECLAMATION DIVISION

STANDARDS FOR EVALUATION OF REVEGETATION SUCCESS AND RECOMMENDED PROCEDURES FOR PRE- AND POSTMINING VEGETATION ASSESSMENTS

REVISED JULY 2003

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GENERAL NOTATIONS

Abbreviations

PSC	ND Public Service Commission
OSM	US Dept. of Interior (USDI), Office of Surface Mining and Regulation
NRCS	US Dept. of Agriculture (USDA), Natural Resources Conservation Service [formerly known as the Soil Conservation Service (SCS)]
FR	Federal Register
USFWS	US Fish and Wildlife Service
ARS	USDA, Agricultural Research Service
NDCC	ND Century Code
SMCRA	Federal Surface Mining Control and Reclamation Act
NDASS	ND Agricultural Statistic Service
NDAC	ND Administrative Code
LRA	Land Resource Area as defined by the NRCS
GPS	Global Positioning System

Mathematical Symbols

CF	Climatic correction factor
PI	NRCS Productivity Index for a soil series based on a rating of 1 to 100
X_{AD}	Adjusted yield standard (bu/ac, t/ac, lbs/ac, etc)
X_{UA}	Unadjusted yield standard developed using NRCS PI values
X_C	Annual county small grain yield as reported by NDASS
X_{CLT}	Long term average (minimum 15 years) NDASS hayland yield
X_{PI}	NRCS PI average county yield for cropland or a minimum of an average of the last 15 years of the NDASS-reported hayland yields
X_{est}	Estimated annual county yield using NDASS-reported X_C and correcting for the prior year's management of either fallow or continuous cropping
X_{ca}	Control area yield
X_{cw}	Unadjusted control area standard yield developed using NRCS PI values
PR	Productivity ratio found by dividing X_{UA} by X_{PI}
s	Sample standard deviation [various subscripts denote weighting (w), sampling strata (h), etc.]
s^2	Sample variance (subscripts denote the same indicator as for standard deviations)
$\lvert\ \rvert$	Indicates the absolute value (always positive) should be used
$\sqrt{}$	Indicates a square root should be calculated
t_{calc}	Calculated Student's t value
d.f.	Degrees of freedom
n	Number of samples used to calculate a mean, etc.
t	Student's t distribution value for a given level of confidence

d	Arbitrary level of accuracy desired (i.e. 10% of a sample mean)
p	Percent surface cover
q	Percent bare ground or 100-p
SEM	Standard error of the mean
x_i	Individual sample value
$\bar{x}$	Sample mean [subscripts denote sampling grouping (i.e. 1, 2), strata (h), weighting (w), etc.]
h	Levels of strata in a stratified sampling system
N_h	Number of sampling units (i.e. acres) in the h^{th} stratum where N equals the total number of sampling units
W_h	Proportion of sampling units in the h^{th} stratum
Σ	Indicates a summation of values

I. OBJECTIVES OF STANDARDS AND PROCEDURES AND OVERVIEW OF REGULATORY REQUIREMENTS

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A. Introduction.....I-A-1

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A. INTRODUCTION

This policy document contains requirements and standards for evaluating revegetation success and recommended procedures for vegetation sampling and data analysis. These standards and procedures are approved by the North Dakota Public Service Commission (PSC) and the Office of Surface Mining (OSM) for use by surface coal mining companies operating in North Dakota. Use of standards or sampling procedures other than those contained herein will require prior approval by PSC and OSM. However, standards and sampling procedures previously approved by the PSC will not be affected by this policy document, unless mid-term reviews or permit renewal reviews indicate they are inconsistent with the standards and procedures contained in this document.

The standards and sampling procedures have been developed using research conducted by Cook and Bonham (1977), Chambers and Brown (1983), Hofmann et al. (1983), Ries and Hofmann (1984), Natural Resources Conservation Service (NRCS) which was formerly known as the Soil Conservation Service (SCS) (2000, 1997, 1988, 1987a, 1987b, 1984a, 1984b, 1982, 1979, 1976, 1975a, 1975b, and 1974), Van Dyne et al. (1984), and others (see Bibliography). This research has been combined with the professional experience of PSC staff, industry representatives, and state and federal scientists and resource managers.

Several agencies were consulted in the development of the standards and methods used in this document. Standards for fish and wildlife habitat were developed in consultation with the North Dakota Game and Fish Department, U.S. Fish and Wildlife Service (USFWS), and staff at North Dakota State University. The NRCS was consulted in the development of standards for prime farmland, cropland, native grassland, tame pastureland, woodlands, and shelterbelts. The USDA-Agricultural Research Service (ARS) was consulted in the development of standards and methods used for native grassland and tame pastureland. In developing these guidelines, a concerted effort has been made to incorporate recent developments in reclamation technology and innovative methods of evaluation of reclamation success. This effort will continue with future research and technological development.

B. OBJECTIVES

The objectives of this document are twofold. First, this document provides requirements and approved standards for assessing revegetation success for bond releases (Chapter II). These standards, and their associated pre- and postmining data requirements, have been approved by both the PSC and OSM, as part of the state's regulatory program. Therefore, the use of these standards by mining companies will require no further approval by the PSC or OSM. However, specific standards to be used by the operator must be included in the approved mining permit. If a mining company proposes to use standards other than those contained in this document, these will require prior approval by the PSC and OSM, on a case-by-case basis.

Second, this document provides recommended procedures for sampling, measurement, and statistical analysis of vegetation parameters (Chapter III). Their use will ensure consistent and objective collection and analysis of vegetation data. Mining companies may propose alternative procedures for sampling and data analysis, but their use will require prior approval by the PSC and OSM.

The standards and the sampling and statistical procedures for various land use categories contained in this document apply to all areas where mining activities occurred after July 1, 1979. Assessment of revegetation success for lands mined between July 1, 1979 and August 1, 1980, may be made in any two years of the ten-year responsibility period. The requirement that revegetation assessment must be made in the last two growing seasons came into effect on August 1, 1980. As an alternative to meeting revegetation success standards for the last two growing seasons, rule changes adopted May 1, 2001, allow mining companies to demonstrate that standards have been met for any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period.

For lands where mining activities occurred between May 3, 1978 and July 1, 1979, the standards and sampling and statistical procedures need to be applied for the assessment of cover and productivity. For lands where mining activities occurred between July 1, 1975 and May 3, 1978, only productivity standards are required to be met, without any statistical requirements.

C. REGULATORY REQUIREMENTS

The current regulatory requirements for revegetation of surface mined lands in North Dakota are based on the environmental protection performance standards contained in Subsections 17 and 18 of North Dakota Century Code (NDCC) Section 38-14.1-24, which went into effect on July 1, 1979. With the exception of some changes in the wording, these Subsections have remained, in essence, unchanged since 1979, and in their latest revised form they mandate the following:

> **NDCC 38-14.1-24(17)**
> Restore lands affected by the surface coal mining operation which have been designated for postmining agricultural purposes to the level of productivity equal to or greater than non-mined agricultural lands of similar soil types in the surrounding area, under equivalent management practices. For those lands which are to be rehabilitated to native grasslands, a diverse, effective and permanent vegetative cover shall be established of the same seasonal variety native to the area to be affected and capable of self-regeneration, plant succession, and at least equal in extent of cover and productivity to the natural vegetation of the area. The level of productivity and cover attained on disturbed lands within the permit area shall be demonstrated by the permittee using comparisons with similar lands in the surrounding area having equivalent historical management practices and that are undisturbed by mining, or comparable disruptive activities.
>
> **NDCC 38-14.1-24(18)**
> Assume the responsibility for successful revegetation, as required by subsection 17, for a period of ten full years after the last year of augmented seeding, fertilizing, irrigation, or other work, provided that, when the commission approves a long-term intensive agricultural postmining land use, the ten-year period of responsibility for revegetation shall commence at the date of initial planting. For the purposes of this subsection, "augmented seeding, fertilizing, irrigation, or other work" does not include normal conservation practices recognized locally as good management for the postmining land use. (Conservation and management practices that may or may not reinitiate the 10-year liability period are discussed in Appendix A.)

The above-mentioned Subsections of North Dakota laws are in conformity with Subsections 515(b)(19) and 515(b)(20) of the Surface Mining Control and Reclamation Act (SMCRA) that went into effect on August 3, 1977. In fact, the North Dakota law exceeds in its scope the Federal law in that it is explicit with respect to the restoration of productivity, whereas the Federal law makes no mention of it. Productivity requirements are, however, addressed in Federal regulations, but the level of stringency does not match that of North Dakota requirements because the Federal regulations require at minimum 90% equivalency (except for prime farmlands), whereas North Dakota rules require 100% equivalency between the reclaimed area and the reference area or yield standard. The same difference between Federal and North Dakota rules exists for cover requirements.

The rules that address the current regulatory requirements for pre- and postmining vegetation inventories and procedures for assessment of revegetation success for areas that were disturbed by mining activities after July 1, 1979, are discussed in subsequent sections. For areas disturbed prior to July 1, 1979, the applicable revegetation requirements are summarized in Appendix B.

II. VEGETATION ASSESSMENT REQUIREMENTS AND SUCCESS STANDARDS

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[1]*Detailed contents are found at the beginning of each section.*

A. INTRODUCTION

This section contains procedures for collecting and submitting pre- and postmining vegetation information and describes the standards that must be used in demonstrating the success of revegetation for different land use categories. The procedures for vegetation assessment include those mandated by the North Dakota law and rules as well as those recommended for the correct application of the approved success standards. Some of these procedures may not apply if other acceptable assessment methods or standards are used.

The revegetation success standards described for different land use categories are based on both reference area and technical standard concepts. The premises and general assumptions made in developing these success standards are:

1. That in establishing the success standards for revegetation "[SMCRA] specifically focuses on the extent of the cover of the natural vegetation in the general area and not on the premining productivity levels of the specific mined areas" (48FR, 40142), while North Dakota Law (NDCC) mandates that the productivity of the reclaimed lands must be equal to or greater than that of the similar soil types in the surrounding areas under equivalent management;

2. That both Federal and North Dakota rules permit the use of USDA or USDI or other available data for the development of standards that reflect the capability of local soils and the influence of climatic conditions;

3. That Federal rules allow the use of appropriately developed or derived variable standards based on average county yields by soil types (48FR, 40151);

4. That Federal rules allow the use of average county yields adjusted for local yield variations for the evaluation of revegetation success on prime farmlands (48FR, 21460); and,

5. That OSM recognizes that it is the States' obligation to develop, identify, and use the success standards which are appropriate for the conditions existing in each state (48FR, 40152).

B. DATA SOURCES FOR DEVELOPMENT OF STANDARDS

The data sources used to develop the revegetation success standards contained in this document were chosen on the basis of the land uses involved. Standards for woodland and fish and wildlife land uses were developed using recommendations of Federal and State agencies along with other requirements specific to those land uses.

Standards for cropland, tame pastureland, and native grassland are based on agricultural data sources, including reference areas on surrounding lands and published technical data. These data sources are used to represent mapping units (e.g., soil series, soil mapping units, range sites) that existed in the reclaimed tracts prior to mining. This enables evaluation of reclaimed tracts by comparison with their premining characteristics and the characteristics of similar lands in the area. Because technical data usually consist of long-term averages or estimates, their use requires correction for annual climatic variations. Several climatic correction methods are provided which include the use of selective reference or control areas, and annual county yield averages. Provisions for using other appropriate climatic correction methods (to be developed) based on correlation of long-term yields with weather related factors (regression equations) are also made.

The data sources used are briefly discussed below.

Reference Areas

Data from reference areas can be used for direct comparisons with the reclaimed tract when all premining mapping units, which existed in the tract are represented by reference areas. A direct comparison also can be made if one reference area has been established on a mapping unit that represents the entire reclaimed tract. However, if reference areas are established for only some of the premining mapping units, then the other units must be represented by published technical data. Data collected from these reference areas must be combined with the technical data to derive a climatically adjusted standard.

Control Areas

A control area is similar to a reference area, as it contains one or more of the premining mapping units that formerly existed in the reclaimed tract. However, data obtained from a control area will not be used for direct comparison with the reclaimed tract; instead, they are used to develop a climatic correction factor. The correction factor is used to adjust published yield estimates of the premining mapping units that existed in the reclaimed tract. Thus, control areas, like some reference areas, will be used to develop a climatically adjusted standard.

NRCS Cropland Productivity Indices

The Natural Resources Conservation Service or NRCS (formerly known as the Soil Conservation Service or SCS) has published productivity indices for each soil series in North Dakota (Cropland Table 1, NRCS 2000). The productivity indices relate the potential spring wheat yield of a soil mapping unit against an index of 100, which is ascribed to the most

productive soil series in a given county. The indices are based on actual field trials and other experiments conducted at agricultural experiment stations, and are therefore reasonably accurate yield ratings for these soils.

Use of productivity indices enables the calculation of an expected wheat yield for each soil series in the reclaimed tract, based on its productivity relative to the most productive soil series in the county (Cropland Table 2, NRCS 2000). Yield estimates are calculated for a given tract, based on premine soil mapping unit acreages. The average yield of the tract is adjusted for climatic variation to derive a standard.

NRCS also provides conversion factors to convert spring wheat yields to yields for other annual crops (Cropland Table 3, SCS 1987a).

Average County Spring Wheat Yields

An average county spring wheat yield, based on soil mapping units within the county and NRCS productivity indices, was calculated for each county. County Soil Surveys list the acreages of each soil mapping unit that are found within that county (Soil Survey Staff 1988, 1987, 1982, 1979, 1978, 1975a, 1975b, 1974, and 1968). NRCS productivity indices (Cropland Table 1) were applied to each soil mapping unit that was rated suitable for cropland. These indices were converted to yields using the county yield conversion factor (Cropland Table 2). Yields were then weighted by the appropriate soil mapping unit acreages, and divided by the total acres to obtain an average county yield. Average county yields are shown in Cropland Table 2. The average county yield can be used to develop a climatic correction factor when correlated with the annual county yield reported by North Dakota Agricultural Statistic Service (NDASS).

North Dakota Agricultural Statistics Service (NDASS) County Cropland Yields

NDASS county yield data collected and published annually by North Dakota State University and the USDA-Statistical Reporting Service (NDASS 1956- current year) can be used to represent the annual average yield for a county. NDASS county yields are based on reports from a large number of farmers randomly selected from each county. Information on acreages and yields for different crops grown in a given year by individual farmers is collected and reviewed by statisticians, who calculate the average yield by dividing the reported total production by the acreage harvested for that crop in a given county. Since NDASS reports actual county yields annually, these data can be used with the average county yields to obtain a correction factor for climatic variability.

NRCS Pasture and Hayland Yields

NRCS has developed yield estimates for groups of soils suitable for pasture and hayland in each Land Resource Area in North Dakota (Tame Pastureland Tables 1 and 2, SCS 1988). These estimated yields can be used to develop pasture and hayland productivity standards when adjusted for climatic variation.

NRCS Native Grassland Data

NRCS has published production estimates for the soil series of each range site in North Dakota (Native Grassland Table 1, SCS 1987b). These estimates are based on long-term averages, and can be used to develop productivity standards for reclaimed native grasslands if they are corrected for climatic variation. The NRCS data are used to represent some of the range sites/soil series, which existed in the reclaimed tract prior to mining. These estimates are corrected for climatic variation using data from reference areas established for some of the predominant range sites/soil series that existed in the tract. Data from both sources are combined to derive a climatically adjusted standard.

ARS Perennial Grassland Cover Data

Research data generated by the USDA-ARS Northern Great Plains Research Center, at Mandan, North Dakota (Hofmann et al. 1983 and Ries and Hofmann 1984) have been used to develop minimum standard values for basal and first-hit cover. These values will be used as standards for third-stage (and in some instance fourth-stage) bond release. In other instances these values may be used only in conjunction with cover data from reference areas to develop a standard.

Updating NRCS Data

Current NRCS data have been provided in tabular form at the end of each land use section. When new data are published by the NRCS, updated tables will be forwarded to the mining companies and the OSM.

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C. CROPLAND

Definition

Cropland, as defined in NDAC 69-05.2-01-02, means land which is used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes, and includes row crops, small grain crops, hay crops, nursery crops, orchard crops and other specialty crops. Land used for facilities in support of cropland farming operations is also considered as cropland. Cropland also includes hayland, which was considered as a separate sub-category prior to June 1,1983.

Requirements for Successful Revegetation

For third-stage bond release on reclaimed croplands, "vegetation shall be considered established after the successful seeding of the crop being grown or a precropland mixture of grasses and legumes" [NDAC 69-05.2-22-07(3)(b)]. For prime farmland, productivity on the permit area must be equal to or greater than that of the approved reference area or standard with 90% statistical confidence for a minimum of three crop years [NDAC 69-05.2-22-07(3)(c)]. For fourth-stage bond release on cropland, productivity (crop yield) is the only vegetation parameter that must be assessed. According to NDAC 69-05.2-22-07(4)(c) and (l), "crop production from the permit area shall be equal to or greater than that of the approved reference area or standard with ninety percent statistical confidence for the last two consecutive growing seasons, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period." For prime farmlands, North Dakota rules require that third stage bond release standards have been met and that the ten-year responsibility period has elapsed [NDAC 69-05.2-22-07(4)(d)].

Reclaimed tracts that remain in precropland vegetation following bond release must be assessed using annual small grain or row crops if the area had been annually cropped prior to mining. However, only representative portions of these tracts need be cropped for bond release assessment as described in Section III (D), Methods for Measuring Productivity, Cover, and Density. On cropland areas where the land after mining will be managed for perennial hay, yields of hay crops may be used to determine revegetation success during the years that yield measurements are taken for final bond release purposes. The productivity standards for tame pastureland, Section II (E) must be used for these areas. However, this will apply only to areas specifically approved in the reclamation plan as perennial hayland, or to areas where the premine land was perennial hayland.

Premining Assessment

The following information is required as a part of the permit application in accordance with NDAC 69-05.2-08:

1. Delineate and identify on a map or aerial photograph of 1:4800 scale [NDAC 69-05.2-08-08(l)(a)(1)]:

a. All cropland tracts within the proposed permit area; and,

b. Each soil-mapping unit for each tract of cropland.

2. Tabulate total acreage of each soil mapping unit for each surface owner within the proposed permit area [NDAC 69-05.2-08-08(l)(c)(1)].

3. Provide an assessment of the production of the principal crop(s) grown on the cropland within the permit area. [NDAC 69-05.2-08-08(l)(c)(2)]. Evaluation of premining production of cropland may be based on:

a. NRCS yield estimates for the various soil mapping units;

b. Historical yield averages for the area, if available; or,

c. The most recent actual yields from the area.

4. If a cropland reference area or control area will be used to determine revegetation success, provide a map showing the location, size, and the soil mapping units of the proposed reference or control area. Also include a discussion that demonstrates that the proposed area adequately represents the conditions in the permit area [NDAC 69-05.2-08-08(2)].

Postmining Assessment

Third-Stage Bond Release

The following information should be submitted for each reclaimed cropland tract with third-stage bond release requests:

1. An aerial photo of adequate scale that delineates the reclaimed cropland tract(s) proposed for bond release.

2. A narrative that includes methods used for seedbed preparation and seeding and describes all management practices used prior to the bond release request [NDAC 69-05.2-12-12(10)].

3. A demonstration of adequate establishment of vegetation under NDAC 69-05.2-22-07(3)(b), or NDAC 69-05.2-22-07(3)(c) for prime farmland, using the approved standard for third-stage bond release.

4. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Third-Stage Bond Release

Precropland or hayland seed mix:

The vegetation will be considered successfully established when the stand consists primarily of grass and legume species. This evaluation will be conducted by PSC field inspection no sooner than the end of the first growing season.

Annual Crops:

The vegetation will be considered successfully established when the stand appears similar to those normally found on undisturbed lands and a harvestable crop is produced. The evaluation will be conducted by PSC field inspection near the end of the growing season, when the crop is mature.

Prime Farmland:

The vegetation will be considered successfully established when the annual production of the reclaimed tract is equal to or greater than the reference area, or standard (as described for fourth-stage bond release success standards for other cropland), with 90% statistical confidence for a minimum of three years, not necessarily consecutive. A separate success standard must be calculated for prime farmland tracts unless a single yield standard has been approved as allowed by NDAC 69-05.2-22-07(4)(l). Spring wheat must be used for this demonstration for at least 2 of the 3 years that productivity measurements are taken. Barley or oats may be used for the other year.

Fourth-Stage Bond Release

The following information should be submitted for each reclaimed cropland tract with fourth-stage bond release requests:

1. An aerial photo of adequate scale that delineates the reclaimed cropland tract(s) proposed for bond release. The aerial photo must depict ownership boundaries if separate landowners are involved, and, within each land ownership, any site type units if a stratified sampling procedure was used. Provide in tabular form the acreages of site type units for each landowner within the reclaimed tract.

2. An aerial photo of adequate scale that delineates the area and soil mapping units that were used to develop the standard.

3. An aerial photo of adequate scale that delineates any corresponding reference or control areas and their soil mapping units, if used to develop the standard.

4. A narrative that includes soil replacement thicknesses and a complete management history of the reclaimed cropland tract(s) and reference or control areas. The narrative should include seed mix and rate, fertilizer program, pesticide control, tillage practices, and any other management techniques used during the liability period [NDAC 69-05.2-12-12(08)].

5. Data and calculations which demonstrate that productivity of each landowner's non-prime reclaimed tract is equal to or greater than the approved standard (with 90% statistical confidence) in each of the last two consecutive growing seasons or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period.

   For reclaimed prime farmland, a separate yield standard must be calculated for each tract and three years (not necessarily consecutive) of data must be submitted that demonstrates that the productivity is equal to or greater than the approved standard with 90% statistical confidence. Alternatively, if a single standard has been approved and calculated for a reclaimed tract containing a mixture of prime and non-prime farmlands as allowed by NDAC 69-05.2-22-07(4)(l), data must be submitted which demonstrates that productivity is equal to or greater than the approved standard (with 90% statistical confidence) in any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. Spring wheat must be used for this demonstration for at least two of the three years when productivity measurements are taken for final bond release. Barley or oats may be used for the other year.

   Sampling locations must also be shown on an appropriate map.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Fourth-Stage Bond Release

For assessment of revegetation success on surface mined lands reclaimed to cropland use, the permittee may use either a reference area standard, or a technical standard based on NRCS data. Each of these standards provides a procedure for climatic correction of yields. If a tract is owned by more than one landowner, production on each landowner's property must be assessed separately. A separate yield must be obtained, and a separate standard developed, for each landowner's property.

Crops most commonly grown prior to mining must be used to measure productivity to determine reclamation success on areas being returned to cropland. Normally spring wheat (hard red spring wheat or durum wheat) must be grown for at least one of the years that measurements are taken on cropland for final bond release assessments. Other crops that may be grown during the other year on non-prime cropland are oats, barley, flax, rye and sunflowers. Use of the other crops for the years that measurements must be taken will be allowed only for extenuating circumstances that receive prior written approval based on site specific situations.

For fourth-stage release on prime farmlands, the ten-year responsibility period must have elapsed and productivity standards for third-stage bond release must have been met.

Method 1: Cropland Reference Area Standard

This standard combines a reference area with NRCS productivity indices for soil mapping units. It is particularly recommended for reclaimed prime farmland and reclaimed cropland tracts which subtend only a few soil series.

A cropland reference area is established for soil mapping units which were predominant in the reclaimed tract prior to mining. The reference area must include one or two reference soils which singly or together occupy more than 50% of the reclaimed tract. The reference area must be topographically similar to the reclaimed tract and must be established in the vicinity of the mine area. The proposed location of the reference area must be identified in the permit application, and must be inspected and approved by PSC staff.

The reference area must be established at least two years before the first year in which the reclaimed tract will be evaluated for bond release. Beginning at this time, the reference area must be managed using practices which may be site-specific, but equal in effect to those used on the reclaimed tract. The reference area and the reclaimed tract must be planted at the same time and with the same crop species and variety in the years when yields will be compared. An exemption from this two-year requirement may be granted if documentation is submitted to the Reclamation Division that demonstrates that the management of the reference area for the previous two years has been equivalent in effect to that of the reclaimed area.

In each of the two final growing seasons (or three years starting no sooner than the sixth year with one year being the last year of the responsibility period for non-prime lands, or any three years for prime farmlands), the yield from each soil mapping unit in the reference area must be separately harvested or sampled. The crop yield of one of the reference soils must be used, along with NRCS soil productivity indices from Cropland Table 1 (NRCS 2000), to calculate the expected yields for the other premining soil mapping units not represented in the reference area. The expected yields are derived by dividing the index value for each soil series by the index value of the reference soil and multiplying by the current year's yield for the reference soil. The actual yields of the reference soils and the expected yields of the other soils are weighted by the acreage each soil mapping unit occupied in the tract prior to mining. The weighted yields are summed and divided by the total acreage of the reclaimed tract to derive the current year's yield standard for the tract. The current year’s actual yield from the reclaimed tract is then compared to the derived standard. The yield standard must be derived for each year that the reclaimed tract is evaluated for bond release.

Since the yield standard is calculated by sampling and obtaining an average, there is a variance associated with the value. Therefore, when the reclaimed tract and reference area are sampled to obtain yields, appropriate statistical tests must be applied as necessary to determine if the yields are significantly different. If the yield of the reclaimed tract is obtained by a random or stratified (site type) sampling procedure, a standard deviation can be calculated which will enable statistical comparison with the yield standard. However, if the entire reclaimed tract is harvested to obtain a yield, a standard deviation cannot be calculated. In this case, special formulas must be used to enable statistical comparison with the standard. Further discussion of sampling and statistical procedures is given in Chapter III.

Example

Assume there is a 50 acre reclaimed cropland tract in Mercer County which, according to the premining soils inventory, contained 30 acres of Bowbells soil, 15 acres of Arnegard soil and

5 acres of Williams soil. Since Bowbells constituted more than 50% of the reclaimed tract, a reference area was established on a Bowbells unit in the vicinity of the mine area. In each of the years that yield comparisons are made for final bond release purposes, the following steps should be taken:

Step 1:

Determine the yield of the reference soil. Assume that the Bowbells reference soil yielded 28 bu/ac in the given year of comparison.

Step 2:

Determine the productivity index for all soil mapping units which were present in the reclaimed tract prior to mining, from Cropland Table 1 (NRCS 2000). The index values for these soils are:

Map Unit Component	**Slope Group**	**Productivity Index Value**
Arnegard	A	100%
Bowbells	B	95%
Williams	A	90%

Step 3:

The Bowbells is used as a reference soil, and has a productivity index (PI) of 95. A correction factor (CF) is calculated by dividing the index value for each mapping unit by the index value of the Bowbells soil. The CF is multiplied by 28 bu/ac (produced by the Bowbells soil in the given year) to derive the expected yields of the other soils for that year. The weighted yield is then calculated for the reclaimed tract by multiplying the expected yield of a soil by the acres of that soil. Finally, an average yield for the tract can be calculated by dividing by total acres.

