BENTONITE
Performance Minerals LLC
Colony, Wyoming Plant
554 US Hwy 212,
Belle Fourche, SD 57717
Phone (307)896-2596/Fax (307)896-4588

June 17, 2024

Eric Holm
Engineer III
Department of Agriculture and Natural Resources
Minerals and Mining Program
523 East Capitol Ave.
Pierre, SD 57501

Dear Eric Holm:

Bentonite Performance Minerals, LLC (BPM) is submitting the enclosed Special, Exceptional, Critical, or Unique Lands Determination Request for Larsen Project report and supporting baselines in accordance with ARSD 74:29:10 for the Larsen bentonite project located west of Belle Fourche, South Dakota. BPM intends to submit a large scale mine permit application to the South Dakota Department of Agriculture and Natural Resources in the fourth quarter of 2024.

Should there be any questions, please give me a call at 307.896.8507 or reach out to Jennifer.Henson@Halliburton.com

Sincerely,

Jennifer Henson

Jennifer Henson
Environmental Specialist

Enclosures:
(1) Special, Exceptional, Critical, or Unique Lands Determination Request

Special, Exceptional, Critical, or Unique Lands Determination Request for the Larsen Project

MAY 2024

PREPARED FOR

Bentonite Performance Minerals, LLC

PREPARED BY

SWCA Environmental Consultants

SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS DETERMINATION REQUEST FOR THE LARSEN PROJECT

Prepared for

Bentonite Performance Minerals, LLC
554 U.S. Highway 212
Belle Fourche, South Dakota 57717
Attn: Jennifer Hensen

Prepared by

Melissa Arnold, Mining Environmental Scientist
and
Lecia Craft, Mining Project Manager

SWCA Environmental Consultants
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Sheridan, Wyoming 82801
(307) 673-4303
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SWCA Project No. 71676

May 2024

CONTENTS

Appendices

Figures

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SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS (ARSD 74:29:10:03(6))

Bentonite Performance Minerals, LLC (BPM), proposes to establish a bentonite mine in Butte County, South Dakota, referred to as the Larsen Project (project). The project lies between Colony, Wyoming, to the west and Belle Fourche, South Dakota, to the east. The project is located on private lands in southwestern Butte County approximately 7 miles northwest of Belle Fourche along U.S. Highway 212. The project is in portions of Sections 2, 3, and 11, Township 9 North, Range 1 East and encompasses approximately 307 acres. Within the project, approximately 228 acres are proposed as being disturbed.

The project and adjacent lands are located in a rural, undeveloped setting used primarily for cattle grazing and historic and active bentonite mining. The project is similar to the surrounding area from a topographic, scenic, historic, and geologic standpoint. No ecologically fragile areas were identified, and existing reclamation techniques will allow the land to be returned to a similar ecological state. Impacts from the project will be temporary in nature, as once mining has been completed, the area will be reclaimed to the standards outlined in the Administrative Rules of South Dakota (ARSD 74:29:07).

This project overlies portions of the Shear/Clarkson East boundary, Permit 471. Permit 471 has been approved for mining by the South Dakota Department of Agricultural and Natural Resource (SD DANR), and there were no areas declared as special, exceptional, critical, or unique (SECU) lands within the Shear/Clarkson East boundary at the time of the approval. This SECU report documents that there have been no significant changes in conditions since the last SECU determination was made, and there are no areas that should be declared as SECU lands.

Appendix 1 provides a Request for Determination Special, Exceptional, Critical, and Unique Lands; Appendix 2 is a cultural resources inventory; Appendix 3 provides a soil survey; Appendix 4 provides a wildlife and vegetation report; Appendix 5 provides a baseline hydrology report; and Appendix 6 provides a socioeconomic report.

Project Map (ARSD 74:29:10:03(3))

Figure 1 shows the general location of the project. The project will be accessed via U.S. Highway 212. Figure 2 shows the general topography, adjacent roads and surrounding lands, surface ownership within and 500 feet adjacent to the project (project buffer), water features in the general area, and the proposed project disturbance.

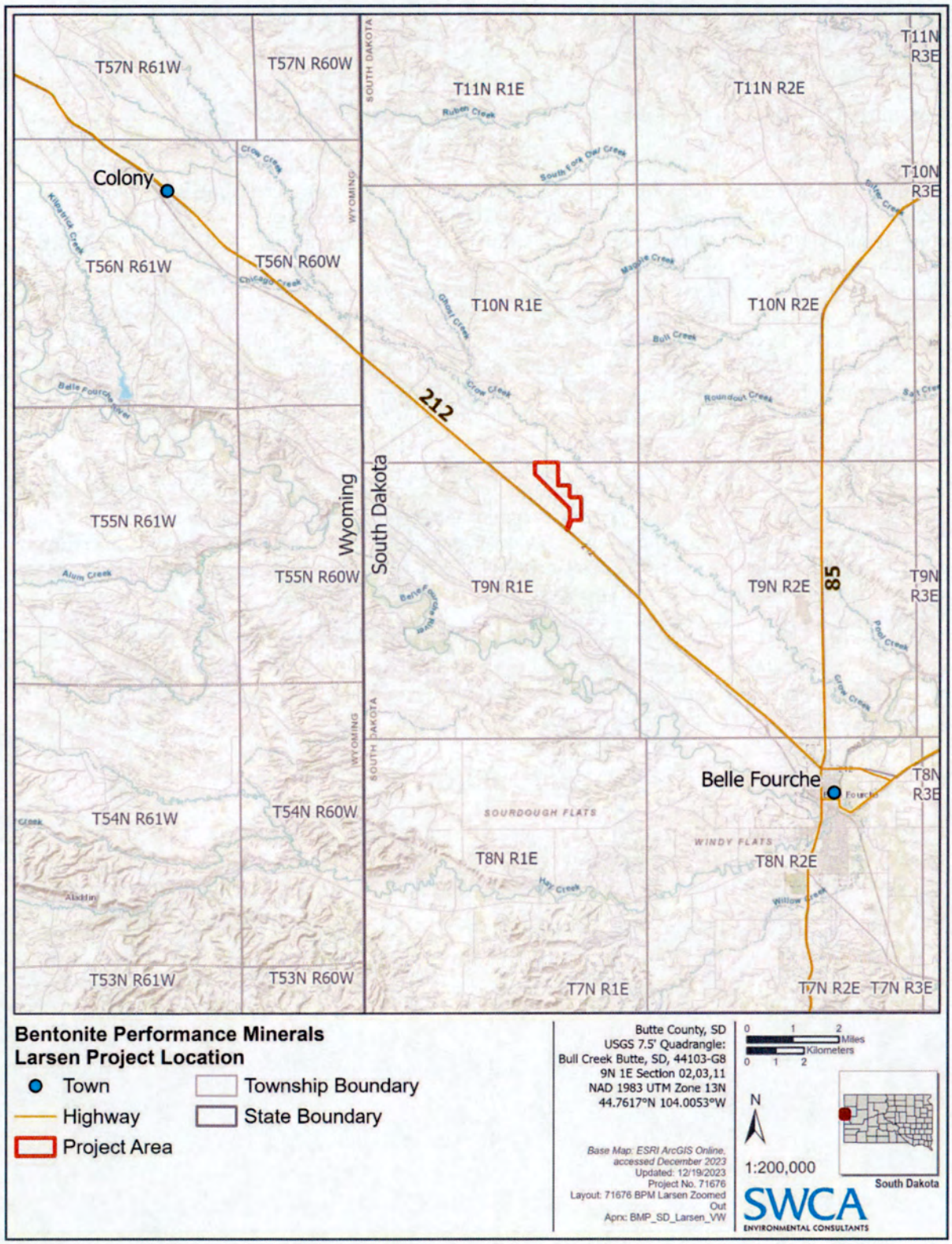

Figure 1. General location of the Larsen Project.

