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2.7 Pre-mining Land Use and Vegetation

2.7.2 Pre-mining Vegetation

2.7.2.1 Introduction

South Heart Coal LLC (SHC) intends to develop the South Heart Lignite Mine (SHLM), located in the Heart River watershed approximately two miles southwest of South Heart, Stark County, North Dakota. In support of the SHLM, WESTECH Environmental Services, Inc., as a subcontractor to Golder Associates, Inc. (Golder), was assigned to conduct a baseline vegetation inventory within the area of proposed development. This inventory will be used to support surface mine permitting and reclamation planning in accordance with laws and regulations administered by the North Dakota Public Service Commission (PSC). A Scope of Work (SOW) was prepared for the vegetation baseline, and submitted to the PSC in October, 2006 for review and comment.

The vegetation baseline SOW was based on PSC "Recommended Procedures for Pre- and Post-mining Vegetation Assessments" (PSC 2003) and field discussions with Mr. Guy Welch of PSC (Welch 2006) on August 18 and 22, 2006. The SOW was designed to provide data suitable to describe existing vegetation resources and to supplement the development of reasonable revegetation success criteria. Upon receipt of PSC's comments, the vegetation SOW was finalized and re-submitted in March, 2007.

Figure 2.7.2-1 shows the vegetation baseline study area (Study Area) and area within the Permit Boundary. The vegetation baseline inventory was conducted in August/September, 2006, within the Study Area where surface access was available. Those portions of the Study Area not accessible during the 2006 field season were inventoried during the May/June, 2007 field season. Results for the entire vegetation baseline Study Area are summarized in Section 2.7.2.4.1. A summary of results within the Permit Boundary is presented in Section 2.7.2.4.2. A description of the field and office methods employed for the vegetation baseline study is given in the following Section 2.7.2.2.

2.7.2.2 Methodology

2.7.2.2.1 Vegetation Type Delineation and Assessment Requirements

Preliminary mapping was conducted within the Study Area using an aerial color ortho-photo (1 inch = 2000 feet scale) and field checked during May, 2006. The Vegetation baseline study is based on plant physiognomy and vegetation-land use types. Vegetation mapping units were based on a combination of dominant plant species, topoedaphic features and disturbance/management history. The preliminary mapping was checked in the field by pedestrian and vehicular surveys, later verified by analysis of quantitative data, and modified as necessary. Derivation of the vegetation classification for the Study Area is explained in the following Results Section 2.7.2.3, based on PSC (2003) vegetation-land use categories, *i.e.*, Cropland, Native Grassland, Tame Pastureland, Woodland, Shelterbelts and Wetlands. The following is excerpted directly or paraphrased from PSC (2003) recommended procedures for pre-mining vegetation assessments for each vegetation-land use type.

Cropland

Cropland, as defined in North Dakota Administrative Code (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 hay-land.

The following tasks were completed as part of the Pre-mining Land Use Study (see Section 2.7.1):

- All cropland tracts and each soil-mapping unit for each tract were delineated and identified on an aerial photograph using a scale of 1:4,800.
- Total acreage of each soil mapping unit for each surface owner was tabulated.
- Production of the principal crops grown within the Study Area was assessed based on the most recent (five-year) actual yields from the area, obtained by interview of landowners/current operators.

Native Grassland

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.

The following baseline tasks were completed in compliance with PSC's pre-mining assessment requirements for native grassland:

- All native grassland tracts within the Permit Boundary and each ecological site and soil mapping unit for each tract, were delineated and identified on an aerial photograph of 1:4,800 scale.

- Total acreage of each ecological site was tabulated for each surface owner within the Permit Boundary.

- A comprehensive list was compiled of all vascular plants occurring in each primary (series) mapping unit in the Study Area using nomenclature in Flora of the Great Plains (1986). The species list includes scientific names, and identifies any rare, endangered, poisonous, or noxious plants.

- Annual production data were collected on-site, and range condition for native grassland was then calculated for each ecological site by landowner using NRCS technical guides (NRCS 2003) and NRCS similarity index form ND-CPA-20 (NRCS 2007a).

A detailed narrative was prepared describing the nature and variability of the vegetation of all ecological sites, woodland and tame pastureland.

Tame Pastureland

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.

The following baseline tasks were completed in compliance with PSC's pre-mining assessment requirements for tame pastureland:

- All tame pastureland tracts within the Permit Boundary, and each soil mapping unit for each tract, were delineated and identified on an aerial photograph of 1:4800 scale.

- Total acreage of each soil mapping unit was tabulated for each surface land owner within the Permit Boundary.

- A comprehensive list was compiled of all vascular plant species found in tame pastureland tracts in the Study Area, including all noxious, poisonous, threatened and rare species.

- Annual production data were collected on-site within tame pastureland.

- A narrative was prepared describing the nature and variability of tame pastureland vegetation in the Study Area, including dominant species and their relative proportions.

Woodland

Woodland is defined by NDAC 69-05.2-01-02 as land where the primary pre-mining natural vegetation is trees or shrubs. Only the immediate area where woody plants exist (whether pre- or post-mine) is considered as woodland. Adjacent areas where the primary vegetation is not woody plants are evaluated based on requirements of the appropriate land use.

The following baseline tasks were completed in compliance with PSC's pre-mining assessment requirements for woodland:

- Areal extent was defined for woodland types (i.e., deciduous trees, tall shrubs, and low shrubs), by depicting them on an aerial photo of 1:4,800 scale. The acreage of each woodland type was determined for each surface owner, and a description of the density of trees and shrubs was prepared, including characteristics of the understory vegetation.

- Cover data were obtained for all herbaceous and woody plant species associated with each woodland type.

- A comprehensive species list was prepared for all vascular plant species recorded in woodland types, including noxious, poisonous, endangered and rare species.

- A narrative was prepared describing the nature and variability of vegetation in each woodland type based on quantitative data collection.

Shelterbelts

A shelterbelt is defined by NDAC 69-05.2-01-02 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. A shelterbelt includes only the immediate area where trees and shrubs exist (whether pre- or post-mine). Adjacent areas where the primary vegetation is not trees or shrubs are evaluated based on the requirements of the appropriate land use.

The following baseline tasks were completed in compliance with PSC's pre-mining assessment requirements for shelterbelts:

- Shelterbelts were depicted on a map of appropriate scale for each shelterbelt.
- The acreage of each shelterbelt was determined for each surface owner.
- The number and arrangement of trees and shrubs, length and number of rows, and associated plant species were inventoried, tabulated and summarized.
- A comprehensive list was prepared of all vascular plant species recorded in shelterbelts, including noxious, poisonous, endangered and rare species.

Wetlands

Wetlands are normally classified in North Dakota according to the system of Stewart and Kantrud (1971). Because the Stewart and Kantrud (1971) classification system was devised to address the prairie pothole region, it is not entirely appropriate for the Study Area. As a result, the PSC was consulted to determine an appropriate classification system. The agreed-upon wetland delineation and sampling procedures are detailed in the Wetlands Section 2.10-1. Wetland vegetation characteristics were summarized from the Wetlands report to be presented in this baseline vegetation report, particularly with regard to riparian native grassland.

Other Land Uses

Other land uses that occur within the Permit Boundary include recreation, residential, and industrial and commercial (including utilities), among other miscellaneous uses. There are no specific requirements for pre-mining land use assessments for these uses under NDAC 69-05.2-08-08. A general description of these pre-mine uses, as required under North Dakota Century Code (NDCC) 38-14.1-14(2)(a), is presented in the Pre-mining Land Use Study (Section 2.7.1).

2.7.2.2.2 Sample Location and Sample Size

Sampling Sites

The following is paraphrased from PSC (2003) guidelines:

> The mapping units used for each land use category are regarded as potential sampling sites, including soil-mapping units for cropland, soil series for tame pastureland, and ecological sites (and, where necessary, soil series) for native grassland. For woodlands and wetlands, each vegetation type is a sampling site. For shelterbelts, each belt is a sampling site. All predominant mapping units are sampled where quantitative assessment is required.

The preliminary map, described in the Methodology section of this report, indicated the general delineation and distribution of vegetation-land use types in the Study Area. A 40-meter grid was overlaid on the Study Area map to select sample sites using a stratified random procedure based on projected sample size for each type. To ensure an even (yet stratified random) distribution of sample plots throughout narrow portions of drainage bottom mapping units, plot sites were sometimes selected where grid lines intersect drainage bottoms because grid points often do not fall within these narrow units. Sample sites were located in the field using the aerial photo-map and a hand-held GPS unit. All sample sites are shown on the vegetation map (Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C).

Sample Size

Sample size varied by type according to variability and the relative areal extent of each type, with more areal extensive types generally receiving proportionately more plots. Sample size was initially based on current PSC guidelines for determining sample size. The intent of the baseline study was to

quantitatively characterize vegetation ecology within the Study Area and show variability among sample sites. Statistically calculated sample adequacy may later be requested for predominant types, however, this was not currently deemed necessary for this baseline study by PSC (Welch 2006). Vegetation types with less acreage were also sampled quantitatively, but less intensively due to aereal extent and limited availability of sample sites. All types quantitatively sampled are qualitatively described in narrative form.

The following is paraphrased from PSC (2003) guidelines:

When on-site sampling is used to measure productivity and cover, the initial number of samples taken in each (predominant) sampling site is as follows:

- Five (5) 0.25 m^2 frames for total production on native grassland and tame pastureland; and
- Fifteen (15) 10-point frames, for total cover.

2.7.2.2.3 Quantitative Inventory

Quantitative data were collected in the field August 18-23 and September 6-11, 2006. Spring flora were identified May 15-17, 2007. Portions of the Study Area not available for access during the 2006 field season were quantitatively inventoried June 12-14, 2007. Quantitative sampling of vegetation-land use types was conducted as described for the following components. A digital color photograph (oblique) was taken at each sample site.

Cover

The following is paraphrased from PSC (2003) guidelines:

> 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. Cover will be recorded by plant species and measured near peak standing crop prior to sampling for productivity.

The multiple-point quadrat method was used to measure basal cover as well as canopy cover in the Study Area. The multiple-point quadrat consisted of 10 points evenly spaced in a frame. The height

of the point frame was tall enough to include all grass species, and the pins were vertical (using bubble-levels).