Soil	Soil PI		Bowbells PI		CF		Bowbells Production		Expected Yield		Acres		Total Bushels
Arnegard	100	÷	95	=	1.05	x	28 bu/ac	=	29 bu/ac	x	15 ac	=	435 bu
Bowbells	95	÷	95	=	1.00	x	28 bu/ac	=	28 bu/ac	x	30 ac	=	840 bu
Williams	90	÷	95	=	0.95	x	28 bu/ac	=	27 bu/ac	x	5 ac	=	135 bu
Total:											50 ac		1410 bu

Weighted average yield = 1410 / 50 ac = 28.2 bu/ac

After rounding, the weighted average yield of 28 bu/ac is the current year's adjusted standard yield for the reclaimed tract.

Step 4:

Compare the current year's actual yield from the reclaimed tract with the adjusted yield standard using the appropriate statistical procedures.

Method 2: NRCS Cropland Technical Standard

NRCS productivity indices may be used to calculate an unadjusted yield standard. The standard must be adjusted for annual climatic variation using any one of four methods discussed later in this section.

Productivity index values for all premining soil mapping units which existed in the reclaimed cropland tract are obtained from Cropland Table 1 (NRCS 2000). As of February 2000, the NRCS has assigned productivity index values to nearly all soil series. However, in the event of a non-rated soil (such as a channeled mapping unit), the soil must be assigned a productivity index of 20%. Index values are converted to yields using the assigned county yield for the Productivity Index of 100% (Cropland Table 2). A yield value is determined for each soil mapping unit in the tract and multiplied by the acreage each mapping unit occupied in the tract. These weighted yields are summed and divided by the total acreage of the tract to obtain a weighted average yield per acre. This value is the unadjusted yield standard (X_{UA}) for the reclaimed cropland tract.

This method is not applicable to hayland because productivity indices are based on spring wheat yields which respond differently to various soils as compared to perennial crops such as grass-legume hay. Therefore, the productivity standard for tame pastureland (Section E) must be used to evaluate hayland.

NRCS yield ratings for productivity indices are based on long-term average data which do not account for annual climatic effects. Therefore, the unadjusted yield standard must be adjusted using one of the following four methods:

Climatic Correction Factors for NRCS Technical Standard:

Correction Method 1:

Annual county yield data (X_C) , reported by NDASS, can be used to calculate an annual climatic correction factor (CF). The unadjusted yield standard (X_{UA}) is multiplied by the correction factor to derive an adjusted yield standard (X_{AD}) for a given year:

$$X_{AD} = X_{UA} \times CF \quad (1)$$

The correction factor is derived by dividing the NDASS county average yield (corrected for cropping management i. e., fallow or continuous cropping) for the current year (X_C) by the NRCS average yield for the county (X_{PI}) listed in Cropland Table 2:

$$CF = X_C / X_{PI} \quad (2)$$

The NRCS average yield for the county (X_{PI}) was derived by weighting the expected NRCS soil survey yields for all cropland soil mapping units in the county by the acreages of those soil mapping units in the county (refer to Section II-B). Calculated county average yields are shown in Cropland Table 2.

By combining equations (1) and (2), we get:

$$X_{AD} = X_{UA} \times (X_C/X_{PI}) \quad (3)$$

Where: X_{AD} = adjusted yield standard

X_{UA} = unadjusted yield standard, obtained using NRCS productivity indices

X_C = NDASS county yield for the current year corrected for management*

X_{PI} = NRCS county average yield (Cropland Table 2)

* For data collection years of 1995 or earlier, the annual average county yields (X_C) of spring wheat and durum are listed in the NDASS publication and are obtained for that year from either the column designated Summer Fallow or Continuous Cropping depending upon the previous year's cropping management of the reclaimed field.

The adjusted yield standard (X_{AD}) must be calculated each year in which actual yield for the reclaimed tract will be compared to the standard.

For spring wheat and durum data collection years of 1996 and later, the NDASS no longer reports individual yield values for Summer Fallow or Continuous cropping. The reported annual county yield (X_C) consists of a combined value for those two cropping management practices. Therefore, the reported county yield must be corrected for the previous year's cropping management prior to the calculation of the climatic correction factor. The PSC has developed updated regression/correlation equations based on long term county data to estimate the yearly yields (expected to occur under conditions of Summer Fallow or Continuous Cropping in the prior year) for use in calculating the CF. The following equations should be used for the appropriate county by inputting the reported NDASS annual county yield (X_C) to estimate Summer Fallow or Continuous Cropping Yields (X_{est}). This value of X_{est} will then be used in place of X_C in Equations 2 and 3.

Adams County:

For Spring Wheat

Summer Fallow Yield Estimate: $X_{est} = 1.03X_C + 0.92$

Continuous Cropping Yield Estimate: $X_{est} = 1.03X_C - 4.89$

For Durum Wheat

Summer Fallow Yield Estimate: $X_{est} = 1.05X_C - 0.24$

Continuous Cropping Yield Estimate: $X_{est} = 0.72X_C + 2.14$

Bowman County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.02X_C + 0.46$

Continuous Cropping Yield Estimate: $X_{est} = 0.99X_C - 4.13$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.68X_C + 12.12$

Continuous Cropping Yield Estimate: $X_{est} = 0.76X_C + 9.66$

Burke County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.98X_C + 0.91$

Continuous Cropping Yield Estimate $X_{est} = 1.23X_C - 8.55$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = X_C + 0.84$

Continuous Cropping Yield Estimate: $X_{est} = 1.11X_C - 7.22$

McLean County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.97X_C + 2.48$

Continuous Cropping Yield Estimate $X_{est} = 1.14X_C - 6.43$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 0.97X_C + 1.63$

Continuous Cropping Yield Estimate: $X_{est} = 1.06X_C - 5.61$

Mercer County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.20$

Continuous Cropping Yield Estimate $X_{est} = 0.94X_C - 3.12$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.02X_C + 0.58$

Continuous Cropping Yield Estimate: $X_{est} = 0.95X_C - 2.71$

Oliver County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.03X_C + 2.31$

Continuous Cropping Yield Estimate: $X_{est} = 1.09X_C - 5.44$

Oliver County (cont.):

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.11X_C + 0.07$

Continuous Cropping Yield Estimate: $X_{est} = 0.80X_C + 0.85$

Stark County:

For Spring Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.47$

Continuous Cropping Yield Estimate: $X_{est} = 1.05X_C - 4.38$

For Durum Wheat:

Summer Fallow Yield Estimate: $X_{est} = 1.04X_C + 0.10$

Continuous Cropping Yield Estimate: $X_{est} = 1.02X_C - 4.81$

Example Using Correction Method 1:

Assume there is a 50-acre tract of land in Mercer County that will be reclaimed to cropland following mining disturbance. Let us further assume that the premining soils inventory has indicated that this area contains 15 acres of Bowbells soil, 25 acres of Williams soil and 10 acres of Zahl soil.

Step 1:

Based on the NRCS productivity indices and calculated yields for these soils, calculate the unadjusted yield standard for the tract by the following procedure:

Soil	Slope Group	Productivity Index Value	Yield (bu/ac)[1]	x	Premine Acres	=	Weighted Yield (bu)
Bowbells	A	100%	37.0		15		555.0
Williams	A	90%	33.3		25		832.5
Zahl	B	57%	21.1		10		211.0
			Total		50		1598.5

[1] Taken from Cropland Table 2, where: 37 bu/ac x %PI = bu/ac
and where: 37 bu/ac = PI of 100% for Mercer County

Unadjusted standard (X_{UA}) = 1598.5 bu / 50 ac = 32 bu/ac

Step 2:

If the year is 1996 or later, adjust the current year's yield as reported by NDASS for the county for the management, either fallow or continuous cropping, used on the reclaimed field. Assume that the annual yield (X_C) reported by the NDASS for Mercer County in 1996 was 28.5 bu/acre and the reclaimed field was continuously cropped. The annual county yield adjusted for management would then be calculated as follows:

Estimated annual county yield (X_{est}) = $0.94(X_C) - 3.12$
(regression equation shown above)

= $0.94(28.5) - 3.12 = 23.7$ bu/ac

Step 3:

Derive the climatic correction factor using the estimated annual county yield as calculated above in Step 2 (or the actual reported county yield if the year is 1995 or earlier). For this example, the estimated annual yield (X_{est}) for Mercer County would be 23.7 bu/acre. The weighted average yield (X_{PI}) for all cropped land in Mercer County on the basis of NRCS yield estimates for each soil type and their respective acreages is 27 bu/ac (Cropland Table 2). Divide the NDASS estimated annual county yield value by the weighted county average yield to determine the correction factor (CF):

$$CF = 23.7 \text{ bu/ac} / 27 \text{ bu/ac} = 0.88$$

This indicates that the current year's yield under continuous cropping management in Mercer County was 0.88 that of the weighted county average yield.

Step 4:

Multiply the unadjusted yield standard for the reclaimed tract calculated in Step 1 by the correction factor to obtain the adjusted yield standard for the current year:

$$\text{Adjusted standard } (X_{AD}) = 32 \text{ bu/ac} \times 0.88 = 28.2 \text{ bu/ac}$$

Step 5:

Compare the current year's adjusted yield standard (28.2 bu/ac) to the actual yield from the reclaimed tract using the appropriate statistical procedures (repeat Steps 2 through 4 for each year).

Correction Method 2:

A control area, which contains some of the predominant premining soil series, or similar soil series (including similar productivity), which existed in the reclaimed tract, can be used to calculate a climatic correction factor. A weighted average yield is calculated for the control area using the same method that was used to calculate the unadjusted yield standard for the reclaimed tract (i.e., using soil mapping units from a professional soil classifiers survey, and NRCS productivity indices). The control area is harvested in the same years that the reclaimed tract is harvested for comparison with the standard. The actual yield from the control area is divided by its weighted average yield to obtain the climatic correction factor for the current year:

$$CF = X_{ca} / X_{cw} \quad (4)$$

This method assumes that the deviation of actual yield from the weighted average yield of the control area is a function of climate. The adjusted standard for the reclaimed tract is derived by combining equations (1) and (4):

$$X_{AD} = X_{UA} \times (X_{ca} / X_{cw}) \quad (5)$$

Where: X_{AD} = adjusted yield standard;

X_{UA} = unadjusted yield standard, obtained using NRCS productivity indices;

X_{ca} = actual yield from the control area for the current year; and,

X_{CW} = weighted average yield for the control area (derived using same method as for X_{UA}).

The proposed location of the control area must be identified in the permit application. Establishment of the control area must occur at least two years prior to the first year that the reclaimed tract is harvested for comparison with the standard. An exemption from this two-year requirement may be granted if documentation is submitted to the Reclamation Division that demonstrates that the management of the control area for the previous two years has been equivalent in effect to that of the reclaimed area. Prior to establishment, the permittee must provide the PSC with information on the control area, including soils descriptions, fertility levels, and management history. The PSC will review this information and inspect the control area prior to approval. Management of the control area and the reclaimed tract may be site specific, but must be equal in effect during the years in which comparisons with the standard will be made.

Example using Correction Method 2:

Step 1:

Assume the same acreages and methodologies used in the previous example to calculate the unadjusted yield standard of 32 bu/ac (refer to Step 1, page 10).

Step 2:

Following the same procedure, calculate the expected yield of the control area. Assume there is a 29-acre control area in Mercer County. Let us further assume that a detailed soil survey, prepared by a professional soil classifier, has indicated that this area contains 8 acres of Sen soil, 18 acres of Williams soil and 3 acres of Zahl soil.

Control Area:

Soil	Slope Group	Productivity Index Value	Yield (bu/ac)[1]	X	Acres	=	Weighted Yield (bu)
Sen	A	80%	29.6		8		236.8
Williams	A	90%	33.3		18		599.4
Zahl	B	57%	21.1		3		63.3
			Total		29		899.5

[1] Derived from NRCS (2000) where: 37 bu/ac x %PI = bu/ac
where: 37 bu/ac = PI of 100% for Mercer County

Control Area unadjusted yield (X_{cw}) = 899.5 bu / 29 ac = 31.0 bu/ac

Step 3:

The current year's actual yield from the control area (X_{ca}, assumed to be 24.5 bu/ac) is divided by the weighted average yield of the control area (X_{cw}) to obtain a climatic correction factor:

$$CF = 24.5 \text{ bu/ac} / 31.0 \text{ bu/ac} = 0.79$$

Step 4:

The unadjusted yield standard for the reclaimed tract (X_{UA}) is multiplied by the correction factor to obtain an adjusted standard:

$$\text{Adjusted standard } (X_{AD}) = 32 \text{ bu/ac} \times 0.79 = 25.3 \text{ bu/ac}$$

Step 5:

Compare the current year's actual yield from the reclaimed tract to the adjusted yield standard (25.3 bu/ac) using the appropriate statistical procedures (repeat Steps 3 and 4 for each year).

NOTE: In the event no PI=100 yield data is available for the crop being grown on both the reclaimed and control areas, the ratio of the weighted productivity indices values from the reclaimed and control areas may be substituted for the CF value and the actual control area yield would be used in Step 4 in order to calculate the adjusted yield for the reclaimed area. For the areas described above, this ratio would be $86.4 / 83.8 = 1.03$ and this value would be multiplied times the actual control area yield. For example, if both the reclaimed and control areas were planted to canola and the control area yielded 1300 lbs/ac then the reclaimed area would have to yield 1339 lbs/ac (1300 x 1.03) to meet the required production standard for final bond release.

Correction Method 3:

NDASS data may be used in conjunction with precipitation, temperature and other pertinent data to calculate a correction factor. The PSC may develop a regression equation or other formula which accurately predicts a deviation from the long-term average yield based on deviation of the current year's effective precipitation, growing season temperature, the long-term average precipitation and temperature.

The correction factor (+ or -) is added to the unadjusted yield standard (derived from NRCS data) for the reclaimed tract to derive the current year's adjusted yield standard. If an acceptable regression equation or other formula is developed, the correction factor will have to be calculated for each year that the reclaimed tract will be compared to the standard.

Any acceptable regression equation or other formula which will be used in this method will be developed and updated by the PSC using all available NDASS, precipitation, temperature and other pertinent data. The PSC will provide permittees with acceptable regression equations or other formulas.

Correction Method 4:

County-Wide Average Correction

When the entire reclaimed field is harvested or when representative strips are entirely harvested to obtain the yield for the reclaimed area, this reclaimed yield may be compared to the annual county yield reported by the North Dakota Agricultural Statistical Service (NDASS). If this method is used, the annual county yield, standard deviation, and sample size for each year that yield comparisons are made must be obtained from NDASS. The standard deviation and sample size from NDASS will be used to establish a 90% statistical confidence interval.

Under this method, an unadjusted yield standard for the reclaimed area must be calculated according to the example provided in Method 1 described earlier. A productivity ratio of the unadjusted yield standard to the average county yield is determined using the average for the county from Cropland Table 2 on Page II-C-20 of this document. The following steps must be completed for each year that comparisons are made for demonstrating reclamation success:

Step 1:

The ratio of the unadjusted yield standard to the average county yield (from Cropland Table 2 on page II-C-20) is calculated as follows:

$$\text{Productivity Ratio (PR)} = \frac{\text{Unadjusted yield standard}}{\text{Average county yield}}$$

Step 2:

An adjusted yield standard for the reclaimed area for the particular year is then calculated by multiplying the PR (obtained in Step 1) by the annual county yield obtained from NDASS corrected for management (as outlined in Correction Method 1) if the data is from year 1996 or later. This multiplication procedure is then also done on the annual (or estimated) county yield's standard deviation (also obtained from NDASS) in order to reflect the adjustment in the annual county yield.

Step 3:

Using the appropriate statistical procedures, the annual reclaimed yield will be compared with the adjusted yield standard obtained in Step 2 by using the annual county yield sample size and adjusted annual county standard deviation value.

Example using Correction Method 4

Assume that the reclaimed tract is in Mercer County, hard red spring wheat is grown, and the following factors apply in a particular year:

Unadjusted yield standard for the reclaimed tract = 19.8 bu/ac
Average yield for Mercer County from Cropland Table 2 = 27 bu/ac
Annual (or estimated if 1996 or after) county yield = 28.0 bu/ac
Annual county yield standard deviation = 7.56
Number of samples for the annual county yield = 60

Annual yield for the reclaimed tract = 20.0 bu/ac

Step 1:

Calculate the Productivity Ratio (PR):

PR = 19.8 / 27 = 0.73

Step 2:

Calculate the adjusted yield standard and adjusted standard deviation for the reclaimed area based on the current year's annual county yield and annual county standard deviation using the PR obtained in Step 1:

Adjusted yield standard =

X_{AD} = Annual (or estimated if 1996 or after) county yield x PR
= 28.0 bu/ac x 0.73
= 20.44 bu/ac

Adjusted standard deviation =

s_{AD} = Annual county standard deviation x PR
= 7.56 x 0.73
= 5.52

Step 3:

Apply the appropriate statistics (t-test, confidence interval) using the adjusted yield standard and adjusted standard deviation calculated in Step 2 and the annual yield from the reclaimed tract for that year:

<u>t-test</u>

(The following t-test formula is added for user convenience)

$$\text{calculated } t = \frac{\left| X_{AD} - \bar{x}_1 \right|}{\frac{s_{AD}}{\sqrt{n_1}}}$$

where:

X_{AD} = adjusted production standard based on NDASS data

$\bar{x}_1$ = production for reclaimed tract based on total field harvest

s_{AD} = adjusted standard deviation of NDASS county yield data

n_1 = number of samples for NDASS county yield data

t_{calc} = (20.44-20.0) / (5.52/√60) = 0.44 / 0.71 = 0.692

$t_{0.10,59df}$ = 1.29

Since t_{calc} is less than $t_{0.10, 59df}$ value, there is no significant difference between the yield values.

90% confidence Interval (one-tail test)

90% Confidence interval = adjusted yield standard - [$t_{O.10,59df}$ x $\sqrt{(5.52^2/60)}$]
= 20.44 bu/ac - 0.92
= 19.52 bu/ac

The actual reclaimed yield of 20.0 bu/ac is greater than 19.52 bu/ac (lower level of the 90% confidence interval). Thus, there is no statistical difference between the adjusted yield standard and the actual reclaimed yield for that year.

Cropland Table 1. Spring wheat productivity indexes (NRCS Soils Interpretive Guide, January, 2000.)

This table lists the percent spring wheat productivity indexes for soil series and phases. The list was prepared by assigning a productivity index for spring wheat to map units in soil surveys and technical guides. Where two values are given for one series (e.g., Tonka, 40-85), the first value refers to an undrained soil, the second value refers to a drained soil. If no surface textural phases are listed, assume that the PI's listed are for all textural phases associated with that soil series. If a surface textural phase is listed (e.g., Amor l, cl), the PI's listed are only for that surface textural phase. Usually, the most common or likely surface textural phases are provided on Table 1. In addition, some stony and saline phases are provided for those soils likely to have stony or saline phases. The PI's provided for the stony and saline phases represent very stony and moderately saline phases, respectively. For textural, salinity, or stony phases or soil series not listed on the table, please consult with Reclamation Division staff. Productivity indexes are provided for E (15-25%) and F (>25%) slope groups. If the map unit has a 15 to 25% slope, then the PI for the E slope phase should be used. However, it is common practice to group the E and F slopes together into a single map unit (e.g., Cabba loam, 15-35% slopes). In this case the midpoint between the E and F slope groups should be used. For example, a map unit of Cabba loam, 15 to 35% slopes would have a PI of 13.5, the midpoint between PI for E slope (16) and F slope(11). Percent PI's are converted to spring wheat yields by multiplying the bu/ac for the county (shown in Cropland Table 2), by a given PI. Conversion factors to convert spring wheat yields to other crops are shown in Cropland Table 3.

SERIES MODIFIERS

Drainage	
ed	excessively drained
wd	well drained
mwd	moderately well drained
spd	somewhat poorly drained
pd	poorly drained
vpd	very poorly drained

Slope Group	
A	0-3%
B	3-6%
C	6-9%
D	9-15%
E	15-25%
F	>25%

Stoniness	
st	stony
stv	very stony
stx	extremely stony

Texture					
cos	coarse sand	lvfs	loamy very fine sand	si	silt
s	sand	cosl	coarse sandy loam	scl	sandy clay loam
fs	fine sand	sl	sandy loam	cl	clay loam
vfs	very fine sand	fsl	fine sandy loam	sicl	silty clay loam
lcos	loamy coarse sand	vfsl	very fine sandy loam	sc	sandy clay
Is	loamy sand	l	loam	sic	silty clay
Ifs	loamy fine sand	sil	silt loam	c	clay

PRODUCTIVITY INDICES (%)

	Slope Group				
Soil Series	**A**	**B**	**C**	**D**	**E-F**
Absher	30	28	22	17	12/8
Amor l, cl	80	76	61	46	32/22
Amor fsl	70	67	54	41	28/20
Amor, very stony	40	38	30	23	16/11
Arnegard	100	95	76	57	40/28
Arnegard, saline	50	48	-	-	-
Arveson sl, fsl - pd	30-55	-	-	-	-
Banks fsl, vfsl	45	43	-	-	-/-
Banks lfs, ls	35	33	-	-	-/-
Bearpaw	90	85	68	51	36/25
Beisigl ls, lfs	35	33	26	20	14/10
Beisigl sl, fsl	45	43	34	26	18/12
Beisigl, very stony	18	17	13	10	7/5
Belfield l, sil	75	71	57	43	30/21
Belfield, saline	38	36	-	-	-/-
Benz	25	24	19	0	0/0
Bowbells	100	95	76	-	-/-
Bowbells, saline	50	47	38	-	-/-
Bowdle	60	57	46	-	-/-
Boxwell	80	76	61	-	-/-
Boxwell, extremely stony	12	11	9	-	-/-
Brandenburg l, ch-l	30	28	22	17	12/8
Breien fsl	40	38	-	-	-/-
Brisbane l, cl	85	80	64	48	34/24
Bryant	90	85	68	51	30/25
Cabba l, sil, cl, sicl	40	38	30	23	16/11
Cabba, very stony	20	19	15	11	8/6
Cabbart, l, sil, cl	40	38	30	23	16/11
Cabbart, very stony	20	19	15	11	8/6
Chama	70	67	54	41	28/20
Chanta	60	57	46	35	24/17
Cherry sil, l, sicl, cl	75	71	57	43	30/21
Chinook	65	63	50	33	26/18
Cohagen	30	28	22	17	12/8
Colvin sil, sicl, vpd	10-60	-	-	-	-/-
Colvin, sil, sicl, pd	40-70	-	-	-	-/-
Colvin, channeled	NR	-	-	-	-/-
Colvin, saline, pd	35	-	-	-	-/-
Daglum cl, sil, l, sil	45	43	34	26	18/12
Daglum l, sil, cl–mod. deep	40	38	30	23	16/11
Daglum, saline	23	22	17	13	9/6
Daglum, very stony	20	18	15	11	8/6
Desart fsl, sl, vfsl	55	52	42	32	22/15
Dilts	30	28	22	17	12/8
Dimmick c, sic	30-70	-	-	-	-/-
Divide l. sil, cl, scl	65	63	-	-	-/-
Divide, saline	33	32	-	-	-/-
Dogtooth	25	24	19	14	11/7
Ekalaka fsl, vfsl, sl	40	38	30	23	16/11
Falkirk	90	85	68	51	36/25
Falkirk, saline	45	42	34	25	18/12
Fargo, saline	45	43	-	-	-/-
Farland	90	85	68	51	36/25
Farnuf	90	85	68	51	36/25
Felor fsl, sl	80	76	61	46	32/22
Flasher ls, lfs	25	24	19	14	11/7
Flasher sl, fsl	35	33	26	20	14/10
Flasher, very stony	13	12	10	7	5/4

	Slope Group				
Soil Series	**A**	**B**	**C**	**D**	**E-F**
Flaxton fsl	70	67	54	41	28/20
Flaxton lfs	55	52	42	32	22/15
Flaxton l	75	71	57	43	30/21
Fleak fsl, sl	35	33	26	20	14/10
Golva	90	85	68	51	36/25
Grail	100	95	76	57	40/28
Grail, saline	50	48	38	-	-/-
Grassna	100	95	76	57	40/28
Grassna, saline	50	48	38	-	-/-
Hamerly	85	80	-	-	-/-
Hamerly, saline	43	40	-	-	-/-
Hamerly, very stony	43	40	-	-	-/-
Hanly fsl, sl	45	43	-	-	-/-
Harriet	25	-	-	-	-/-
Havre	85	80	-	-	-/-
Havre, channeled	NR	NR	-	-	-/-
Havrelon, l, sil, sicl	85	80	-	-	-/-
Havrelon, channeled	NR	NR	-	-	-/-
Havrelon, fsl, vfsl	75	71	-	-	-/-
Heil sicl, sil	35	-	-	-	-/-
Janesburg l, sil, sicl, cl	40	38	30	23	16/11
Korchea fsl, sl, vfsl	80	76	-	-	-/-
Korchea cl, sicl, l ,sil	90	85	-	-	-/-
Korchea, channeled	NR	NR	-	-	-/-
Krem fs	35	33	26	20	14/10
Krem ls, lfs	50	48	38	29	20/14
Kremlin	85	80	64	48	34/24
LaMoure	40-70	-	-	-	-/-
Lawther sicl	85	80	64	48	34/24
Lawther c, sic	80	76	61	46	32/22
Lefor	60	57	46	35	24/17
Lehr l, sl	45	43	34	26	18/12
Lihen fsl, sl	55	52	42	32	22/15
Lihen lfs, ls	45	43	34	26	18/12
Linton	85	80	64	48	34/24
Lisam	30	28	22	17	12/8
Livona fsl, sl	70	67	54	41	28/20
Livona lfs, ls	50	48	38	29	20/14
Lohler sic, c	80	76	-	-	-/-
Magnus sicl	85	80	-	-	-/-
Makoti	95	90	72	54	38/26
Mandan	95	90	72	54	38/26
Manning fsl, sl	40	38	30	23	16/11
Marysland	30-60	-	-	-	-/-
Max	85	80	64	48	34/24
Max, very stony	45	43	34	26	18/12
McKenzie, pd	25-45	-	-	-	-/-
Moreau sic	65	63	50	38	26/18
Moreau sicl, cl	70	67	54	41	28/20
Moreau, saline	32	32	25	19	13/9
Morton	85	80	64	48	34/24
Morton, very stony	45	43	34	26	18/12
Mott	60	57	46	35	24/17
Niobell	75	71	57	43	30/21
Noonan l, sil	45	43	34	26	18/12
Nutley sic, c	90	85	68	51	36/25
Oburn	30	28	22	17	12/8
Omio	85	80	64	48	34/24

PRODUCTIVITY INDICES (cont.)