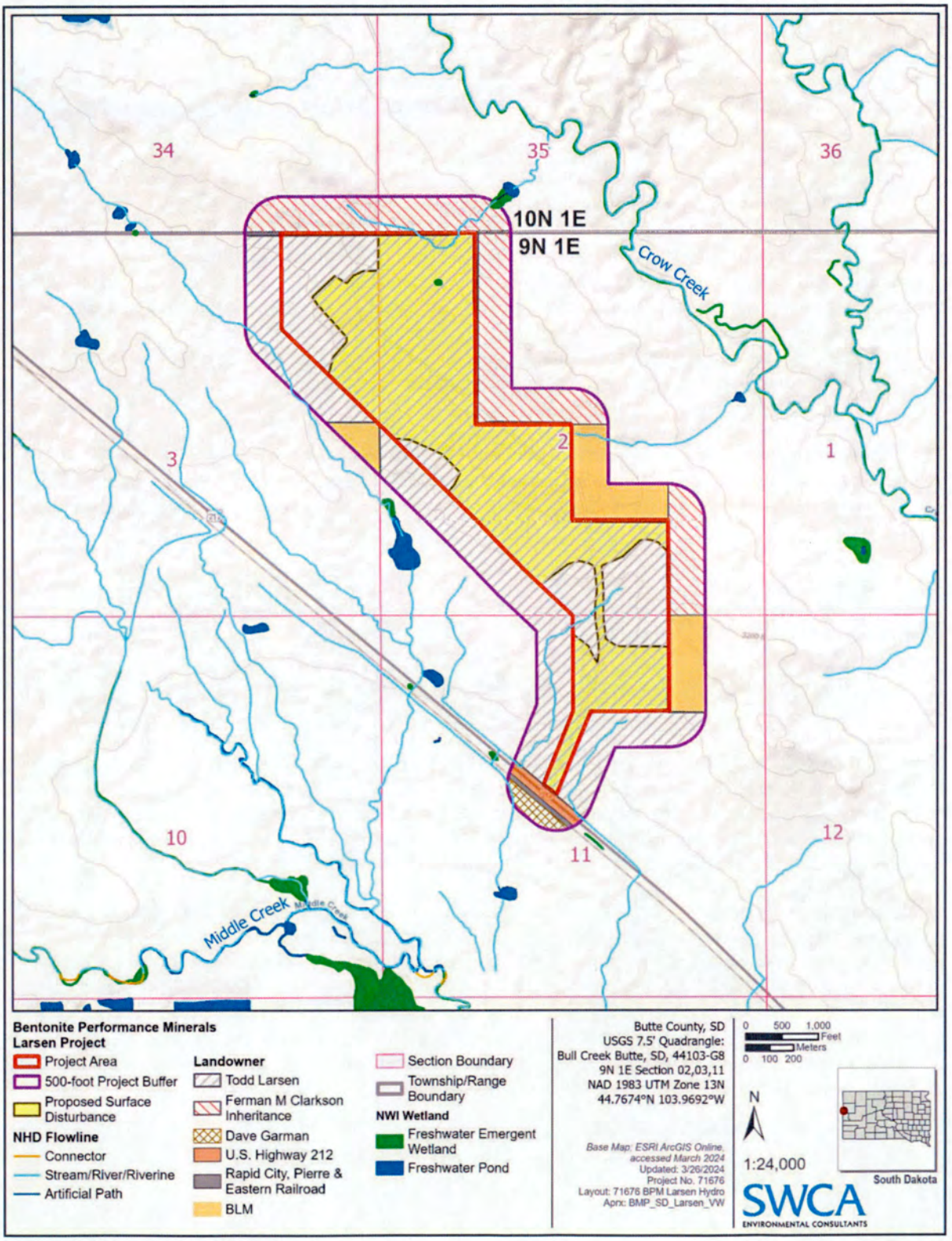

Figure 2. Larsen Project area.

General Description of Mining (ARSD 74:29:10:03(5))

BPM will extract bentonite from the proposed project area. The expected life of the mine is anticipated to be 15 years. Exploratory drilling was conducted in 2021, and drilling did not exceed 50 feet below the drilling surface. There was no water encountered during the drilling. The overburden is between 18 and 29 feet thick, and the clay bed is between 2 and 3 feet thick.

Each pit series begins with an initial pit requiring permanent relocation of overburden to a spoil pile or a pit located on an adjacent area in order to provide room to extract bentonite from the initial pit. Topsoil and subsoil are removed with scrapers and stockpiled adjacent to the pit or live spread on a previously mined area. Dozers are typically used to rip spoil in each lift, and spoil is generally removed using rubber-tired scrapers or an excavator and haul trucks. The spoil is placed on an area where topsoil and subsoil have been removed. Bentonite is hauled out of the pit via haul trucks, loaders, and scrapers. Once the initial pit has been mined, the subsequent pit is started, and topsoil and subsoil are typically stockpiled or live hauled to a contoured area for final placement. Spoil from the second pit is then placed into the initial pit area.

The pit progression continues in the same manner until the final pit has been mined. The final pit will be contoured to blend with the surrounding topography to reestablish through-drainage using spoil backfill and highwall reduction if necessary. Stockpiled topsoil and subsoil are then used to cover it and the area is revegetated.

Special, Exceptional, Critical, or Unique Land Determination (ARSD 74:29:10:03(6))

Ecological Evaluation (SDCL 45-6B-33.3(1) and (2))

Per South Dakota requirements, an assessment of the project must be conducted for critical resources (South Dakota Codified Laws [SDCLs] 45-6B-92(1) and (3)). The critical resources for vegetation include riparian zones, mountain meadows, wetlands, and threatened or endangered species. Critical resources for wildlife include critical deer winter range, threatened or endangered species, and any other critical wildlife resource identified by the South Dakota Game, Fish and Parks (SDGFP) (South Dakota Legislative Research Council 2024).

Qualified biologists were provided with a critical resource list and were instructed to document any such critical resources, or signs of such resources, present within the project area. For vegetation critical resources, no riparian zones, mountain meadows, wetlands, or threatened or endangered species were observed in the project area. Additionally, no critical resources were observed for wildlife in terms of critical deer winter range or observations of threatened or endangered species. The project is not anticipated to negatively impact populations of greater sage-grouse (*Centrocercus urophasianus*), because the project area is not ideal in terms of nesting, brood-rearing, or winter use site selection, which is discussed further in the scientific and wildlife sections of this report (see Appendix 4).

Scenic, Historic, Archaeologic, Topographic, Geologic, Ethnologic, Scientific, Cultural or Recreational (SDCL 45-6B-33.3)

SCENIC

The project area has historically been used for rangeland. The area is similar to surrounding lands and does not exhibit unique scenic or aesthetic qualities. The project lies in an area that has been and is currently being mined for bentonite and sand and gravel, including the Shear/Clarkson East bentonite mine, which overlaps portions of this project.

The project is north of U.S. Highway 212, with a small section of the project extending to the highway. Some mine-related activities and disturbance may be visible from the highway; however, this is not an uncommon sight for travelers along the highway, as there are several other bentonite mines visible from the highway in this area. BPM's concurrent reclamation practices will minimize the amount of disturbed land visible from the highway.

There are no residences located within 0.5 mile of the project.

HISTORIC, ARCHAEOLOGIC, ETHNOLOGIC, AND CULTURAL

The project is in an area that has typically been used for rangeland and is located in the Black Hills bentonite mining district; see the geologic section below for more information.

Based on previous cultural resources surveys and in consultation with the South Dakota State Historic Preservation Office (SHPO), a Level III intensive field survey was conducted in accordance with SDCL 1-19A-11.1 to account for historic properties that may be damaged, destroyed, or encroached upon by projects, and SDCL 45-6B-33.3(3) (evaluation of SECU lands).

The survey defined and recorded four previously unidentified cultural resource localities: one prehistoric lithic scatter and three prehistoric isolated finds. During the inventory, a previously recorded site, a historic farmstead, was further evaluated and is recommended as not eligible for the National Register of Historic Places. The SHPO has reviewed the field survey report and concluded that sites identified in the report should be considered not eligible for listing in the National Register of Historic Places. The Level III survey report and SHPO concurrence letter are provided as Appendix 2.

Field observations indicate that the project area demonstrates shallow soil development overlying ancient parent material. With the state of the soils and previous disturbance from farming within the project area, the potential for the presence of in situ subsurface cultural materials is considered low.

TOPOGRAPHIC

The project area lies in a rural, undeveloped setting used primarily for rangeland. There are no unique topographic features within or near the project. The project is located to the northwest of the Black Hills in Butte County, South Dakota, and is approximately 7 miles northwest of Belle Fourche, South Dakota. The project sits on an upland area between Crow Creek to the north and Middle Creek to the south. There are several hills across the project area, and the land generally slopes downward from the northwest to the southeast at an average slope of approximately 3%. Elevations in the project area range from 3,114 to 3,254 feet above mean sea level, with the highest area being in the northeast corner.

GEOLOGIC

The project area is located in the Black Hills bentonite mining district, which includes parts of Crook County, Wyoming; Carter County, Montana; and Butte County, South Dakota (U.S. Geological Survey [USGS] 1962). Bentonite mining has occurred in the Belle Fourche area for over 50 years. Today, there are several active bentonite mines located between Colony, Wyoming, and Belle Fourche, South Dakota.

The project is in the Semiarid Pierre Shale Plains of the Northwestern Great Plains ecoregion (Bryce et al. 1996). The overall geologic structure of this area is that of a broad northwestward-plunging anticline, in which the strata dips gently toward the northeast, north, and northwest. The overall structure is interrupted, however, by several subordinate folds.

The northern Black Hills district is an important source of commercial gel-forming bentonite (USGS 1962). Based on exploration drilling, the overburden depth ranges from 18 to 29 feet, and the bentonite bed is approximately 2 to 3 feet thick.

RECREATIONAL

There are no unusual or aesthetic features suggesting that the area should be classified as a recreational site or that it has been used for recreational activities. The project has historically been used as rangeland and lies in a rural, undeveloped setting. Farther beyond the project are Crow Creek to the north and Middle Creek to the south. Both streams are more than 1,000 feet, at their closest point, from the project boundary. Neither stream will be directly impacted by the proposed mining activity. Notably, there has been mining activity related to bentonite southeast of the project in Section 11, Township 9 North, Range 1 East.

The landowner allows hunting on this land. During periods of active mining, hunting access may be restricted in areas being mined.

SCIENTIFIC

Baseline soil, vegetation, wildlife, and hydrologic surveys show that the project area is similar to what is typically found in this region.

SOILS

The project area is composed of six different soil map units, according to the Web Soil Survey (Natural Resources Conservation Service 2022) and the soil survey conducted by SWCA Environmental Consultants. The soil survey report is provided as Appendix 3. Percentages of the soil map units in the project area include 43.1% Kyle clay, 2 to 6 percent slopes; 20.7% Penrose clay, 3 to 15 percent slopes; 12.6% Arvada silt loam, 0 to 3 percent slopes, 10.7% Twotop clay, 0 to 9 percent slopes, 7.6% Arvada-Slickspots complex 0 to 3 percent slopes; and 5.4% Grummit-Rock outcrop complex, 6 to 40 percent slopes. All of these soil units are common to the area. These soils have suitable topsoil and subsoil and should not present any unusual challenges for revegetation efforts during reclamation.