The point quadrat was used with the following methods:

1. Basal cover measurements, where each sharpened pin was lowered through the vegetation canopy to the ground surface, where it came in contact with the basal portion of an individual plant, plant litter, lichens, moss, rock or bare soil; and

2. First-hit and subsequent-hit measurements of the vegetation canopy, where each pin was lowered until it came in contact with a portion of a live plant (if any). Frames were placed at stratified random locations and orientations.

The number of samples required may be statistically established based on total basal cover using the point frame as one sample. However, this was not currently deemed necessary for this baseline study by PSC (Welch 2006). Cover for each species, total vegetation, litter, lichens, moss, rock and bare ground were calculated by dividing the summation of hits for a species or category by the total number of pins. Relative cover values can be calculated by dividing the summation of hits of a species by the summation of hits of all species. Cover values for each species and cover class were tabulated so that average cover values could be determined for each sampling site, and ultimately for each ecological site or vegetation type.

In woodland areas, total ground cover was determined by sampling a combination of herbaceous and woody vegetation. Total cover of woody plants in woodlands was measured using the line intercept method, by recording the intercept of each shrub and tree species along a 50-meter transect. The cover of herbaceous vegetation was determined using the same point quadrat method described above, using five 10-point frames distributed regularly along the 50-meter line intercept transect. Transects were randomly located and oriented to the extent that they remained within a single woodland type (based on plant physiognomy and composition).

The sample location, date, personnel, percent slope, aspect, topography, slope configuration and ecological site were recorded on each point quadrat sample field form. Cover data were tabulated by sample site, and summarized by ecological site or vegetation type. Using these data, stratified cover values and relative cover values were generated to assist in evaluations of plant composition and diversity.

The sample design layout implemented at each sampling site for native grassland (including herbaceous drainage bottoms) and tame pastureland sites is shown in Figure 2.7.2-2. The sampling design for woodland sites is shown in Figure 2.7.2-3.

To enhance the evaluation of plant species composition and diversity within the Study Area, an ocular estimate of canopy cover and basal cover was made at each sample site (Figures 2.7.2-2 and Figure 2.7.2-3). In each 0.01-hectare native grassland and tame pasture cover plot (5.64-meter radius) and 0.03-hectare woodland cover plot (10-meter radius), an ocular estimate was made of percent cover for ground cover classes, including bare ground, rock, litter, lichens, moss and basal vegetation to total 100 percent. Non-stratified canopy cover was estimated to the nearest percent in each ocular plot for total live vascular plant cover, for each morphological (or functional) class category (tree, shrub, perennial graminoid, annual graminoid, perennial forb and annual/biennial forb), and for each vascular plant species. Ocular estimates of tree cover were made by walking around the plot and estimating the extent of tree canopy extending within a vertical projection of the plot perimeter. Ocular cover data were tabulated and summarized similarly to the point quadrat cover data.

Productivity

The following is paraphrased from PSC (2003) guidelines:

> As defined in NDAC 69-05.2-01-02, productivity means the vegetative yield produced by a unit area for a unit of time. For perennial crops, the annual yield (lb/ac or t/ac) of the entire above-ground biomass is measured to determine productivity. Perennial crop yields (native grassland, hay-land, and pastureland) may be obtained from a whole field harvest or portions of a field may be sampled to obtain an estimated yield.

In the Study Area, production data were obtained from native grassland, woodland and tame pastureland using the quadrat, hand-harvest method (Figure 2.7.2-2 and Figure 2.7.2-3). In pastures where cattle were present, percent utilization was estimated. Production data were collected at all randomly located sample sites, except where heavy livestock utilization (greater than about 50 percent) precluded a reasonably accurate production sample.

Samples were clipped at ground level within a sampling quadrat (0.25 m^2), with dominant species near peak production. In each 0.25 m^2 quadrat, annual above-ground production was clipped and separated for the following herbaceous classes rooted within the quadrat: perennial grasses and

sedges, annual grasses, perennial forbs and annual/biennial forbs. Each of these classes was further separated as to origin (native vs. introduced). All native perennial graminoids were additionally separated by species to facilitate range condition determinations. Annual production of shrubs was estimated by clipping ten annual leaders of each species, then counting the remaining leaders within a vertical projection of the quadrat to be used as a multiplier. Shrub production was harvested by species. In the laboratory, all production samples were dried until constant weight was achieved, and weighed to the nearest 0.1 gram.

Density of Woody Vegetation

The PSC (2003) guidelines allow that the density of woody vegetation may be measured by direct counts of all woody species, or by density quadrat sampling. Within the Study Area, direct counts were conducted for shelterbelts, or modified direct counts (where possible) based on row length and average spacing of woody plant species. The density quadrat method was used for natural woodlands.

In the density quadrat method, (systematically) randomly placed quadrats were used to obtain density counts (Figure 2.7.2-3). Quadrat shape and size was proportional to the vegetation sampled. A sampling quadrat of 10 x 10 meter (m) was used to count all trees and saplings within the quadrat, and individual plants were recorded by species and diameter at breast height class (dbh) as < 1-inch dbh, one to four inches, four to eight inches, etc. A sampling quadrat of 4 x 4 m was used for measuring tall shrub density, and a sampling quadrat of 2 x 2 m was used for measuring low shrub density. All shrubs found within the quadrat were counted and recorded by species and age class (mature or immature).

Species Composition and Diversity

Species composition, origin, utility, seasonality and diversity parameters are inherently determined for each vegetation-land use type using cover and production data, as detailed in PSC (2003) guidelines and based on discussions with PSC. Species nomenclature and functional groups follow Flora of the Great Plains (1986).

Species List/Sensitive Plants/Noxious Weeds

All vascular plant species encountered in the Study Area were recorded and a comprehensive list was compiled (Appendix A). The list was annotated for each species as to its occurrence in each vegetation-land use type. The list includes all records from quantitative sampling, and qualitative and mapping surveys. Particular attention was given to the search for sensitive plant species, including taxa currently federally- and state- listed as rare, threatened or endangered in North Dakota, and taxa which may represent significant range extensions. Poisonous or noxious plants were also identified.

Taxa not readily identified in the field were collected and identified in the laboratory using a stereozoom binocular scope and taxonomic references including (but not limited to) Great Plains Flora Association (1977 and 1986), Gleason and Cronquist (1991), Holmgren (1998) and Bailey (1949). Nomenclature of vascular plant species follows Great Plains Flora Association (1986).

Noxious or declared weeds listed by Stark County were qualitatively assessed for distribution and abundance, as well as quantitatively sampled on cover estimation plots.

Ecological Site Condition and Utility Evaluation

Ecological sites (formerly "range sites") were identified and mapped using the 2006 to 2007 baseline soils inventory discussed in Section 2.4. Similarity index (formerly range condition) of Native Grassland was then calculated from baseline production data in conjunction with ecological site identification, using National Resources Conservation Service (NRCS 2007a) guidelines. Current stocking rates defined as Animal Unit Months (AUM)/acre) were determined via landowner/operator interviews, as presented in the Pre-mining Land Use Study (Section 2.7.1).

Delineation of Hydrophytic Vegetation

Areas within the Study Area supporting hydrophytic vegetation were sampled concurrently with the baseline inventory, and were delineated on Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C as various complexes of the saline, subirrigated, wet meadow and/or wet land mapping units. These data were used to assist in planning and conducting a wetlands inventory and delineation of the Study Area (Section 2.10-1).

2.7.2.3 Results

The following results include quantitative descriptions of the vegetation within the Study Area. A summary of the vegetation within the Permit Boundary is presented in Section 2.7.2.4.

2.7.2.3.1 Vegetation Classification

The vegetation classification for this study was based on PSC (2003) guidelines: "Recommended Procedures for Pre-mining Vegetation Assessments". Accordingly, native grasslands consisted of six ecological groups as outlined in Table 2.7.2-1. The vegetation-land use mapping categories consisted of Native Grassland - 100 series, Tame Pastureland - 200 series, Woodland - 300 series, Shelterbelts - 400 series, Wetlands - 500 series, Cropland - 600 series and Miscellaneous land uses - 700 series as outlined in Table 2.7.2-6 and Table 2.7.2-7. An overview of the vegetation is presented on Figure 2.7.2-1. The detailed vegetation is presented in Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C.

Cropland, for purposes of vegetation mapping, was comprised of six mapping units (Table 2.7.2-6) including cultivated (annual crops), grassed waterway, mixed hay, grass hay, alfalfa hay, and CRP (Conservation Reserve Program). The Pre-mining Land Use Study (Section 2.7.1) contains substantially more detailed cropland mapping, as well as detailed crop productivity information (five-year on-site yields, and United States Department of Agriculture (USDA) 30-year county yield statistics), cropping practices (2002-2006), and landowner/ operator interviews.

Native Grassland, following PSC guidelines, was classified and delineated according to NRCS ecological sites, comprised of 14 ecological sites in six ecological groups (Table 2.7.2-1). Five ecological sites were identified and mapped as three complexes within the High Water Table ecological group due to their intricate mosaic nature tied to the soils associated with most drainage bottom and terrace sites in the Study Area. There were three ecological sites identified in the Shallow and Very Shallow ecological group, and two ecological sites in the Claypan ecological group. The Study Area had one ecological site each in the Sandy and Clayey groups, and four ecological sites in the Loamy ecological group.

Tame Pasture (Table 2.7.2-1) includes lands seeded (or perhaps in some cases interseeded) with various mixes of introduced perennial grass and/or forb species. Tame Pasture is used primarily for

livestock grazing but occasionally mowed for hay. Tame pastureland occurs on a wide variety of soils in the Study Area.

Woodland (Table 2.7.2-1) in the Study Area consists of two primary tree types, often in association with smaller openings or fringes of low mesophytic shrubs (*e.g.*, snowberry and rose) or tall shrubs (*e.g.*, plum and buffaloberry). The Riparian Woodland type is a conspicuous element along the floodplain of the South Branch Heart River in the Study Area and, to a lesser extent, some of its tributary drainages. The Deciduous Tree Woodland type occupies wooded draws draining to the south side of Heart River in the northern portion of the Study Area.