Soil Series	Slope Group A	B	C	D	E-F
Parnell sic, sil, sicl	20-75	-	-	-	-/-
Parshall	70	67	54	41	28/20
Parshall, saline	35	33	27	-	-/-
Parshall, wet	80	76	61	-	-/-
Patent l, sil, cl, sicl	50	48	38	29	20/14
Reeder	85	80	64	48	34/24
Reeder, very stony	45	43	34	26	18/12
Regan, pd	35-65	-	-	-	-/-
Regan, vpd	20-55	-	-	-	-/-
Regan, saline	33	-	-	-	-/-
Regent sicl, cl, sil	85	80	64	48	34/24
Rhame	60	57	46	35	24/17
Rhoades	30	28	22	17	12/8
Rhoades, saline	13	12	10	-	-/-
Ringling l, ch-l	35	33	26	20	14/10
Ringling chv-l	20	19	15	11	8/6
Roseglen	100	95	76	57	40/28
Ruso	40	38	30	23	16/11
Sakakawea	60	57	48	35	24/17
Savage	90	85	68	51	36/25
Savage, saline	45	43	34	25	18/13
Schaller fsl, sl	40	38	30	23	16/11
Searing	65	63	50	38	26/18
Sen	80	76	61	46	32/22
Seroco lfs, ls	35	33	26	20	14/10
Sham l	45	43	34	26	-/-
Shambo	85	80	64	48	34/24
Sinai sicl	95	90	72	54	38/26
Sinnigam	30	28	22	17	12/8
Sinnigam, very stony	15	14	11	8	6/4
Southam	0-50	-	-	-	-/-
Stady	60	57	46	35	24/17
Stirum sl, fsl	20	-	-	-	-/-
Stirum, ponded	10	-	-	-	-/-
Straw	95	90	72	54	38/26
Straw, channeled	NR	NR	-	-	-/-
Sutley sil	60	57	46	35	24/17
Tally fsl, sl	65	63	50	38	26/18

Soil Series	Slope Group A	B	C	D	E-F
Tansem	85	80	64	48	-/-
Telfer fsl, sl	50	48	38	29	20/14
Telfer, lfs, ls	40	38	30	23	16/11
Temvik	85	80	64	48	34/24
Tiffany sl, fsl, vfsl	30-75	-	-	-	-/-
Tiffany l, sil	30-85	-	-	-	-/-
Toby	55	43	42	32	
Tonka	40-85	-	-	-	-/-
Trembles fls, sl	65	63	-	-	-/-
Tusler fsl, sl	45	43	36	30	24/20
Ustorthents	40	38	30	23	16/11
Vallers	40-70	-	-	-	-/-
Vallers, saline	35	-	-	-	-/-
Vallers, very stony	35	-	-	-	-/-
Vanda sicl	25	24	19	14	11/7
Vebar fsl, sl	60	57	46	35	24/17
Vebar l	70	67	54	41	28/20
Vebar, stony	33	31	25	19	13/9
Velva fsl, sl, vfsl	70	67	-	-	-/-
Velva l, cl	80	76	-	-	-/-
Velva, saline	35	-	-	-	-/-
Velva, channelled	NR	NR	-	-	-/-
Wabek l	35	33	26	20	14/10
Wabek, very stony	13	12	9	7	6/4
Wanagan	60	57	46	35	24/17
Watrous	65	63	50	38	26/18
Wayden sicl, cl	35	33	26	20	14/10
Wayden, very stony	15	14	11	9	6/4
Werner	45	43	34	26	18/12
Williams	90	85	68	51	36/25
Williams, very stony	45	43	34	26	18/12
Wilton	95	90	72	54	-/-
Wolf Point sicl	85	80	-	-	-/-
Yawdim sicl, cl	35	33	26	20	14/10
Yegen l	85	80	64	48	34/24
Yetull fsl, sl	40	38	30	23	16/11
Zahill	50	48	38	29	20/14
Zahl	60	57	46	35	24/17

Cropland Table 2. County spring wheat yields equivalent to productivity indexes (PI) of 100% and calculated average county yields. Percent PI's are converted to spring wheat yields by multiplying the bu/ac for a county (shown below), by a given PI (from NRCS 2000.) Calculated average county yields are based on yield ratings for soil mapping units and acres of each soil mapping unit rated for cropland in the county (NRCS 2000 and Soil Survey Staff, County soil surveys.)

County	Wheat Yield Equivalent to a PI of 100% (bu/ac)	Calculated Average County Wheat Yield (bu/ac)
Adams	37	25
Bowman	32	21
Burke	41	29
McLean.	41	32
Mercer	37	27
Oliver	37	28
Stark	37	25

Cropland Table 3. Conversion factors to calculate yields of other annual crops, based on spring wheat yields. To convert, multiply the spring wheat yield by the following conversion factors (NRCS 2000).

Crop	Conversion Factor	Unit of Measure
Oats	2.1250	bushel
Barley	1.6250	bushel
Flax	0.5000	bushel
Rye	1.2750	bushel
Sunflowers	50.000	hundred weight
Sugar Beets	0.3625	ton

II-D. NATIVE GRASSLAND

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D. NATIVE GRASSLAND

Definition

Native grassland, as defined in NDAC 69-05.2-01-02, means land on which the natural potential plant cover is principally composed of native grasses, grass-like plants, forbs, and shrubs valuable for forage and is used for grazing, browsing, or occasional hay production. Land used for facilities to support ranching operations, which is adjacent to or an integral part of these operations is also included.

Requirements for Successful Revegetation

According to NDAC 69-05.2-22-02(3) when the approved postmining land use is native grassland, the permittee shall select species of grasses, legumes, forbs, half-shrubs or shrubs seeded or planted and their pattern of distribution, to provide a diverse, effective, and permanent vegetative cover with seasonal variety, succession, and regenerative capabilities native to the area. Following establishment of vegetation, comparisons must be made between the reclaimed land and either a reference area or an approved standard. During the responsibility period, controlled grazing of the reclaimed native grasslands is highly encouraged. However, initial grazing plans must be approved by the PSC (NDAC 69-05.2-22-06).

Reference areas or approved standards must be used to verify that productivity, cover, diversity, seasonality and permanence of the reclaimed land equal or exceed that of similar agricultural lands in the surrounding area under equivalent management (practices which are similar but may have site specific requirements incorporated) (NDAC 69-05.2-22-01). For third-stage bond release, ground cover (limited to perennial species not detrimental to the land use, and litter) must be equal to or greater than that of the reference area or approved standard with 90 percent statistical confidence [NDAC 69-05.2-22-07(3)(a)].

For fourth-stage bond release, productivity and ground cover must be equal to or greater than that of the reference area or approved standard. Demonstration of equivalence for both productivity and ground cover must be made with 90% statistical confidence for herbaceous vegetation in each of the final two consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period [NDAC 69-05.2-22-07(4)(a) and (l).

Additionally, diversity, seasonality, and permanence of reclaimed native grassland should be equivalent to that of the approved standard; however, these parameters do not require statistical comparisons.

Premining Assessment

The following information is required as a part of the permit application package [NDAC 69-05.2-08]:

1. Delineate and identify on a map or aerial photograph of 1:4800 scale [NDAC 69-05.2-08-08(l)(a)]:

   a. All native grassland tracts within the proposed permit area;

   b. All range sites; and,

   c. Soil mapping units.

2. Tabulate total acreage of each range site for each surface owner within the proposed permit area [NDAC 69-05.2-08-08(l)(c)(1)].

3. Compile a comprehensive list of all vascular plants [NDAC 69-05.2-08-08(l)(b)]. Special effort must be made to include information from all mapping units in the permit area. Recommended nomenclature found in Flora of the Great Plains (1986) or a newer similar source should be used. The species list must:

   a. Include scientific names; and,

   b. Identify any rare, endangered, poisonous, or noxious plants (if no such species are found, a statement to that effect should be made).

4. Provide the following information for all range sites:

   a. Annual production [NDAC 69-05.2-08-08(l)(c)(2)]; and,

   b. Range condition in percent by methodology described in the SCS (1976) [NDAC 69-05.2-08-08(l)(c)(3)]. The permit application must include the results of sampling that is done to determine range condition, including the list of species composition. If ocular estimation is carried out by an experienced person the results of initial sampling and weighing to standardize his or her technique must also be included in the permit application.

5. Provide a detailed narrative describing the nature and variability of the vegetation of all range sites [NDAC 69-05.2-08-08(l)(d)].

6. For reference areas, which will be used to assess revegetation success, provide a brief description indicating which range sites will be represented, the proposed area where they will be located, and a narrative describing the general condition of the area. At the time equivalent management practices commence [NDAC 69-05.2-08-08(2)]:

   a. Provide the number of reference areas and approximate size of each;

   b. Delineate each reference area on a map of 1:4800 scale, or of sufficient scale to accurately show field location and boundaries; and,

   c. Demonstrate that the proposed reference areas adequately characterize the range sites which they propose to represent by:

(1) Inventorying vegetation parameters on the reference area including:

A. Annual production;

B. Ground cover (basal or first-hit); and,

C. Range condition in percent by methodology described in the SCS (1976). The list of species composition by weight used to determine range condition must be included.

(2) Providing a comparison of reference area data [NDAC 69-05.2-08-08(2)(c)] with:

A. SCS (1987b) or actual production values for the premine soil series mapping units represented;

B. Qualitative assessment of premine cover values;

C. Premine range condition; and,

D. Conduct a field inspection with Commission personnel.

Postmining Assessment

Third-stage bond release

The following information should be submitted for each reclaimed tract when making third-stage bond release requests:

1. An aerial photo of adequate scale which delineates the postmining native grassland tract(s) proposed for bond release [NDAC 69-05.2-12-12 (4)].

2. A narrative which includes the seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to and following seeding (e.g. fertilization, weed control, burning) [NDAC 69-05.2-12-12 (10)].

3. A demonstration of adequate establishment of vegetation by quantitative measurement of cover [NDAC 69-05.2-12-12 (7)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map, which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success standards for third-stage bond release

The technical standard for evaluating ground cover is based on ARS research conducted by Hofmann et al. (1983) and Ries and Hofmann (1984) on reclaimed grasslands in North Dakota. According to Ries and Hofmann, erosion from reclaimed grasslands is similar to that of undisturbed native grassland when total cover is 73% or greater, based on basal hits measured with a point frame; or when total cover is 83% or greater, based on first-hits measured with a point frame. Therefore, for third-stage bond release, the reclaimed tract must have at least 73% total cover (live + litter), based on basal hits; or 83% total cover (live + litter), based on first-hits. Live cover included in the standard must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)].

Either standard must be achieved with 90% statistical confidence. In statistical calculations, a standard deviation of ±18 for basal cover and a standard deviation of ±16 for first-hit cover should be used for ARS data. These values are based on a sample size of 60 10-point frames (Hofmann, personal communications 1987). Calculations of standard deviation for the reclaimed tract must be based on the same methodology, i.e., use of one 10-point frame as the sample unit. A field inspection is required at this time.

Fourth-stage bond release

The following information should be submitted for each reclamation tract when making fourth-stage bond release requests:

1. An aerial photo of adequate scale, which delineates postmining native grassland tract(s) proposed for bond release. The aerial photo must depict ownership boundaries if separate landowners are involved, and for each landowner any site type units if a stratified sampling procedure was used. Provide in tabular form the acreages of site type units for each land-ownership within the reclaimed tract.

2. An aerial photo of adequate scale, which delineates the area and soil-mapping units that were used to develop the standard.

3. An aerial photo of adequate scale, which delineates all corresponding reference areas and their soil-mapping units, which were used to develop the standard.

4. A narrative, which includes the soil replacement thicknesses, seed mix and seeding rate, and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to and following seeding (e.g., fertilization, weed control, burning.)

5. Data and calculations which demonstrate that productivity and ground cover are equal to or greater than (with 90% statistical confidence) the approved standard in each of the last two, consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. Production data must be provided by growth form (refer to Section III-D). Cover data must include composition

by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. All data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

6. A map which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

7. Information which is required to demonstrate that diversity, seasonality and permanence are equivalent to the approved standards.

8. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for fourth-stage bond release

Vegetation data collected from reference areas may be used as the criteria for evaluating production and cover on reclaimed native grasslands. In this case, all areas in the premine tract must be represented by an appropriate reference area and direct comparisons made using weighted averages. However, since rangeland in North Dakota typically has a diverse landscape, which is dissected into several units or range sites (which often do not include large acreages), this type of assessment would require a large number of reference areas. Therefore, the following technical standards may be applied to reclaimed native grasslands, provided some of the premining native grassland areas are represented by reference areas to adjust data for climatic variation. In addition, technical standards have been developed for species diversity and seasonality. Although reference areas are not required for the diversity and seasonality standards, assessing diversity and seasonality based on production or cover data from the reference areas will be useful to justify any request for a variance from the technical standards.

A reference area is defined in NDAC 69-05.2-01-02 as a land unit maintained under appropriate management for the purpose of measuring vegetation ground cover, productivity and plant species diversity that are produced naturally (in the case of native grasslands). Reference areas must be representative of the geology, soil, slope and vegetation in the permit area. A range site, as defined by the NRCS, Bureau of Indian Affairs, and North Dakota Agricultural Experiment Station (Soil Survey Staff 1982), is: "An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production." Therefore, reference areas selected on the basis of range sites meet all the environmental criteria (i.e., geology, soil, slope and vegetation) that are required for proper selection of reference areas. In addition, range sites are also the required mapping units for premine native grassland assessments. Since one range site may encompass one to several soil series (SCS 1987b), the potential production of range sites is more accurately defined by the production estimates of its specific soil series. Therefore, to account for variability in production due to the soil series occupying a range site, it is necessary to include the soil series of each range site selected as a reference area. Soils of the reference area must be mapped by a professional soil classifier.

Selection of reference areas should be made by demonstrating that they adequately represent the premining areas, and are typical of the rangeland found in the area. Selection should be based on:

1. Proper representation of the premine area by range sites as described by the NRCS (SCS 1975a);

2. Proper representation of the premine area by soil series;

3. Similarity of the reference area's actual production to NRCS production values (SCS 1987b) utilized in proposed standards;

4. Similarity of the reference area's range condition to that of the premine area; and,

5. Proximity to the permit area.

The range condition of reference areas should be similar to that of the corresponding premine range site. A rancher may have used the land more intensively prior to mining disturbance than if the goal had been sustained yields for several years. Therefore, it is recommended that management practices, which will maintain or improve the condition of the reference area be used during the liability period. Management of the reference area should be equivalent in effect to that required for the approved postmining land use of the permit area, and reference areas and reclaimed areas must receive management that is equivalent in effect during the responsibility period as required by NDAC 69-05.2-22-07(1). Treatments such as grazing, haying, or burning must be based on site-specific requirements. Reference areas must be approved by the Commission prior to their establishment.

Finally, reference area data and values from NRCS or ARS data (when required for a technical standard) for each range site (and corresponding soil series where appropriate) are weighted by corresponding premine acreage to develop a standard for each parameter for comparison with the reclaimed native grassland. The reclaimed native grassland must be delineated by landowner and into site types if any recognizable differences in vegetation are noted. Vegetation parameters should be measured on all site types. Weighted average values should be calculated based on total acreage of each site type. Adequacy of sample numbers for measurements of total cover and total production should be estimated for each sampling unit (range sites or soil series for reference areas and site types for the reclaimed area).

PRODUCTION

Productivity standards for reclaimed native grasslands can be derived utilizing NRCS production values in conjunction with reference area data to correct for climatic variation. NRCS production data (SCS 1987b) for native grasslands in North Dakota, based on soil series in a normal year, are included in Native Grassland Table 1.

A minimum of one reference area is required for each bond release tract to adjust the standard for climatic variation. It is recommended, however, that reference areas be established and maintained for all predominant range sites and that data from as many reference areas as

possible be utilized. Reference areas used to correct for climatic variation must be representative of the premine soil(s) of the reclaimed tract. Direct yields of reference areas must be used when reference areas representing premine range site/soil series are utilized. However, if a reference area was not established on a soil identical to that found on the premine tract, a reference area on a soil series representative of the reclaimed tract may be used to develop a climatic correction factor. The soil of the reclaimed tract may be characterized by an evaluation of the premine soil survey data and the expected mixing that will occur, or by a field analysis of respread soils. This will eliminate the need for representing those range sites which are extremely shallow or those which have restrictive layers because soils of reclaimed areas tend to be more homogeneous.

To derive the productivity standard for a given reclaimed native grassland tract, a climatic correction factor is calculated by dividing the actual production of the reference area by the NRCS production estimates for its respective soil series. The NRCS production values of the soil series present in the premine tract, but not represented by reference areas, are then multiplied by the correction factor to obtain corrected production values. These values are weighted by the premine acreage of each soil series. Direct yields of represented reference areas (range site/soil series) are also weighted by the premine acreage of each soil series. The summation of all these yields divided by the tract acreage is the target value.

Example

Assume a 31-acre native grassland tract, in Land Resource Area 54 (Native Grassland Figure 2), which consisted of 5 acres overflow/Arnegard (range site/soil series), 1 acre clayey/Belfield, 2 acres shallow/Cabba, 21 acres silty/Amor, and 2 acres thin claypan/Rhoades in its premine condition. Reference areas have been established on clayey/Belfield and silty/Amor sites.

Step 1:

Calculate a climatic correction factor (CF). In this example, NRCS yield estimates for range sites/soil series, which are not represented by a reference area will be corrected for climatic variation with the yield from the silty/Amor reference area since it was prevalent in the premine tract. Assume the reference area produced 1950 lb/ac.

Divide the actual production measured on the silty/Amor reference area by the NRCS production value for the silty/Amor range site/soil series (Native Grassland Table 1):

CF = Actual yield of reference area / NRCS estimated yield of reference area

therefore: CF = 1950 lb/ac / 1800 lb/ac = 1.083

Step 2:

In tabular form indicate acreages of range sites and soil series, which existed in the premine tract but were not represented by a reference area. List the appropriate production values for each range site/soil series from Native Grassland Table 1, and multiply these by the correction factor (CF) to obtain their adjusted production values:

Range site/soil series	NRCS production estimates (lb/ac)	CF	Adjusted production values (lb/ac)
Overflow/Arnegard	2600	1.083	2816
Shallow/Cabba	1400	1.083	1516
Thin claypan/Rhoades	700	1.083	758

Step 3:

List values of actual production measured on represented reference areas and adjusted production values of range sites/soil series that are not represented by reference areas, and weight by their appropriate premine acreages:

Premine Information

Range site/soil series	acres	Production (lb/ac)	Weighted Data Source	Production (lbs)
Clayey/Belfield	1	1600	Actual	1600
Silty/Amor	21	1950	Actual	40950
Overflow/Arnegard	5	2816	NRCS	14080
Shallow/Cabba	2	1516	NRCS	3032
Thin claypan/Rhoades	2	758	NRCS	1516
TOTAL	31			61178

Step 4:

Divide the weighted production by the total acreage to obtain the standard in lb/ac:

61178 lbs / 31 ac = 1973 lb/ac

Step 5:

The standard must be calculated for comparison with the actual yield from the reclaimed tract in each of the growing seasons that such comparisons are made for final bond release purposes.

COVER

A cover standard for a reclaimed native grassland tract can be derived by utilizing cover data from a representative reference area in conjunction with a fixed standard based on ARS (Hofmann et. al. 1983 and, Ries and Hofmann 1984). The ARS standard is based on the cover required to adequately protect grassland areas from erosion (i.e. 73% basal cover or 83% first-hit cover).

A minimum of one reference area is required for each bond release tract to ensure cover is similar to that occurring in natural vegetation of the area. Reference areas used must be

representative of the soil of the reclaimed tract. The soil of the reclaimed tract may be characterized by an evaluation of the premine soil survey data and the expected mixing that will occur, or by a field analysis of respread soils. This will eliminate the need for representing range sites which are extremely shallow or those with restrictive layers because soils of reclaimed areas tend to be more homogeneous. In most cases, the reference area may be limited to a sandy, silty or clayey range site, whichever is most representative of the reclaimed tract. If a silty, sandy, or clayey range site was not present in the premine range site acreage, the cover value from the reference area most similar to the predominant range site should be used. For example, if a premine sandy range site is predominant, the cover value of the sandy range site reference area should be weighted by the premine sandy range site acreage. This methodology assumes that the predominant premine range site will contribute most to the soil characteristics of the reclaimed tract. Cover for premine range sites not represented by the reference area will be represented by ARS data (i.e., total ground cover of 73% basal or 83% first-hit.) Cover values must be weighted by the representative premine range site acreage.

Example using basal cover (10-point frame) measurement

Assume a 31-acre reclaimed native grassland tract, which consisted of 5 acres overflow, 1 acre clayey, 2 acres shallow, 21 acres silty and 2 acres thin claypan range sites. A reference area has been established on a silty range site since soils of the reclaimed native grassland would simulate this condition.

Step 1:

In tabular form list premine range sites and acreages:

Range Site	**Acres**	
overflow	5	
clayey	1	
shallow	2	
silty	21	(represented by reference area)
thin claypan	2	
	31	

Step 2:

Measure cover values of the reference area and summarize (values which follow are assumed):

	Basal cover (%)		
Reference area	**Live**	**Litter**	**Bare**
silty	6	93	1

Step 3:

Weight cover values by premine range site acreages, using reference area data and ARS standard value (73% in this example since basal points are used), and divide by the total acreage to derive a per acre cover value:

	Cover				
Area	**Live**	**Litter**	**Total**	**Acreage**	**Weighted Cover**
Reference area	6%	93%	99%	21	2079
Other range sites			73%	10	730
				31	2809

2809/ 31 = 90.6% total basal cover (live + litter)

Therefore, the approved standard in this example (using basal cover) is 90.6% total ground cover.

Step 4:

The mean total basal cover value from the reclaimed tract is compared to the standard in each of the growing seasons that such comparisons are made for final bond release purposes.

REQUIREMENTS FOR DIVERSITY AND SEASONALITY

The presence of adequate plant species diversity in the reclaimed native grasslands is of much importance because it reflects environmental/community stability and ensures some degree of sustainability under the intended land use. Both cool and warm season grass species are important and needed in native grasslands. Therefore, reclaimed native grasslands must be established predominantly with both cool and warm season native grass species and other appropriate plant species in the approved seed mixtures. The diversity and seasonality standards that follow require that either production or cover data be used to show that the standards have been achieved. However, the same methodology must be used when measuring both diversity and seasonality in each of the years these measurements are taken on a given tract.

For final bond release, the permittee must demonstrate that at least five native grass species are present on the reclaimed tract and that native plant species comprise at least 65% of the total composition by cover or weight. The relative composition of all warm season grasses must be at least 15%. Four native grass species must each contribute at least 3% relative live basal cover or at least 5% relative composition by weight during the years sampling data is used for final bond release purposes. Of these four species, at least two must be warm season grasses and at least one must be a cool season grass. For each sampling year that is used to prove reclamation success, the permittee must also show that a fifth native grass species is present based on the sampling data. Non-native species included in the approved seed mixture may be counted towards meeting these diversity and seasonality standards. Also, up to its percent composition on the approved reference area(s), Kentucky bluegrass on the reclaimed tract may

be counted towards meeting the 65% total native species composition requirement. However, it cannot be otherwise counted as a native grass species for diversity purposes.

The presence of invasive introduced (not seeded and non-native) species will be evaluated at the time of the final bond release inspection. Highly competitive invasive introduced species that are capable of out competing and displacing native grasses, such as smooth bromegrass, crested wheatgrass, and noxious weeds, must not be present in quantities that may be considered detrimental to the native grassland use.

The following table provides an example of a prospective bond release tract that would be considered to have met the above mentioned standards for diversity and seasonality in a given year. Although the diversity and seasonality standards can be demonstrated using either live basal cover or plant weight data, this example shows that standards have been met using either methods. In this example, the native species constitute 73% (by cover) or 72% (by weight) of the total vegetation in the tract and thereby exceeds the minimum requirement of 65%. There are 7 (based on cover) or 8 (based on weight) native grass species (5 required) in the tract. Of these, 4 are present in sufficient quantities (i.e., each of them exceeds 3% cover or 5% weight requirement) to be considered countable for meeting the 4 species standard. The tract contains 3 countable warm season grass species (2 required) and 1 cool season grass species as minimally required. Thus all components of the diversity standard for the tract are met. The warm season grass species constitutes 52% of live basal cover, or 42% of vegetation by weight, when only 15% is required to meet the seasonality standard.

Vegetation Composition Group/Species	Composition /Diversity / Seasonality Based on Cover				Composition / Diversity / Seasonality Based on Weight			
	% Cover Composition		Diversity (3% or greater count)	Seasonality (cool:warm)	% Weight Composition		Diversity (5% or greater count)	Seasonality (cool:warm)
	by species	by group			by species	by group		
Native Cool Season Grasses								
Western Wheatgrass	16		1		21		1	
Green Needlegrass	2		0		4		0	
Slender Wheatgrass	2		0		3		0	
All cool season native grasses		**20**	**1**	**20**		**28**	**1**	**28**
Native Warm Season Grasses								
Sideoats Grama	28		1		13		1	
Switchgrass	16		1		16		1	
Big Bluestem	7		1		10		1	
Blue Grama	1		0		1		0	
Little Bluestem	0		0		1		0	
All warm season native grasses		**52**	**3**	**52**		**41**	**3**	**41**
Native shrubs/half-shrubs & Forbs (x species)		**1**	0	0		**3**	0	0
Introduced Grasses*(x species)		23	0	0		21	0	0
Smooth Bromegrass	13		0	0	11		0	0
Kentucky Bluegrass**	10	**10**	0	0	10	**10**	0	0
Introduced Forbs*(x Species)		3	0	0		3	0	0
Noxious Weeds*(x species)		1	0	0		4	0	0
Total number of native grass sps.	**7**				**8**			
Total Composition – all species		**100**				**100**		
Native species component (%)		**83**				**82**		
Number of native grass species exceeding 3% cover or 5% wt			**4**				**4**	
Composition of cool vs warm season species				**20 : 52**				**28 : 41**

* Introduced grasses or forbs may be counted towards diversity and seasonality if they were a part of the approved seed mixture. However, in the above example, none of the introduced grasses or forbs were part of the seed mixture.

** For this example, it was assumed that Kentucky bluegrass was present on the approved reference area in excess of 10% so this species was counted towards meeting the 65% native species requirement.