VEGETATION

Per South Dakota requirements, a vegetation assessment of the project area for critical resources was conducted (SDCL 45-6B-92(1) and (3)). The critical resources for vegetation include riparian zones, mountain meadows, wetlands, and threatened or endangered species. Qualified biologists were provided with the critical resource list and were instructed to document any such critical resources, or signs of such

resources, present within the project area. No riparian zones, mountain meadows, wetlands, or threatened or endangered species were observed in the project area. The report is provided in Appendix 4.

The U.S. Fish and Wildlife Service (USFWS) does not list any federally listed plant species as occurring in Butte County (USFWS 2022b). Two plant species are currently listed under South Dakota Endangered and Threatened Species Law (SDCL Chapter 34A-8). The range and distribution of these species were reviewed, and there is no suitable habitat within the project area.

The baseline vegetative survey identified two dominant plant communities, including mixed-grass prairie habitat, which makes up 77% of the project area; big sagebrush shrubland, which makes up 22% of the project area, and a small area of reclaimed vegetation.

WATER RESOURCES

The project sits on an upland area between Crow Creek to the north and Middle Creek to the south. Bentonite mining, both historic and active, is common along Middle Creek and Crow Creek. There will be no direct mining impacts to either of these streams.

The National Wetlands Inventory and National Hydrography Dataset shows two National Hydrography Dataset flowlines and one wetland feature (freshwater emergent wetland) located within the project boundary (see Appendix 5, Figure 1) (USFWS 2022b; USGS 2022). No wetlands were observed or recorded during baseline surveys. Watersheds identified in association with the project are the Middle Creek-Belle Fourche River and the Lower Crow Creek watersheds. There are no water quality monitoring stations near the project. A monitoring station is located downstream of the project along the Belle Fourche River; both Middle Creek and Crow Creek are tributaries to the Belle Fourche River. No waterbodies within either watershed have been assessed against South Dakota surface water quality standards (SD DANR 2023).

There are no surface water rights or groundwater wells within the project or within 1 mile of the project (SD DANR 2024). Exploration drilling was conducted to a depth of no more than 50 feet, and no groundwater was encountered. Drilling showed that the overburden is between 18 and 29 feet thick, and the clay bed is between 2 and 3 feet thick. No groundwater issues are anticipated.

SD DANR was consulted regarding the need to conduct a site-specific hydrologic survey. Roberta Hudson, Engineer Manager at SD DANR, confirmed via an email dated June 29, 2022, that baseline sampling would not be required for this project.

WILDLIFE

Baseline wildlife surveys were conducted in 2022 and 2023 to provide information necessary to determine the potential effects of the project's mining and reclamation operations on wildlife species. A desktop analysis was performed and field verified for potential habitat or presence of federally or state-listed species or other species of concern. The wildlife survey report is provided in Appendix 4, and major findings are summarized below.

The Information for Planning and Consultation (IPaC) planning tool provides information regarding federally threatened, endangered, proposed, and candidate species within a given area. If a proposed project overlaps the area of influence of an Endangered Species Act (ESA)–listed species, then the IPaC planning tool will indicate that potential project impacts should be assessed for that species. The IPaC planning tool indicates that the project area is within the ranges of one ESA candidate species, monarch butterfly (*Danaus plexippus*), and two ESA threatened species, rufa red knot (*Calidris canutus rufa*) and northern long-eared bat (*Myotis septentrionalis*) (USFWS 2022b).

- The project is within the known range for the monarch butterfly (USFWS 2022c); however, potentially suitable habitat in the project is marginal at best. Although some warm-season grass species do occur, the project area is primarily dominated by cool-season grasses. No monarch butterfly or milkweed species were observed during the baseline wildlife surveys or during the 2004 through 2007 surveys; however, it should be noted that this species was not specifically surveyed for in 2004 through 2007 (Jones & Stokes 2007).
- The project is within the known range for the rufa red knot but does not contain any of the known suitable habitat types that have been studied thus far (USFWS 2022d). No rufa red knot were observed during the baseline wildlife surveys or during previous surveys or during the 2004 through 2007 surveys; however, only the red knot (*Calidris canutus*), and not the rufa red knot, was specifically surveyed for in 2004 through 2007 (Jones & Stokes 2007).
- The project is within the known range for the northern long-eared bat (USFWS 2022e); however, no caves or mines that would provide suitable winter habitat are in or surrounding the project area. Additionally, no large tracts of contiguous forested habitat occur in or surrounding the project. No northern long-eared bats were observed during the baseline wildlife surveys or during the 2004 through 2007 surveys (Jones & Stokes 2007).

There are 21 species listed under South Dakota's Endangered and Threatened Species Law (SDCL Chapter 34A-8) (SDGFP 2022a). The range and distribution of these species was evaluated and all identified state-listed species, with the exception of the swift fox (*Vulpes velox*), osprey (*Pandion haliaetus*), and peregrine falcon (*Falco peregrinus*), were unlikely to occur in the project area. Species that have the potential to occur based on range and habitat associations are discussed further in the following sections.

- The project is located within the known range for the swift fox year-round and contains suitable habitat (SDGFP 2022b). However, no swift fox individuals or dens were observed during the baseline wildlife surveys or during the 2004 through 2007 surveys (Jones & Stokes 2007).
- The project is within the known migratory range for the osprey; however, the nearest identified summer range for this species in South Dakota is in the Black Hills and the extreme northeastern corner of the state (SDGFP 2022b). Trees suitable for nesting are present along Crow Creek within the 0.5-mile buffer of the project shown in Attachment 4. However, no trees suitable for nesting or large bodies of water that could serve as a potential prey base occur within the project. No osprey individuals or nests were observed during the baseline wildlife surveys or during the 2004 through 2007 surveys (Jones & Stokes 2007).
- The project is within the known migratory range for the peregrine falcon; however, the nearest identified summer range for this species is located in the Black Hills (SDGFP 2022b). No peregrine falcon individuals, suitable cliff habitat, or nests were observed during the baseline wildlife surveys or during the 2004 through 2007 surveys (Jones & Stokes 2007).

While the project is in greater sage-grouse core area, no greater sage-grouse individuals or sign was observed in the project area during opportunistic surveys or during protocol-level lek surveys conducted by SWCA and BPM in 2022 and 2023. No sage-grouse individuals were observed in the 2004-2007 Shear/Clarkson surveys (Jones & Stokes 2007). Middle Creek lek surveys conducted by SDGFP confirm the last known lek attendance was in 2020 and BLM surveys show the last known lek attendance in 2018. The Parsons (2019) study, as discussed in Appendix 4, describes a number of variables at the local and landscape scale that were biologically relevant to sage-grouse nest, brood-rearing and winter use site selection. Based on these variables, the project is not anticipated to negatively impact populations of greater sage-grouse in terms of nesting, brood-rearing, or winter use site selection.

In terms of nesting potential for greater sage-grouse, the project area contains short-statured sagebrush on average, which are not compensated for by favorable tall-statured grasses, because grasses have been heavily grazed. In addition, greater sage-grouse tend to avoid areas with high grass cover, and both the mixed-grass prairie and big sagebrush shrubland habitat types within the project area yield grass cover as their highest percent canopy cover category on average. Given this, it is unlikely that hens would use the project area for nesting purposes.

Greater sage-grouse brooding potential is low, because hens will typically select areas near water that have a greater percentage of sagebrush cover and taller grasses, none of which are well represented in the project area. Additionally, the main portion of the project is less than 0.5 mile from U.S. Highway 212 and a powerline running parallel on the north side of Highway 212, brood-rearing hens are known to actively avoid using areas near roads and powerlines.

In the winter, greater sage-grouse select areas near sagebrush because it is their main source of food at that time. There is some potential for greater sage-grouse use within the project area in the winter; however, given the overall lack of sagebrush height (and therefore potential to be a plentiful resource above the snow's surface) and given the reduced sagebrush cover in relation to other recorded growth forms (grasses, forbs, etc.), that potential is low overall. This assumption is further bolstered by the overall lack in detectable evidence of greater sage-grouse use and presence as presented earlier.

Greater sage-grouse mitigation measures as presented in Appendix 4 will be incorporated into the mine and reclamation plan.

SUMMARY

The proposed project is similar to the surrounding land, and no special scenic, historic, archaeologic, topographic, geologic, ethnologic, cultural, or recreational characteristics were identified. The project area has been used primarily as rangeland similar to that of the surrounding area, and the project would not impact the ability to continue grazing on adjacent lands. The project is also located in an area where historic and active bentonite mining continues today.

Baseline wildlife surveys did not identify any federal or state threatened or endangered wildlife species or associated habitat in the project area. The area is occupied by a variety of common wildlife species. Individuals may be impacted temporarily during mining but will return once the area is reclaimed when mining is completed.

Baseline vegetation surveys did not identify any federal or state threatened, endangered, or sensitive plant species in the project area. Once mining is completed, the area will be reclaimed with an approved NRCS grassland seed mix similar to what exists today. Nothing in the baseline soil survey indicates that there should be any issues with reclaiming the area once mining has been completed.

The project is located in an area that SDGFP identified and mapped as a greater sage-grouse core area. Baseline wildlife surveys conducted in 2022 and 2023 identified no greater sage-grouse individuals, and no evidence of greater sage-grouse use or sign was detected within the project. No sage-grouse individuals were observed in the 2004-2007 Shear/Clarkson surveys (Jones & Stokes 2007). Middle Creek lek surveys conducted by SDGFP confirm the last known lek attendance was in 2020 and BLM surveys show the last known lek attendance in 2018. The Parsons (2019) study, as discussed in Appendix 4, describes a number of variables at the local and landscape scale that were biologically relevant to sage-grouse nest, brood-rearing and winter use site selection. Based on these variables, the project is not anticipated to negatively impact populations of greater sage-grouse, because the project area is not ideal in terms of nesting, brood-rearing, or winter use site selection. Greater sage-grouse mitigation measures

will be incorporated into the mine and reclamation plan, and disturbance of big sagebrush shrubland communities will generally be avoided.