Shelterbelts (windbreaks) are tree and shrub plantings in strips or belts near farmsteads, roads and agricultural fields (Table 2.7.2-8). Shelterbelts were also inventoried during the vegetation baseline survey (Section 2.7.2.3.4).

Wetlands were inventoried as a separate baseline survey of the Study Area (Section 2.10-1). Pertinent wetlands vegetation information is included in this report for the three mapping units in the High Water Table ecological group (Table 2.7.2-1).

Table 2.7.2-1 lists ecological sites and vegetation types quantitatively sampled in the Study Area in 2006 and 2007. Although vegetation resources in the Study Area were additionally classified into community types (refer to the narrative ecological site descriptions in the following Section 2.7.2.3.2), a few plots do not directly reflect species dominance of the type name. These stands are intermediate between two (or more) types, and are grouped with the type most similar in either species composition or site parameters.

2.7.2.3.2 Ecological Site and Vegetation Type Descriptions

Following is a narrative description of ecological sites and vegetation types identified within the Study Area during the 2006 to 2007 inventory. Table 2.7.2-1 identifies plot numbers and sample size by mapping unit (see Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C for plot locations). Summary data are presented for point-intercept cover in Table 2.7.2-2, similarity index by ecological site and by landowner within the Permit Boundary (Table 2.7.2-3), shrub and tree density (Table 2.7.2-4), ecological site/vegetation type/soils correlations (Table 2.7.2-5), acreage of ecological sites/vegetation types by landowner within the Permit Boundary (Table 2.7.2-6), and acreage of ecological sites/vegetation types within the Permit and Study Areas (Table 2.7.2-7).

All summary tables are presented in the tables section, following the text. Additional acreage calculations for the land use and soil mapping units are presented in the Land Use Section 2.7.1.

The summary tables listed above are derived from the quantitative data presented by sample site within the Study Area in the following appendices: ocular canopy cover/constancy (Appendix B), absolute and relative annual production (Appendix C), shrub and tree density (Appendix D), point-intercept cover by ecological site (Appendix E), point-intercept cover by sample site (Appendix E Attachment), line-intercept cover of shrub and tree species (Appendix F), and average number of vascular plant species by plot for diversity assessment (Appendix G).

The following type descriptions are arranged to generally follow a gradient of site parameters, particularly soil texture (apparent water-holding capacity) and/or topographic position. Departures from this arrangement account for species dominance and considerations of relative susceptibility to various disturbances (particularly grazing history). The following descriptions discuss native grassland, woodland and tame pastureland, and can be used to facilitate practical comparisons with any future revegetation efforts for the SHLM (*i.e.*, reclamation planning and development of bond release success standards). Subsequent sections discuss cropland (Section 2.7.2.3.3) and shelterbelts (Section 2.7.2.3.4).

Saline Lowland – Wet Land – Subirrigated Complex Native Grassland

The Saline Lowland – Wet Land – Subirrigated Complex ecological site comprises 1.4 percent of native grassland, occupying about 12 acres (0.2 percent) of the Study Area. A total of nine plots (including forty-five 10-point pin frames) were sampled, primarily on drainage bottoms, swales and lower slopes of gentle (zero to six percent) slope. Aspect was with one exception northerly, as dictated by the general direction of drainage. The predominantly associated soils were the Wet Saline and Wayden silty clay soils mapping units.

Plant communities sampled in this mapping unit included *Distichlis spicata/Puccinellia nuttalliana, Spartina pectinata/Carex praegracilis, Spartina pectinata/Bromus inermis* and *Symphoricarpos occidentalis/Spartina pectinata/Agropyron cristatum*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

SALINE LOWLAND-WET LAND-SUBIRRIGATED COMPLEX
n=9

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	57	Perennial	10	Shrub	4
Annual	-	Annual/Biennial	9	Tree	-
Spartina pectinata	13	*Suaeda depressa*	4	*Symphoricarpos occidentalis*	3
Distichlis spicata	12	*Aster pansus*	2		
Puccinellia nuttalliana	8	*Helianthus maximilianii*	2		
Agropyron cristatum	4	*Atriplex heterosperma*	1		
Bromus inermis	4	*Grindelia squarrosa*	1		
Puccinellia cusickii	4	*Iva axillaris*	1		
Carex praegracilis	3	*Melilotus officinalis*	1		
Eleocharis xyridiformis	2	*Sonchus arvensis*	1		
Poa glaucifolia	2				
Poa pratensis	1				
Hordeum jubatum	1				
Juncus balticus	1				

n = number of samples

Total annual production averaged 273.5 grams per square meter (2,440 pounds per acre), primarily native perennial graminoid (71 percent relative production), introduced perennial grass (11 percent), native perennial forb (seven percent), introduced annual/biennial forb (four percent), shrub (three percent), and native annual/biennial forb (three percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Saline Lowland ecological site in fair to low-good condition to be 1,800 pounds per acre (91 percent graminoids), ranging from 1,300 to 2,300 pounds per acre. In high-good to excellent condition, the Saline Lowland ecological site can be expected to produce 2,500 pounds per acre (93 percent graminoids) varying from 2,000 to 3,000 pounds per acre. Ecological site condition (similarity index) of this mapping unit was 20 percent (poor) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Saline Lowland ecological site in excellent condition.

Loamy Overflow - Subirrigated – Wet Land Complex Native Grassland

The Loamy Overflow - Subirrigated – Wet Land Complex ecological site comprises only 0.2 percent of native grassland, occupying two acres (less than 0.1 percent) of the Study Area. A total of six plots (including thirty 10-point pin frames) were sampled, primarily on drainage bottoms/ banks of gentle (two to three percent) slope. Aspect was primarily easterly, as dictated by the prevailing direction of drainage. All six sample sites were associated with the River Channels soils mapping unit.

The plant community representing this mapping unit was a dense *Carex aquatilis* fringe, usually under a *Fraxinus pennsylvanica* overstory. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

LOAMY OVERFLOW-SUBIRRIGATED-WET LAND COMPLEX
n=6

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	68	Perennial	8	Shrub	2
Annual	<1	Annual/Biennial	2	Tree	9
Carex aquatilis	61	*Rumex crispus*	2	*Fraxinus pennsylvanica*	9
Spartina pectinata	2	*Aster simplex*	2	*Symphoricarpos occidentalis*	1
Poa pratensis	2	*Rumex mexicanus*	1		
Carex laeviconica	2				

n = number of samples

Total annual production for the one plot harvested was 348.4 grams per square meter (3,109 pounds per acre), entirely native perennial graminoid (*Carex aquatilis*). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Subirrigated ecological site in fair to low-good condition to be 3,000 pounds per acre (81 percent graminoids), ranging from 1,800 to 4,200 pounds per acre. In high-good to excellent condition, the Subirrigated ecological site can be expected to produce 4,000 pounds per acre (78 percent graminoids) varying from 3,300 to 4,700 pounds per acre. Using relative cover data for all six sample sites in the Study Area collectively, range condition was approximately 28 percent (low-fair) of "historic climax" for the Subirrigated ecological site in excellent condition. Ecological site condition (similarity index) of this mapping unit was two percent (very poor) within the Permit Boundary, based on 2006 annual production data (one plot), using NRCS guidelines for the Subirrigated ecological site.

Wet Land – Wet Meadow Complex Native Grassland

The Wet Land – Wet Meadow Complex ecological site constitutes 1.3 percent of native grassland acreage, occupying 11 acres (0.2 percent) of the Study Area. A total of nine plots (including forty-five 10-point pin frames) were sampled, primarily on drainage bottoms and swales of gentle (one to three percent) slope. Aspect was variable, as dictated by direction of drainage. The predominantly associated soils were the Lallie silty clay, Arnegard clay loam and Cabba loam soils.

Plant communities sampled in this mapping unit were dominated by various associations of *Carex laeviconica, Spartina pectinata, Hordeum jubatum* and *Polygonum amphibium.* Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

WET LAND-WET MEADOW COMPLEX
n=9

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	74	Perennial	16	Shrub	3
Annual	<1	Annual/Biennial	2	Tree	2
Carex laeviconica	34	*Polygonum amphibium*	13	*Symphoricarpos occidentalis*	2
Hordeum jubatum	12	*Rumex mexicanus*	1	*Fraxinus pennsylvanica*	2
Spartina pectinata	12	*Aster pansus*	1		
Eleocharis xyridiformis	5				
Carex praegracilis	3				
Poa pratensis	2				
Agropyron smithii	1				
XAgrohordeum macounii	1				

n = number of samples

Total annual production for four plots harvested averaged 530.3 grams per square meter (4,732 pounds per acre), comprised of native perennial graminoid (75 percent relative production) and native perennial forb (25 percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Wet Meadow ecological site in fair to low-good condition to be 3,500 pounds per acre (93 percent graminoids), ranging from 3,000 to 4,000 pounds per acre. In high-good to excellent condition, the Wet Meadow ecological site can be expected to produce 4,500 pounds per acre (96 percent graminoids) varying from 4,000 to 5,000 pounds per acre. Vegetation composition of the four production sample sites generally compares most favorably with the ecological site description for Wet Meadow (NRCS 2003). Ecological site condition of this mapping unit was 18 percent (poor) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Wet Meadow ecological site in excellent condition.

Riparian Woodland Vegetation Type

The Riparian Woodland vegetation type is a conspicuous component of the Study Area, primarily associated with the floodplain of the South Branch Heart River. It occupies 274 acres (about four percent) of the Study Area. A total of 32 plots (including 145 10-point pin frames) were sampled, primarily on floodplain terraces and river channel bottoms of gentle (zero to five percent) slope, and incised channel banks of 40-100 percent slope. Aspect was variable (but not southwesterly), most commonly northeasterly as dictated by prevailing direction of the South Branch Heart River drainage. The predominantly associated soils were the River Channels, Havrelon silt loam (saline/sodic substratum), Havrelon silt loam, Entic Haplustolls silt loams and silty clay loams (saline/sodic substratum) and Entic Haplustolls silt loams and silty clay loams soils mapping units.