The Commission may suitably modify these diversity and seasonality standards based on a demonstration that:

1. Natural fluctuations in diversity or seasonality due to climate or other factors have occurred. The permittee must demonstrate that similar fluctuations have occurred on the reference area(s) used to establish the cover or production standards; or

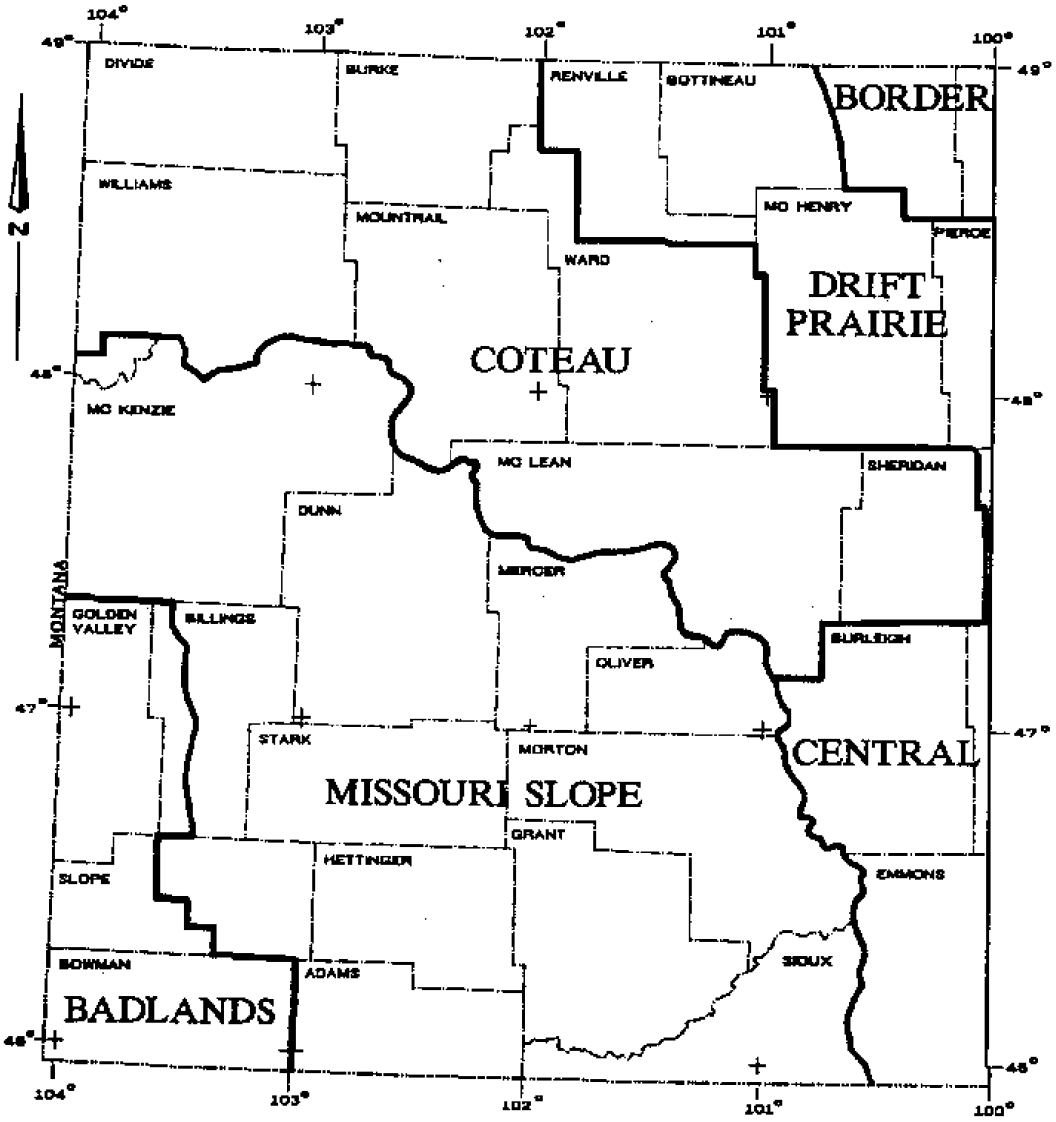
2. Data collected during the responsibility period indicate a trend towards a diverse community. Based on the history of applied management and appropriate species composition data, the permittee must demonstrate that diversity counts on the reclaimed tract are approaching the standard.

PERMANENCE

Ground cover, productivity, diversity and seasonality data will be used to assess the permanence of established vegetation.

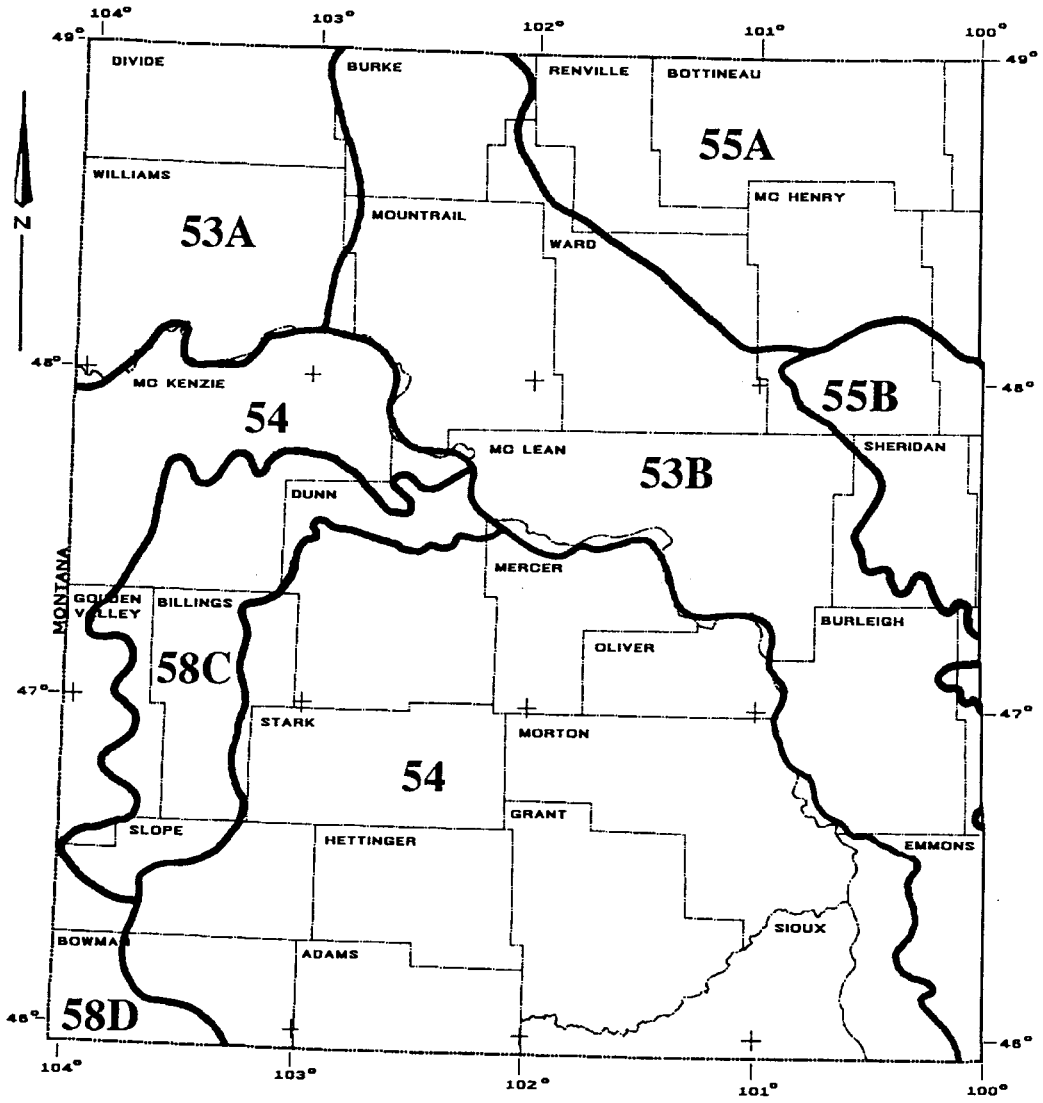
The revegetation responsibility period of ten years will provide sufficient time to prove vegetation establishment and regeneration; therefore, by meeting all other requirements for fourth-stage bond release, permanence will be deemed achieved.

Native Grassland Figure 1. Vegetation zones of North Dakota, lying west of the 100th Meridian, for use in range condition classification and range seeding (SCS 1974).



Legend	Average Annual PPT. (in.)
Badlands(Wheatgrass-Grama-Stipa-Artemisia)	13-15
Missouri Slope (Wheatgrass-Stipa-Grama)	15-16
Coteau (Wheatgrass-Stipa-Snowberry)	14-16
Central (Wheatgrass-Stipa-Snowberry)	16-18
Drift Prairie (Wheatgrass-Bluestem-Stipa-Quercus)	16-18
Border (Wheatgrass-Bluestem-Stipa-Quercus)	16-18

Native Grassland Figure 2. Land resource areas of North Dakota lying west of the 100th Meridian (SCS 1979).



Legend

55A	Northern Black Glaciated Plains
55B	Central Black Glaciated Plains
53A	Northern Dark Brown Glaciated Plains
53B	Central Dark Brown Glaciated Plains
54	Rolling Soft Shale Plain
58C	Northern Rolling High Plains, northeastern part
58D	Northern Rolling High Plains, eastern part

Native Grassland Table 1. Expected production values (lb/ac) of native grassland by soil series, for Major Land Resource Areas 53 and 54, in a normal year (SCS 1987).

Major Land Resource Areas (MLRA)

MLRA 53	Northern Dark Brown Glaciated Plains and Central Dark Brown Glaciated Plains
MLRA 54	Rolling Soft Shale Plains

Range Sites (RS)

CD	Closed Depression	SbSa	Subirrigated Sands	SwG	Shallow to Gravel
CP	Claypan	Si	Silty	TCp	Thin Claypan
Cy	Clayey	SL	Saline Lowland	TSa	Thin Sands
LSb	Limy Subirrigated	Sy	Sandy	TU	Thin Upland
NA	Not Assigned	SyCp	Sandy Claypan	VS	Very Shallow
Ov	Overflow	Sw	Shallow	WL	Wetland
Sa	Sands	SwC	Shallow Clay	WM	Wet Meadow
Sb	Subirrigated				

Range Site Yield Data (lb/ac)

		MLRA	
Soil Series & Phase	**RS**	**53**	**54**
Amor	Si	1900	1800
Arikara	NA		000
Arnegard, saline	SL	2800	2500
Arnegard, wet	Ov	2900	2600
Arnegard, 0-3% slopes	Ov	2900	2600
Arnegard, 3-20% slopes	Si	2300	2200
Arveson, poorly drained	Sb	3800	3900
Arveson, very poorly drained	WL	5500	5200
Aquolls			2600
Aquolls, saline			2500
Baahish	VS		700
Banks, commonly flooded	Ov	2900	2600
Banks, none-rarely flooded	Sa	2700	2400
Bearpaw	Cy	2000	
Beisigl	Sa		1900
Belfield	Cy		1700
Belfield, saline	SL		2500
Bowbells, 0-3% slopes	Ov	2900	2600
Bowbells, 3-6% slopes	Si	2300	2200
Bowdle	Si	1900	1800
Brandenburg	VS		700
Breien, commonly flooded	Ov		2600
Breien, rarely flooded	Sy		2300
Brisbane	Si		1900
Bryant	Si	2100	
Cabba	Sw		1400
Chama	Si		1800
Cherry	Si		2000
Cohagen	Sw		1400
Colvin, saline	SL		2500
Daglum Variant	Cp		1400
Daglum, saline	SL		2500
Desart	Sy		2000

		MLRA	
Soil Series & Phase	**RS**	**53**	**54**
Dimmick	WL		5200
Divide	LSb	3600	
Divide, saline	SL	2800	
Dogtooth	TCp		1400
Ekalaka	SyCp		2000
Exline	TCp	800	
Falkirk	Si	2100	2000
Farland	Si	1900	2000
Farnuf	Si		2000
Felor	Si		2000
Flasher	Sw	1700	1400
Flaxton, fsl, sl	Sy	2200	2000
Flaxton, lfs, ls	Sa	2700	2400
Glendive, commonly flooded	Ov		2600
Glendive, non-rarely flooded	Sy		2300
Golva	Si		2000
Grail, saline	SL		2500
Grail, 0-3% slopes	Ov		2600
Grail, 3-9% slopes	Si		2200
Grassna Variant	SL		2200
Grassna, saline	SL	2800	2500
Grassna, 0-3% slopes	Ov	2900	2600
Grassna, 3-6% slopes	Si	2300	2200
Hamerly	LSb	3600	
Hamerly, saline	SL	2800	
Harriet	SL	2800	2500
Harriet Variant	SL		2500
Havrelon Variant	Ov		2600
Havrelon, commonly flooded	Ov	2900	2600
Havrelon, none-rarely flooded	Si	2300	2200
Havrelon, saline	SL	2800	2500
Heil	CD	2600	2400
Hidatsa	Si		1800

		MLRA	
Soil Series & Phase	**RS**	**53**	**54**
Janesburg	TCp		700
Korchea, channeled	Ov		2600
Korchea, commonly flooded	Ov		2600
Korchea, none-rarely flooded	Si		2200
Krem	Sa	2500	2200
Lakoa	NA		000
Lallie	WL	5500	5200
Lallie, saline	SL	2800	2500
LaPrairie, non-rarely flooded	Si	2300	
Lawther	Cy		1700
Lawther Variant	Cy		1700
Lefor	Sy		2000
Lehr	SwG	1600	1300
Lemert	TCp		700
Lihen, fsl, sl	Sy	2200	2000
Lihen, lfs, ls	Sa	2400	2100
Linton	Si	2100	2000
Livona, fsl, sl	Sy	2200	2000
livona, lfs, ls	Sa	2700	2400
Lohler, commonly flooded	Ov	2900	2600
Lohler, none-rarely flooded	Cy	2100	1800
Ludden	Ov	2900	
Ludden, saline	SL	2800	
Magnus, commonly flooded	Ov	2900	2600
Magnus, none-rarely flooded	Cy	2100	1900
Makoti	Si	2200	2100
Mandan	Si	2200	2100
Manning	Sy	2000	1800
Marysland, poorly drained	Sb	3800	
Marysland, very poorly drained	WL	5500	
Max	Si	2100	
McKenzie	CD	2600	2400
Miranda	TCp	800	700
Moreau	Cy		1500
Moreau Variant	Sw		1400
Moreau, saline	SL		2500
Morton	Si	1900	1800
Mott	Sy		2000
Neche Variant	WM	4300	
Niobell	Cy	1900	1700
Noonan	Cp	1600	1400
Nutley	Cy	2000	
Omio	Si	1900	1800
Parnell	Wl	5500	5200
Parnell, ponded	NA	000	000
Parshall	Sy	2200	2000
Parshall, saline	SL		2500
Parshall, wet	Ov		2600
Reeder	Si		1800
Regan, poorly drained	Sb	3800	3900
Regan, saline	SL	2800	2500
Regan, very poorly drained	Sb	3800	3900
Regan, saline	SL	2800	2500
Regan, very poorly drained	WL	5500	5200
Regent	Cy		1700
Rhoades	TCp	800	700
Rhoades, saline	SL		2500
Ringling	VS		600
Roseglen	Si	2200	
Ruso	Sy	2000	1800
Sakakawea	TU	1900	
Savage	Cy		1800
Savage, saline	SL		2500
Schaller	VS		700

		MLRA	
Soil Series & Phase	**RS**	**53**	**54**
Searing	Si		1800
Sen	Si	1900	1800
Seroco	TSa	1700	1500
Shambo	Si	2100	2000
Sinai	Cy	2100	
Sinnigam	SwG		1300
Southam	NA	0000	
Stady	Si	1900	1800
Stirum	Sb	3800	
Straw, channeled	Ov	2900	2600
Straw, commonly flooded	Ov	2900	2600
Straw, none-rarely flooded	Si	2300	2200
Sutley	TU	1900	
Tally	Sy	2200	2000
Tansem	Si	2100	
Telfer, fsl, sl	Sy	2200	2000
Telfer, lfs, ls	Sa	2400	2100
Temvik	Si	2100	2000
Tiffany	Sb	3800	
Tonka	WM	4300	4000
Trembles Variant	Ov		2600
Trembles, commonly flooded	Ov	2900	2600
Trembles, none-rarely flooded	Sy	2500	2300
Vallers	Sb	4000	
Vallers, saline	SL	2800	
Vebar	Sy	2000	1800
Velva, commonly flooded	Ov	2900	2600
Velva, none-rarely flooded	Sy	2500	2300
Velva, saline	SL	2800	2500
Wabek	VS	800	700
Wanagan	Si		1800
Watrous	Si		1800
Wayden	SwC		1200
Werner	Sw		1400
Williams	Si	2100	2000
Wilton, 0-3% slopes	Ov	2900	2600
Wilton, 3-9% slopes	Si	2200	2200
Yegen	Sy		2000
Zahill	TU	1600	
Zahl	TU	1900	1700

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E. TAME PASTURELAND

Definition

Tame pastureland, as defined in NDAC 69-05.2-01-02 means land used for the long-term production of predominantly adapted, domesticated species of forage plants to be grazed by livestock or occasionally cut and cured for livestock feed. Land used for facilities in support of pastureland that is adjacent to or an integral part of these operations is also included.

Requirements for successful revegetation

When the approved postmining land use is tame pastureland, the permittee shall seed or plant species of grasses and legumes adapted to the local site conditions and capable of supporting grazing and occasional haying under proper management [NDAC 69-05.2-22-02(2)]. Any introduced species that are used must be compatible with plant and animal species of the region, must meet the requirements of applicable state seed or introduced species statutes, and must not be poisonous or noxious [NDAC 69-05.2-22-01].

The evaluation of revegetation success on tame pastureland includes measurements for productivity and ground cover. For third-stage bond release, vegetation establishment is determined on the basis of ground cover only. All species used in determining ground cover must be perennial species not detrimental to the approved postmining land use [NDAC 69-05.2-22-07(3)(a)]. For fourth-stage bond release, ground cover and productivity of the permit area must be equal to or greater than that of the approved standard, with 90% statistical confidence [NDAC 69-05.2-22-07(4)(b)].

Premining assessment

The following information is required as a part of the permit application [NDAC 69-05.2-08]:

1. Delineate and identify on a map or aerial photograph of 1:4800 scale [NDAC 69-05.2-08-08(l)(a)(2)]:

    a. All tame pastureland tracts within the proposed permit area; and,

    b. Each soil-mapping unit in each tract of tame pastureland.

2. Tabulate total acreage of each soil mapping unit for each surface land owner within the proposed permit area [NDAC 69-05.2-08-08(l)(c)(1)].

3. Include all species which were found in tame pastureland tracts in the plant species list for the permit area. All noxious, poisonous, threatened, and rare species must be included; if none were found, a statement to that effect must be included [NDAC 69-05.2-08-08(l)(b)].

4. Provide an assessment of annual production, based on actual data or 1988 SCS estimates.

5. Provide a narrative which describes the vegetation of each pastureland area, including dominant species and their relative proportions [NDAC 69-05.2-08-08(l)(d)].

6. If a control area will be used to develop a revegetation success standard (see page II-E-4), provide a map showing the general location and soil-mapping units of the area. Also include a narrative which demonstrates that the area adequately represents the conditions in the permit area [NDAC 69-05.2-08-08(2)], and describes the method which will be used to establish the control area.

Postmining assessment

Third-Stage Bond Release

The following information must be submitted for each reclaimed pastureland tract when making third-stage bond release requests:

1. An aerial photo of adequate scale, which delineates the reclaimed tame pastureland tract(s) proposed for bond release.

2. A narrative which includes the seed mix and seeding rate, describes the methods used for seedbed preparation and seeding, and all management practices used [NDAC 69-05.2-12-12(10)].

3. A demonstration of adequate establishment of vegetation [NDAC 69-05.2-22-07(3)(a)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map which identifies the approximate locations of sampling transects or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Third-stage Bond Release

Each reclaimed tract must have at least 73% total cover (live + litter), based on basal hits, or 83% total cover (live + litter), based on first-hits, determined by the point frame method. All species used in determining ground cover must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)]. The standard must be achieved with 90% statistical confidence. Methodology is described in Native Grassland, Section II-D. A field inspection will also be required to verify that ground cover is adequate to control erosion.

Fourth-Stage Bond Release

The following should be submitted for each reclaimed pastureland tract when making fourth-stage bond release requests:

1. An aerial photo of adequate scale which delineates the reclaimed tame pastureland tract(s) proposed for bond release. The aerial photo must depict ownership boundaries if separate landowners are involved and within each ownership any site type units if a stratified sampling procedure was used. Provide in tabular form the acreages of site type units for each landowner within the reclaimed tract.

2. An aerial photo of adequate scale which delineates the area and soil-mapping units that were used to develop the standard.

3. An aerial photo of adequate scale which delineates any corresponding reference or control areas and their soil-mapping units, if used to develop the standard.

4. A narrative which includes the soil replacement thicknesses, seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices used (i.e., fertilization, weed control, burning, grazing, etc.) [NDAC 69-05.2-12-12(10)].

5. Data and calculations, which demonstrate that productivity and ground cover of each landowner's reclaimed tract are equal to or greater than (with 90% statistical confidence) the approved standard in each of the last two consecutive growing seasons, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. All data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

6. A map, which identifies the approximate locations of sampling, transects or the sampling areas and number of randomly located sample units per area, whichever method is used.

7. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards For Fourth-Stage Bond Release

Production

The NRCS has categorized soil series of each Land Resource Area (LRA) in North Dakota into “Suitability Groups” based on pasture and hayland species adaptability, yield, and management factors. For each group of soils considered suitable for pasture and hayland use, the NRCS has provided yield estimates for low-level and high-level management [SCS Technical

Guide, Pasture and Hayland Suitability Groups, Section IIK (SCS 1988)]. These data can be used to develop productivity standards for reclaimed tame pastureland and hayland.

If a tract is owned by more than one landowner, production on each landowner's property must be separately assessed. A separate yield must be obtained, and a separate yield standard developed, for each landowner's property.

The standard is derived by assigning the appropriate suitability group to each named soil series in the map unit, which existed in the reclaimed tract prior to mining (Pastureland Table 1). The yield estimate (per acre) for each soil is obtained for the appropriate suitability group (Pastureland Table 1) and Land Resource Area (Pastureland Figure 1). Yield ranges are given for low-level and high-level management. The median value of the entire range will be used since this management level, as defined by the NRCS (SCS 1988), appears to best describe the management which is most commonly used on reclaimed pasture and hayland in North Dakota. However, the median value of the high-level management value must be substituted if the mine operator fertilizes reclaimed pasture and hayland. Low-level management does not apply to reclaimed lands since they are not overgrazed or improperly managed. The management techniques must correspond to those defined by the NRCS (SCS 1988).

Yields shown in Pastureland Table 2 are the median values of the range given for high-level management, and the median value for the entire range listed including both high- and low-level management. Estimated values are included to be used for those soil groups that are not suited for pasture or hayland. These values were derived using 50% of the yield of suitability group or soil series most similar to them. For example, a value of 0.75 t/ac was assigned as the median value for suitability group H1, LRA 53, strongly saline soils. This value is 50% of 1.50 t/ac, the yield given for suitability group G4, LRA 53, saline soils. Suitability group H1 was not rated for pastureland use, whereas suitability group G4 was. Fifty percent of the yield was selected, based on NRCS (SCS 1988) recommendations, since these soils are rated non-suitable due to machinery limitations and erosion rather than productivity potential.

The yield value for each soil is weighted by the acreage that soil occupied in the tract prior to mining. The weighted values for all soils are summed and divided by the total acreage of the tract to obtain a weighted average yield per acre. This value is the unadjusted yield standard for the tract.

The unadjusted yield standard must be corrected for annual climatic variations by one of the following methods:

Correction Method 1:

Annual county yield data, reported by NDASS, can be used to calculate an annual climatic correction factor (CF). [If the hayland/tame pastureland vegetation on the reclaimed tract contains more than 25% alfalfa, the “alfalfa hay” yield reported by NDASS must be used. If the hayland/tame pastureland vegetation on the reclaimed tract contains less than 25% alfalfa, the “all other hay” yields reported by NDASS should be used.] The correction factor is derived by dividing the NDASS county yield for the current year (X_C) by the long-term average yield for

the county (X_{CLT}). The county average yield (X_{CLT}) is derived using a long-term average calculated from NDASS data. Calculation of the average should include data from the last fifteen years.

$$CF = X_C / X_{CLT} \quad (1)$$

This correction value is then multiplied by the unadjusted yield standard to derive the annual target value.

Correction Method 2:

This method is similar to a correction method used for cropland (see Cropland, Section II-C, Correction Method 3). The PSC may develop a regression equation or other formula that predicts a deviation from the long-term average NDASS yield based on the current year's effective precipitation, growing season temperature, and other pertinent data. This deviation (+ or -) is the correction factor, which is added to the unadjusted yield standard (derived from 1988 SCS data) for the reclaimed tract to derive the current year's adjusted yield standard. Any regression equation or other formula that will be used for this method will be developed and updated by the PSC. The PSC will provide permittees with acceptable regression equations.

Correction Method 3:

This method involves the use of a control area which may be established using one of the following options:

1. An existing grass-legume tract that possesses similar species composition may be used. This control area must be established at least five years prior to the first year that the reclaimed tract is assessed for bond release.

2. Land may be cultivated and seeded with the same species mixture that will be planted on the reclaimed area. This control area must be seeded at the same time as the reclaimed tract.

In either case, the proposed location of the control area must be identified in the permit application. The control area must be established in the same Land Resource Area and as close as possible to the permit area. The control area should contain some of the predominant premine soil series that occupied the reclaimed tract and should have similar slope and aspect. Prior to establishment, the permittee must provide the PSC with a description of the control area, including species composition and management history if option 1 is used. The PSC will review this information and inspect the control area prior to approval.

Management of the control area and the reclaimed tract may be site specific, but must be equal in effect during the years in which comparisons with the standard will be made.

A weighted average yield for the control area is obtained using the 1988 SCS yield estimates in the same manner as for the reclaimed pastureland tract. The control area is harvested each year that the reclaimed tract will be assessed for bond release. The actual yield of the control area is divided by the weighted average yield to derive the climatic correction factor for the current year. The unadjusted yield standard for the reclaimed tract is multiplied by the correction factor to obtain an adjusted yield standard. The actual yield from the reclaimed tract must equal or exceed the adjusted standard in each of the last two consecutive growing seasons, or three years starting no sooner than the sixth year with one year being the last year of the responsibility period.