SHPO has determined that the project will not impact any historic properties that are eligible for listing on the National Register of Historic Places.

There are no special, critical, or unique water resources such as riparian zones or wetlands in the project area. Neither of the streams in the area will be directly impacted by the proposed mining.

The soils in the project area are typical of the soils in the region. These soils should not present any unusual challenges for revegetation efforts during reclamation.

There were no ecologically fragile areas identified within the project. Existing reclamation techniques will allow the land to be returned to a similar ecological state. Impacts from the project will be temporary in nature, as the area will be reclaimed after mining has been completed.

LITERATURE CITED

Bryce, S.A., J.M. Omernik, D.E. Pater, M. Umler, J. Schaar, J. Freeouf, R. Johnson, P. Kuck, and S.H. Azevado. 1996. Ecoregions of North Dakota and South Dakota. Color poster with map, descriptive text, summary tables and photographs. Scale 1:1,500,000. Reston, Virginia: U.S. Geological Survey.

Jones & Stokes. 2007. *American Colloid Company Shear/Clarkson Permitting Project Wildlife Baseline Inventory.* Submitted to American Colloid Company. Prepared for South Dakota Department of Game, Fish and Parks. Gillette, Wyoming: Jones & Stokes.

Parsons. 2019. Greater sage-grouse survival, breeding ecology, resource selection, and West Nile virus prevalence on the eastern fringe of their range. Ph.D. dissertation, Natural Resource Management, South Dakota State University, Brookings.

Natural Resources Conservation Service. 2022. Web Soil Survey. Available at: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed December 2023.

South Dakota Department of Agriculture and Natural Resources (SD DANR). 2023. South Dakota Surface Water Quality Standards. Available at: https://sdgis.sd.gov/portal/apps/experiencebuilder/experience/?id=60c4f285d6c1458db0f6eac2b4f26c04. Accessed December 2023.

———. 2024. Interactive GIS Maps. Available at: https://danr.sd.gov/Press/DataAndMapping.aspx. Accessed March 2024.

South Dakota Department of Game, Fish and Parks (SDGFP). 2022a. Threatened and Endangered Species. Available at: https://gfp.sd.gov/threatened-endangered/. Accessed November 2022.

———. 2022b. South Dakota Wildlife Action Plan Explorer. Available at: http://apps.sd.gov/gf43wap/. Accessed November 2022.

South Dakota Legislative Research Council. 2024. Codified Laws 45-6B-92. Available at: https://sdlegislature.gov/Statutes/Codified_Laws/2066416. Accessed March 2024.

U.S. Fish and Wildlife Service (USFWS). 2022a. National Wetlands Inventory (NWI). 2022. Available at: https://www.fws.gov/wetlands/. Accessed November 2022.

———. 2022b. Information for Planning and Consultation (IPaC). Available at: http://ecos.fws.gov/ipac/. Accessed November 2022.

———. 2022c. Species Profile for Monarch Butterfly (*Danaus plexippus*). Available at: https://ecos.fws.gov/ecp/species/9743. Accessed November 2022.

———. 2022d. Rufa Red Knot. Available at: https://www.fws.gov/species/rufa-red-knot-calidris-canutus-rufa. Accessed November 2022.

———. 2022e. Species Profile for Northern Long-eared Bat (*Myotis septentrionalis*). Available at: https://ecos.fws.gov/ecp/species/9045. Accessed November 2022.

U.S. Geological Survey (USGS). 1962. *Bentonite deposits of the northern Black Hills district, Wyoming, Montana, and South Dakota*. Bulletin 1082-M. Washington, D.C.: U.S. Government Printing Office.

———. 2022. National Hydrography Dataset. Available at: http://nhd.usgs.gov/. Accessed December 2022.

APPENDIX 1

Request for Determination Special, Exceptional, Critical, and Unique Lands

2024 Request for Determination and Notice of Intent

RECEIVED
JUN 20 2024
MINERALS & MINING PROGRAM

Department of Agriculture and Natural Resources
Minerals and Mining Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3182
605 773-4201; Fax: 605 773-5286

REQUEST FOR DETERMINATION OF SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS AND NOTICE OF INTENT TO OPERATE

Pursuant to SDCL 45-6B and ARSD 74:29:10

Operator's name: Bentonite Performance Minerals, LLC

Telephone: 307-896-2596

Mailing address: Colony Wyoming Plant
554 U.S. Highway 212
Belle Fourche, SD 57717

Telephone: 307-896-2596

Local address: Colony Wyoming Plant
554 U.S. Highway 212
Belle Fourche, SD 57717

Legal description: Township 9 North, Range 1 East
Portions of Sections 2, 3 and 11
As shown on Figures 1-1 and 1-2

County: Butte County

Name and address of surface owner:

Todd and Cindy Larsen, 17816 Prairie Winds Lane, Belle Fourche, South Dakota 57717

Name and address of mineral owner:

BDZ, LLC, 1403 West Boulevard, Rapid City, South Dakota 57704

Robert Shear, 17828 Prairie Winds Lane, Belle Fourche, South Dakota 57717

Name and address of surface owners within 500 feet of the proposed mining operation:

See attached Table 1

I declare and affirm under the penalties of perjury that this claim (petition, application, information) has been examined by me, and to the best of my knowledge and belief, is in all things true and correct.

Signature _____ Date: 5/28/24

Title: Operations Manager

FOR DEPARTMENT USE ONLY

The land described in this Request for Determination of Special, Exceptional, Critical, or Unique Lands and Notice of Intent to Operate _____ is _____ is not eligible for inclusion on the list of special, exceptional, critical, or unique lands.

_____ Date: _____

Secretary, Department of Agriculture and Natural Resources

Operator appeal date: _____ Intervenor contest date: _____

The land described in this Request for Determination of Special, Exceptional, Critical, or Unique Lands and Notice of Intent to Operate _____ is _____ is not eligible for inclusion on the list of special, exceptional, critical, or unique lands.

_____ Date: _____

Chairman, SD Board of Minerals and Environment

Table 1 - Name and address of surface owners within 500 feet of the proposed mining operation.

Name	Address	City	State	Zip code
Todd and Cindy Larsen	17816 Prairie Winds Lane	Belle Fourche	South Dakota	57717
Bureau of Land Management	309 Bonanza Street	Belle Fourche	South Dakota	57717
State of South Dakota U.S. Highway 212	830 6th Avenue #1	Belle Fourche	South Dakota	57717
Ferman M. Clarkson (Inheritance Trust)	PO Box 729	Belle Fourche	South Dakota	57717
Rapid City, Pierre & Eastern Railroad, Inc. Subsidiary of Genesee & Wyoming, Inc.	246 Founders Park Drive, Suite 202	Rapid City	South Dakota	57701
David J. Garman	PO Box 207	Belle Fourche	South Dakota	57717

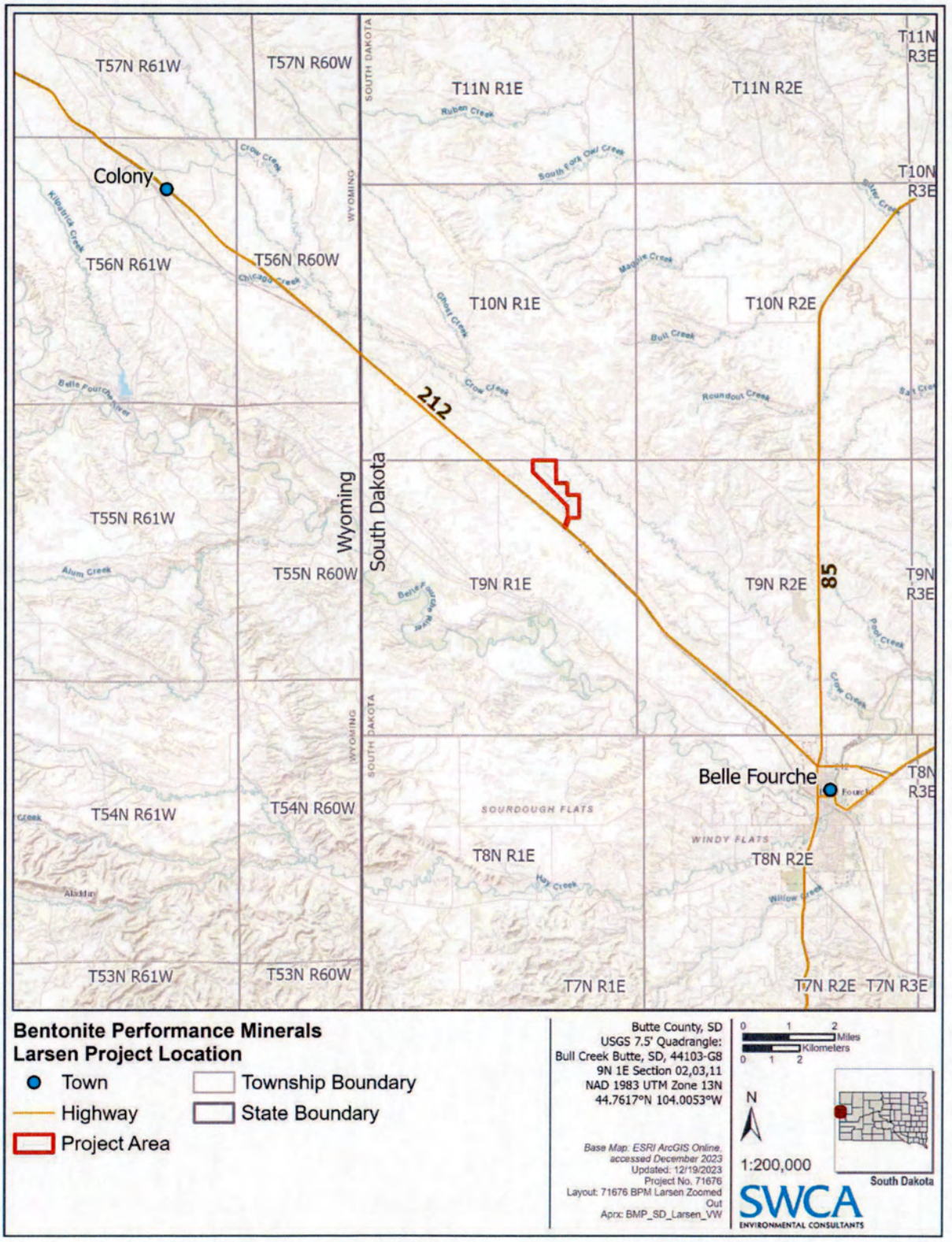

Figure 1-1. General location of the Larsen Project.