Plant communities sampled in this mapping unit were dominated in the overstory by *Fraxinus pennsylvanica*, *Acer negundo* and occasionally *Ulmus americana*, while understories were dominated by *Bromus inermis*, *Poa pratensis* and frequently *Symphoricarpos occidentalis*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

RIPARIAN WOODLAND
n=32

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	87	Perennial	6	Shrub	19
Annual	<1	Annual/Biennial	7	Tree	46
Bromus inermis	47	*Atriplex subspicata*	3	*Fraxinus pennsylvanica*	29
Poa pratensis	26	*Taraxacum officinale*	1	*Acer negundo*	13
Agropyron smithii	2	*Cirsium arvense*	1	*Symphoricarpos occidentalis*	13
Agropyron cristatum	2	*Arctium minus*	1	*Ulmus americana*	4
Elymus virginicus	2	*Chenopodium album*	1	*Prunus virginiana*	2
Carex laeviconica	2			*Rosa woodsii*	1
Buchloe dactyloides	1			*Shepherdia argentea*	1

n = number of samples

Total annual production averaged 407.8 grams per square meter (3,639 pounds per acre) for ten clip plots harvested in the Study Area, primarily introduced perennial grass (96 percent relative production) and introduced perennial forb (two percent). Six of the ten production plots were located within the Permit Boundary. Using baseline soils mapping correlated with NRCS ecological site designations (NRCS 2007b), all six clip plots in the Riparian Woodland vegetation type were associated with the Loamy Terrace ecological site in very poor to poor condition, however plant

composition generally compared more favorably with the site description for the Subirrigated ecological site in poor to low-fair condition. The NRCS (2003) has determined a representative value for total production in the Loamy Terrace ecological site in poor to low-fair condition to be 2,600 pounds per acre (72 percent graminoids), ranging from 1,700 to 3,500 pounds per acre. Site condition was additionally estimated using relative cover data for all 32 Study Area plots collectively (using NRCS guidelines for the Loamy Terrace ecological site), indicating 23 percent of expected climax (NRCS 2003) for the site, *i.e.*, high-poor condition. Ecological site condition of Riparian Woodland was one percent (very poor) within the Permit Boundary, based on 2006 annual production data (six clip plots), using NRCS guidelines for the Loamy Terrace ecological site in excellent condition.

Shrub and tree density data are presented by sample plot in Appendix D, and summarized in Table 2.7.2-4 for the three Woodland types present in the Study Area. Shrub density averaged 30,800 live stems per acre, of which 90 percent were *Symphoricarpos occidentalis*, five percent *Rosa woodsii*, two percent *Prunus virginiana*, and two percent were *Ribes setosum*. Density of trees greater than one-inch dbh averaged 193 trees per acre for 32 sample sites, including *Fraxinus pennsylvanica* (127 per acre), *Acer negundo* (48), *Ulmus americana* (11) and *Salix amygdaloides* (6).

Deciduous tree species in the riparian woodland type generally range from 40 to 60 feet tall and are in late-mature to decadent age structure (perhaps 100 – 150+ years old), with abundant evidence of heart rot and resultant blow-down particularly as the result of a very intense wind storm June 30, 2006. During the field studies it was apparent that there was a low recruitment of tree seedlings throughout the riparian woodland type.

Deciduous Tree Woodland Vegetation Type

The Deciduous Tree Woodland vegetation type is a relatively minor component of the Study Area, associated with narrow, wooded draws draining to the south side of the South Heart River. The Deciduous Tree Woodland type occupies about 12 acres (0.2 percent) of the Study Area. Three plots (including five 10-point pin frames) were sampled, located on wooded draws (two sample sites) and a steep (95 percent) bluff slope adjoining the Heart River. Aspect was northeasterly, as dictated by the direction of draws draining to the south side of the Heart River. All three sample sites were associated with the Regent silty clay loam soil.

Plant communities sampled in this mapping unit were dominated in the overstory by *Fraxinus pennsylvanica* and *Ulmus americana*, with understories dominated by *Bromus inermis*, *Poa pratensis*, *Symphoricarpos occidentalis* and often *Prunus virginiana*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

DECIDUOUS TREE WOODLAND
n=3

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	74	Perennial	17	Shrub	62
Annual	-	Annual/Biennial	4	Tree	51
Bromus inermis	40	*Toxicodendron rydbergii*	5	*Fraxinus pennsylvanica*	44
Poa pratensis	23	*Taraxacum officinale*	4	*Symphoricarpos occidentalis*	23
Agropyron repens	6	*Parietaria pensylvanica*	2	*Prunus virginiana*	14
Agropyron smithii	2	*Galium boreale*	1	*Shepherdia argentea*	7
Spartina pectinata	1			*Ulmus americana*	7
				Rosa woodsii	6
				Amelanchier humilis	6
				Cornus stolonifera	3
				Ribes setosum	2

n = number of samples

Ecological site condition of this mapping unit was five percent (low-poor) within the Study Area, based on 2007 cover data for the three sample sites, using NRCS (2003) guidelines for the Clayey ecological site in excellent condition.

Shrub density averaged 19,410 live stems per acre, of which 81 percent were *Symphoricarpos occidentalis*, six percent *Atriplex nuttallii*, six percent *Rosa arkansana*, and three percent were *Prunus virginiana*. Density of trees greater than one-inch dbh averaged 253 trees per acre for two sample sites, entirely *Fraxinus pennsylvanica* on the density quadrats sampled.

Shallow Clayey Native Grassland

The Shallow Clayey ecological site constitutes about six percent of native grassland acreage, occupying 50 acres (0.7 percent) of the Study Area. Two plots (including ten 10-point pin frames) were sampled on a midslope of six percent slope, and a ridge of 17 percent slope. Aspect was northerly and southwesterly for the two sample sites. Both sample sites were associated with the Wayden silty clay soil.

Plant communities sampled in this mapping unit included *Calamovilfa longifolia*/*Carex filifolia* and *Stipa comata*/*Carex filifolia*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

SHALLOW CLAYEY
n=2

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	72	Perennial	8	Shrub	3
Annual	-	Annual/Biennial	<1	Tree	-
Carex filifolia	32	*Solidago missouriensis*	2	*Rosa woodsii*	3
Calamovilfa longifolia	13				
Stipa comata	9				
Bouteloua gracilis	9				
Poa pratensis	5				
Koeleria pyramidata	4				
Poa sandbergii	2				

n = number of samples

Total annual production averaged 107.3 grams per square meter (958 pounds per acre), comprised of native perennial graminoid (74 percent relative production), introduced perennial grass (19 percent), shrub (four percent) and native perennial forb (two percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Shallow Clayey ecological site in fair condition to be 900 pounds per acre (80 percent graminoids), ranging from 600 to 1,300 pounds per acre. The two sample sites, however, compare more favorably with the plant composition described for the Shallow Sandy ecological site in fair condition (NRCS 2003). Ecological site condition of this mapping unit was 20 percent (high-poor) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Shallow Clayey ecological site in excellent condition. However, using Shallow Sandy guidelines, fair to high-fair condition would be indicated.

Shallow Loamy Native Grassland

The Shallow Loamy ecological site comprises 13 percent of native grassland acreage, occupying 104 acres (1.5 percent) of the Study Area. A total of 16 plots (including 80 10-point pin frames) were sampled, primarily on midslopes, upper slopes and ridges of moderate (10 to 25 percent) slope. Sample sites were on all aspects, most commonly southwesterly. The predominantly associated soils were the Cabba loam and Cabba silt loam soils.

Plant communities sampled in this mapping unit in good condition included Stipa comata/Carex filifolia in association with Calamovilfa longifolia or, occasionally, Bouteloua gracilis or Muhlenbergia cuspidata, and Andropogon scoparius/Carex filifolia in association with Calamovilfa longifolia or Stipa comata. Community types in fair condition included Agropyron smithii/Carex filifolia in association with Bouteloua gracilis and/or Buchloe dactyloides. Communities in poor condition were dominated by Buchloe dactyloides/Bouteloua gracilis. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

SHALLOW LOAMY
n=16

GRAMINOIDS		**FORBS**		**WOODY PLANTS**	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	65	Perennial	14	Shrub	1
Annual	<1	Annual/Biennial	2	Tree	-
Carex filifolia	15	*Selaginella densa*	2		
Bouteloua gracilis	12	*Antennaria microphylla*	2		
Buchloe dactyloides	8	*Artemisia frigida*	1		
Stipa comata	7	*Artemisia ludoviciana*	1		
Koeleria pyramidata	5	*Grindelia squarrosa*	1		
Agropyron smithii	5				
Calamovilfa longifolia	2				
Poa pratensis	2				
Agropyron dasystachyum	1				
Andropogon scoparius	1				
Muhlenbergia cuspidata	1				
Carex heliophila	1				
Stipa viridula	1				

n = number of samples

Total annual production averaged 114.0 grams per square meter (1,017 pounds per acre) for 14 clip plots harvested in the Study Area, almost entirely native perennial graminoid (89 percent relative production) and native perennial forb (10 percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the

Shallow Loamy ecological site in fair to low-good condition to be 1,300 pounds per acre (80 percent graminoids), ranging from 800 to 1,800 pounds per acre. Ecological site condition of this mapping unit was 33 percent (low-fair) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Shallow Loamy ecological site in excellent condition.

Shallow Sandy Native Grassland

The Shallow Sandy ecological site comprises about three percent of native grassland acreage, occupying 26 acres (0.4 percent) of the Study Area. Two plots (including ten 10-point pin frames) were sampled, on a midslope of 18 percent slope, and a ridge of 10 percent slope. Aspects were southerly. Both sample sites were associated with the Flasher sandy loam soil.

Plant communities sampled in this mapping unit included *Andropogon scoparius*/*Calamovilfa longifolia* and *Stipa comata*/*Calamovilfa longifolia*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

SHALLOW SANDY
n=2

GRAMINOIDS		**FORBS**		**WOODY PLANTS**	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	65	Perennial	7	Shrub	<1
Annual	-	Annual/Biennial	<1	Tree	-
Bouteloua gracilis	13	*Opuntia polyacantha*	1		
Stipa comata	13				
Calamovilfa longifolia	11				
Carex filifolia	7				
Andropogon scoparius	7				
Carex eleocharis	6				
Koeleria pyramidata	5				
Agropyron smithii	2				
Agropyron dasystachyum	1				
Poa sandbergii	1				

n = number of samples

Total annual production averaged 113.5 grams per square meter (1,013 pounds per acre), composed of native perennial graminoid (95 percent relative production) and native perennial forb (five percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Shallow Sandy ecological site in fair to low-good condition to be 1,200 pounds per acre (85 percent graminoids), ranging from 800 to 1,600 pounds per acre. Ecological site condition of this mapping unit was 35 percent (fair) within the Permit Boundary, based on 2006 annual production data (one plot), using NRCS guidelines for the Shallow Sandy ecological site in excellent condition.