Example

The following is an example that uses the control area to calculate a climatic correction factor for a tract in LRA 54:

Step 1:

Obtain yields for each premine soil series in the reclaimed tract and control area from the NRCS data (SCS 1988.) Weight each yield by the acreage the soil series occupies in the tract. Sum the weighted yields and divide by the total acreage to obtain an unadjusted yield standard for the reclaimed tract and a weighted average yield for the control area:

Reclaimed tract:

Premine Soil	Suitability Group	Median yield (t/ac)[1]		Premine acres		Weighted yield (t)
Arnegard	A3	2.10	X	3	=	6.30
Savage	A4	1.35	X	4	=	5.40
Vebar-Cohagen	F3 &H4	1.05 & 0.43[2]	X	2	=	1.60
Straw	A1	1.50	X	10	=	15.00
TOTAL				19		28.30

[1] Median yield of all management (Pastureland Table 2)

[2] Percentages of each soil series in the complex soil-mapping unit were not described; therefore, this example assumes 60% Vebar and 40% Cohagen

Unadjusted yield standard = 28.30 tons / 19 acres = 1.49 ton/ac or 1.5 ton/ac

Control area:

Soil	Suitability Group	Median yield		Acres		Weighted yield
Straw	A1	1.75	X	5	=	8.75
Belfield	F1	1.25	X	2	=	2.50
Flaxton	A6	1.35	X	1	=	1.35
TOTAL				8		12.60

Weighted average yield = 12.60 tons / 8 ac = 1.58 ton/ac or 1.6 ton/ac*

Step 2:

The actual yield of the control area for the current year (assumed to be 1.1 ton/ac) is divided by the weighted average yield of 1.6 ton/ac to obtain a climatic correction factor:

CF = 1. 1 ton/ac / 1.6 ton/ac = 0. 6875

Step 3:

Multiply the unadjusted yield standard of the reclaimed tract (1.5 ton/ac) by the correction factor to obtain a standard, which has been adjusted for climatic variation:

Adjusted yield standard = 1.5 ton/ac x 0.6875 = 1.03 ton/ac*

*The same precision (i.e., decimal places) and units used in field measurements should be used for yields based on NRCS data.

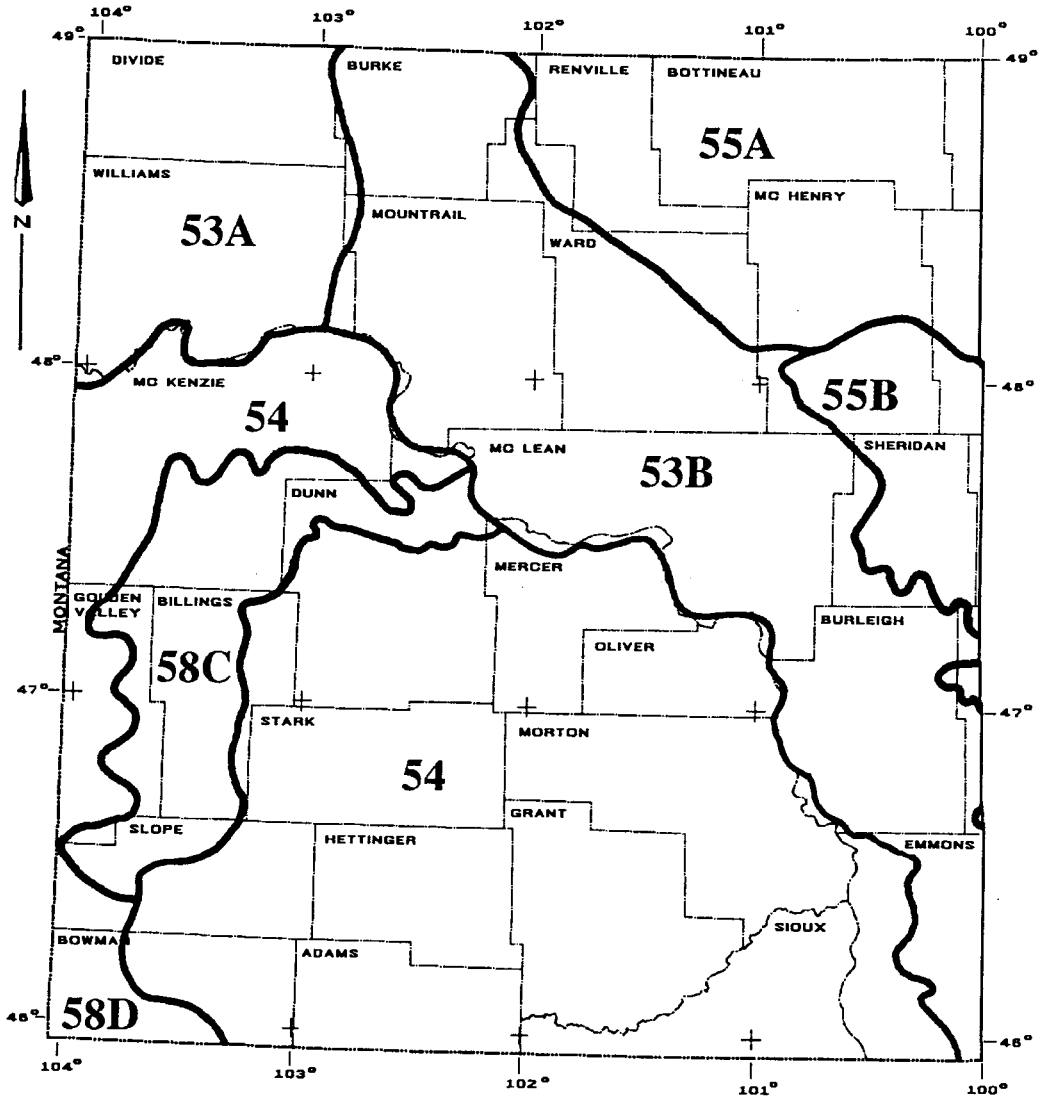
Step 4:

Compare the adjusted standard to the current year's actual yield from the reclaimed tract using appropriate statistical procedures (repeat steps 2 and 3 for each year of comparison). Further discussion on sampling and statistical procedures is given in Chapter III.

COVER

The same standard used for third-stage bond release must be used to assess cover for fourth-stage bond release. In addition, the perennial species included in the approved tame pastureland seed mixture must be present and any non-seeded species must not be detrimental to the land use. This will be evaluated at the time of the final bond release based on the cover data and a field review of the reclaimed tract.

Tame Pastureland Figure 1. Land resource areas of North Dakota lying west of the 100th Meridian (SCS 1979).



Legend

55A	Northern Black Glaciated Plains
55B	Central Black Glaciated Plains
53A	Northern Dark Brown Glaciated Plains
53B	Central Dark Brown Glaciated Plains
54	Rolling Soft Shale Plain
58C	Northern Rolling High Plains, northeastern part
58D	Northern Rolling High Plains, eastern part

Pastureland Table 1. Soils key for pasture and hayland suitability groups (SG) in Land Resource Areas 53 and 54 in North Dakota (SCS 1988).

Soil Series	SG	Soil Series	SG	Soil Series	SG
Absher	G2	Frazer	A1	non-saline	C1
Amor	F2	Glendive		saline	G4
Arikara	H3	none-rare flooding	A3	Miranda	G2
Arnegard		occas-freq flooding	A6	Moreau	A4
>3% slope	A1	Golva	A1	Morton	F2
<3% slope	A3	Grail		Mott	A6
Arveson		>3% slope	A1	Niobell	F1
poorly drained	C1	<3% slope	A3	Noonan	G1
very poorly drained	H6	Grassna		Nutley	A4
Baahish		>3% slope	A1	Oburn	G2
<25% slope	B2	<3% slope	A3	Ojata	H1
>25% slope	H3	Hamerly		Omio	F2
Banks		non-saline	A5	Parnell	H6
fsl, sl	A6	saline	G4	Parshall	A6
lfs, ls	A7	Hanly	A7	Patent	A1
s, fs	H5	Harriet	G3	Rauville	H6
Bearpaw	A4	Havre		Reeder	F2
Beisigl	F3	none-rare flooding	A1	Regan	
Belfield	F1	occas-freq flooding	A3	poorly drained	C1
Benz	G2	Havrelon		very poorly drained	H6
Bowbells		none-rare flooding	A1	Regent	F2
>3% slope	A1	occas-freq flooding	A3	Rhame	F3
<3% slope	A3	saline	G4	Rhoades	
Bowdle	A1	Heil	G3	<25% slope	G2
Boxwell	F2	Hidatsa	B1	>25% slope	H3
Brandenburg		Korchea		Ringling	B2
<25% slope	B2	none-rare flooding	A1	Roseglen	A1
>25% slope	H3	occas-freq flooding	A3	Ruso	B1
Breien	A6	Krem	A7	Sakakawea	A2
Brisbane	A1	Kremlin	A1	Savage	A4
Bryant	A1	Ladner	G1	Schaller	
Cabba	H4	Lakoa		<25% slope	B2
Cabbart	H4	<25% slope	A1	>25% slope	H3
Chama	F2	>25% slope	H3	Searing	A1
Chanta	B1	Lallie		Sen	F2
Cherry	A1	poorly drained	C1	Seroco	H5
Chinook		saline	G4	Sham	G1
<25% slope	A6	very poorly drained	H6	Shambo	A1
>25% slope	H3	Lawther	A4	Sinai	A4
Cohagen	H4	Lefor	F3	Sinnigam	
Colvin		Lehr	B1	<25% slope	B2
poorly drained	C1	Lihen		>25% slope	H3
saline	G4	fsl, sl	A6	Southam	H6
very poorly drained	H6	lfs, ls	A7	Stady	A1
Daglum	G1	Linton	A1	Straw	
Desart	F3	Lisam	H4	none-rare flooding	A1
Dilts	H4	Livona	A6	occas-freq flooding	A3
Dimmick	H6	Lohler	A3	Sutley	
Divide	A5	Ludden	C1	<25% slope	A2
Dooley	A1	Magnus	A3	>25% slope	H3
Easby	H1	Makoti	A1	Tally	
Ekalaka	G1	Mandan	A1	<25% slope	A6
Falkirk	A1	Manning	B1	>25% slope	H3
Farland	A1	Marmarth	F2	Tansem	A1
Farnuf	A1	Marysland		Telfer	
Felor	A1	poorly drained	C1	fsl,sl	A6
Flasher	H4	very poorly drained	H6	lfs, ls	A7
Flaxton	A6	Max	A1	Temvik	A1
Fleak	H4	McKenzie		Tiffany	C1

Soil Series	SG
Toby	A6
Tonka	C1
Trembles	A3
Tusler	F3
Vallers	
non-saline	C1
saline	G4
Vanda	G2
Vebar	
<25% slope	F3
>25% slope	H3
Velva	A3
Wabek	
<25% slope	B2
>25% slope	H3
Wanagan	A1
Watrous	
<25% slope	F2
>25% slope	H3
Wayden	H4
Werner	H4
Williams	A1
Wilton	A1
Wolf Point	
none-rare flooding	A1
occas-freq flooding	A3
Yawdim	H4
Yegen	A6
Yetull	H5
Zahill	A2
Zahl	
<25% slope	A2
>25% slope	H3
Zeona	H5

Pastureland Table 2. Median yields (t/ac) for pasture and hayland suitability groups in Land Resource Areas 53 and 54 in North Dakota (SCS 1988).

SUITABILITY GROUP		LRA 53		LRA 54	
		High [1]	Median [2]	High [1]	Median [2]
A1	loam & silty soils	2.20	1.95	1.75	1.50
A2	thin upland soils	1.10	1.00	0.95	0.85
A3	overflow & run-on soils	2.55	2.30	2.35	2.10
A4	clayey soils	1.75	1.50	1.60	1.35
A5	limy subirrigated soils	2.25	2.00	[3]	[3]
A6	sandy soils	1.75	1.50	1.35	1.20
A7	sands .	1.60	1.35	1.40	1.20
B1	shallow to gravel soils	1.60	1.35	1.40	1.20
B2	very shallow to gravel soils	0.85	0.75	0.75	0.65
C1	wet soils	2.65	2.25	2.15	1.90
F1	clayey subsoils	1.40	1.20	1.25	1.05
F2	moderately deep silty soils	1.75	1.50	1.40	1.20
F3	moderately deep sandy soils	1.60	1.35	1.25	1.05
GI	claypan soils	1.25	1.05	1.05	0.90
G2	thin claypan soils	0.75	0.65	0.65	0.55
G3	sodic-saline soils	1.40	1.20	1.10	0.90
G4	saline soils	1.75	1.50	1.40	1.20
H1	strongly saline soils	0.88 [4]	0.75 [4]	0.70 [4]	0.60 [4]
H2	stony soils	[5]	[5]	[5]	[5]
H3	steeply sloping soils	[6]	[6]	[6]	[6]
H4	shallow soils	0.55 [7]	0.50 [7]	0.48 [7]	0.43 [7]
H5	sands soils	0.80 [8]	0.68 [8]	0.70 [8]	0.60 [8]
H6	wetland soils	1.33 [9]	1.13 [9]	1.08 [9]	0.95 [9]

[1] Median yield under high-level management
[2] Median yield of all management
[3] Does not occur in this LRA
[4] 50% of Suitability Group G4
[5] Use 50% of the Suitability Group of the non-stony phase of the same soil series
[6] Use 50% of the Suitability Group of the lower slope class of the same soil series
[7] 50% of Suitability Group A2
[8] 50% of Suitability Group A7
[9] 50% of Suitability Group C1

II-F. WOODLAND

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F. WOODLAND

Definition

NDAC 69-05.2-01-02 defines woodland as land where the primary premining natural vegetation is trees or shrubs. Trees, shrubs, half-shrubs, and woody vines constitute woody plants [NDAC 69-05.2-01-02]. Based on these definitions, only the immediate area where woody plants exist (whether pre- or postmine) will be considered as woodland. Adjacent areas where the primary vegetation is not woody plants must be evaluated based on the requirements of the appropriate land use.

Requirements for Successful Revegetation

NDAC 69-05.2-22-02(4) requires that when the approved postmining land use is woodland, the permittee shall plant woody species adapted for local site conditions and climate, in combination with a cover of grains, grasses, legumes, or forbs to provide a diverse, effective, and permanent vegetative cover with the seasonal variety, succession, and regenerative capabilities native to the area. Commission approval of species composition, minimum stocking, spacing and planting arrangements of trees, shrubs, half-shrubs and ground cover will be based on local and regional recommendations following consultation with the State Game and Fish Department, State Forester and NRCS [NDAC 69-05.2-22-02(4)]. NDAC 69-05.2-22-07(4)(e) requires that success of revegetation on lands reclaimed to woodland be determined on the basis of tree and shrub numbers, vegetative ground cover, and an evaluation of species diversity, seasonal variety, and regenerative capacity of the vegetation on the permit area.

For third-stage bond release, the number of trees and shrubs must be equal to or greater than the approved standard. Understory growth must be controlled on young stands. Erosion must be adequately controlled by mulch or site characteristics [NDAC 69-05.2-22-07(3)(d)]. Planting understory herbaceous vegetation may inhibit growth of woody species; therefore, it may be deferred until it no longer interferes with the establishment of woody species. This is a normal conservation practice in North Dakota, as recommended by NRCS and the North and South Dakota Extension Services (Frank et. al. 1982, Helwig and Rader 1981, SCS 1984a, SCS 1984b, and Van Deusen 1979) and is not considered an augmented seeding.

For fourth-stage bond release, the permittee must demonstrate in the final two consecutive years or any three years starting no sooner than the sixth year and with one-year being the last year of the responsibility period that:

1. The number of woody plants established on the permit area is equal to or greater than the stocking of live woody plants of the same life form of the approved standard with 90% statistical confidence [NDAC 69-05.2-22-07(4)(e)(1)].

2. The number of woody plants established is adequate to meet density standards, based on approved stocking rates, or on the density that existed prior to mining. Those which may be counted include trees, shrubs, half-shrubs, root crowns and root sprouts that:

a. Are healthy;

b. Have been in place for at least two growing seasons; and,

c. Have met the time-in-place requirement (80% in place for 6 years), which may be shown either by actual counting or by demonstrating that no replanting was done during the last 6 years of the responsibility period.

3. The ground cover is equal to or greater than 90% of the ground cover of the approved standard with 90% statistical confidence and is adequate to control erosion [NDAC 69-05.2-22-07(4)(e)(2).

4. Species diversity, seasonal variety, and regenerative capacity of the vegetation meet or exceed the calculated survival and reproduction rates for the species stocked [NDAC 69-05.2-22-07(4)(e)(3)].

Premining Assessment

The following information is required as a part of the permit application package [NDAC 69-05.2-08]. Premining assessments are necessary when the woodland in question will be disturbed and woodland is the postmining land use:

1. Define areal extent by woodland type, i.e., deciduous trees, tall shrubs, and low shrubs:

   a. Depict woodland types, i.e., trees, tall shrubs and low shrubs, on a map (scale 1:4800) with appropriate legend [NDAC 69-05.2-08-08(l)(a)(4)];

   b. List the acreage of each woodland type for each surface owner [NDAC 69-05.2-08-08(l)(c)(1)]; and,

   c. Provide a detailed description of the number and arrangement of trees and shrubs, probable age of trees, height of trees and characteristics of the understory vegetation [NDAC 69-05.2-08-08(l)(c)(4)]. The number of trees and shrubs may be estimated from density measurements.

2. Obtain cover data for herbaceous species associated with each woodland type using methods described in the methods sections of this document when necessary for the development of the standard. The permittee must generate a weighted average cover value, weighted by the acreage of each woodland type [NDAC 69-05.2-08-08(l)(c)(7)].

3. Prepare a comprehensive species list using scientific names for all vascular plant species, including noxious, poisonous, endangered and rare species [NDAC 69-05.2-08-08(l)(b)].

4. Provide a narrative describing the nature and variability of the vegetation in each woodland type based on a thorough reconnaissance and qualitative assessment [NDAC 69-05.2-08-08(l)(d)].

Postmining Assessment

Third-Stage Bond Release

The following information should be submitted for each reclaimed tract when making third-stage bond release requests:

1. Provide an aerial photo or map of adequate scale which delineates the woodland areas in the proposed bond release tract(s).

2. Provide a description of the woody species stocked, the type of stocking used (e.g., bare root stock, containerized), and the stocking rate of each species. Include a narrative which indicates the herbaceous seed mix used and methods for seedbed preparation, seeding and seeding rate. Provide information on all management practices implemented on the area.

3. Provide all other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Third-Stage Bond Release

An on-site inspection by Commission personnel, the Reclamation Advisory Committee and the landowner will be conducted to determine that tree and shrub species are sufficient in number to provide a woodland that is healthy, based on the following characteristics:

(1) All tree species stocked are capable of survival;
(2) Shrubs are capable of regeneration;
(3) Understory vegetation does not interfere with growth of woody species; and,
(4) Erosion is adequately controlled.

Fourth-Stage Bond Release

The following information should be submitted for each reclaimed tract when making fourth-stage bond release requests:

1. A map of adequate scale which delineates the reclaimed woodland tract(s) proposed for bond release [NDAC 69-05.2-12-12(4)].

2. A description of the woody species stocked, the type of stocking used (e.g., bare root stock, containerized), stocking rate of each species and any management practices that occurred after the woody species were planted and herbaceous understory was seeded.

3. Data to demonstrate, using quantitative methods, that herbaceous ground cover is equal to or greater than 90% of the ground cover of the approved standard with 90% statistical confidence [NDAC 69-05.2-22-07(4)(e)(2)].

4. A calculation of the woody species density [NDAC 69-05.2-22-07(4)(e)(1)] based on:

a. The following major factors:

(1) Species and woodland types;
(2) Initial planting rate;
(3) Suckering ability of the species utilized; and,
(4) Estimated percent survival rates of species utilized; or,

b. Density estimates of each woodland type described in the premine assessment.

5. Data to demonstrate that species diversity, seasonal variety and regenerative capacity have been achieved based on species stocked and expected survival and reproduction rates [NDAC 69-05.2-22-07(4)(e)(3)].

6. Documentation that trees and shrubs have met the time in place requirement.

7. All other information as required by NDAC 69-06.2-12-12.

Revegetation Success Standards for Fourth-Stage Bond Release

Revegetation success in reclaimed woodlands must be measured during the last two consecutive years, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. The standard will be determined on the basis of whether the stocking rates were based on local and regional recommendations or on the premining vegetation data. The following standards have been developed.

For plantings based on local and regional stocking recommendations:

1. Meet the calculated woody species density [NDAC 69-05.2-22-07(4)(e)(1)], which has been pre-designated based on planting rates of woody species on the following regenerative capacities [NDAC 69-05.2-22-07(4)(e)(3)]:

a. At least 70% of the trees planted will remain at the time of final bond release;

b. Tall shrub and mixed tall and low shrub plantings will at least triple in number by suckering; and,

c. Low shrub plantings will at least quadruple in number by suckering.

2. Provide an assessment of diversity and seasonal variety [NDAC69-05.2-22-07(4)(e)(3)] made on the basis of species stocked and expected survival rates:

a. Each species of tree, tall shrub and low shrub included in the initial planting should be present at the end of the responsibility period. At least 60% of the number of tree species planted should be present at 50% of the initial planting rate and at least 60% of the number of shrub species (tall and low) planted should each comprise at least 10% of the density standard; and

b. No trees and shrubs planted for less than two growing seasons shall be counted in determining stocking adequacy. However, tree and shrub stems occurring as a result of natural regeneration may be counted.

3. Provide verification that trees and shrubs have met the time in place requirement.

a. Since natural woodlands in North Dakota are comprised of a dense stand of intermingled trees, tall shrubs, and low shrubs, locating the original planted species is not practicable, or necessary to ensure the success of the stand. Permanent quadrats may be established in each woodland community to document the time in place requirement. The total number of plants in year one must be provided. In year four or in the year that 60% of the liability period falls after, 80% of the total number planted must be present. This requirement will be deemed satisfied if the operator demonstrates that no replanting was done in the last six years of the responsibility period. This will verify that the success is based on the survival and reproduction of the majority of the trees and shrubs in the initial planting. Data from quadrats within a community may be averaged to obtain a value for the entire community; and,

b. Documentation must be provided which verifies that not more than 20% of the numbers present in year four have been replanted. The Federal Register, Volume 53, No. 173 page 34639 states that the rule [§816.116(b)(3)(ii)], in effect limits replanting to a maximum of 20% of the required stocking before restarting the liability period. Since the majority of the species planted are relatively short-lived species, and since the required stocking (standard) is based on reproduction rather than survival rates, the required stocking will not be present until near the end of the responsibility period. Therefore, the number of replantings allowed will be based on the number of plants present in year four. This interpretation is based on the U.S. Forest Service definition (USFS 1979), which defines stocking as the proportion of an area occupied by woody species, not as a planting density. A worksheet of each shrub and tree community must be provided, which lists annual replantings of each species. Receipts or appropriate records from nurseries or persons hired to do replantings must be retained for verification.

4. Since extensive herbaceous cover may be incompatible with maximum tree survival and growth, a light herbaceous cover is acceptable, provided total ground cover is adequate to protect the soil surface from erosion. Ground cover may be determined by sampling either total ground cover, a combination of herbaceous and woody vegetation, or herbaceous understory only. Total ground cover (i.e., live herbaceous, litter, and canopy from woody vegetation) must be at least 83%. If only herbaceous understory is measured, the live herbaceous cover and litter must constitute at least 66% total basal cover [90% of a 73% standard based on Ries and Hofmann (1985)] or 75% first-hit cover [90% of an 83% standard based on Ries and Hofmann (1984)]. The total ground cover, including the canopy cover of woody vegetation must provide adequate protection from erosion. The herbaceous cover must be comprised of desirable species not detrimental to the growth of woody vegetation.

Example:

Trees:

Tree	Initial Planting rate (trees/acre)
green ash	820
burr oak	200
boxelder	280
cottonwood	500
aspen	90
	1890

The density standard for trees: 1890 trees (planted per acre) x 0.70 (30% expected mortality rate) equals 1323 trees per acre.

The reclaimed area should have, at a minimum, 60% of the species present (5 species x 60% = 3 species) at 50% of the initial planting rate. However, a total of 1323 trees per acre must also be present at final bond release (70% of the initial planting rate = 0.70 x 1890 = 1323).

Tall Shrubs (and Mixed Tall and Low Shrub Plantings):

Tall Shrub	Initial planting rate (stalks/acre)
plum	266
chokecherry	420
buffalo berry	124
	810

The density standard for tall shrubs: 810 shrub stalks (planted per acre) x 3 (tripling rate assumption) equals 2430 shrub stalks.

The reclaimed area should have, at a minimum, 60% of the number of tall shrub species planted (3 species planted x 0.60 = 1.8 = 2 species) each contributing 10% of the tall shrub density standard (0.10 x 2430 shrubs = 243 shrub stalks/acre).

Low Shrubs

Low shrub	Initial planting rate (stalks/acre)*
western wild rose	900
snowberry	900
silverberry	900
	2700

*A stalk is defined as the main trunk of a shrub which emanates from the ground and serves as the axis from which branches grow. It includes root crowns and root sprouts, that have been in place for at least 2 growing seasons, and are healthy. Of these, at least 80% must be in place for six years. (According to NDAC 69-05.2-22-07(4)(e)(1), this provision will be deemed satisfied if the operator demonstrates that no tree, shrub, or half-shrub replanting was done during the last six years of the liability period).

The density standard for low shrubs: 2700 shrub stalks (planted per acre) x 4 (quadrupling rate assumption) equals 10,800 shrub stalks per acre.

The reclaimed area should have, at a minimum, 60% of the number of low shrub species planted (3 species planted x 0.60 = 1.8 = 2 species) each contributing 10% of the low shrub density standard (0.10 x 10,800 shrub stalks = 1,080 shrub stalks/acre).

For plantings based on premining assessments:

1. Provide a comparison of woody species density of the reclaimed tract to that found in the premining assessment (with 90% statistical confidence) [NDAC 69-05.2-22-07 (4)(e)(1)].

2. Assess species diversity, regenerative capacity and seasonal variety by comparison with data from the premine area and by on-site inspection by Commission personnel and other interested parties [NDAC 69-05.2-12-12(11)].

3. Provide verification of the time in place requirement using methods described on page II-F-5, part 3.

4. Since extensive herbaceous ground cover may be incompatible with maximum tree survival and growth, a light herbaceous cover is acceptable, provided total ground cover is adequate to protect the soil surface from erosion. Herbaceous cover of the reclaimed woodland must be equal to or greater than 90% of the herbaceous cover that existed on the premine area for each woodland type, on a weighted basis, and adequate to control erosion. Herbaceous cover must be comprised of desirable species not detrimental to the growth of woody species.

In addition to either of the standards, the Commission will consider:

1. Modifying the target number of species and number of plants per species present at the end of the liability period if a natural disaster (e.g., disease epidemic, prolonged drought, etc.) affects the woody planting.

2. The use of an experimental planting over and above species planted to meet the standard. Extant "experimental" woody plants at the end of the liability period may be counted toward the target value of plants/species per acre.

II-G. SHELTERBELT

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G. SHELTERBELTS

Definition

A shelterbelt is defined as a strip or belt of trees or shrubs planted by man in or adjacent to a field or next to a farmstead, feedlot or road. Shelterbelt is synonymous with windbreak [NDAC 69-05.2-01-02]. Only the immediate area where trees and shrubs exist (whether pre- or postmine) will be considered a shelterbelt. Adjacent areas where the primary vegetation is not trees or shrubs must be evaluated based on the requirements of the appropriate land use. The standards in this section apply to shelterbelts that are specified in the reclamation plan as a postmining land use, or as otherwise required by the Commission as part of the approved permit.