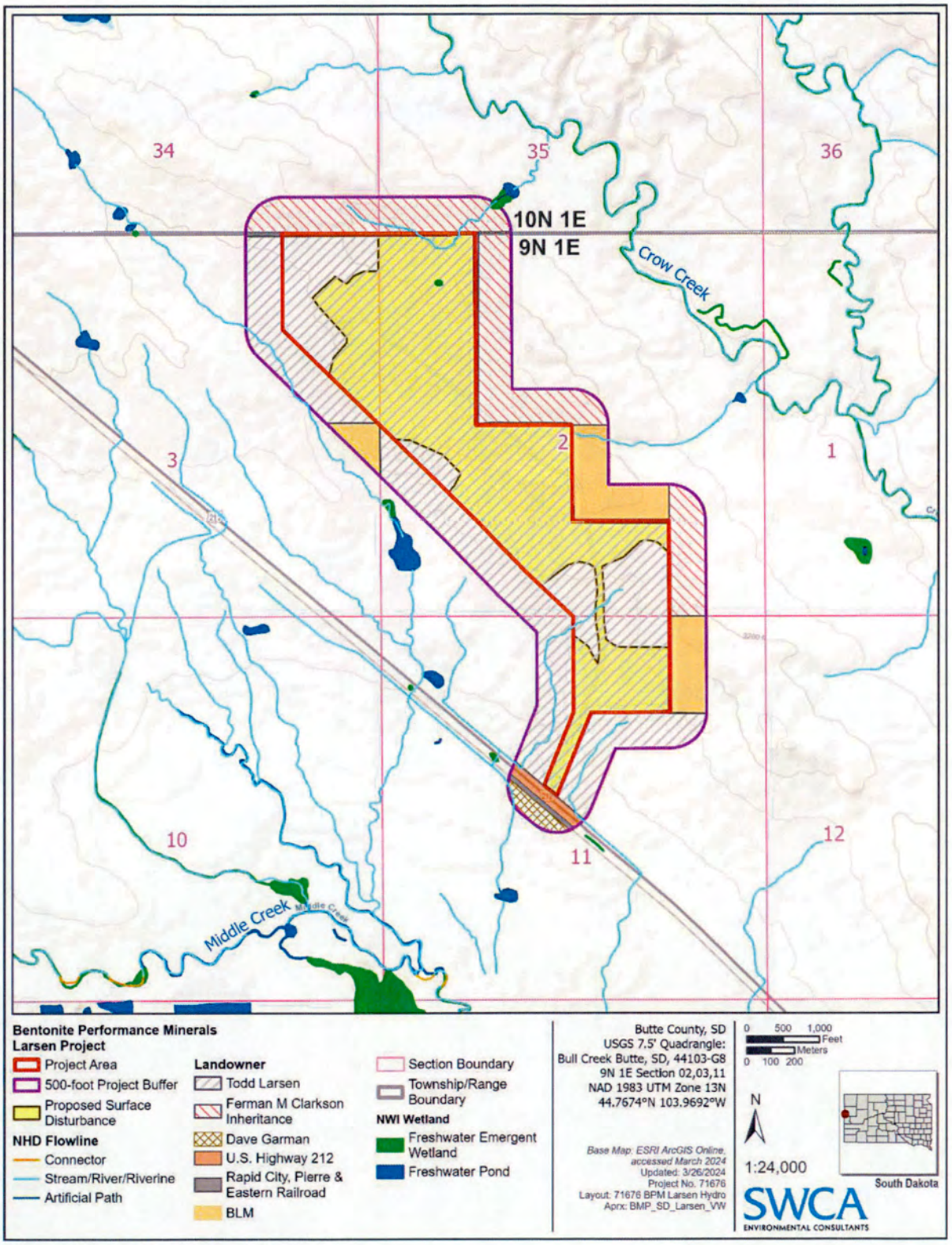

Figure 1-2. Larsen Project Area.

CONFIDENTIAL

APPENDIX 2

Level III Cultural Resource Inventory of the Bentonite Deposit, Butte County, South Dakota

Confidential

APPENDIX 3

Baseline Soil Survey for Bentonite Performance Minerals, LLC's, Larsen Project in Butte County, South Dakota

Baseline Soil Survey for Bentonite Performance Minerals, LLC's Larsen Project in Butte County, South Dakota

MARCH 2024

PREPARED FOR

Bentonite Performance Minerals, LLC

PREPARED BY

SWCA Environmental Consultants

BASELINE SOIL SURVEY FOR BENTONITE PERFORMANCE MINERALS, LLC'S LARSEN PROJECT IN BUTTE COUNTY, SOUTH DAKOTA

Prepared for

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1 INTRODUCTION

SWCA Environmental Consultants (SWCA) conducted a baseline soil survey for Bentonite Performance Minerals, LLC's Larsen Project (project) in Butte County, South Dakota. The project area lies between Colony, Wyoming, to the west and Belle Fourche, South Dakota, to the east. The project is on private lands in the southwestern portion of Butte County, South Dakota, approximately 7 miles northwest of Belle Fourche in portions of Sections 2, 3, and 11, Township 9 North, Range 1 East along U.S. Highway 212. The project encompasses approximately 307 acres (Figure 1). Within the project, approximately 228 acres are proposed as being disturbed.

The purpose of the soil survey was to identify the amount of suitable topsoil and subsoil resources present in the project area for use in reclamation. Methods were designed to collect data that was suitable for describing soil resources in accordance with the requirements of the Administrative Rules of South Dakota 74:29 and the South Dakota Mined Land Reclamation Act (South Dakota Codified Law 45-6B). The regulatory agency for this project is the South Dakota Department of Agriculture and Natural Resources.

The Natural Resources Conservation Service (NRCS) initially completed an Order 2/3 soil survey in 1970 that covered the project area. The most current NRCS soil survey information for the project area was accessed through the NRCS Web Soil Survey (NRCS 2019). American Colloid Company (ACC) conducted a soil survey in September 2007, which encompassed much of the project area (Appendix A).

SWCA conducted a more intensive soil survey in the portion of the project area where ACC did not evaluate soil resources. The boundaries of the ACC survey and the current project area are not congruent. As discussed with the South Dakota Department of Agriculture and Natural Resources, SWCA's survey focused on the portions of the project area that were not assessed by the ACC survey. Information from the SWCA survey, the ACC survey, and NRCS data are summarized in this report to provide the information needed for environmental analysis, permitting, and reclamation.