Claypan Native Grassland

The Claypan ecological site constitutes 3.6 percent of native grassland acreage, occupying 28 acres (0.4 percent) of the Study Area. One plot (including five 10-point pin frames) was sampled on the bottom of a four percent slope and northwesterly aspect. The associated soil was the Daglum silty clay loam.

The sample site was in a *Hordeum jubatum*/*Distichlis spicata*/*Puccinellia nuttalliana* community type. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation).

CLAYPAN
n=1

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	62	Perennial	<1	Shrub	-
Annual	-	Annual/Biennial	1	Tree	-
Hordeum jubatum	20				
Distichlis spicata	15				
Poa glaucifolia	13				
Puccinellia nuttalliana	13				

n = number of samples

Total annual production for the one site sampled was 209.8 grams per square meter (1,872 pounds per acre), comprised entirely of native perennial graminoid. The NRCS correlates the Daglum silty clay loam soil with the Claypan ecological site, however, plant composition at the sample site is much more comparable to the description for the Saline Lowland ecological site. The NRCS (2003) has determined a representative value for total production in the Saline Lowland ecological site in fair condition to be 1,800 pounds per acre (91 percent graminoids), ranging from 1,300 to 2,300 pounds per acre. Ecological site condition of this mapping unit was 13 percent (poor) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Claypan ecological site in excellent condition.

Thin Claypan Native Grassland

The Thin Claypan ecological site is the largest component of native grassland in the Study Area (comprising 33 percent of native grassland acreage), occupying 262 acres (nearly four percent) of the Study Area. A total of 16 plots (including 80 10-point pin frames) were sampled, primarily on lower slopes and midslopes of gentle to moderate (one to 15 percent) slope. Sample sites were on all aspects, approximately half of them southerly. The associated soils were the Rhoades silty clay and Dogtooth silty clay loam.

Plant communities sampled in this mapping unit on moist sites included *Agropyron trachycaulum*/*Puccinellia nuttalliana* and *Distichlis spicata*/*Buchloe dactyloides*. Upland sites in good condition included *Agropyron smithii*/*Stipa viridula* and *Agropyron smithii*/*Stipa comata* communities, both in association with *Bouteloua gracilis* or *Buchloe dactyloides.* Sites in fair condition were *Agropyron smithii* (or *Agropyron dasystachyum*)/*Poa sandbergii* community types, usually in association with *Buchloe dactyloides*. Sites in low-fair condition were in *Agropyron smithii*/*Buchloe dactyloides* or *Agropyron smithii*/*Bouteloua gracilis* communities. Three sample sites represented *Artemisia cana*/*Agropyron smithii*, mostly in association with *Poa pratensis* and *Poa sandbergii* as subdominant species. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

THIN CLAYPAN
n=16

GRAMINOIDS		**FORBS**		**WOODY PLANTS**	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	60	Perennial	15	Shrub	3
Annual	<1	Annual/Biennial	7	Tree	-
Buchloe dactyloides	16	*Achillea millefolium*	3	*Artemisia cana*	3
Agropyron smithii	11	*Taraxacum officinale*	2		
Bouteloua gracilis	8	*Grindelia squarrosa*	2		
Poa sandbergii	6	*Vicia americana*	2		
Poa pratensis	6	*Thlaspi arvense*	1		
Koeleria pyramidata	3	*Selaginella densa*	1		
Poa juncifolia	2				
Stipa viridula	2				
Distichlis spicata	2				
Carex eleocharis	1				
Agropyron dasystachyum	1				
Agropyron cristatum	1				

n = number of samples

Total annual production averaged 118.6 grams per square meter (1,058 pounds per acre) for 14 clip plots harvested in the Study Area, composed of native perennial graminoid (79 percent relative production), native perennial forb (10 percent), introduced perennial grass (four percent), native annual/biennial forb (three percent), and introduced annual/biennial forb (two percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Thin Claypan ecological site in fair to low-good condition (80 percent of the 14 baseline sample sites) to be 650 pounds per acre (88 percent graminoids), ranging from 350 to 1,000 pounds per acre. In high-good to excellent condition (20 percent of baseline sample sites), the Thin Claypan ecological site can be expected to produce 800 pounds per acre (88 percent graminoids) varying from 400 to 1,200 pounds per acre. Ecological site condition of this mapping unit was 41 percent (mid-fair) within the Permit Boundary, based on 2006 annual production data (ten plots), using NRCS guidelines for the Thin Claypan ecological site in excellent condition.

Sandy Native Grassland

The Sandy ecological site comprises four percent of native grassland acreage, occupying 32 acres (0.4 percent) of the Study Area. A total of five plots (including 25 10-point pin frames) were sampled on lower to upper slopes of moderate to moderately steep (seven to 34 percent) slope. Sample sites were on northeasterly, easterly and southwesterly aspects. The associated soils were the Manning sandy loam and Parshall sandy loam.

Plant communities sampled in this mapping unit were predominantly *Stipa comata*/*Agropyron smithii*, variously in association with *Carex filifolia*, *Carex heliophila*, *Buchloe dactyloides* or *Bouteloua gracilis*. One sample site in good condition represented a *Calamovilfa longifolia*/*Stipa comata* community type with *Carex heliophila* subdominant. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

SANDY
n=5

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	65	Perennial	17	Shrub	<1
Annual	<1	Annual/Biennial	1	Tree	-
Buchloe dactyloides	10	*Artemisia ludoviciana*	5		
Stipa comata	9	*Selaginella densa*	4		
Bouteloua gracilis	9	*Taraxacum officinale*	1		
Carex heliophila	7				
Carex filifolia	6				
Poa pratensis	5				
Calamovilfa longifolia	4				
Agropyron smithii	3				
Carex eleocharis	3				
Agropyron cristatum	2				
Koeleria pyramidata	2				
Agropyron dasystachyum	1				

n = number of samples

Total annual production averaged 127.5 grams per square meter (1,138 pounds per acre), comprised of native perennial graminoid (72 percent relative production), native perennial forb (20 percent), and introduced perennial grass (eight percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Sandy ecological site in fair condition to be 800 pounds per acre (88 percent graminoids), ranging from 500 to 1,100 pounds per acre. In good condition, the Sandy ecological site can be expected to produce 2,200 pounds per acre (80 percent graminoids) varying from 1,400 to 3,000 pounds per acre. Ecological site condition of this mapping unit was 25 percent (high-poor to low-fair) within the Permit Boundary, based on 2006 annual production data (three plots), using NRCS guidelines for the Sandy ecological site in excellent condition.

Clayey Native Grassland

The Clayey ecological site is the second-most abundant native grassland type at approximately 15 percent of native grassland acreage, occupying 120 acres (two percent) of the Study Area. A total of eight plots (including 40 10-point pin frames) were sampled, primarily on terrace and lower slope positions of gentle (one to six percent) slope. Aspect was variable, commonly southerly. The predominantly associated soils were the Savage silty clay loam and Regent silty clay loam.

Plant communities sampled in this mapping unit were mostly in low-fair condition, including *Agropyron smithii*/*Buchloe dactyloides* and *Agropyron smithii*/*Bouteloua gracilis*, often with scattered *Artemisia cana*. Sites in better condition were *Agropyron smithii*/*Stipa comata* with *Bouteloua gracilis* in the understory. Three sample sites represented the *Artemisia cana*/*Agropyron smithii* community type, usually in association with *Poa pratensis*, *Bouteloua gracilis*, *Stipa comata* and/or *Stipa viridula*. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

CLAYEY
n=8

GRAMINOIDS		**FORBS**		**WOODY PLANTS**	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	74	Perennial	6	Shrub	5
Annual	<1	Annual/Biennial	2	Tree	-
Agropyron smithii	21	*Artemisia frigida*	2	*Artemisia cana*	5
Bouteloua gracilis	16	*Grindelia squarrosa*	1		
Buchloe dactyloides	14	*Achillea millefolium*	1		
Poa pratensis	6	*Gutierrezia sarothrae*	1		
Stipa comata	4				
Koeleria pyramidata	3				
Stipa viridula	3				
Poa sandbergii	3				
Carex eleocharis	2				
Distichlis spicata	2				

n = number of samples

Total annual production averaged 147.8 grams per square meter (1,318 pounds per acre), comprised of native perennial graminoid (81 percent relative production), introduced perennial grass (seven percent), native perennial forb (six percent), native annual/biennial forb (three percent), and shrub (two percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Clayey ecological site in fair condition to be 700 pounds per acre (88 percent graminoids), ranging from 400 to 900 pounds per acre. In good condition (one of the eight sample sites), the Clayey ecological site can be expected to produce 1,900 pounds per acre (89 percent graminoids) varying from 1,200 to 2,600 pounds per acre. Ecological site condition of this

mapping unit was 40 percent (mid-fair) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Clayey ecological site in excellent condition.

Loamy Native Grassland

The Loamy ecological site comprises four percent of native grassland acreage, occupying 31 acres (0.4 percent) of the Study Area. Two plots (including ten 10-point pin frames) were sampled on a terrace of one percent slope, and a 19 percent midslope of southerly aspect. The two sample sites were located in the Amor loam and Arnegard clay loam soils mapping units.