Requirements for Successful Revegetation

NDAC 69-05.2-22-02(5) requires that when the approved postmining land use is a shelterbelt, the permittee shall plant woody species adapted for local site conditions and climate. Understory vegetation must be controlled until it no longer interferes with the growth of woody species. The stocking of trees and shrubs must normally follow current standards and specifications developed by the NRCS for farmstead and field windbreaks in North Dakota. However, the Commission may allow stocking of trees and shrubs that follow specifications approved by the State Game and Fish Department or State Forest Service. Success of revegetation on lands reclaimed to shelterbelts will be determined on the basis of tree and shrub density and vigor, and erosion control [NDAC 69-05.2-22-07(4)(f)].

For third-stage bond release of shelterbelts, the number of trees and shrubs must be equal to or greater than the approved standard. Understory growth must be controlled on young stands. Erosion must be adequately controlled by mulch or site characteristics [NDAC 69-05.2-22-07(3)(d)]. Planting understory herbaceous vegetation may inhibit growth of woody species; therefore, it may be deferred until it no longer interferes with the establishment of woody species. This is a normal conservation practice in North Dakota, as recommended by NRCS and the North and South Dakota Extension Services (Frank et. al. 1982, Helwig and Rader 1981, SCS 1984a, SCS 1984b, Van Deusen 1979), and is not considered an augmented seeding.

For fourth-stage bond release of shelterbelts, the permittee must demonstrate in the last two consecutive years, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period that:

1. Density and vigor are equal to or greater than that of the approved standard [NDAC 69-05.2-22-07(4)(f)(1)].

2. Erosion is adequately controlled [NDAC 69-05.2-22-07(4)(d)(1)].

3. Time-in-place requirements have been satisfied.

Premining Assessment

The following information is required as a part of the permit application package [NDAC 69-05.2-08]:

1. Depict shelterbelts on a map of appropriate scale and legend [NDAC 69-05.2-08-08(l)(a)].

2. List the acreage of each shelterbelt for each surface owner [NDAC 69-05.2-08-08(l)(c)(1)].

3. Provide a description of the number and arrangement of trees and shrubs, length and number of rows, and associated plant species [NDAC 69-05.2-08-08(l)(c)(6)].

4. Prepare a comprehensive species list using scientific names for all vascular plant species, including noxious, poisonous, endangered and rare species [NDAC 69-05.2-08-08(l)(b)].

Postmining Assessment

Third-Stage Bond Release

Third-stage bond release requests should include:

1. An aerial photo or map of adequate scale which delineates shelterbelt areas in the proposed bond release tract.

2. A narrative, which indicates the purpose, stocking rate and planting arrangements of trees and shrub species. Include information on all management practices prior to and following stocking.

3. Information, which confirms that each row of tree and shrub species has been adequately established.

4. All other information as required by NDAC 69-06.2-12-12.

Revegetation Success Standards for Third-Stage Bond Release

An on-site inspection by Commission personnel, the Reclamation Advisory Committee and the landowner will be conducted following a request for third-stage bond release. Trees and shrubs must be healthy. No gaps of two or more consecutive trees in any row may occur. Competitive vegetation must be controlled so that it is not interfering with tree or shrub growth. The site will be inspected to confirm that erosion control is adequate. In most cases the prevailing site characteristics (e.g., slope, soil type) of the site will prevent erosion; however, on erosive sites an evaluation of annual crop cover or mulch will be made.

Fourth-Stage Bond Release

Fourth-stage bond release requests should include the following:

1. A map of adequate scale which delineates the reclaimed shelterbelts in the proposed bond release tract(s) [NDAC 69-05.2-12-12(4)].

2. A description of the planting of tree and shrub species (e.g., bare root stock, containerized), planting rate of each species, and any management practices that occurred after initial planting.

3. The Windbreak Suitability group (SCS 1975b, Technicians Guides to Woodland Suitability, Section II-F) that the reclaimed shelterbelt site most resembles.

4. Information on potential growth of each tree species planted including: expected height at 20 years (SCS 1975b, Technicians Guides to Woodland Suitability, Section II-F) and life expectancy (Shelterbelt Table 1).

5. Verification of the time in place requirement.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation Success Standards for Fourth-Stage Bond Release

Revegetation success in reclaimed shelterbelts must be measured during the last two consecutive years, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. Selected characteristics of shelterbelts will be evaluated.

Success standards for shelterbelts are based on evaluation methods, developed by Frank, Gavit and Heintz (1982); Helwig, Baer and Dronen (1981); Van Deusen (1979); and SCS (1984a and 1984b).

Factors to be used in the evaluation are:
(1) Shelterbelt effectiveness;
(2) Vigor;
(3) Competition of understory within rows;
(4) Erosion control between rows;
(5) Species diversity, seasonal variety and regenerative capacity; and,
(6) Time in place requirement.

Criteria for evaluation of each factor are:

Shelterbelt effectiveness

Shelterbelt effectiveness is correlated with the density of canopy cover provided by the shelterbelt. Density of the shelterbelt is evaluated as a percentage of the total area that should be occupied by the shelterbelt in relation to crown density and expected height from an observation point perpendicular to the face or tree rows of the shelterbelt. Tree spacing, number of rows and species planted are contributing factors.

Standard: A profile density of 40% for a single-row or 60% for a multirow shelterbelt must exist (Frank et al. 1982). Replacements must be made to eliminate gaps of two or more consecutive trees and/or shrubs in any row unless the gaps are not detrimental to windbreak function (SCS 1984a and 1984b).

Vigor

Vigor will be assessed in spring or late summer when plants are actively growing. Healthy plants are characterized by an abundance of dark green foliage. Loss of vigor is characterized by wilted or dry foliage, yellowish or brown foliage, reduction in normal leaf size and reduction in crown density (less total foliage). In severe cases, portions of the crown may be broken or dead. The assessment of vigor is subjective and should be assigned by rows, not individual plants.

Standard: At least 75% of the trees and shrubs must be structurally sound, and have average or above average growth (Frank et al. 1982).

Competition

Weed and grass control in shelterbelts is necessary to reduce competition for moisture. Control should be implemented until the understory vegetation no longer interferes with the growth of trees or until control is no longer physically possible. Weed control in the rows will be considered based on these requirements when evaluating ground cover at the time of bond release. A recommended weed control timetable for selected tree species developed by Helwig et al. (1981) is found in Shelterbelt Table 1.

Erosion control between tree and shrub rows

Erosion control must be adequate. On sites subject to erosion, an evaluation of the permanent vegetation cover between tree and shrub rows will be made. Vegetation cover between tree and shrub rows should have been established according to NRCS recommendations (SCS 1984a and 1984b) and must be comprised of desirable species.

Species diversity, seasonal variety and regenerative capacity

Species diversity, seasonal variety and regenerative capacity will be evaluated based on species stocked and planting arrangements. Local and regional recommendations will be considered (SCS 1984a and 1984b).

Time in place requirement

The operator must provide documentation that at least 80% of the trees and shrubs have been in place for at least 60% of the liability period, or demonstrate that no replanting was done in the last six years of the liability period. A worksheet of each shelterbelt must be provided which lists annual replanting of each species. Documentation may be made by tagging or marking with paint, by photographic records, or by preservation of sales receipts from nurseries.

Natural disaster modifications

The Commission will consider modifying the shelterbelt profile density standard if it is demonstrated that a natural disaster (e.g., disease epidemic, prolonged drought, etc.) has affected the planting. Any replanting due to a natural disaster will be considered a normal husbandry practice which will not restart the liability period.

Shelterbelt Table 1. Life Expectancy (Helvig et al. 1981) and recommended timetable for weed control (Frank et al. 1982) for trees planted in North Dakota shelterbelts.

Species	Approximate Life Expectancy (years)	Recommended Number of years of Weed Control
Boxelder	70	10
Caragana	55	5
Green Ash	60	10
Hackberry	60	10
Juniper	75	14
Oak	75	10
Pines	65	14
Poplars	30	5
Siberian elm	30	5
Spruces	55	14
Willows	30	5

II-H. FISH AND WILDLIFE HABITAT

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H. FISH AND WILDLIFE HABITAT

Introduction and Definitions

Fish and wildlife habitat as defined in NDAC 69-05.2-01-02 means lands or waters used partially or wholly for the maintenance, production, protection, or management of fish or wildlife species. Fish and wildlife habitat often encompasses several "land uses" or vegetation types, as structural diversity and food source are of utmost importance for wildlife use. For this reason, this document segregates postmine fish and wildlife habitat standards into woodland, shelterbelt, grassland, wetland and annual grain crop vegetation types. This will enable appropriate postmine evaluations to be made of all areas included in fish and wildlife habitat. Vegetation types that occupy 5 percent or more of the total acreage of the fish and wildlife habitat must be evaluated (SCS 1982). However, if a fish and wildlife habitat area occupies less than 40 acres, this determination will be made on a site specific basis.

When an area is primarily used by wildlife prior to mining, the premine assessment must include a breakdown of vegetation types (i.e., woodland, shelterbelt, grassland, wetlands and annual grain crops), and descriptions as required by NDAC 69-05.2-08-08. Wetlands that occur in any land use must be assessed separately as described in this section. In all other cases, premine assessments must be categorized and analyzed as described for the appropriate primary land use.

Woodland: land where the primary vegetation is trees or shrubs, i.e., natural wooded areas.

Shelterbelt: a strip or belt of trees or shrubs planted by man in or adjacent to a field or next to a farmstead, feedlot or road. Shelterbelt is synonymous with windbreak.

Grassland: land where the primary vegetation is perennial grasses. This includes both areas of native species and those planted with introduced grass-legume mixtures.

Wetland: a natural depressional area that is capable of holding shallow, temporary, intermittent, or permanent water. Wetlands, here defined, also refer to reclaimed basins intended to replace natural wetlands.

Annual grain crops: annual grains specifically planted to provide food and cover for wildlife use. Since annual grain crops planted for wildlife use either remain standing or are cut and stacked, performance standards based on agronomic yields are not appropriate.

NDAC 69-05.2-22-02(6) requires that where fish and wildlife habitat is included in the postmining land use, the permittee shall consult with appropriate state wildlife and land management agencies and select those plant species that will fulfill the needs of wildlife for food and cover. Plant groupings and water resources must be appropriately spaced and distributed. For areas reclaimed to fish and wildlife habitat land use, specific requirements and procedures for the assessment of each vegetation type follow.

WOODLAND AND SHELTERBELT

The requirements and guidelines for meeting third-stage and fourth-stage bond releases and the success standards are synonymous with those described in the section entitled Woodlands and Shelterbelts of this document.

GRASSLAND

Requirements for Successful Revegetation

NDAC 69-05.2-22-07(3)(a) requires that for third-stage bond release, ground cover must be equal to or greater than that of the approved reference area or standard with 90% statistical confidence. All species used in determining ground cover must be perennial species not detrimental to the land use. For fourth-stage bond release, ground cover must be equal to or greater than the approved standard with 90% statistical confidence and adequate to control erosion. In addition, species diversity, seasonal variety and regenerative capacity must meet the approved standard. These requirements must be met the last two consecutive years, or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period [NDAC 69-05.2-22-07(4)(h) and (l)].

Postmining Assessment

Third-stage bond release

The following should be submitted for each reclamation tract when making third-stage bond release requests:

1. An aerial photo of adequate scale which delineates the postmining grassland tract(s) proposed for bond release [NDAC 69-05.2-12-12 (4)].

2. A narrative which includes the seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to, and following, seeding (e.g., fertilization, weed control, burning) [NDAC 69-05.2-12-12 (10)].

3. A demonstration of adequate establishment of vegetation by quantitative measurement of cover [NDAC 69-05.2-12-12 (7)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map, which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. All other information as required by NDAC 69-05.2-12-12.

Success standards for third-stage bond release

Each reclaimed tract must have at least 73% total cover (live + litter), based on basal hits, or 83% total cover (live + litter), based on first-hits, determined by the point frame method. All species used in determining ground cover must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)]. The standard must be achieved with 90% statistical confidence. Methodology is described in Native Grassland, Section II-D. A field inspection will also be required to verify that ground cover is adequate to control erosion.

Fourth-stage bond release

The following should be submitted for each reclamation tract when making fourth-stage bond release requests:

1. An aerial photo of adequate scale which delineates postmining grassland tract(s) proposed for bond release. Provide in tabular form the acreage of each reclaimed tract.

2. A narrative, which includes the seed mix and seeding rate and describes methods used for seedbed preparation and seeding. Include information on all management practices prior to and following seeding (e.g., fertilization, weed control, burning).

3. Data and calculations, which demonstrate that ground cover is equal to or greater than the approved standard (with 90% statistical confidence) during the last two consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period [NDAC 69-05.2-22-07(4)(h)(1)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

4. A map which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

5. Information which is required to evaluate species diversity, seasonal variety and regenerative capacity.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation success standards for fourth-stage bond release

Cover

1. To ensure adequate cover for erosion control, the same standard used for third-stage bond release must be used to assess cover for fourth-stage bond release.

2. To ensure wildlife cover, vegetation must be sufficient to provide protection to wildlife going into the winter months. (This will be field assessed at the time of final bond release).

Species diversity and seasonal variety

The permittee must demonstrate that a majority of the species specified in the reclamation plan has become established in the tract and that the seeded species comprise at least 60% of the total composition during the years sampling is conducted for the purpose of final bond release. The presence of non-seeded species will be evaluated at the time of the final bond release inspection. Noxious weeds and other highly competitive species that are capable of out competing and displacing seeded species must not be present in quantities that may be considered detrimental to the desired use.

Regenerative capacity

Regenerative capacity will be assessed by an evaluation of live surface cover and will be subjectively evaluated during the bond release field review. Sufficient live cover must be present to ensure regenerative capacity.

WETLANDS

The following sections refer to the immediate wetland basin, and its characteristic vegetation, unless otherwise stated.

Requirements for Successful Vegetation

For fish and wildlife habitat, where the vegetation type is wetland, vegetation zones and dominant species must be equal to those of the approved standard at the time of final bond release. In addition, wetland permanence and water quality must meet approved standards [NDAC 69-05.2-22-07(4)(g)].

Wetland Classification

Wetlands are classified according to the system of Stewart and Kantrud (1971). The use of prairie wetlands by waterfowl is strongly influenced by water characteristics, i.e., permanence, depth, and chemistry, and by land use. The complex interrelationships of these parameters are reflected in vegetation characteristics, including: life form, cover interspersion, species composition and species dominance. Vegetation zones in wetlands are distinguished by a unique community structure or life form, and a unique assemblage of plants. Since these characteristics are readily discernible in the field, they have been used as the principal criteria for classification. Stewart and Kantrud describe seven wetland classes. They are:

Class I	ephemeral ponds; deepest part of the pond basin supports low-prairie vegetation;
Class II	temporary ponds; deepest part of the pond basin supports wet-meadow vegetation;
Class III	seasonal ponds and lakes; deepest part of the pond basin supports shallow-marsh hydrophytes, often with peripheral wet-meadow and low-prairie zones;
Class IV	semi-permanent ponds and lakes; deepest part of the pond basin supports deep-marsh hydrophytes, often with peripheral shallow-marsh, wet-meadow and low-prairie zone;
Class V	permanent ponds and lakes; permanent open-water zone of submergent hydrophytes, often with peripheral deep-marsh, shallow-marsh, wet-meadow and low-prairie zones;
Class VI	alkali ponds and lakes; intermittent shallow saline water alternating with salt flats in the central zone, often with peripheral shallow-marsh, wet-meadow, and low-prairie zones; and
Class VII	fen (alkaline bog) ponds; central zone represented by fen vegetation, often with peripheral wet-meadow and low-prairie zones.

For mining permit applications submitted prior to January 1, 1987, all premine Class III-VI wetlands had to be identified and replaced. Class I and Il wetlands did not have to be identified nor were specific plans for replacement needed. Fen ponds (Class VII wetlands) are

unlikely to occur in the mining regions of North Dakota; however, if fen ponds do occur, they must be treated on a site specific basis.

For mining permit applications submitted after January 1, 1990, the NRCS will be consulted during the wetland inventory and identification process. This is required to ensure compliance with the Wetland Conservation Provisions of the 1985 Food Security Act and the 1990 Food Agricultural, Conservation, and Trade Act. Consultation with the State Game and Fish Department and U.S. Fish and Wildlife Service is also recommended during the wetland inventory and identification process. Required notification must be given to the Army Corps of Engineers.

The success standards that follow apply to all Class III through VI wetlands. The total acreage of postmine wetlands, including Class I and II prior to final bond release, for the mine must equal the total premine acreage.

Premining Assessment

1. Identify and show all Class I-VII wetlands on a map or aerial photograph (scale 1:4800) [NDAC 69-05.2-08-08(l)(a)(5)(b)].

2. For Class III-VII wetlands, tabulate total acreage of each wetland class for each surface owner within the proposed permit area [NDAC 69--05.2-08-08(l)(b)(1)].

3. For Class I and II wetlands provide the total acreage, list land use and extant vegetation. If these wetlands are tilled, indicate the crop normally grown.

4. Identify Class III wetlands, which are sampled. Wetlands sampled must be based on the number present, distribution and variability. Sample numbers, must be approved by the Commission.

5. For sampled Class III wetlands and all Class IV-VI wetlands, provide:

    a. A description of vegetation zones or plant communities, identified by ecological dominant or co-dominant species, through the use of a line drawing of appropriate scale. Where premine wetlands, are disturbed by land use management, a discussion of the succession phase should be included.

    b. A narrative describing the relationship among vegetation, soils and surface and groundwater hydrology in the wetlands as well as observed or historical anthropomorphic use.

    c. A species list for each vegetation zone or plant community, which includes date(s) evaluated.

    d. An assessment of surface water quality. Sampling Class IV-VII wetlands should be conducted two times per year, at high and low water, to reflect seasonal variation [NDAC 69-05.2-08-07(3)(b)]. Class III wetlands should be sampled

once a year, in the early spring. A composite sample of three grabs should be taken from Class III wetlands, whereas a minimum of three randomly located samples should be taken from Class IV-VI wetlands and reported as a mean and range. The number of years, that data is collected, must be approved by the Commission based on distribution and variability of wetlands. Results of this water quality analysis together with a discussion regarding the effects of water quality on extant vegetation should be provided. Water quality data must include:

(1) Total dissolved solids;

(2) Specific conductance in mmhos/cm^3;

(3) Major cations (calcium, magnesium, sodium and potassium);

(4) Major anions (bicarbonate, carbonate, sulfate and chloride);

(5) Total suspended solids;

(6) pH;

(7) Total iron; and

(8) Any additional parameters (e.g., selenium) as determined on a site specific basis.

6. Provide a narrative describing the nature and variability of the vegetation of each wetland class [NDAC 69-05.2-08-08(l)(d)].

Postmining Assessment

Third-Stage Bond Release

The following information must be submitted for each reclaimed wetland when making third-stage bond release requests:

1. An aerial photograph (1:4800) which delineates reclaimed wetland basins and contiguous postmining land uses (if fish and wildlife habitat is the contiguous land use, vegetation types must be delineated).

2. A narrative which describes any plugging, seeding, respread of topsoil containing wetland species propagules, or other practices that were used to establish vegetation of the wetland basin [NDAC 69-05.2-12-12(7)(a)].

3. Evidence of vegetation zone development and adequate establishment of wetland vegetation [NDAC 69-05.2-12-12(7)(a)]. Include the following information:

   a. A low altitude aerial photograph;

b. A detailed map to accompany the aerial photograph which delineates vegetation zone (if identifiable);

c. A descriptive narrative of each vegetation zone or plant community identified; and,

d. A species list for each vegetation zone or plant community identified.

4. A demonstration that erosion is being adequately controlled by the established vegetation in the contiguous vegetation types or land uses [NDAC 69-05.2-12-12(7)(b)]. Data required for the appropriate vegetation types within fish and wildlife habitat or land uses must be submitted.

5. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Third-Stage Bond Release

An on-site inspection by Commission personnel, the Wetlands Advisory Committee and landowner will be conducted following a request for third-stage bond release. [Personnel from the U.S. Fish and Wildlife Service, North Dakota Game and Fish Department, North Dakota State University, and the University of North Dakota will be invited to participate on the Wetlands Advisory Committee.] The wetland basin must exhibit the capacity to hold water. This can be shown by the establishment of wetland vegetation. Ground cover in the contiguous vegetation types or land uses must be adequate to control erosion to avoid sedimentation into the wetland basin. The extent of the contiguous area will be evaluated on a site specific basis to ensure that an adequate buffer zone is provided. Erosion control must be demonstrated as described for third-stage bond release requirements of the appropriate vegetation type(s), or appropriate land uses.

Fourth-Stage Bond Release

The following information should be submitted for each reclaimed wetland when making fourth-stage bond release requests:

1. An aerial photograph of adequate scale which delineates reclaimed wetlands and adjacent land uses (or vegetation types within fish and wildlife habitat land use) proposed for bond release. In tabular form, include the acreage of the wetland(s).

2. A narrative which describes any plugging, seeding, or respread of topsoil containing wetland species propagules or other practices that were used to establish vegetation and any management employed thereafter [NDAC 69-05.2-12-12(8)(b)].

3. A brief description of the wetland design including the class (Stewart and Kantrud 1971) the wetland was designed to become.

4. A measure of the surface water quality (using methodology described for the premine assessment) for the last three years of the liability period, including:

a. Total dissolved solids;

b. Specific conductance in mmhos/cm^3;

c. Major cations (calcium, magnesium, sodium and potassium);

d. Major anions (bicarbonate, carbonate, sulfate and chloride);

e. Total suspended solids;

f. pH;

g. Total iron; and,

h. Any additional parameters (e.g., selenium) as determined on a site specific basis.

5. A postmining topography map which delineates the entire watershed of the wetland basin.

6. Data on quality, quantity and dates of any water pumped into the wetland basin.

7. Documentation that the vegetation of the reclaimed wetland exhibits vegetation characteristics of the wetland class it was designed to become. This information must be submitted annually to the Commission or at the time of bond release and include data collected during each of the last three years of the liability period. Each year's data must include:

   a. A low altitude, preferably low oblique, aerial photograph;

   b. A detailed map to accompany each aerial photograph which delineates identifiable vegetation zones;

   c. A plant species list of each vegetative zone which ranks the occurrence of each species (i.e., very rare, occasional, abundant, very abundant, subdominant, dominant); and,

   d. A descriptive narrative which characterizes each vegetation zone.

8. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Fourth-Stage Bond Release

An on-site inspection by Commission personnel, the Wetlands Advisory Committee and landowner will be conducted following a request for final bond release. The wetland basin must exhibit the degree of permanence for the class for which it was designed (based on water supply from normal year precipitation as described by the ND Water Commission or based on basin configuration and the 50% annual water yield from the contributory watershed), to ensure the required acreage replacement. All, or nearly all, of the watershed must have final grade approval

and additional water (e.g., water pumped in) must not be added to the wetland basin for the last five years of the liability period. A natural system must be present in order to evaluate the class size and ensure sufficient potential water supply.

A successfully revegetated wetland basin must exhibit vegetation zones dominated by native, perennial, emergent and submergent hydrophytes appropriate for the abiotic characteristics of the intended class. This will be determined by comparison with species lists for vegetation zones as listed by Stewart and Kantrud (1971), and with premine species lists. Species diversity, seasonal variety and regenerative capacity of species present on the reclaimed wetland must be similar to those in the zones listed by Stewart and Kantrud. Small zones of vegetation from a more permanent wetland class (i.e., deep-marsh emergent and submergent hydrophytes) are acceptable in a portion of a Class III wetland basin. Ground cover in the contiguous area must meet the appropriate ground cover standards for erosion control to avoid sedimentation into the wetland basin. The extent of the contiguous area will be provided on a site specific basis to ensure that an adequate buffer zone is evaluated. Water quality parameters will be evaluated based on recommendations from the Wetlands Advisory Committee.

ANNUAL GRAIN CROPS

Postmining Assessment

Third-Stage Bond Release

The following should be submitted for each reclaimed tract when making third-stage bond release requests:

1. An aerial photograph of adequate scale which delineates annual grain crops within the Fish and Wildlife Habitat.

2. A narrative which includes methods used for seedbed preparation, seeding and all management practices used prior to the bond release request [NDAC 69-05.2-12-12(10)].

3. A demonstration that the tract is capable of supporting crops and that standing crop, stubble or crop residues are adequate to control erosion [NDAC 69-05.2-22-07(3)(d)].

4. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Third-Stage Bond Release

The vegetation will be considered suitable for the postmining land use upon demonstration that an adequate food source and adequate cover are present.

Fourth-Stage Bond Release

The following should be submitted for each reclaimed tract when making fourth-stage bond release requests:

1. An aerial photograph of adequate scale which delineates reclaimed annual grain crops within the fish and wildlife habitat proposed for bond release.

2. A narrative which includes a complete management history of the reclaimed annual grain crops. The narrative should include seed mix and rate, fertilizer program, conservation tillage practices, and any other management techniques used during the liability period [NDAC 69-05.2-12-12(10)].

3. Data showing the height of the standing grain crop or residual cover for the last consecutive two years or any three years starting no sooner than the sixth year and with one-year being the last year of the liability period.

4. Evidence that conservation tillage is practiced on the area and that erosion is adequately controlled to prevent the contribution of suspended solids to runoff.

5. All other information as required by NDAC 69-05.2-12-12.

Success Standards for Fourth-Stage Bond Release

Revegetation success of annual grain crops for fish and wildlife habitat must be evaluated during the last two consecutive years or any three years starting no sooner than the sixth year and with one year being the last year of the responsibility period. The ground cover will be deemed successful upon demonstration that an adequate food source and adequate cover are present. Documentation must be provided to indicate that conservation tillage practices have been used and that suspended solids are not detrimental to stream flow.

II-I. OTHER LAND USES

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I. OTHER LAND USES

Introduction

Other land uses that may occur in the permit area are "recreation," "residential" and "industrial and commercial." There are no specific requirements for premining land use assessments for these uses under NDAC 69-05.2-08-08. Only a general description of the premine use is required under NDCC 38-14.1-14(2)(a).

For areas to be developed for recreation, residential, or industrial and commercial following mining, NDAC 69-05.2-22-07(4)(j) requires the vegetative ground cover on these areas not be less than that required to control erosion. This standard must be met at the time of fourth-stage (final) bond release. There is no specific third-stage bond release standard for these land uses under NDAC 69-05.2-07(3). However, vegetation must be established on the areas and documentation provided to show that the areas are not contributing suspended solids to streamflow or runoff outside the permit area as required by NDAC 69-05.2-12-12(7) for third-stage bond release. Therefore, the same standard will be applied for both third- and fourth-stage bond release on areas to be developed for recreation, residential, or industrial and commercial land uses. In addition, if areas developed for recreation use include woodland plantings and/or shelterbelts, the woody plants must meet all applicable fourth-stage bond release standards described under sections II-F and II-G of this document.