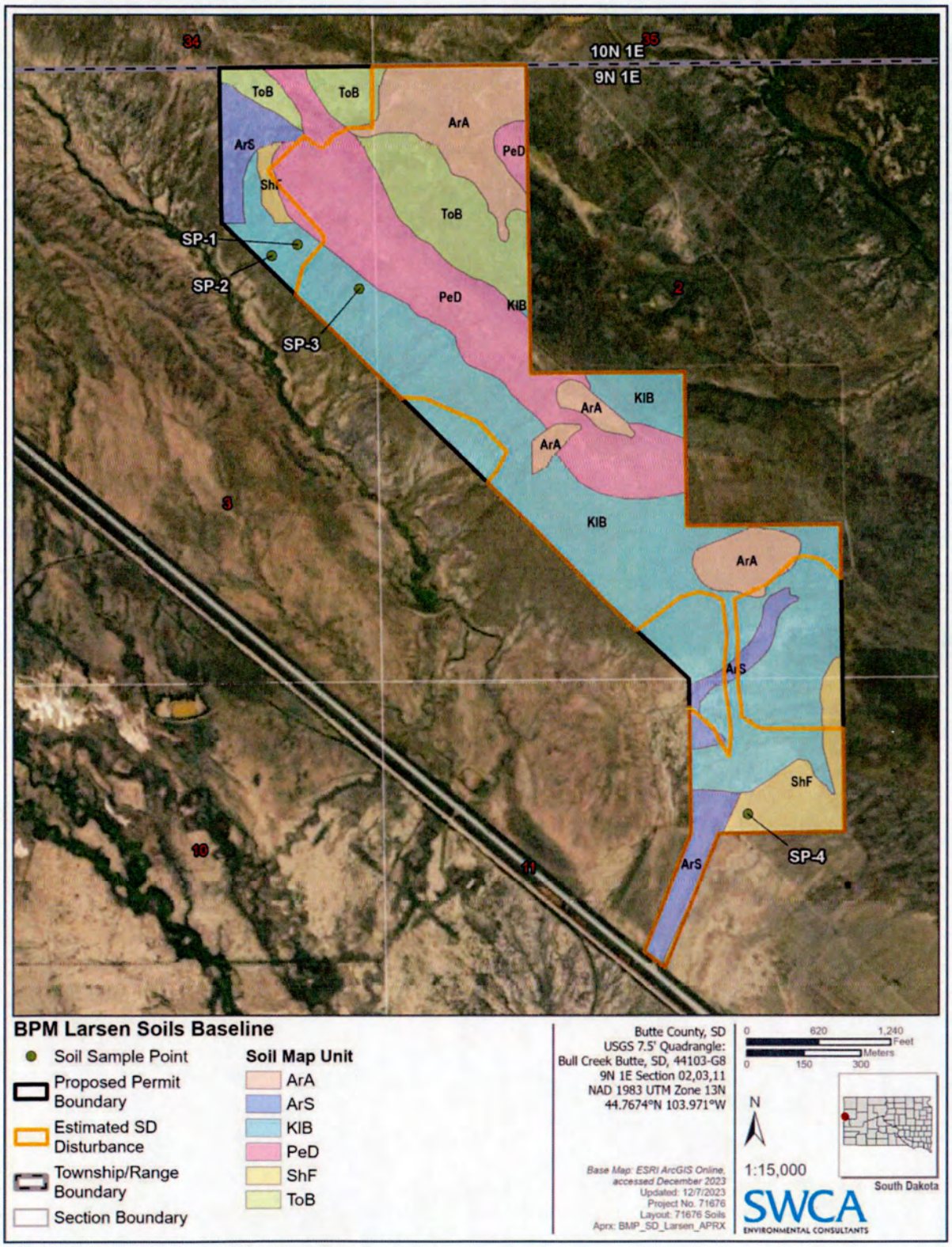

Figure 1. BPM Larsen Soils Baseline.

2 METHODS

2.1 General

A SWCA Certified Professional Soil Scientist (Chris Johnston, CPSS # 200121) conducted a review of the existing literature and completed all soil survey fieldwork.

2.2 Review of Existing Literature

SWCA accessed the Web Soil Survey (NRCS 2019) to review the existing Order 2/3 level soil survey that covers the project area. NRCS soil series descriptions were used to identify soil series present in the field (Appendix B). The Web Soil Survey was used to access the wind and water erosion hazard of each soil map unit. The ACC report was reviewed to assess the soil characteristics within the project area.

2.3 Soil Survey

Field mapping of soil boundaries was conducted in accordance with the standards of the National Soil Survey Handbook (NRCS 2017). Other sources used during the study included the U.S. Department of Agriculture's Soil Survey Manual (Soil Science Division Staff 2017) and Field Book for Describing and Sampling Soils, Version 2.0 (Schoeneberger et al. 2002). Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD) Guideline No. 1A Topsoil and Subsoil (WDEQ-LQD 2015) was used as a guide to assess the topsoil and subsoil resources and compile information included in this permit application as South Dakota does not have a similar applicable soils guideline.

SWCA surveyed the project area in the summer of 2022. Soil profiles were delineated throughout the project area where the ACC survey did not evaluate soil resources. SWCA used a trailer-mounted Giddings hydraulic soil sampling, coring, and drilling machine. Physical and chemical characteristics of the soil profile were used to delineate soils into map units.

2.4 Soil Sampling, Description, and Analysis

Samples were collected to a maximum depth of 60 inches or shallower if paralithic contact or an impermeable layer was encountered. Soil samples were collected by horizon and delivered to Pace Analytical, Sheridan, Wyoming, for analysis of saturated paste pH, electrical conductivity, and saturation percentage; texture; coarse fragment content; soluble calcium, magnesium, and sodium; sodium adsorption ratio (SAR); organic matter content; boron; and selenium.

SWCA's soil sample locations are shown on Figure 1. Photographs of soil core profiles are included in Appendix C. NRCS official soil series descriptions for all soil series encountered in the project area are included in Appendix B. Field soil profile descriptions for each soil map unit delineated by SWCA in the project area are included in Appendix D.

3 RESULTS AND DISCUSSION

3.1 Soil Survey

Soils within the project area consist mainly of fine-textured soils ranging from clay loam to clay in the surface horizon and silty clay to clay in the subsurface horizons. Generally, shallower soils were found on hills, ridges, and uplands and moderate to deep soils were found on alluvial fans and terraces and in drainages.

SWCA's survey and the ACC survey identified six soil map units within the project area; all were within the proposed disturbance area. Within the project area, Kyle clay (KIB) accounted for 43.05% of soil map units and Penrose clay (PeD) accounted for 20.68% of soil map units. The four remaining soil map units accounted for smaller portions of the remaining 36.27% of map units. Soil map distribution in the project area and proposed disturbance area are provided in Table 1 and Table 2, respectively. Delineated soil map unit boundaries are shown on Figure 1.

Table 1. Soil Map Unit Distribution for the Project Area

Map Symbol	Map Unit Name	Total Area (acres)	Total Area (percent)
ArA	Arvada silt loam, 0 to 3 percent slopes	38.8	12.6%
ArS	Arvada-Slickspots complex, 0 to 3 percent slopes	23.2	7.6%
KIB	Kyle clay, 2 to 6 percent slopes	132.1	43.1%
PeD	Penrose clay, 3 to 15 percent slopes	63.4	20.7%
ShF	Grummit-Rock outcrop complex, 6 to 40 percent slopes	16.5	5.4%
ToB	Twotop clay, 0 to 9 percent slopes	32.8	10.7%
Total		306.8	100.0%

Table 2. Soil Map Unit Distribution for the Proposed Disturbance Area

Map Symbol	Map Unit Name	Total Area (acres)	Total Area (percent)
ArA	Arvada silt loam, 0 to 3 percent slopes	38.2	16.8%
ArS	Arvada-Slickspots complex, 0 to 3 percent slopes	10.2	4.8%
KIB	Kyle clay, 2 to 6 percent slopes	86.1	37.8%
PeD	Penrose clay, 3 to 15 percent slopes	57.7	25.3%
ShF	Grummit-Rock outcrop complex, 6 to 40 percent slopes	12.0	5.8%
ToB	Twotop clay, 0 to 9 percent slopes	23.8	10.4%
Total		228.0	100.00%

3.2 Analytical Results

Laboratory analysis on the physical and chemical parameters was conducted to establish appropriate soil salvage depths and suitability of soils for reclamation. Laboratory analytical reports for soil samples collected during this survey are included in Appendix E. The results from the ACC soil survey are presented in Appendix A.

3.3 Soil Erosion Properties

Water and wind erosion hazards for the project area were also evaluated using Web Soil Survey data (NRCS 2019). The soil erodibility factor, or K-Factor, is an estimate of the susceptibility of the soil for water to detach and move soil particles. K-Factors vary from 0.02 to 0.69, with values increasing with higher susceptibility to soil erosion as a result of flowing water. The potential hazard for water erosion varied from slight to high within the project area.

The wind erodibility factor is an estimate of the susceptibility to wind erosion and ranges from 1 to 8, with the lower classes representing those soils that are most susceptible to wind erosion. The potential for wind erosion is moderate for all soils within the project area. The fine texture of many of the soils found in the project area makes them more susceptible to water erosion than wind erosion. A summary of wind and water erosion hazards is included in Table 3.

Table 3. Wind and Water Erosion Hazards for Soils Within the Project Area

Map Symbol	Map Unit Name	Water Erosion Hazard*	Wind Erosion Hazard†
ArA	Arvada silt loam, 0 to 3 percent slopes	High	Moderate
ArS	Arvada-Slickspots complex, 0 to 3 percent slopes	High	Moderate
KlB	Kyle clay, 2 to 6 percent slopes	Moderate	Moderate
PeD	Penrose clay, 3 to 15 percent slopes	Moderate	Moderate
ShF	Grummit-Rock outcrop complex, 6 to 40 percent slopes	Slight	Moderate
ToB	Twotop clay, 0 to 9 percent slopes	Slight	Moderate

* Based on Kw factor, whole soil, from the NRCS Web Soil Survey (NRCS 2019).
† Based on Wind Erodibility Group from the NRCS Web Soil Survey (NRCS 2019).

3.4 Soil Suitability Evaluation

The WDEQ-LQD Guideline 1A criteria (WDEQ-LQD 2015) were used to establish suitable salvage depths of topsoil and subsoil resources for each soil series/map unit identified within the project area. Boron, selenium, and coarse fragments were omitted from the ACC sample analysis (2007) but were analyzed in the SWCA analysis (2022). Laboratory results indicate that all sampled soil map units have limiting chemical or physical properties in the profile that make topsoil and subsoil resources marginally suitable or unsuitable for salvage and use as a reclamation medium. Laboratory results indicate that soil pH, electrical conductivity, SAR, boron, selenium, and texture may be limiting. Soil containing shale should be avoided because of elevated sodicity and acidity. Salvageable soil should not be contaminated with shale. Marginal and unsuitable parameters are summarized in Table 4 for SWCA samples and Table 5 for ACC samples.