Plant communities sampled in this mapping unit included *Agropyron smithii*/*Bouteloua gracilis* associated with *Poa pratensis* or *Carex filifolia* as subdominant species. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

LOAMY
n=2

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	82	Perennial	3	Shrub	<1
Annual	<1	Annual/Biennial	1	Tree	-
Agropyron smithii	22				
Bouteloua gracilis	16				
Carex filifolia	14				
Poa pratensis	13				
Poa sandbergii	5				
Stipa comata	5				
Koeleria pyramidata	3				
Buchloe dactyloides	3				
Stipa viridula	2				
Carex eleocharis	1				
Agropyron cristatum	1				

n = number of samples

Total annual production averaged 222.3 grams per square meter (1,984 pounds per acre), primarily native perennial graminoid (75 percent relative production) and introduced perennial grass (23 percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Loamy ecological site in fair condition to be 700 pounds per acre (84 percent graminoids), ranging from 400 to 1,000 pounds per acre. In good condition, the Loamy ecological site can be expected to produce 2,200 pounds per acre (87 percent graminoids) varying from 1,300 to 3,000 pounds per acre. Ecological site condition of this mapping unit was 47 percent (high-fair) within the Permit Boundary, based on 2006 annual production data, using NRCS guidelines for the Loamy ecological site in excellent condition.

Loamy Overflow Native Grassland

The Loamy Overflow ecological site comprises 0.6 percent of native grassland acreage, occupying five acres (<0.1 percent) of the Study Area. Four plots (including twenty 10-point pin frames) were sampled on low terrace drainages of two percent slope. Aspect was northerly and northwesterly, according to the general direction of drainage. All four sites were associated with the Havrelon silt loam (channeled) soils mapping unit.

Plant communities sampled in this mapping unit were all low-shrub woodland types, including three *Symphoricarpos occidentalis*/*Poa pratensis* sample sites and one *Symphoricarpos occidentalis*/*Bromus inermis* site. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

LOAMY OVERFLOW
n=4

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	33	Perennial	15	Shrub	49
Annual	-	Annual/Biennial	-	Tree	<1
Poa pratensis	17	*Euphorbia esula*	8	*Symphoricarpos occidentalis*	46
Bromus inermis	13	*Artemisia ludoviciana*	4	*Artemisia cana*	2
Agropyron smithii	1	*Cirsium arvense*	2	*Rosa woodsii*	2
Stipa viridula	1				

n = number of samples

Total annual production for the one clip plot was 677.0 grams per square meter (6,041 pounds per acre), comprised of introduced perennial grass (75 percent relative production), shrub (21 percent), and introduced perennial forb (four percent). A more realistic expectation of total production for the Loamy Overflow site in low-fair to mid-fair condition, using NRCS long-term average annual production data, would be 2,700 pounds per acre ("representative value"), ranging from 2,000 to 3,400 pounds per acre (NRCS 2003). Ecological site condition of this mapping unit was three percent (low-poor) within the Permit Boundary, based on 2006 annual production data, and ten percent (mid-poor) using relative cover composition for all four Study Area plots collectively, using NRCS guidelines for the Loamy Overflow ecological site in excellent condition.

Shrub density averaged 141,900 live stems per acre, of which 98 percent were *Symphoricarpos occidentalis*, one percent *Artemisia cana*, and one percent were *Rosa woodsii*.

Loamy Terrace Composite Native Grassland

The Loamy Terrace Composite ecological site combines four sample sites in the indeterminate "Loamy Terrace (occasionally Clayey Terrace)" mapping unit with 21 sample sites in the Loamy Terrace ecological site to facilitate data interpretation. The combined mapping unit comprises 14.5 percent of native grassland acreage, occupying 116 acres (1.6 percent) of the Study Area. A total of 25 plots (including 105 10-point pin frames) were sampled on terraces and low benches of gentle (zero to four percent) slope, and variable aspect (but not southwesterly). The Loamy Terrace site was primarily associated with the Havrelon silt loam (saline/sodic substratum) soil, and occasionally with the Shambo loam (saline/sodic substratum), Fluvents silt loams and silty clay loams, and Fluvents silt loams and silty clay loams (saline/sodic substratum) soils.

Plant communities sampled in this mapping unit were primarily shrub/grassland communities. These included *Artemisia cana*/*Agropyron smithii* (52 percent of sample sites) in association with *Poa pratensis* and *Bouteloua gracilis* or *Stipa viridula* as subdominant species. *Symphoricarpos occidentalis*/*Poa pratensis* represented 20 percent of sample sites. Grassland sites sampled (20 percent of sample sites) included *Agropyron smithii*/*Poa pratensis* (often with *Stipa viridula* subdominant), one site in *Agropyron smithii*/*Stipa comata*, and one *Spartina pectinata*/*Carex laeviconica* site. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

LOAMY TERRACE COMPOSITE (WITH OCCASIONALLY CLAYEY TERRACE)
n=25

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	73	Perennial	7	Shrub	15
Annual	<1	Annual/Biennial	4	Tree	<1
Agropyron smithii	20	*Artemisia ludoviciana*	2	*Artemisia cana*	8
Poa pratensis	20	*Achillea millefolium*	1	*Symphoricarpos occidentalis*	7
Bouteloua gracilis	9	*Grindelia squarrosa*	1		
Stipa viridula	6	*Medicago lupulina*	1		
Stipa comata	2				
Agropyron cristatum	2				
Carex eleocharis	2				
Bromus inermis	2				
Carex laeviconica	2				
Spartina pectinata	2				
Koeleria pyramidata	1				
Poa sandbergii	1				
Agropyron dasystachyum	1				
Carex brevior	1				

n = number of samples

Total annual production averaged 213.4 grams per square meter (1,904 pounds per acre) for 14 clip plots harvested in the Study Area, primarily native perennial graminoid (75 percent relative production), introduced perennial grass (10 percent), shrub (8 percent), and native perennial forb (six percent). Based on compilation of long-term annual production data, the NRCS (2003) has determined a representative value for total production in the Loamy Terrace ecological site in poor to low-fair condition to be 1,000 pounds per acre (80 percent graminoids), ranging from 700 to 1,400 pounds per acre. In fair condition, with a conspicuous shrub component, the Loamy Terrace ecological site can be expected to produce 2,600 pounds per acre (72 percent graminoids) varying from 1,700 to 3,500 pounds per acre. Ecological site condition of this mapping unit was 34 percent (mid-fair) within the Permit Boundary (11 plots), based on 2006 annual production data, using NRCS guidelines for the Loamy Terrace ecological site in excellent condition.

Tame Pasture Vegetation Type

The Tame Pasture Vegetation Type (excluding CRP land) occurs on 564 acres (7.9 percent) of the Study Area. A total of 47 plots (including 235 10-point pin frames) were sampled, virtually on all topographic positions from terraces to lower, middle and upper slopes and ridges. Slopes were mostly gentle (one to seven percent slope) and occasionally moderate (12-15 percent slope), occupying all aspects. The 47 Tame Pasture sample sites were associated with a wide variety of soils, totaling 20 different soils mapping units, and 9 distinct ecological sites. The predominantly associated soils included the Daglum silty clay loam, Arnegard clay loam, Cabba loam, Tally sandy loam and Savage silty clay loam soils.

Plant communities sampled in this mapping unit include formerly cultivated areas seeded, or rangeland interseeded, with *Agropyron cristatum* and/or *Bromus inermis*. The most common Tame Pasture community was dominated by *Agropyron cristatum*, with *Bromus inermis* subordinate (14 plots, or 30 percent of Tame Pasture sample sites), of which three sites had *Buchloe dactyloides* as a subdominant species. Occasionally (three plots), Tame Pasture sites were essentially an *Agropyron cristatum* monoculture. Eleven plots (23 percent of Tame Pasture plots) represented "go-back" Tame Pasture where native grasses were co-dominant with *Agropyron cristatum*, including *Agropyron cristatum*/*Buchloe dactyloides* (seven plots), *Agropyron cristatum*/*Stipa comata* (four plots) and *Agropyron cristatum*/*Bouteloua gracilis* (two plots). Mesic *Agropyron cristatum* go-back sites represent *Agropyron cristatum*/*Poa pratensis* (two plots), and *Agropyron cristatum*/*Symphoricarpos occidentalis* (two plots) communities. A number of Tame Pasture fields (eight plots, or 17 percent of Tame Pasture sample sites) are dominated by *Bromus inermis*, with *Agropyron cristatum* subordinate; of these, four plots had *Poa pratensis* as a subdominant species, and one plot had *Koeleria pyramidata* subdominant. Go-back *Bromus inermis* Tame Pasture included *Bromus inermis*/*Stipa comata* (one plot), and on mesic sites, *Bromus inermis*/*Poa pratensis* (three plots) and *Bromus inermis*/*Symphoricarpos occidentalis* (two plots) communities. Plant species dominance is shown below, based on mean percent canopy cover (ocular estimation) rounded to the nearest percent.

TAME PASTURE
n=47

GRAMINOIDS		FORBS		WOODY PLANTS	
Class/Species	Percent Cover	Class/Species	Percent Cover	Class/Species	Percent Cover
Perennial	68	Perennial	5	Shrub	3
Annual	<1	Annual/Biennial	1	Tree	-
Agropyron cristatum	28			*Symphoricarpos occidentalis*	3
Bromus inermis	15				
Poa pratensis	8				
Buchloe dactyloides	6				
Stipa comata	2				
Bouteloua gracilis	2				
Agropyron smithii	2				
Koeleria pyramidata	1				
Carex eleocharis	1				
Agropyron repens	1				

n = number of samples

Total annual production averaged 228.5 grams per square meter (2,039 pounds per acre) for 34 clip plots harvested, comprised of introduced perennial grass (82 percent relative production), native perennial graminoid (10 percent), shrub (5 percent), and native perennial forb (2 percent).

2.7.2.3.3 Cropland

Acreage that is currently cropped comprises about 70 percent (4,991 acres) of the Study Area (Table 2.7.2-7), with about 70 percent in cultivated annual crops, two percent in mixed hay, one percent in grass hay, one percent in alfalfa hay, and 25 percent in CRP pasture.

The Pre-mining Land Use Study (Section 2.7.1) includes substantially more detailed cropland mapping, as well as detailed crop productivity information (five-year on-site yields, and USDA 30-year county yield statistics), cropping practices (2002-2006), and landowner/ operator interviews.

2.7.2.3.4 Shelterbelts

Sixteen shelterbelts (including windbreaks) or shelterbelt complexes were identified and inventoried, comprising about 35 acres or 0.50 percent of the Study Area. Table 2.7.2-8 lists species, number of shrubs or trees, spacing, condition and age class for each shelterbelt. Acreage of each shelterbelt by landowner is presented in Table 2.7.2-9. Figure 2.7.2-4 shows an overview of the shelterbelts and identification codes. Each shelterbelt is presented by landowner, and species composition by row, in Figure 2.7.2-5 through Figure 2.7.2-20. Understory composition is also shown for each shelterbelt.