Postmining Assessment

For each tract to be developed to recreation, residential, or industrial and commercial land use, the following information should be submitted when making third-stage or fourth-stage bond release requests:

1. An aerial photo of adequate scale, which delineates the tract(s) proposed for bond release [NDAC 69-05.2-12-12(4)].

2. A demonstration of adequate establishment of vegetation by quantitative measurement of cover [NDAC 69-06.2-12-12(7)]. Cover data must include composition by species, litter and a measure of bare ground. Data submitted must include absolute cover values. Relative cover may also be submitted to aid in data interpretation. Data should be submitted in tabular form, and the table heading must include information on sampling method, location, sample size, and sampling date.

3. A map, which identifies the approximate locations of sampling transects, or the sampling areas and number of randomly located sample units per area, whichever method is used.

4. If a recreation area includes woodland plantings, a demonstration, with supporting data, must be included showing that the applicable standards described under section II-F are met.

5. If a recreation area includes shelterbelts, a demonstration, with supporting data, must be included showing that the applicable standards described under section II-G are met.

6. All other information as required by NDAC 69-05.2-12-12.

Revegetation success standards for third stage and fourth stage bond release

The technical standard for evaluating ground cover is based on ARS research conducted by Hofmann et al. (1983) and Ries and Hofmann (1984) on reclaimed grasslands in North Dakota. According to Ries and Hofmann, erosion from reclaimed grasslands is similar to that of undisturbed native grassland when total cover is 73% or greater, based on basal hits measured with a point frame; or when total cover is 83% or greater, based on first-hits measured with a point frame. Therefore, for third-stage bond release, the reclaimed tract must have at least 73% total cover (live + litter), based on basal hits; or 83% total cover (live + litter), based on first-hits. Live cover included in the standard must be perennial species not detrimental to the land use [NDAC 69-05.2-22-07(3)(a)].

Either standard must be achieved with 90% statistical confidence. In statistical calculations, a standard deviation of +18 for basal cover and a standard deviation of +16 for first-hit cover should be used for ARS data. These values are based on a sample size of 60 10-point frames (Hofmann, personal communications 1987). Calculations of standard deviation for the reclaimed tract must be based on the same methodology, i.e., use of one 10-point frame as the sample unit. A field inspection is required at this time.

For recreation areas that include woodland plantings and/or shelterbelts, the woody plants must meet all applicable standards described in Sections II-F and II-G for fourth-stage bond release.

III. PROCEDURES FOR SAMPLING, MEASUREMENT AND STATISTICAL ANALYSIS OF VEGETATION PARAMETERS

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E. Statistical Analyses III-E-1

A. INTRODUCTION

Detailed information on various methods used in vegetation sampling and measurement is found in numerous agricultural and ecological publications. Some recent sources of information with direct relevance to vegetation assessment on premine and reclaimed lands include Cook and Bonham (1977), Bonham et al. (1980), Chambers and Brown (1983), Redente et al. (1983), and Van Dyne et al. (1984).

Before using a method for vegetation sampling or measurement of any vegetation parameter, it is recommended that the original source(s) of information be thoroughly reviewed, and checked for applicability. Moreover, it is recommended that mine operators confer with the PSC staff prior to implementation of the sampling plan designed for a reclaimed tract. This way, problems or questions can be addressed prior to bond release.

The following discussion summarizes recommended methodology for premine and postmine vegetation inventory and for evaluation of reclamation success.

B. USE OF SOIL MAPPING UNITS

IN THE CALCULATION OF STANDARDS

Soil Surveys

The standard for a given tract of land must be derived using acreages of Soil mapping units from the professional soil classifier's soil survey for the permit area. Use of the County soil survey will not be allowed except in cases where the more detailed soil survey was not conducted.

Delineation of Bond Release Tracts

One of two methods described below may be used to develop a specific standard for a given tract of land. Use of either method must be limited to a specific land use, and a separate standard must be developed for each landowner. Each land ownership must be sampled separately, unless otherwise approved by the Commission. Either method may be used; however, only one method may be used per designated area and must be specified in the permit.

1. The standard may be derived based on the acreage of all premine soil-mapping units that existed in a land use/landowner unit. The same standard must then be used for all bond release tracts that fall within the defined land use/landowner unit. For example, if an individual owns a quarter section that was all cropland, one cropland standard may be developed for use within this quarter section. This standard would be used for all individual bond release tracts for that quarter section. However, the various landforms (i.e., slope percentage, aspect, concave positions, convex positions, etc.) occurring in the larger unit used for developing the standard should also be adequately represented in each bond release tract. Otherwise, some individual bond release tracts may not meet the standard, while others exceed it.

   Larger land use/landowner units for standards and bond release tracts are recommended since smaller units and/or tracts may result in biased estimates. Considering the mixing of the soils and the changes in topography that have occurred during reclamation, it is recommended that (to the extent possible) standards be developed from land use/landowner units of at least 40 acres in size, but not exceeding one section (640 acres).

2. The standard may be derived based on the acreage of premine soil-mapping units that existed in each specific bond release tract, i.e., whatever soil-mapping units occurred in a premine area will be used in the calculation of the standard for the same postmine area. Thus each bond release tract will have its own separate standard. If this method is employed, it must be used for all bond release tracts, regardless of premine soil-mapping units within a specific bond release tract. Therefore, this method should be used only if the postmining topography closely resembles the premine topography or if all bond release tracts are large and reflect the various landforms that occurred prior to mining.

In cases where the postmining land uses of nearby parcels within the same ownership have switched, the standard for each land use parcel will be derived based on the premine soil mapping units of the other. For example, the west half of Section 1 is owned by John Smith. In the premine condition, the NW quarter of Section 1 is cropland and the SW quarter is native grassland. Due to topographic changes resulting from the reclamation process, the SW quarter is reclaimed to cropland and the NW quarter to native grassland. Soil-mapping units from the premine cropland (NW quarter) must be used to derive the standard for the postmine cropland in the SW quarter, and soil-mapping units from the premine native grassland (SW quarter) must be used to derive the standard for the postmine native grassland in the NW quarter.

Soil Complexes

In some cases, complex soil-mapping units are included rather than a consociation. Where this occurs, the description of the complete mapping unit found in the professional soil classifiers soil survey for the permit area should list percentages for each soil series. These percentages should then be used to develop the standards for the complex soil-mapping unit. If the soil classifier does not list percentages, the percentages specified in the county soil survey for that complex mapping unit should be used. If percentages are not listed in either soil survey, assume 60-40% distribution of soil series for each respective mapping unit. These percentages can then be applied to the acreage of the complex mapping unit to derive the standard.

C. SAMPLING DESIGN

Sampling Sites

For assessment of vegetation parameters on premining tracts and reference areas, the mapping units used for each land use category should be regarded as potential sampling sites. These include soil-mapping units for cropland and soil series for tame pastureland, and range sites (and, where necessary, soil series) for native grassland. For woodlands and fish and wildlife habitat, each vegetation type is a sampling site. For shelterbelts, each belt is a sampling site. All predominant mapping units must be sampled when quantitative assessment is required. Small sites need not be sampled if data from larger sites or published data can be used to represent them.

Where a mapping unit occurs once in the permit area, only that location needs to be sampled. However, if the same mapping unit occurs more than once, a maximum of three such sites should be sampled, if necessary, to ensure that the data are representative of the mapping unit. An adequate number of samples must be taken from each mapping unit.

On reclaimed tracts, each landowner's property must be sampled separately. A stratified sampling procedure may be used where the tract is divided into site types based on recognizable differences in vegetation. When the permittee assigns site types within reclaimed tracts, it is recommended that the PSC review and approve the assignment of site types. If one site type crosses a land ownership boundary, data from the entire site type may be used in the calculation of both landowner standards. Data from other site types may be used to represent similar small or isolated sites which are not practical to sample. An adequate number of samples must be taken from each site type. If no recognizable differences occur in the vegetation, each landowner's reclaimed tract will constitute one sampling site from which an adequate number of samples must be taken.

Sample Size Adequacy

The number of samples or observations taken in a premining or reclaimed tract or reference area must be adequate to reflect the population mean for production and cover with 90% statistical confidence. The number of samples required within each sampling site will depend upon the variability of the vegetation being measured and should be determined using one of the procedures discussed below. In cases where the sample size derived from a given equation may appear to be unreasonably large due to non-parametric distributions, the PSC will evaluate such cases and establish a maximum sample size.

Determining an adequate sample size requires an iterative process where initial sampling is conducted to obtain estimates of the mean and variance of each site type or reference area. The required number of samples is then calculated from these estimates and the cycle is repeated. New observations are added to the original data set until an adequate number of observations are taken from the population. When hand sampling is used to measure productivity and cover, the initial number of samples which must be taken in each sampling site is as follows:

Five (5) 0.25 m^2 frames for total production on native grassland and tame pastureland;

Five (5) samples of appropriate size for production on cropland; and,

Fifteen (15) 10-point frames, for total cover. (NOTE: A minimum of forty (40) 10-point frames should be taken if cover data is to be used to demonstrate that diversity and seasonality success standards have been met.)

The mean and variance derived from the initial sampling must be used to calculate adequate sample size using one of the following procedures. The equation selected will depend on the type of data being analyzed. Cover data generally have a Poisson distribution (Hofmann and Ries 1990), while yield data usually show approximately a normal distribution (Greig-Smith 1983).

Two-stage sampling technique

For use with production measurements:

Stein's two-stage equation allows one to determine the necessary sample size to estimate a sample mean ($\bar{x}$) by a confidence interval that falls within a given distance from the population mean (μ). Following the initial sampling, an estimate of the variance is obtained. This allows the calculation of the number of the samples necessary, using the following equation (Steel and Torrie 1980):

$$n = \frac{t^2 s^2}{d^2} \qquad (1)$$

Where:

	n	=	the minimum number of samples needed
	t	=	t distribution value for a given level of confidence (90%, 1-tailed t distribution table)
	s^2	=	the variance estimate from preliminary vegetation sampling
	d	=	the level of accuracy desired; 10% of sample mean, for the area being sampled, must be used

Following the determination of sample size based on preliminary sampling data, the additional number of samples required are taken and the calculation repeated. This equation is applicable when the population sampled has a normal distribution (Sowards 1982).

For use with cover measurements:

When the population sampled has a Poisson or binomial distribution (i.e. ground cover data), the following equation must be substituted (Hofmann and Ries 1990):

$$n = \frac{t^2\, pq}{d^2} \qquad (2)$$

Where:
- n = the minimum number of samples needed
- t = t distribution value for a given level of confidence (90%, 1-tailed t distribution table)
- p = cover percentage
- q = 100 - p
- d = absolute mean error = 10%

Following the determination of sample size based on preliminary sampling data, the additional numbers of samples required are taken and the calculation repeated.

Standard error as a percentage of the mean

Sample size (n) can be determined by setting the standard error of the mean equal to a predetermined percentage of the sample mean and solving for n, when examining a population with a normal distribution (Mueller-Dombois and Ellenberg 1974.) To derive a sample size comparable to that obtained with Equation 1, 6% of the sample mean must be used as the standard error. The calculations are as follows:

$$SEM = \frac{s}{\sqrt{n}} = 0.06\,\bar{x} \qquad (3)$$

or

$$\sqrt{n} = \frac{s}{0.06\,\bar{x}} \qquad (4)$$

or

$$n = \frac{s^2}{(0.06\,\bar{x})^2} \qquad (5)$$

Where:
- SEM = standard error of the mean
- $0.06\,\bar{x}$ = 6% of the sample mean
- s = sample standard deviation
- s^2 = sample variance
- n = number of samples required

Determination of Sampling Adequacy for Two Populations

In situations where two different sites are to be compared, such as reference area versus a reclaimed area, sampling adequacy can be determined by the following procedure:

Step 1:

Obtain estimate of mean ($\bar{x}$) and variance (s^2) of production or cover from equal sample sizes (number of samples) from both the reference and reclaimed areas from a pre-sample or from past sampling experience.

Step 2:

Using the site with the largest variance and setting the value for d at 10% of the mean value for that site, compute the minimum sample size for the site as suggested by Chambers and Brown (1983) by doubling the minimum number of samples using Equation (1) as shown below in Equation (6) :

$$n = \frac{t^2 2s^2}{d^2} \qquad (6)$$

For the initial estimate, t may also be set at 2.0. However, the t value should be based on n-1 degrees of freedom (df) and 0.1 probability and obtained from a one-tailed t value table.

Step 3:

Using the number of samples necessary as estimated using Equation (6), then:

A. If the initial number of samples taken is less than the estimated number of samples from Equation (6), additional equal numbers of samples must be taken from both sites and Steps 1 through 3 repeated until the number of samples taken exceeds the number estimated by Equation (6); or,

B. If the number of samples taken exceeds the estimated number of samples from Equation (6) then sample adequacy has been met and any additional statistical comparisons may be made as required.

Sample size determination equations for stratified sampling

Let there be h strata (groups within the populations) to be sampled and index the strata by h=1,2,3,…h. Further suppose that each stratum is of size N_h and that the total area to be sampled is $N_1+N_2+\ldots+N_h=N$. Define the estimated stratum standard deviations to be given by s_h and let n_h be the number of sample values to be selected within the h^{th} stratum. Then the optimum allocation (i.e. proportional to stratum size as well as stratum standard deviation) is given by:

$$n_h = \frac{nW_h s_h}{\sum_{h=1}^{h}(W_h s_h)} \qquad (7)$$

where: $W_h=N_h/N$ and n is determined from the following:

$$n = \frac{Z^2_{1-\alpha/2} \sum_{h=1}^{h}\left(\frac{W_h s_h^2}{d^2}\right)}{1 + Z^2_{1-\alpha/2} \sum_{h=1}^{h}\left(\frac{W_h s_h^2}{d^2 N}\right)} \qquad (8)$$

where: d is defined as 10% of the sample mean or $0.10\,\bar{x}$

N is the total number of sampling units summed over all strata, and

$Z_{1-\alpha/2}$ is the standard normal deviate from Appendix Table A1, Cumulative Normal Distribution values (Gilbert, 1987). Some selected values from this table for commonly used values of α are as follows:

α	0.20	0.10	0.05	0.01
$Z_{1-\alpha/2}$	1.2816	1.6449	1.960	2.5758

For cover measurements using point frames, N is infinite and the denominator of Equation 8 reduces to 1.0.

The estimate of the mean from the stratified sample would be:

$$\bar{x}_{ST} = \sum_{h=1}^{h}\left(W_h\,\bar{x}_h\right),$$

and the variance of the mean would be:

$$s^2_{ST} = \sum_{h=1}^{h}\frac{W_h^2 s_h^2}{n_h}.$$

Allocation proportional to stratum standard deviation can be obtained if W_h is replaced by 1.0 in Equations 7 and 8.

For additional information and examples, see Chapter 4 in Gilbert (1987).

D. METHODS FOR MEASURING

Sampling procedures for demonstrating revegetation success need to reflect the variability in 1) soil redistribution thicknesses; 2) landscape forms; and, 3) reclamation age occurring in the reclaimed site(s) being sampled.

PRODUCTIVITY, COVER, AND DENSITY

Productivity

As defined in NDAC 69-05.2-01-02, productivity means the vegetative yield produced by a unit area for a unit of time. Annual yield (bu/ac or lb/ac) is used to determine productivity of annual crops. For perennial crops (pasture, hay or native grass), the annual yield (lb/ac or t/ac) of the entire aboveground biomass is measured to determine productivity. Production of pasture, hay or native grass may be assessed by determining annual peak standing yield or by annual harvested yield. Methods used will vary based on land use and the respective requirements for premine and postmine assessments. Recommended procedures to measure productivity are outlined below.

Annual Crops

Annual crop yields may be obtained by harvesting the entire bond release field or by a statistically valid sampling procedure. When harvesting or sampling annual crops, one of the following procedures must be used.

1. Entire Field Harvest

The entire field may be harvested using standard combining procedures. If the grain is taken to an elevator, the weight receipts and test weight and dockage grading records from the elevator must be retained. If the farmer is storing the grain rather than taking it to the elevator, the stored grain from the reclaimed tract must be accurately measured and samples taken to determine average test weight and dockage. If any other method will be used, the operator must document the method of yield determination, and the plan for yield measurements must be approved by the Reclamation Division, before proceeding with the harvest.

2. Combine Sampling Procedure

A. The entire field may be divided into strips (sampling sites) allowing the harvest of strips through the entire field using standard combining methods. A strip may be defined as a single or several combine/swather widths from one end of the field to the other end. All strips should be of equal size. The strips must be distributed throughout the field and the number of strips needed must be determined using a sample adequacy formula that reflects 90% statistical confidence. The yield for each strip must be obtained by harvesting, and weighing the crop harvested from that strip.

B. Combines equipped with Global Positioning System (GPS) yield monitoring systems may be used to develop yield data for a field. The yield monitor must be calibrated before use and the calibration information included with the rest of the yield data in the bond release application for verification of accuracy of the unit. The data collected from the yield monitors may be used in one of two ways:

   i. A single, entire field yield may be developed from the printout data, or

   ii. A mean field yield and variance may be developed using the individual yields printed for the various parts of the field as recorded by the GPS yield monitor.

In addition, test weight, moisture content, and dockage of the crop must be determined and reported if either of these two combine sampling techniques are used. If the yield monitor calibration does not correct yield values for test weight and moisture content, these corrections must also be made when reporting yield data used to show reclamation success.

3. Hand Sampling Procedures

Hand sampling annual grain crops will be allowed to prove reclamation success only when either the Cropland Reference Area Standard (Correction Method 1) or a Control Area (when Correction Method 2 is used for the climatic correction for the NRCS Cropland Technical Standard) is used to assess productivity and both the reference or control area and reclaimed tract are hand sampled in the same manner.

Hand sampling will not be allowed when either Correction Method 1 (NDASS county average yield) or Correction Method 3 (regression equations) are used to adjust the yield derived using the NRCS Cropland Technical Standard. The adjusted yields derived using these other correction methods are based primarily on yields from fields that are mechanically harvested. Grain yield measurements taken by hand sampling may result in significantly higher yields than when sample strips are harvested mechanically or when an entire plot is harvested (Bauer, 1992). Therefore, it is not appropriate to hand sample, reclaimed tracts when the other climatic correction methods are used.

If hand sampling will be carried out on a reclaimed tract and reference or control area to assess productivity, seed rows must be harvested within sampling sites. The length of seed rows or area harvested will be dependent on the crop grown and approved sampling methodology. At each sampling location, drill overlap areas and field edges must be avoided. The number of samples needed for each sampling site must be determined using a sample adequacy formula that reflects 90% statistical confidence. If the entire reclaimed tract is considered one sampling site, the sampling locations must be randomly distributed throughout the tract. A mean yield in bu/ac must be calculated for each sampling site.

4. Representative Strips

Representative strips within a tract seeded to a pre-cropland mix may be broken and cropped to prove reclamation success on the larger tract while the rest of the vegetation of the tract remains in the pre-cropland mix which may be hayed or grazed. At least three representative strips of adequate size must be established. The “representative strips" for measuring productivity must reflect the variability in 1) soil redistribution thicknesses; 2) landscape forms; and, 3) reclamation age occurring in the larger reclaimed areas they represent. The representative strips must extend across the entire tract they represent and, to the extent possible considering factors 1-3 above, the strips should be equally spaced across the entire tract. The total acreage of the representative strips cropped each year that yield measurements are taken for final bond release must, at a minimum, equal ten percent of the entire reclaimed tract they represent. In addition, separate representative strips must be established for each landowner, unless the landowner agrees that other representative strips having the same characteristics are adequate to represent his or her reclaimed land. A map identifying proposed representative strips should be submitted to the Reclamation Division and approved prior to final selection. It is preferred that representative strips be entirely harvested to obtain a single yield value. However, if the representative strips are sub-sampled rather than completely harvested, then the number of sub-samples must meet sampling adequacy requirements.

Perennial Crops

Perennial crop yields (native grassland, hayland, and pastureland) may be obtained from a whole field harvest or portions of a field may be sampled to obtain an estimated yield. When harvesting perennial crops, one of the following procedures must be used.

1. Harvesting the Whole Field

Annual harvested yield may be obtained by haying the entire tract to obtain one yield value. After counting all bales within the tract, a random sample of bales (a minimum of 5 individual bales or at least one truckload of 6 or more bales) from each sampling site should be weighed to obtain an average bale weight. If the bales are green (wet), a random sample should also be used to obtain an average moisture content and a wet-to-dry adjustment factor. No adjustment is needed for air-cured bales. Based on dry weights of counted bales, average production in lbs/acre or t/ac must be calculated for each sampling site.

2. Harvesting a Portion of the Field

To obtain annual harvested yield, the entire tract may be divided into sampling sites (e.g., strips); each site is separately hayed to obtain a bale count. If the sampling sites are very small, all harvested bales from each site must be weighed. Otherwise a random sample of bales for each site (a minimum of 5 bales or at least one truckload of at least 6 bales) must be used to obtain an average bale weight and moisture content, as described above.

Perennial grasses may also be hand harvested. Samples are clipped at ground level within a sampling quadrat. A single clipping per year of aboveground biomass may be made

when dominant species are near peak production. The size and shape of the sampling quadrat used should be determined on the basis of the type of vegetation community to be clipped; however, consistent use of one size and shape is recommended. The number of samples for each sampling site must be derived using a sample adequacy formula. Production data from native grasslands for assessing seasonality, diversity, and composition must be separated by growth forms including: 1) annuals; 2) perennial cool season grasses and sedges; 3) perennial warm season grasses; 4) forbs; and, 5) shrubs and half-shrubs, and noxious weeds.

All clipped samples must be dried to a constant weight as soon as possible and weighed. Based on dry weights of the replicated samples, average production in lbs/ac must be calculated for each sampling site.

Cover

1. Herbaceous Ground Cover

Ground cover as defined in NDAC 69-05.2-01-02 "means the area of ground covered by vegetation and the litter that is produced naturally on site, expressed as a percentage of the total area of measurement." Ground cover can be determined by basal or first-hit measurements. The type of cover measurement, whether basal or first-hit, must be consistent in premine and postmine measurements. The measurement used must be specified and, thereafter, referred to as either basal or first-hit cover. Measurements for litter, rock, and bare soil must be included. Cover must be recorded by plant species. Measurement of cover near peak standing crop and prior to sampling for productivity is recommended.

Several methods are commonly accepted for quantitative analysis of vegetation cover on native grasslands; however, the point quadrat method is recommended because it is the most commonly used technique for Northern Great Plains vegetation (Van Dyne et al. 1984 b).

The single or multiple point quadrat method can be used to measure basal cover as well as canopy cover. Owensby (1973) provides a description of the single point or step-point quadrat. A multiple point quadrat generally possesses 10 points evenly spaced in a frame. Frames most frequently used are similar to the one described by Heady and Rader (1958). If first-hits are used, the height of the point frame must be tall enough to include all grass species, and the pins should be vertical.

It is recommended that basal ground cover be measured since basal estimates are less influenced by wind; height of vegetation; time of season; or, effects of wildlife or livestock. However, the point quadrat may be used with the following methods: 1) basal cover measurements, where each sharpened pin is lowered through the vegetation canopy to the ground surface, where it comes in contact with the basal portion of an individual plant, plant litter, rock or bare soil; or, 2) first-hit measurements, where each pin is lowered until it comes in contact with a portion of the live plant, bare ground, rock or litter.

It is recommended that frames be placed at random or stratified random locations and randomly oriented. Hofmann et al. (1978) found that quadrat orientation (in respect to seeded row direction) did not significantly affect vegetation analysis; however, complete randomization

in final frame placement must exist. Therefore, to ensure complete randomization of frame placement, it is suggested that frame orientation is also random.

The number of samples required should be statistically established based on total cover, using the point frame as one sample.

Cover values can be calculated from field information. Cover for each species, total vegetation, litter, rock and bare ground can be calculated by dividing the summation of hits for a species or cover by the total number of pins. Relative vegetation values can be calculated by dividing the summation of hits of a species by the summation of hits of all species.

Average values of total cover, live cover by species, litter, and bare ground must be calculated for each sampling site. On reclaimed tracts, the total cover (live + litter) of sampling sites must be weighted by the respective acreage to obtain a weighted mean total cover for the tract.

2. Total Ground Cover in Woodland Areas

Total ground cover for woodland areas includes live and litter components of herbaceous and woody vegetation. Total ground cover may be determined by sampling a combination of herbaceous and woody vegetation, or by sampling only the herbaceous understory. Total cover in woodlands may be measured using a Daubenmire frame (Daubenmire, R. 1959), or the line intercept method (Canfield, R.H. 1941 or Deibert, E.J. 1971.) The Daubenmire and line intercept methods may be used only where woody vegetation is present. If only herbaceous cover (live and litter) is sampled in woodlands, either the first hit or basal point quadrat method previously described may be used. It is recommended that the cover of herbaceous vegetation be determined using the first hit or basal point quadrat method when possible.

Diversity, Seasonality, and Composition

Cover or production data may be used for assessing native grassland diversity, seasonality and composition.

Double sampling procedures may be used to aid in the evaluation of composition, diversity and seasonality. The technique of double sampling involves the collection of data indirectly by estimating, and directly by harvesting. Estimates of yields are corrected against harvested yields using regression analysis. Estimators must undergo extensive field training at the beginning of each field season. This involves clipping and weighing species, immediately after estimating species weights. Pechanec and Pickford (1937) outline procedures for training double sampling estimators.

In sampling, weights of individual species or groups of species are ocularly estimated prior to harvesting in all quadrats. Species are then clipped and weighed from randomly located quadrats. The number of quadrats clipped must meet sampling adequacy criteria required for the estimation of total production and must comprise 20% of the total number of quadrats. [Pechanec and Pickford (1937) recommend that 10-20% of all frames are weighed.] If a species

occurs within an estimated quadrat, but is not included within a clipped quadrat, it should be clipped (within an estimated quadrat) so that its weight can be adjusted.

All estimated values must be adjusted by regression analysis. Clipped weights are considered the dependent variable (y) and estimated weights are considered the independent variables (x).

Density of Woody Vegetation

Density of woody vegetation may be measured by direct counts of all woody species or by density quadrat sampling. Direct counts are recommended for shelterbelts; the density quadrat method is recommended for natural woodlands.

In the density quadrat method, randomly placed quadrats are used to obtain density counts. Quadrat shape and size should be proportional to the vegetation sampled. It is recommended that plots be permanently established within each reclaimed planting. A sampling quadrat of 10 x 10 m is sufficient for measuring trees. All trees and tree saplings which occur within the quadrat are counted and recorded by species. A sampling quadrat of 4 x 4 m is sufficient for measuring tall shrub density. A sampling quadrat of 2 x 2 m is sufficient for measuring low shrub density. All shrubs and saplings which occur within the quadrat are counted and recorded by species. Enough samples must be taken to reflect the population mean with 90% statistical confidence. The number of woody plants established must equal or exceed the approved standard with 90% statistical confidence.

E. STASTISTICAL ANALYSES

I. Reclaimed sample mean values **equal to or greater** than the reference or adjusted standard.

For assessment of revegetation success for bond release, production and cover on a reclaimed tract must equal or exceed that of a reference area or adjusted technical standard. If the production or cover equals or exceeds those of the reference area or adjusted technical standard, no further statistical analyses are necessary. The reclaimed area will be considered to have met the requirements for final bond release.