Table 4. Marginal and Unsuitable Soil Parameters Identified by SWCA Environmental Consultants

Soil Sample Number	Soil Map Unit	Depth (inches)	Marginal*	Unsuitable*
SP-1	Kyle clay (KIB)	0–2	Texture	–
		2–10	Texture	–
		10–18	Texture	–
SP-2	Kyle clay (KIB)	0–1	Texture	–
		1–9	Texture	–
		9–22	Texture	Boron
		22–30	pH, texture	–
SP-3	Kyle clay (KIB)	0–2	Texture	–
		2–13	Texture	–
		13–20	Sat %, EC, texture, selenium	SAR, boron
		20–40	Sat %, EC, texture, selenium	SAR, boron
		40–60	Sat %, EC, texture, selenium	SAR
SP-4	Grummit complex (ShF)	0–7	Texture	–
		7–16	Texture	–
		16–25	Texture	SAR
		25–31	Texture	SAR
		31–38	Texture	pH, SAR
		38–60	SAR, texture	pH

Note: – = Analytes are below the marginal or unsuitable threshold; EC = electrical conductivity; SAR = sodium absorption ratio; Sat % = saturation percent.

* Marginal and unsuitable soil parameters determined by comparing soil profile descriptions and lab data with Wyoming Department of Environmental Quality-Land Quality Division Guideline 1A, Attachment 82 - Criteria to Establish Suitability of Soil (Wyoming Department of Environmental Quality-Land Quality Division 2015)

Table 5. Marginal and Unsuitable Soil Parameters identified by American Colloid Company

Soil Sample Number	Soil Map Unit	Depth (inches)	Marginal*	Unsuitable*
SC1†	Twotop clay (ToB)	0–4	–	–
		4–14	Texture	–
		14–22	Texture	–
		22–36	SAR, texture	–
		36–48	Texture	SAR
SC2†	Kyle clay (KlB)	0–3	Texture	–
		3–10	Texture	–
		10–18	Texture	–
		18–32	Texture	–
		32–46	Texture	pH
SC3†	Penrose clay (PeD)	0–3	Texture	–
		3–10	Texture	–
		10–18	Texture	–
SC4†	Grummit complex (ShF)	0–3	Texture	pH
		3–10	Texture	pH
		10–17	Texture	pH
SC5†	Reclaimed land	0–6	Texture	–
		6–12	Texture	–
		12–20	Sat %, EC, texture	SAR
SC6†	Penrose clay (PeD)	0–3.5	Texture	–
		3.5–11	Texture	–
		11–18	Texture	–
SC7†	Reclaimed land	0–6	Texture	–
		6–12	Texture	–
		12–20	SAR, texture	–
SC8†	Grummit complex (ShF)	0–3	Texture	pH
		3–10	Texture	pH
		10–18	Texture	pH
SC9†	Penrose clay (PeD)	0–3	–	–
		3–12	Texture	–
		12–20	Texture	–
SC10†	Penrose clay (PeD)	0–3	Texture	–
		3–12	Texture	–
		12–20	Texture	–

Note: – Analytes are below the marginal or unsuitable threshold; EC = electrical conductivity; SAR = sodium absorption ratio; Sat % = saturation percent.

* Marginal and unsuitable parameters determined by comparing soil profile descriptions and lab data with Wyoming Department of Environmental Quality-Land Quality Division Guideline 1A, Attachment B2 - Criteria to Establish Suitability of Soil (Wyoming Department of Environmental Quality-Land Quality Division 2015).

† ACC samples were not analyzed for selenium, boron, or coarse fragments.

3.5 Topsoil Volume Calculations

Topsoil and subsoil salvage depths for each soil map unit within the project area were determined using field and laboratory data. All soil map units have some topsoil and subsoil suitable for salvage. The topsoil and subsoil salvage depths vary slightly within each unit based on topography, precipitation, aspect, and other soil forming factors. The suitable salvage depth was used to calculate the approximate volume of topsoil and subsoil for each soil map unit in the project area and proposed disturbance area. A summary of topsoil and subsoil depths and volumes within the project area and proposed disturbance area are provided in Tables A-6 and A-7, respectively.

3.6 Prime Farmland Assessment

Prime farmland was assessed for the project area using the NRCS Web Soil Survey farmland classification tool (NRCS 2019). No prime farmland was identified.

Table 6. Approximate Soil Salvage Depths and Volumes for Map Units in the Project Area

Map Unit Symbol	Map Unit Name	Soil Sample Location Number	Total Salvage Depth (inches)	Topsoil/Subsoil Salvage (inches)	Topsoil Volume (cubic yards)	Subsoil Volume (cubic yards)	Limitations to Deeper Salvage
ArA	Arvada silt loam, 0 to 3 percent slopes	–	13	2/11	10,432	57,373	Elevated salinity and sodicity below 13 inches
ArS	Arvada-Slickspots complex, 0 to 3 percent slopes	–	13	2/11	6,245	34,349	Elevated salinity and sodicity below 13 inches
KlB	Kyle clay, 2 to 6 percent slopes	SP-1, SP-2, SP-3, SC2*	9	3/6	53,280	106,561	Elevated acidity, sodicity, and boron
PeD	Penrose clay, 3 to 15 percent slopes	SC3,*SC6,* SC9,* SC10*	20	6/13	51,181	110,891	Salvage to shale
ShF	Grummit-Rock outcrop complex, 6 to 40 percent slopes	SP-4, SC8*	Gr: 16 Shale: 0	Gr: 6/10 Shale: 0/0	13,279	22,132	Salvage to shale; very strongly acidic, elevated sodicity; avoid shale outcrop
ToB	Twotop clay, 0 to 9 percent slopes	SC1*	22	10/12	44,099	52,919	Elevated sodicity
Total					**178,516**	**384,225**	
Approximate replacement depth (inches)					4	9	

Note: – = ArA and ArS were not sampled during SWCA Environmental Consultants' survey or American Colloid Company's (ACC's) survey; GR = Grummit.

* Samples from the ACC report.

Table 7. Approximate Soil Salvage Depths and Volumes for Map Units in the Proposed Disturbance Area

Map Unit Symbol	Map Unit Name	Soil Sample Location Number	Total Salvage Depth (inches)	Topsoil/Subsoil Salvage (inches)	Topsoil Volume (cubic yards)	Subsoil Volume (cubic yards)	Limitations to Deeper Salvage
ArA	Arvada silt loam, 0 to 3 percent slopes	–	13	2/11	10,281	56,545	Elevated salinity and sodicity below 13 inches
ArS	Arvada-Slickspots complex, 0 to 3 percent slopes	–	13	2/11	2,745	15,099	Elevated salinity and sodicity below 13 inches
KIB	Kyle clay, 2 to 6 percent slopes	SP-1, SP-2, SP-3, SC2*	9	3/6	34,745	69,489	Elevated acidity, sodicity and boron
PeD	Penrose clay, 3 to 15 percent slopes	SC3,*SC6,* SC9,* SC10*	20	6/13	48,518	100,789	Salvage to shale
ShF	Grummit-Rock outcrop complex, 6 to 40 percent slopes	SP-4, SC8*	Gr:16 Shale: 0	Gr: 6/10 Shale: 0/0	9,647	16,076	Salvage to shale; very strongly acidic, elevated sodicity
ToB	Twotop clay, 0 to 9 percent slopes	SC1*	22	10/12	31,933	38,319	Elevated sodicity
Total					**135,869**	**296,320**	
Approximate replacement depth (inches)					**4**	**9**	

Note: – = ArA and ArS were not sampled during SWCA Environmental Consultants' survey or American Colloid Company's (ACC's) survey; GR = Grummit.

* Samples from the ACC report.

4 LITERATURE CITED

Natural Resources Conservation Service (NRCS). 2017. *National Soil Survey Handbook*, title 430-VI. Available at: https://www.nrcs.usda.gov/resources/guides-and-instructions/national-soil-survey-handbook. Accessed December 15, 2023.

———. 2019. Web Soil Survey: Soil Map. Available at: http://websoilsurvey.nrcs.usda.gov/app/. Accessed December 15, 2023.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson (editors). 2002. *Field book for describing and sampling soils, Version* 2.0. Lincoln, Nebraska: Natural Resources Conservation Service, National Soil Survey Center.

Soil Science Division Staff. 2017. Soil survey manual. Edited by C. Ditzler, K. Scheffe, and H.C. Monger. U.S. Department of Agriculture Handbook 18. Washington D.C.: United States Department of Agriculture, Government Printing Office.

Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD). 2015. Guideline 1A, Topsoil and Overburden. On file, Sheridan, Wyoming: SWCA Environmental Consultants.

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APPENDIX A

American Colloid Company Soil Report

SOILS/
GEOLOGICAL

SHEAR/CLARKSON LARGE SCALE MINING PERMITS

Mining on the Shear/Clarkson East and West Permits will consist of surface mining for bentonite clay located in the "F" bentonite bed.

Bentonite clay is a fine-grained rock composed mainly of montmorillonite minerals. The formation of bentonite was an in situ alteration of rhyolitic, volcanic ash. Pyroclastic material was ejected into the atmosphere by volcanic activity and deposited as sediment in a marine environment. The resulting alteration of volcanic ash is the material we call bentonite.

The ""F" bentonite bed is located in the upper portion of the lower member of the Belle Fourche Shale Formation which was formed during the Lower and Upper Cretaceous periods. In order to reach the "F" bentonite bed, ACC will mine through the upper portion of the Belle Fourche Shale Formation which consists of dark-gray shale with highly calcareous concretions and calcite.

The above formation is not considered to be geologically unique and has been mined extensively.

Depth of the overburden in the areas of proposed mining on the permit ranges from 2-50'; thickness of the "F" bentonite bed on the project averages approximately 3'.

Drill logs for the properties do not indicate that anything special or unique was encountered during drilling.