Many of the shelterbelts were planted in the 1950's and 1960's and are becoming decadent with substantial mortality of Siberian elm and Russian olive. An extremely strong windstorm on June 30, 2006 resulted in much blowdown in older shelterbelts.

Newer plantings, generally within the last five to twenty years (SB-02, SB-04B, SB-07A, SB-09B, SB-10, parts of SB-12A, SB-14 and SB-15), have relied more heavily on native species including ponderosa pine, green ash, Rocky Mountain juniper, common chokecherry and wild plum. These plantings with native species, in combination with the ubiquitous and hardy Siberian pea-shrub, are in good condition.

2.7.2.3.5 Species List/Plant Species of Concern

Appendix A is a list of vascular plant taxa identified during the 2006 to 2007 quantitative and mapping inventory of the Study Area. A total of 353 taxa were identified, with forbs (231 species) comprising the majority (65 percent). Forbs included 149 perennial taxa (130 native, 16 introduced

and three fern allies), and 82 annual/biennial taxa (59 native and 23 introduced). Of 76 grasses and grass-like plants identified (22 percent of the total), there were 64 perennial taxa (54 native and 10 introduced), and 12 annual grass taxa (three native and nine introduced). The 46 woody plant taxa (13 percent of the total) recorded in the Study Area included 29 shrubs and vines (24 native) and 17 tree species (nine native).

No federally listed or proposed endangered or threatened plant species were identified within the Study Area. The North Dakota Parks and Recreation Department (Hanson 2006) reviewed records of the North Dakota Natural Heritage Inventory (NDNHI) indicating the presence of sensitive plant species within a 20-mile buffer of the Study Area, as listed in Table 2.7.2-10. No sensitive plant occurrences have been recorded by the NDNHI within the Study Area, and of the seven species listed within the 20-mile buffer, none were found during the South Heart vegetation baseline inventory.

2.7.2.3.6 Significant Ecological Communities

The NDNHI database (Hanson 2006) was searched for records of Significant Ecological Communities within a 20-mile buffer of the Study Area. The results indicated that 14 such communities are present within a 20-mile buffer of the Study Area (Table 2.7.2-10). The NDNHI has records for three of these communities within the Study Area, including *Artemisia cana/Agropyron smithii* sparse shrubland (one record), *Fraxinus pennsylvanica-Ulmus americana/Symphoricarpos occidentalis* forest (five records), and *Symphoricarpos occidentalis* shrubland (one record).

Various representations of the three communities listed above were sampled during the 2006 to 2007 South Heart vegetation baseline study. An additional five of the fourteen NDNHI-listed communities in Table 2.7.2-10 were sampled during the vegetation baseline inventory (see Appendix B for ocular cover values by plot). A synopsis of baseline plots which represent the eight NDNHI-listed communities is shown below (plot locations are shown on Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C). It should be noted that many of these sample sites are not good or even fair representations of "Significant Ecological Communities", in that herbaceous understories are often invaded and dominated by introduced perennial grasses, weedy annual/biennial species, and occasionally noxious weeds (introduced perennial forbs). For example, of 32 baseline sample sites in the Riparian Woodland type, many do not fairly represent NDNHI's "western floodplain forest" (the *Fraxinus pennsylvanica-Ulmus americana/Symphoricarpos occidentalis* community), because *Ulmus americana* and/or *Symphoricarpos occidentalis* are absent or present in only trace amounts as a result

of intense, sustained grazing and other management practices (perhaps in combination with drought cycles), leading to understories commonly dominated by exotics such as *Bromus inermis* and *Poa pratensis.*

NDNHI-listed Significant Ecological Communities	**Baseline Sample Site[1] (Exhibit 2.7.2-1A, Exhibit 2.7.2-1B and Exhibit 2.7.2-1C)**	**n**
Agropyron smithii –Bouteloua gracilis–Carex filifolia Prairie	SwLy-1, 3, 12 Sy-2 Cy-8 Ly-1,2 LyT-19	3 1 1 2 1
Artemisia cana/Agropyron smithii Shrubland	TCp-6, 8, 9, 10 Cy-4, 6, 7 LyT-5, 7, 8, 9, 10, 11, 12, 13, 15, 18, 21	4 3 11
Distichlis spicata –-Hordeum jubatum–Puccinellia nuttalliana Saline Meadow	SL-1, 7, 9 Cp-1	3 1
Fraxinus pennsylvanica – Ulmus americana/Prunus virginiana Woodland	DTW-2, 3 (DTW-1)	2 1
Fraxinus pennsylvanica – Ulmus americana/Symphoricarpos occidentalis Forest	RW-3, 16, 21, 24 (RW-8, 13, 17, 18, 19, 28)	4 6
Shepherdia argentea Shrubland	Qualitative Riparian Woodland inclusions	N/A
Stipa comata –Bouteloua gracilis–Carex filifolia Prairie	SwCy-2 SwLy-4, 7, 9, 11, 15 Sy-3, 4	1 5 2
Symphoricarpos occidentalis Shrubland	Qualitative Riparian Woodland inclusions	N/A

[1]Plots in parentheses qualify only marginally at best.
n = number of samples

2.7.2.3.7 Similarity Index (Range Condition) and Utility

Table 2.7.2-5 identifies the ecological site and soil mapping unit for each vegetation plot sampled in the Study Area in 2006 to 2007. Annual production data were collected on-site, and are presented by sample site in Appendix C and summarized in Appendix C11. These data were converted to relative production values as presented in Appendix C12. Similarity index (i.e., range condition) was calculated for each sample site by tract and landowner using these production data transposed to current NRCS SI form ND-CPA-20 and instructions (NRCS 2007a). These forms and a summary table are presented in Table 2.7.2-3. Similarity index was calculated for each ecological site based on information presented in recent NRCS technical guides (NRCS 2003). These data provide an

assessment of the condition of grazing land within the Permit Boundary, in relation to the "historic climax plant community" (NRCS 2003 technical guides). Condition values in Table 2.7.2-3 are briefly summarized below.

Ecological Site/ Vegetation Type	Average Condition (Percent)	n
GROUP 1 - HIGH WATER TABLE		
Saline Lowland-Wet Land- Subirrigated	20	4
Loamy Overflow-Subirrigated-Wet Land	2	1
Wet Land-Wet Meadow	18	4
WOODLAND		
Riparian Woodland	1	6
GROUP 2 - SHALLOW AND VERY SHALLOW		
Shallow Clayey	20	1
Shallow Loamy	33	8
Shallow Sandy	35	1
GROUP 3 - CLAYPAN		
Claypan	13	1
Thin Claypan	41	10
GROUP 4 - SANDY		
Sandy	25	3
GROUP 5 - CLAYEY		
Clayey	40	8
GROUP 6 - LOAMY		
Loamy	47	1
Loamy Overflow	3	1
Loamy Terrace	34	11

n = number of samples within the Permit Boundary

Range condition varied considerably among ecological sites within the Permit Boundary. Condition in the High Water Table group collectively averaged about 11 percent (poor condition), ranging from very poor at 1 percent in the Riparian Woodland type to poor at 18 percent in the Wet Meadow and 20 percent in the Saline Lowland ecological sites (Table 2.7.2-3).

Condition of the Shallow group was about 32 percent (low-fair) collectively, ranging from 20 percent (high-poor) for the Shallow Clayey ecological site to 33 and 35 percent (mid-fair) for the Shallow Loamy and Shallow Sandy sites, respectively.

Condition of the Claypan group collectively averaged about 39 percent (mid-fair), ranging from 13 percent for one sample in the Claypan ecological site to 41 percent (high-fair) for 10 samples in the Thin Claypan ecological site.

Three samples in the Sandy ecological site averaged 25 percent (low-fair) condition, and eight samples in the Clayey ecological site averaged 40 percent (mid-fair).

Three ecological sites in the Loamy group varied greatly in condition ratings, with one sample in the Loamy Overflow site reflecting the very poor rating of similar High Water Table sample sites at 3 percent condition. Higher condition was indicated for a sample in the Loamy ecological site at 47 percent (high-fair) and eleven samples in the Loamy Terrace ecological site (excluding Riparian Woodland samples) at 34 percent condition (mid-fair).

Range condition cannot technically be calculated for Special Use Pasture, as any land tilled and seeded for tame pasture or cropland is not considered to represent an ecological site due to soil disturbance and, typically, the deliberate seeding of exotic species.

2.7.2.3.8 Plant Species Diversity

The diversity of vascular plant species was evaluated by determining the average number of species per ocular cover plot in each ecological site/vegetation type (Appendix G). It should be cautioned that these tallies are dependent on sample size. However, for types with similarly large samples, such as Riparian Woodland (n=32) and Tame Pasture (n=47), Table 2.7.2-7 provides a reasonable assessment of the relative diversity of species by class among the various types.

2.7.2.3.9 Weeds

Problematic weeds are annotated as such in Appendix A of this report. State-listed noxious weeds (North Dakota Century Code chapter 63-01.1 Article 7-06 2007) encountered in the Study Area included:

- Absinth wormwood (*Artemisia absinthium*);
- Canada thistle (*Cirsium arvense*);
- Field bindweed (*Convolvulus arvensis*);
- Leafy spurge (*Euphorbia esula*); and
- Spotted knapweed (*Centaurea maculosa*).

Noxious weeds are discussed in the Pre-mining Land Use Study (Section 2.7.1).

2.7.2.4 *Summary of Vegetation Resources within the Permit Boundary*

Vegetation types and communities, associated soils, and site characteristics described in the Results Section 2.7.2.3 are representative of the vegetation within the Permit Boundary. These results are summarized below for vegetation within the Permit Boundary.

The ecological groups, vegetation types and the number of sample sites located within the Permit Boundary are presented in Table 2.7.2-1. Based on intensity of livestock utilization, selected sample sites were clipped to determine annual production and similarity index (formerly range condition). Similarity index of Native Grasslands were calculated using NRCS guidelines and derived from annual production data presented in Appendix C. The results are presented in Table 2.7.2-3 by tract/landowner. Data were collected where possible; however, many of these sites were heavily grazed and unsuitable for clipping. As a result, ecological site condition was calculated using cover data for these sites. Where samples were clipped, production for the plant community is identified in pounds per acre and the similarity index is calculated by tract/landowner. Common names for each vegetation species are identified in Appendix A.