II. Reclaimed sample mean values **less than** the reference or adjusted standard values.

If the yield or cover on a reclaimed tract does not equal or exceed that of the reference area or adjusted technical standard, statistical tests may be used to determine whether the production or cover value from a reclaimed tract is statistically equivalent to that of the reference area or adjusted technical standard. If the appropriate statistical test demonstrates that, at the 90% confidence level, the production or cover value from a reclaimed tract is not significantly less than that of the reference area or adjusted standard, it will be assumed that the production or cover equals that of the reference area or adjusted standard for final bond release purposes.

Some of the notations used in this section are shown below.

Symbol	Definition
$\bar{x}$	Sample mean
x_i	Individual sample value
n	Number of individual sample values within a sample mean
N	Total number of sampling sites (ie acres) summed over all strata
N_h	Total number of sampling sites (ie acres) in the h^{th} stratum
W_h	Proportion of population sampling sites in stratum h, $W_h=N_h/N$
Σ	Summation
s^2	Sample variance
s	Sample standard deviation
$\lvert\ \rvert$	Indicates that the absolute value (always positive) is used

Note: Subscript numbers are used to denote different sampling sites for means, variances, etc.; w as a subscript denotes the value is weighted

Step 1: In order to conduct any statistical testing, the following values must first be calculated:

Sample Mean

$$\bar{x} = \frac{x_1 + x_2 + x_3 + ... + x_n}{n} \qquad \text{or} \qquad \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Example 1: An area has 5 sample values of 12, 18, 29, 17, and 16 bu/ac. Thus n = 5 and the mean value of this area would be:

$$\bar{x} = \frac{12 + 18 + 29 + 17 + 16}{5} = 18.4 \text{ bu/ac}$$

Variance

$$s^2 = \frac{\left(x_1 - \bar{x}\right)^2 + \left(x_2 - \bar{x}\right)^2 + \left(x_3 - \bar{x}\right)^2 + ... + \left(x_n - \bar{x}\right)^2}{n - 1}$$

or

$$s^2 = \frac{\sum_{i=1}^{n} \left(x_i - \bar{x}\right)^2}{n - 1}$$

Using the 5 values shown in Example 1 above of 12, 18, 29, 17, and 16 bu/ac, then the variance would be the following:

$$s^2 = \frac{(12 - 18.4)^2 + (18 - 18.4)^2 + (29 - 18.4)^2 + (17 - 18.4)^2 + (16 - 18.4)^2}{(5 - 1)} = 40.3$$

Standard Deviation

$$s = \sqrt{s^2} = \left(\frac{\sum_{i=1}^{n} \left(x_i - \bar{x} \right)}{n - 1} \right)^{1/2}$$

Using the variance calculated above for Example 1:

$$s = \sqrt{40.3} = 6.35$$

Step 1A. If the tract is divided into a number of different sampling strata (for example by acres within the total area due to differences in vegetation, soils, soils depths, etc.), a weighted mean proportional by area can be calculated as follows using the example below:

Example 2:

Sampling Area (strata)	Acres (N_h)	Sample Values* (tons/acre)	Average Productivity (tons/acre)
1	8	0.6, 1.8	1.2
2	10	1.6, 2.2, 1.6	1.8
3	23	2.5, 3.2, 3.0	2.9
4	15	1.5 1.9	1.7
5	12	1.9, 1.3	1.6
-	**Total acres=N=68**	**n=12**	-

*** NOTE:** The number of sample values (n) per strata need not be equal.

Weighted Mean

$$\bar{x}_w = \frac{\bar{x}_1 (W_1) + \bar{x}_2 (W_2) + \bar{x}_3 (W_3) + ... + \bar{x}_h (W_h)}{N}$$

or

$$\bar{x}_w = \frac{\sum_{h=1}^{h} \left(\bar{x}_h \, W_h \right)}{N}$$

For the data shown above in Example 2, the weighted mean would be calculated as follows:

$$\bar{x}_w = \frac{(1.2 * 8) + (1.8 * 10) + (2.9 * 23) + (1.7 * 15) + (1.6 * 12)}{68} = 2.04 \quad \text{tons/acre}$$

Weighted Variance

$$s_w^2 = \frac{\sum_{i=1}^{n} x_i^2 W_h - \frac{\left(\sum_{i=1}^{n} x_i W_h\right)^2}{n}}{n-1}$$

For the data shown in Example 2, the weighted variance would be calculated as follows:

$$s_w^2 = \frac{\left[\left(0.6^2 * \frac{8}{68}\right) + \left(1.8^2 * \frac{8}{68}\right) + ... + \left(1.3^2 * \frac{12}{68}\right)\right] - \frac{\left[\left(0.6 * \frac{8}{68}\right) + \left(1.8 * \frac{8}{68}\right) + ... + \left(1.3 * \frac{12}{68}\right)\right]^2}{12}}{11}$$

$$= \frac{12.973 - \frac{29.976}{12}}{11} = \frac{10.475}{11} = 0.952$$

Weighted Standard Deviation

For the data in Example 2, the weighted standard deviation would be calculated as follows:

$$s_w = \sqrt{s_w^2} = \sqrt{0.952} = 0.976$$

Step 2: Determining the type of test to be used

A. Using a t-Test for determining differences between mean values

A one-tailed t-test can be used to determine whether the mean production or cover value from a reclaimed tract is significantly less than that of a reference area or adjusted technical standard. A t value is calculated using the sample means and variances. The calculated t value is then compared to a tabular t value designated for the desired confidence level and degrees of freedom (df) (see t distribution table at end of this section). If the calculated t value exceeds the tabular t value, the mean from the reclaimed tract is considered significantly less than the mean of the reference area or technical standard.

NOTE: The type of t-test to be used depends on the availability of the information (such as weighted or unweighted means, standard deviations, and different sample sizes) for the areas that are to be compared. Adjusted technical standards or full field harvest techniques may also be used; however, no variance value or sample size will be available for these latter two cases. Following are examples of two t-tests that may be used based upon the amount of sample information available.

1. t-Tests for means (**NOTE:** if mean values are weighted, weighted variances and standard deviations should also be used)

   a. Reclaimed sample means versus adjusted field standards or full-field harvest values

   Example 3: Assume the following information

   Reclaimed site production: Yield mean = $\bar{x}_1 = 33.0$ bu/ac
   Variance = $s_1^2 = 1.10$
   Standard deviation = $s_1 = 1.05$
   $n_1 = 15$

   Adjusted yield standard (or full field harvest): Yield value = $\bar{x}_2 = 33.2$ bu/ac

Calculate the t_{calc} value

$$t_{calc} = \frac{\left|\bar{x}_1 - \bar{x}_2\right|}{\left(\frac{s_1}{\sqrt{n_1}}\right)}$$

For Example 3, t_{calc} would be calculated as the following:

$$t_{calc} = \frac{\left|33 - 33.2\right|}{\frac{1.05}{\sqrt{15}}} = \frac{0.2}{0.27} = 0.74$$

Find the tabular value for t at the desired confidence level and degrees of freedom and compare with the calculated t value.

The tabular t value for a 90% confidence level and n-1 degrees of freedom (14 d.f.) from the table at the end of this section indicates the tabular t value would be 1.345.

For this example we would conclude that since t_{calc} is **less than** the tabular t value, the reclaimed yield **is not significantly different** than the adjusted yield standard (or full field harvest) and **would demonstrate revegetation success** for final bond release purposes.

b. Where means and variances are known for both sites (sample sizes may be equal or unequal)

Example 4: Assume the following

Reclaimed site production: Yield mean = $\bar{x}_1 = 28.5$ bu/ac
Variance = $s_1^2 = 1.20$
$n_1 = 23$

Reference area production: Yield mean = $\bar{x}_2 = 29.2$ bu/ac
Variance = $s_2^2 = 0.80$
$n_2 = 25$

Calculate the t_{calc} value

$$t_{calc} = \frac{\left|\bar{x}_1 - \bar{x}_2\right|}{s_{pooled}\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where: $$s_{pooled} = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

$$= \frac{|28.5 - 29.2|}{0.996\sqrt{\left(\frac{1}{23} + \frac{1}{25}\right)}} = \frac{0.7}{0.288} = 2.43$$

$$\text{d.f.} = n_1 + n_2 - 2 \qquad \textbf{(except where noted below)}$$

Find the tabular value for t at the desired confidence level and degrees of freedom and compare with the calculated t value.

The tabular t value for a 90% confidence level and (n_1+n_2-2) degrees of freedom (46 d.f.) from the end of this section would be approximately 1.3. Thus for this example we would conclude that since t_{calc} is greater than the tabular t value that the reclaimed yield **is not** equal to the adjusted yield standard (or full field harvest) and **would not qualify** for demonstrating vegetation success for final bond release purposes.

NOTE: The above calculation for degrees of freedom assumes that the variances calculated for the two means are statistically equal. If, however, the ratio of the variances is greater than 3, then it may be assumed that the variances **are not** equal and a correction in calculating the number of degrees of freedom must be used. The following formula (Satterthwaite Correction Factor) should be used to determine the degrees of freedom if the variances are considered unequal:

$$\text{d.f.} = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\left(\frac{\left(\frac{s_1^2}{n_1}\right)^2}{(n_1 - 1)} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{(n_2 - 1)}\right)}$$

For example, assume two samples have variances of 1.80 and 0.35 with sample sizes of 12 and 18, respectively. Assuming equal variances would result in 28 degrees of freedom. However, since the ratio of the variances is greater than 3, the corrected number of degrees of freedom that should be used is calculated as follows

$$\text{d.f.} = \frac{\left(\frac{1.8}{12} + \frac{0.35}{18}\right)^2}{\left[\frac{\left(\frac{1.8}{12}\right)^2}{12-1} + \frac{\left(\frac{0.35}{18}\right)^2}{18-1}\right]} = \frac{0.0287}{0.00204 + 0.000022} = 13.9$$

= 14 degrees of freedom

c. Using weighted mean values for both sites (equal or unequal sample sizes)

Example 5: Assume the following values have been calculated from the weighted field values using the equations given earlier:

Reclaimed site production: Yield mean = $\bar{x}_{w1}$ = 29.2 bu/ac
Variance = s_{w1}^2 = 1.70
n_1 = 22

Reference area production: Yield mean = $\bar{x}_{w2}$ = 29.5 bu/ac
Variance = s_{w2}^2 = 1.80
n_2 = 27

Calculate the t_{calc} value:

$$t_{calc} = \frac{\left|\bar{x}_{w1} - \bar{x}_{w2}\right|}{s_{pooled}\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where: $$s_{pooled} = \sqrt{\frac{(n_1 - 1)s_{w1}^2 + (n_2 - 1)s_{w2}^2}{n_1 + n_2 - 2}} = 1.325$$

$$= \frac{|29.2 - 29.5|}{1.325\sqrt{\left(\frac{1}{22} + \frac{1}{27}\right)}} = \frac{0.3}{0.38} = 0.79$$

and $\text{d.f.} = n_1 + n_2 - 2$ **(except as noted above)**

Find the tabular value for t at the desired confidence level and degrees of freedom and compare with the calculated t value.

The tabular t value for a 90% confidence level and (n_1+n_2)-2 degrees of freedom (47 d.f.) from the end of this section would be approximately 1.3. Thus for this example we would conclude that since t_{calc} is **less than** the tabular t value that the reclaimed yield is equal to the adjusted yield standard (or full field harvest) and **would demonstrate** vegetation success for final bond release purposes.

B. Using one-tailed confidence limits or error estimates of a mean when an adjusted technical standard or full field harvest value is used

The confidence limit approach compares the difference between the sampled mean estimate of cover or production of the reclaimed site and the adjusted standard or reference mean value to a calculated confidence interval. Since only the reclaimed site was sampled, one cannot be entirely confident that the mean ($\bar{x}$) of the sampled data set is the same as the reference (X_{ref}) or adjusted standard (X_{AD}) yield. Therefore, a range of values (confidence range) exists above and below the reclaimed mean value where one is uncertain (not confident) if the reference or adjusted standard yield lies within that range. The reference or adjusted standard yield cannot lie

outside the end point of the confidence range in order to be considered equal to the reclaimed mean value. Thus, a confidence range can be used to indicate that the mean from the reclaimed sample is not significantly different than the reference or adjusted standard value.

The equation for confidence limit approach assumes that the difference in yield values must be smaller than the estimated confidence interval in order for the two means to be statistically equal. The confidence limit approach is calculated as follows:

$$\left|\bar{x} - (X_{ref} \text{ or } X_s)\right| \leq (t_\alpha s) \Big/ \sqrt{n}$$

where t_α has n-1 degrees of freedom.

Example 6: Assume the following information:

Reclaimed site production: Yield mean = $\bar{x}_1$ = 1900 lbs/acre
Variance = s_1^2 = 155.2
n_1 = 21

Reference site production or adjusted standard:

Yield = X_{ref} or X_{AD} = 1950 lbs/acre

Calculate the interval estimate for the difference between the two means at a 90% confidence level:

$$|1900 - 1950| \leq [(1.325)(12.46)] \Big/ \sqrt{21} = 50 \leq 3.60$$

Thus since the difference between the two yield values (50) is **greater than** the estimated confidence interval (3.60), we would conclude that the reclaimed production **is not equal** to the production of the reference site or adjusted standard and would not demonstrate revegetation success for final bond release.

t-DISTRIBUTION VALUES FOR ONE-TAILED t-TESTS

df	90% level	df	90% level	df	90% level
1	3.078	13	1.350	25	1.316
2	1.886	14	1.345	26	1.315
3	1.638	15	1.341	27	1.314
4	1.533			28	1.313
5	1.476	16	1.337	29	1.311
		17	1.333	30	1.310
6	1.440	18	1.330		
7	1.415	19	1.328	40	1.303
8	1.397	20	1.325		
9	1.383			60	1.296
10	1.372	21	1.323		
		22	1.321	120	1.289
11	1.363	23	1.319		
12	1.356	24	1.318	∞	1.282

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V. APPENDICES

Appendix A – Initiation of the Revegetation Liability Period and Management During the Liability Period

Appendix B – Summary of Reclamation Laws and Rules 1969-1978

APPENDIX A

INITIATION OF THE REVEGETATION LIABILITY PERIOD AND MANAGEMENT DURING THE LIABILITY PERIOD

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Initiation of Liability Period

On cropland and prime farmland, the liability period begins on the date of the seeding of a precropland seed mix, a temporary "green manure" crop, or a harvestable crop. Establishment of a precropland mix rather than a crop at the beginning of the liability period is recommended for soil development and erosion control. However, in some cases immediate cropping of a reclaimed area may be desired.

The liability period begins following completion of the last augmented seeding, fertilization, irrigation, or other work on all non-cropland land uses. If a nurse or cover crop is seeded, the liability period is not initiated until that crop is replaced with a seed mix that has been approved for the postmine land use. If seeding is done in two phases (e.g., warm season grasses and forbs followed by cool season grasses), the responsibility period will not be initiated until the last seeding is completed.

Shelterbelts and woodlands should be planted at the same time that the surrounding area is seeded, so that the liability period begins at the same time. This will ensure that the entire unit can be released at the same time. The liability period on wetlands begins following respread of soils in the wetland basin and seeding of contiguous areas.

Management During the Liability Period

After initiation of the liability period, the use of augmentation practices that drastically affect revegetation will reinitiate the liability period. A differentiation must be made between augmentation practices and "normal conservation practices". Augmentation practices are those which exceed the commonly used management techniques on similar unmined lands in the surrounding area. In contrast, normal conservation practices are commonly used management techniques which provide sustained yields or vegetation cover.

Because the distinction between normal conservation practices and augmentation practices is not always clear, management practices must be reviewed on a site specific basis to determine whether they affect the liability period. The PSC should be consulted prior to implementing practices, which drastically affect established vegetation. Following is a discussion of those practices that are considered normal conservation practices which, when approved on a site specific basis, will not reinitiate the liability period. The discussion under "Augmentation Practices," includes those practices which will reinitiate the liability period.

Normal Conservation Practices

Normal conservation practices are defined as: those, which are used, as part of long-term management, or practices which if discontinued will not reduce the probability of permanent revegetation success. These are regarded as normal conservation practices since they are often routinely employed on unmined lands. This definition is consistent with 30 CFR 817.116(c)(4) which allows the regulatory authority to approve selective husbandry practices. NDCC 38-14.1-24(18) allows local conservation practices to be used in postmining management without restarting the liability period. The Journal of the North Dakota Senate, March 6, 1981, discusses

House Bill 1455 which provides further rationale for NDCC 38-14.1-24(18). The Journal stated that the term "normal conservation practices" is intended to mean those activities that include, but are not limited to: mowing; strip cropping; stubble mulching; shelterbelts; pest control; weed control; erosion control; interseeding; and, supplementary fertilization.

On all land uses, normal conservation practices include pest management (e.g., weeds, insects, etc.), which is usually routinely performed as required by infestations. Acceptable weed control techniques include: manual or mechanical removal; controlled burning; and, pesticide applications. Reseeding or interseeding of small areas, which may be necessitated by pest control, is considered a part of the management practice. Repair and subsequent management of minor erosion features is also regarded as a normal conservation practice because it is routinely done on agricultural lands in North Dakota. Repair may include backfilling and blading, and reseeding or interseeding small areas, along with curlexing, mulching, and other stabilization techniques.

Fertilization and irrigation are considered as normal management practices when they are part of long-term management plans for the reclaimed area (i.e., for cropland and hayland). Irrigation may be used during the first growing season to enhance establishment on any land use. However, irrigation and fertilizer application should not be continued during the liability period if they are not expected to be continued following bond release.

Normal conservation practices on cropland include the use of green manure crops, strip-cropping, or minimum tillage. Plowing alfalfa or other hayland to reestablish the stand every 4 to 5 years also is an acceptable management practice.

Normal conservation practices on reclaimed native grassland and tame pastureland include burning, mowing, and grazing, as part of long-term management. Fertilizer or herbicide applications which are used to manipulate the cool season/warm season grass ratio are considered normal conservation practices since these are important management tools (Ries et al. 1987). Occasional haying, burning or light grazing of fish and wildlife habitat (grassland and wetland areas only) are frequently used in North Dakota (Fulton et al. 1986). Reinforcement interseeding to modify species composition or reestablish certain species, during stand establishment, is regarded as a normal conservation practice on native grasslands in the Northern Great Plains. Reinforcement interseedings do not reduce or enhance the probability of permanent vegetation success, and therefore, will not restart the liability period. A single reinforcement interseeding on an area may occur before the stand is considered established. A stand will be considered established when evaluated as a critical area planting as described in PM Technical Note ND-12 (SCS 1989), more specifically, the standard of 8 plants per square foot of bunch grasses and rhizomatous grasses must be achieved. Since reclamation of surface mined lands also requires a diverse and seasonal stand, a frequency measurement of the established plants must also be recorded. The frequency of species seeded must indicate that at least 50% of the seeded species are becoming established. The area must be evaluated as specified by the SCS (1989). SCS (1989) states that native warm-season species may require three growing seasons for establishment. Therefore, the evaluation should be conducted in year four to allow time for all species seeded to become established. At this time, the mining company must provide data which indicates that the stand has not become established. If it is

determined that the stand is not adequately established, a reinforcement interseeding will be allowed at the next favorable seeding time (spring of year five). Any interseeding after year five will be considered a failed seeding and will restart the liability period.

Normal conservation practices, which are used to manage woodland or shelterbelt plantings include; weed control, supplemental watering, and delayed establishment of understory vegetation. These practices are commonly used to reduce competition and enhance woody plant establishment. Replacement of dead trees and shrubs and pruning and thinning also are considered normal conservation practices. According to USDA SCS Technical Guide Notice ND-39, "Field Windbreaks" and "Farmstead and Feedlot Windbreaks" (SCS 1984a and SCS 1984b), "any tree or shrub which fails within two years after planting should be replaced; however, as a minimum, replacements will be made to eliminate gaps of two or more consecutive trees and/or shrubs in a row and to maintain a stand of at least 85 percent." Because these practices are recommended by the NRCS and are commonly used for management of shelterbelts in North Dakota, they are considered as normal conservation practices. Also, voluntary plantings of trees and shrubs on agricultural land at the request of the landowner or to enhance fish and wildlife habitat are considered normal conservation practices.

Augmentation Practices

Augmentation practices are those which exceed the management practices commonly used on similar unmined lands in the surrounding area. The use of an augmentation practice on reclaimed lands will reinitiate the liability period. Some examples include:

Fertilization or irrigation, if not used as specified in the management plan for that tract, on cropland, hayland, and pastureland.

Fertilization, when used in excessive amounts (based on soil tests and historic use), on cropland, hayland, and pastureland.

Fertilization or irrigation, when used to boost production on native grassland or on grasslands in fish and wildlife habitat.

Reseeding native grasslands, pasturelands, or grasslands in fish and wildlife habitat, to reintroduce the desired species.

Extensive replanting, plugging, or addition of soil containing propagules on wetlands.

Extensive replanting in woodland or shelterbelts.

Any significant surface modifications, which redisturb the topsoil.

Any change in land use that requires a seed mix modification to support the intended land use.

APPENDIX B

SUMMARY OF NORTH DAKOTA RECLAMATION LAWS AND RULES

1969-1978

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INTRODUCTION

Since some areas were mined under different sets of laws and rules, the release of areas from bond will have to be made on the basis of the requirements that existed when they were mined. North Dakota's reclamation law was enacted in 1969 and later revised in 1971, 1973, 1975, 1977 and 1979. In 1980, the Office of Surface Mining conditionally approved North Dakota's permanent regulatory program. Since then some additional changes in the law and rules have occurred, but the impact of such changes on requirements related to vegetation inventory or evaluation of revegetation success have been minimal. In view of these facts, it will be relevant to our present purpose to trace the development of revegetation requirements along with grading and soil requirements since the inception of the reclamation law in North Dakota.

1969 Law

The operator was required to grade the land affected by surface mining to a rolling topography with slopes not to exceed 25% and traversable by farm machinery if the affected area was to be used as cropland or hayland. Peaks and ridges, were required to be struck off to a minimum width of 24 feet if the area was to be afforested, and to a minimum width of 35 feet if seeded to pasture. There were no requirements for soil removal or respreading. The operator was required to sow, set out or plant on the affected land seeds, plants, cuttings of trees, shrubs, grasses, or legumes as per the approved reclamation plan. Planting was not required on depressed haulage roads, final cuts and other areas subject to ponding of water. Reclamation had to be "acceptable" and would be deemed completed after the second seeding or planting.

1971 Law

The operator was required to grade the land affected by surface mining to a rolling topography not to exceed 20% and traversable by farm machinery if the affected area was to be used as cropland or hayland. Peaks and ridges were required to be struck off to a minimum width of 35 feet if the area was to be afforested or seeded to pasture. There was no soil removal or respreading requirements. Revegetation requirements were similar to those of the 1969 law.

1973 Law and Rules

The operator was required to return the land affected by surface mining to its approximate original contour or rolling topography or different topography required for an intended higher use. Final cuts and end walls were required to be backsloped to an angle not to exceed 35 degrees from the horizontal, unless water impoundments or other special topographic features were desired. Up to two feet of soil materials, were required to be removed and replaced on the regraded spoil. Seeding and planting requirements were similar to those of the 1969 law, but no exception was made for the final cuts and haulage roads within the mined area. The part of the law deeming reclamation as having been completed following second seeding or planting was repealed. Instead, reclamation was to be accomplished to the satisfaction of the Commission.

1975 Law and Rules

The operator was required to return the land affected by surface mining to its approximate original contour unless required otherwise by the Commission. Final cuts and endwalls were required to be backsloped to an angle not to exceed 35 percent. Soil materials up to a maximum depth of 5 feet were required to be saved, segregated and respread on the regraded spoil. Characteristics of suitable plant growth materials were specified and topsoil had to be segregated from subsoil.

Seeding and planting requirements remained as they were in the 1969-1973 laws, but restoration of the level of inherent productivity equal to or greater than which existed prior to mining was mandated for the first time. No specific requirements were set for the procedures to be used in evaluating the revegetation success except that a request for bond reduction was required to be accompanied by appropriate soil tests, a complete history of initial and subsequent seeding and fertilization and supplemental irrigation or any other management practices employed. Reclamation was required to be conducted to the satisfaction of the Commission.

1977 Law and Rules

The operator was required to backfill and regrade the mined areas to the gentlest topography consistent with the adjacent unmined landscape. All final cuts, highwalls, and endwalls were required to be backsloped to an angle not to exceed 35 percent from the horizontal, unless the operator wanted to implement alternative plans such as water impoundments or establish special topographic features. All soil materials within the permit area determined suitable for plant growth were required to be saved, segregated and respread in two lifts. Submission of maps delineating pre- and postmining land uses along with the major vegetation types and their distribution, was required under rules.

Requirements for seeding and planting were similar to the previous laws. However, pursuant to Commission rules which are intended to apply to all areas initially disturbed by mining after July 1, 1975, the operator was required to provide documentation that vegetation establishment and yield had achieved a level equal to or exceeding the premining level. On areas returned to permanent grass cover, the operator was required to submit pre- and postmining species composition, cover, density, and yield data. Bond release requests were required to be accompanied by a complete history of initial and subsequent seedings and fertilization, appropriate soil tests, supplemental irrigation or any other management practices employed. Reclamation was required to be conducted to the satisfaction of the Commission.

1978 Interim Rules

When the federal interim regulations were developed following the enactment of SMCRA, the Commission also made changes in its rules in 1978 to comply with the federal requirements. According to these revised rules, the operator was required to develop “A premining and postmining vegetation inventory process . . . . from established reference areas pursuant to methods approved by the Commission that [would] be used to determine the degree of success in the revegetated area. The purpose of this vegetation inventory [was] to develop a data base to compare postmining vegetation success". . . "For all new permits applied for after

October 1, 1978, reference areas [were to] be selected and premining inventory information, as specified and approved by the Commission [was to] be submitted with the permit application. Reference areas for all land affected after July 1, 1975, under [the then] existing permits and for all new permits issued prior to October 1, 1978 [were to] be selected in a timely manner and [were to] be specified and approved by the Commission".

Operators were required to "provide documentation that vegetative establishment and yield have achieved a level equal to or exceeding the premining level. The ground cover and productivity of living plants on all significant portions of the revegetated area [were] required to be shown to equal or exceed the ground cover and productivity of living plants of the approved reference area with a 90% statistical confidence for a minimum of two growing seasons". However, an exception was allowed for reaffected areas that were previously mined and, in some instances, reclaimed prior to the effective date of these interim rules. Ground cover for these areas was required to the extent that it "controlled erosion" and was not less than that existing before redisturbance. (However, if the reaffected areas were initially disturbed by mining activities after July 1, 1975, then the premine productivity level must be restored.) Also, the use of reference areas for evaluation of crop production was required.

The rules under the permanent regulatory program based on the new law that became effective July 1, 1979 are discussed in Section I of the guidelines.