Point-intercept cover data for each vegetation type and species are presented in Table 2.7.2-2. Soil mapping units associated with the ecological sites are identified in Table 2.7.2-5. Soils within the Permit Boundary vary considerably and are described in more detail in Section 2.4. Acreage for each vegetation type/land use is presented in Table 2.7.2-6 by landowner and in Table 2.7.2-7 by ecological site/vegetation type. Acreage for soil mapping units, including tame pasture and cropland, are presented by land use in the Land Use Section Appendix 2.7.1-1. Information from these tables is summarized below.

Cropland

Approximately 68 percent of the area (3,104 acres) within the Permit Boundary is cropland. Cropland occurs predominantly on Lawther silty clay and Manning sandy loam soils (Appendix 2.7.1-1). Cultivated annual crops are the most common cropland type within the Permit Boundary. Crop production, average yield and crop land use are described in detail in Section 2.7.1.

Native Grassland

Approximately 603 acres (13 percent) within the Permit Boundary are native grasslands. The most abundant native grassland within the Permit Boundary occurs in the Thin Claypan ecological site (Claypan Ecological Group). Thin Claypan occurs primarily on lower slopes and midslopes of gentle to moderate slope. The corresponding soil series for the Thin Claypan ecological site include Rhoades silty clay and Dogtooth silty clay loam. Depending on range condition and soil moisture, the seven primary grassland communities are collectively dominated by buffalograss (*Buchloe dactyloides),* western wheatgrass (*Agropyron smithii),* blue grama *(Bouteloua gracilis),* sandberg's bluegrass *(Poa sandbergii)* and Kentucky bluegrass (*Poa pratensis).* Using NRCS guidelines, Thin Claypan is in high-fair ecological site condition within the Permit Boundary.

The second-most abundant native grassland within the Permit Boundary occurs in the Clayey ecological site (Clayey Group). The Clayey ecological site occurs primarily on terraces and gentle lower slopes. The primary soil series associated with the Clayey ecological site include Regent silty clay loam and Savage silty clay loam. The four primary plant communities are collectively dominated by western wheatgrass, blue grama, buffalograss and Kentucky bluegrass. Using NRCS guidelines, Clayey is in mid-fair ecological site condition within the Permit Boundary.

The third-most abundant native grassland within the Permit Boundary occurs in the Loamy Terrace ecological site (Loamy Group). The Loamy Terrace ecological site occurs primarily on terraces and low benches of gentle slope. Havrelon silt loam (saline/sodic substratum) is the most common soil series associated with the Loamy Terrace ecological site. The dominant plant communities are primarily shrub/grassland community types, collectively dominated by western wheatgrass, Kentucky bluegrass, blue grama, silver sagebrush (*Artemisia cana),* western snowberry (*Symphoricarpos occidentalis*), and green needlegrass (*Stipa viridula*). Using NRCS guidelines, Loamy Terrace is in mid-fair ecological site condition within the Permit Boundary.

Tame Pastureland

Approximately 275 acres (6 percent) within the Permit Boundary are Tame Pastureland. Tame Pastureland includes lands seeded (or perhaps in some cases interseeded) with various mixes of introduced perennial grass and/or forb species. Tame Pastureland is used primarily for livestock grazing but occasionally mowed for hay. Tame Pasturelands occur on terraces and lower to upper slopes of gentle to moderate slope and are associated with a wide variety of soils including Daglum silty clay loam, Arnegard clay loam, Cabba loam, Tally sandy loam and Savage silty clay loam.

Tame Pasture sites are collectively dominated by crested wheatgrass (*Agropyron cristatum),* Kentucky bluegrass, smooth brome *(Bromus inermis)* and buffalograss.

Woodland

Approximately 309 acres (7 percent) within the Permit Boundary are Woodlands. These areas are commonly grazed as part of established pastures. The most abundant woodland type within the Permit Boundary is Riparian Woodland which occurs primarily on the floodplain of the South Branch Heart River. The most common soils associated with Riparian Woodland include River Channels, Havrelon silt loam (saline/sodic substratum), Havrelon silt loam, Entic Haplustolls silt loams and silty clay loams (saline/sodic substratum) and Entic Haplustolls silt loams and silty clay loams. The overstory is predominantly comprised of green ash *(Fraxinus pennsylvanica),* boxelder *(Acer negundo)* and American elm (*Ulmus americana*). The understories are dominated by smooth brome, Kentucky bluegrass and western snowberry.

Deciduous tree species in the Riparian Woodland type generally range from 40 to 60 feet tall and are in late-mature to decadent age structure (perhaps 100 – 150+ years old), with abundant evidence of heart rot and resultant blow-down particularly as the result of a very intense wind storm June 30, 2006. During the field studies it was apparent that there was a low recruitment of tree seedlings throughout the riparian woodland type.

Shrub and Tree density for woodland and loamy overflow sites are presented in Table 2.7.2-4. The density of low shrub species in Riparian Woodland is predominantly comprised of mature western snowberry and wood's rose *(Rosa woodsii).* Tall shrub density is primarily comprised of mature common chokecherry *(Prunus virginiana).* Tree density in the Riparian Woodland type is primarily comprised of green ash and boxelder.

Shelterbelts

Approximately 25 acres (0.6 percent) within the Permit Boundary are shelterbelts. Shelterbelt locations, the number of rows and the species identified at each shelterbelt location are shown in detail on Figures 2.7.2-4 through Figures 2.7.2-20. The number, age, height and condition of shrubs and trees for each shelterbelt are presented in Table 2.7.2-8. Acreages of shelterbelts are presented for each landowner within the Permit Boundary in Table 2.7.2-9. Siberian elm (*Ulmus pumila)* and Siberian pea-shrub (*Caragana arborescens)* are the most common shelterbelts. Siberian elm was planted during the 1950's and 1960's and is mostly decadent in age. It ranges in height from

15-50 feet and is in poor to fair condition. The hardy Siberian pea-shrub is in mostly mature good condition, and ranges in height from 6-14 feet.

Wetlands

Wetlands within the Permit Boundary are described in detail in Section 2.10-1. Wetland vegetation occupies approximately 51 acres (1 percent) within the Permit Boundary. Herbaceous wetland, the most abundant wetland within the Permit Boundary, is primarily associated with the Saline Lowland – Wet Land –Subirrigated and Wet Land-Wet Meadow ecological site complexes (High Water Table ecological group). These sites_occur primarily on drainage bottoms and swales of gentle slope. The predominantly associated soils include Saline Silty Clay Loam, Wayden Silty Clay, Arnegard clay loam, Cabba loam, and Lallie silty clay. The dominant plant species on Wetland sites generally include smoothcone sedge (*Carex laeviconica*), prairie cordgrass (*Spartina pectinata*), foxtail barley (*Hordeum jubatum*), inland saltgrass (*Distichlis spicata*), Nuttall's alkaligrass (*Puccinellia nuttalliana*), common spikesedge (*Eleocharis xyridiformis*) and clustered field sedge (*Carex praegracilis*). Using NRCS guidelines, Wetland sites are generally in poor ecological site condition within the Permit Boundary.

Plant Species List

The vegetation baseline study included a review of the area within the Permit Boundary for the occurrence of rare, endangered, noxious, or poisonous plant species in accordance with Section 69-05.2-08-08 ((1)(b). No federally listed or proposed, endangered or threatened plant species were identified within the Permit Boundary. The occurrence of endangered or threatened species was determined by pedestrian traverses of the study area and quantitative sampling throughout the study area and compared to the records of the NDNHI (Hanson 2006).

Records of the NDNHI reviewed by the North Dakota Parks and Recreation Department (Hanson 2006) indicated the historical presence of sensitive (rare) plant species within a 20-mile buffer of the Study Area, as listed in Table 2.7.2-10. No sensitive plant occurrences have been recorded by the NDNHI within the Permit Boundary, and of the seven species listed within the 20-mile buffer, none were found during the vegetation baseline inventory.

The NDNHI database (Hanson 2006) was searched for records of Significant Ecological Communities within a 20-mile buffer of the Study Area. These records are discussed in Section 2.7.2.3.6. In summary, these sample sites are not good or even fair representations of

"Significant Ecological Communities" due to invasive perennial grasses, weedy annual/biennial species, and occasionally noxious weeds dominating the herbaceous understories.

Noxious or declared weeds listed by Stark County were assessed for distribution and abundance. A comprehensive list of vascular plant species, including noxious weeds and plants poisonous to livestock, identified during the vegetation baseline inventory is presented in Appendix A by land use. Noxious weeds encountered include absinth wormwood (*Artemisia absinthium*), Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis*), leafy spurge (*Euphorbia esula*),and spotted knapweed (*Centaurea maculosa*). Poisonous plants include hemp dogbane (*Apocynum cannabinum*), showy milkweed (*Asclepias speciosa*), two-grooved milkvetch (*Astragalus bisulcatus*), spotted water-hemlock (*Cicuta maculata*), broom snakeweed (*Gutierrezia sarothrae*), purple locoweed (*Oxytropis lambertii*), silky locoweed (*Oxytropis sericea*), smooth horsetail (*Equisetum laevigatum),* common cocklebur (*Xanthium strumarium),* common chokecherry (*Prunus virginiana*), and ponderosa pine (*Pinus ponderosa*). None of these species is believed to pose a significant threat to livestock due to the general lack of abundance and/or availability within the Permit Boundary.

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LIST OF VASCULAR PLANT SPECIES IDENTIFIED –

VEGETATION STUDY AREA
STARK COUNTY, NORTH DAKOTA, 2006-2007

APPENDIX B

PERCENT CANOPY COVER/CONSTANCY BY PLOT FOR ECOLOGICAL SITES, WOODLAND AND TAME PASTURE

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SHRUB AND TREE CANOPY COVER BY SAMPLE SITE FOR WOODLAND SITES

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AVERAGE NUMBER OF SPECIES PER PLOT FOR ECOLOGICAL SITES, WOODLAND AND TAME PASTURE