SHEAR/CLARKSON LARGE SCALE MINING PERMITS

SOIL RESOURCES

1.0 INTRODUCTION

The identification and proper management of the topsoil resources in the proposed Shear/Clarkson Permit areas is essential for the success of reclamation and the achievement of the post-mining land use. The information presented in this Section is designed to aid in formulating a practical and successful reclamation plan.

Location of the Proposed Project

The Shear/Clarkson permit project is located in Butte County, South Dakota, approximately seven to twelve miles northwest of Belle Fourche and immediately north to about 1 mile north of US Highway 212. The Shear/Clarkson Permit project is divided into two permits, the **Shear/Clarkson West Permit** and the **Shear/Clarkson East Permit**, separated by a little more than one mile. Please refer to the Introduction Section of the permit application packages for the complete legal descriptions.

A detailed Order 1-2 soil survey was conducted on the proposed Shear/Clarkson Permit areas. The survey covered approximately **840 acres** in portions of Sections 29 and 33, Township 10 North, Range 1 East (the West Permit) and in portions of Sections 2, 3, 11, and 12, Township 9 North, Range 1 East (the East Permit). The soil survey covered all areas where proposed mining will occur on the project.

American Colloid Company (ACC) personnel extrapolated soils data from Sections 29 and 33 to cover 5.5 acres added to the West Permit boundaries in 2008.

Topography, Vegetation, and Hydrology of the Proposed Area

Please refer to the soil maps included at the end of this Section for an illustration of the topography of the project area. Please refer to the Vegetation Section for detailed vegetation information. Please refer to the Hydrology Section for detailed hydrologic information.

2.0 METHODOLOGY

Portions of the Shear/Clarkson project in both the West and East Permits were previously mapped and evaluated by ACC in 1982, although no soil samples were collected for laboratory analysis at that time (Pharr, 2007). This information was obtained and reviewed and remains on file at ACC's Permitting & Reclamation Office.

Because the current Shear/Clarkson project is larger in size than the previous survey area

and because no samples were collected during the previous survey and some of the area has been mined and reclaimed, it was decided to conduct a new soil survey of the entire area according to current standards and procedures. Soils information for the nearby Kudlock Permit (Permit #469, approved by DENR 3/15/07) was also reviewed. The Kudlock area is located approximately 1.25 miles southeast of the east part of the Shear/Clarkson East Permit.

Soils mapping, profile description, sampling, and taxonomic classification were conducted in accordance with current procedures and standards of the National Cooperative Soil Survey (Soil Survey Staff 1993 and 1999; and Schoeneberger et. al. 2002). Initial mapping units were identified using the USDA Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service-SCS) air-photo base, Order 3 soil survey maps; the USGS 7.5' Bull Creek Butte and Middle Creek Butte topographic quadrangle maps; and ACC's 1"=400' topographic base maps for all applicable sections (6 maps). The proposed permit area is located on portions of Map Sheets 81, 82, and 91 of the published Butte County, South Dakota, Soil Survey (Johnson, 1976).

The soil resources of the proposed Shear/Clarkson Permit area were investigated by Jim Nyenhuis, Certified Professional Soil Scientist/Soil Classifier (ARCPACS 2743), during July and September, 2006. Mr. Nyenhuis had participated in data evaluation for the previous Kudlock Project in 2003.

Lands within the Shear/Clarkson project were mapped at the detailed Order 1-2 level of intensity. The previous soil boundaries were used during initial field reconnaissance and observation but were later revised or changed entirely during the detailed soil mapping phase of the project.

The land was traversed on foot. Soil map unit boundaries were delineated by exposing soil profiles using a sharpshooter and bucket auger as well as observing surface conditions, vegetation, slope gradient and slope aspect. Soil resource information for adjacent permitted areas was reviewed to determine whether previous soils and their recommended salvage depths were similar to those within the new project area.

Following soils mapping, representative locations were selected for all major soils proposed to be disturbed by mining activities, and these sites were fully described and sampled. A total of **thirty-four soil samples** were collected from **ten sample locations.** The samples were sent to Intermountain Laboratories (IML) in Sheridan, Wyoming for standard soil analysis.

The laboratory analysis included: pH; electrical conductivity (EC); saturation percent; calcium, magnesium, and sodium (meq/l); calculation of Sodium Adsorption Ratio (SAR); percent organic matter (Walkley-Black method); and soil texture (percent sand, silt, and clay). Ten percent QA/QC rerun analysis was performed by IML, and confirming data is on file at their office in Sheridan, Wyoming.

Coarse fragment content (volume percent based on screening with a 2-millimeter-opening 'No.10' soil screen) and calcium carbonate content (lime estimate based on fizz rating as none, slight, moderate, strong, or violent) were determined in the field at the time of soil sample collection and description. The results of the lab analyses are included following this report.

The results of soils field mapping, profile descriptions, and laboratory analyses are used to evaluate topsoil suitability and generate soil salvage recommendations. The recommended salvage depths are listed and discussed in the soil mapping unit descriptions in the Results section of this report.

3.0 RESULTS

The Shear/Clarkson project area in Butte County is within a "mesic" soil temperature regime (mean annual air temperature about 43 to 48 degrees F.) and an "ustic-aridic" to "aridic-ustic" soil moisture regime (mean annual precipitation about 12 to 15 inches). The frost-free period is about 125 days (Johnson, 1976). The project is characterized by the presence of very shallow, shallow, and deep soils.

Grummit clay is a very shallow to shallow (5 to 20 inches to shale), fine textured, well drained soil located on or nearby to shale upland ridges. Penrose clay is a shallow (10 to 20" deep), well drained soil developing in thin slopewash alluvium and residuum from calcareous, chalky shale and thin limestone bedrock. The other four soils (Arvada, Broadhurst, Kyle, and Twotop) are all deep, well drained soils. Arvada is forming in slopewash alluvium and colluvium from sodic shale on alluvial fans and lower sideslopes of hills and ridges. Arvada is often mapped in complex with 'slickspots' which are unvegetated, sodic spots in small depressions 10 to 100' wide. Twotop clay is a very clayey soil that is neutral to moderately alkaline in reaction (pH). Kyle clay is also very clayey with slightly acid to mildly alkaline reaction in the upper part of the soil and very strongly acid reaction in the lower part. Broadhurst clay is very clayey and moderately acid in the upper part of the soil and very strongly acid throughout the lower part.

SOILS TABLE 1 (List of Map Units and Mining Area Topsoil Salvage Summary) lists the soil map units within the proposed permit area, their soil sample location numbers, and summarizes salvage depths and limitations to deeper salvage.

SOILS TABLE 2 (Summary of Soil Types in Mining Area) lists the composition of each soil map unit to be affected by mining in acres and as a percent of the total area, as well as the recommended topsoil/subsoil salvage depth and limitations to deeper salvage.

The **Shear/Clarkson Soil Maps (7)** follow the soils report. They were compiled on ACC topographic base maps at a scale of 1"=400' and a contour interval of 20 feet.

The following text is a description of the project area soil map units and their component soils, as well as an evaluation of topsoil suitability and recommended salvage depths. The descriptions are presented in alphabetic order by map unit symbol:

Map Unit ArS	**Arvada-Slickspots complex, 0 to 3% slopes**
Map Unit ArA	**Arvada silt loam, 0 to 3% slopes**
Map Unit BtB	**Broadhurst clay, 0 to 6% slopes**
Map Unit DL	**Disturbed Land**
Map Unit GrE	**Grummit clay, 3 to 25% slopes**
Map Unit KiB	**Kyle clay, 2 to 6% slopes**
Map Unit PeD	**Penrose clay, 3 to 15% slopes**
Map Unit RLT	**Reclaimed Land, Topsoiled**
Map Unit ShF	**Shale Land-Grummit complex, 15 to 45% slopes**
Map Unit ToB	**Twotop clay, 0 to 9% slopes**

3.1 Map Unit ArS: Arvada-Slickspots complex, 0 to 3% slopes

Arvada-Slickspots complex (Map Unit ArS) is located primarily along proposed haul road corridors and not within projected mining areas. Due to its small acreage, it was not sampled for laboratory analysis. Arvada is a very deep, well drained soil that is forming in nearly level alluvium and colluvium derived from sodic shale. Arvada silt loam accounts for about 80% of the map unit, with the other 20% consisting of 'slickspots' which are unvegetated, sodic spots in small depressions 10 to 100' wide. Arvada has a claypan subsoil and its permeability is very slow, and the surface runoff is medium to very high.

Arvada Taxonomic Class: Arvada is classified as a "Fine, smectitic, mesic Ustertic Natrargid". Arvada is an established soil series that has been mapped extensively in eastern Wyoming, eastern Colorado and parts of the adjacent states. The most recent NRCS official soil series description for Arvada, dated December 2003, is on file at ACC.

Arvada Typical Sample Pedon: Because of the very small disturbance associated with Arvada and because it was previously mapped on an adjacent project, it was not sampled for laboratory characterization on the Shear/Clarkson project area. Based on NRCS information (Johnson, 1976), Arvada typically has a surface layer about 2 inches thick. It is a light brownish gray (2.5Y 4/2) silt loam with a weak, thin platy structure parting to weak, very fine granular structure. It has soft, very friable, nonsticky and nonplastic consistence, and is slightly acid to slightly alkaline in reaction (pH). The underlying natric horizon subsoil layer extends from 2 to 13 inches in depth and is a grayish brown (2.5Y 5/2) to dark grayish brown (2.5Y 4/2) silty clay that is neutral to strongly alkaline in

reaction (pH). Clay content ranges from about 35 to 60 percent. The underlying lower subsoil and substratum horizons are a gray to brownish gray silty clay loam to a depth of 60 inches or deeper.

Arvada Range of Characteristics: Depth to effervescent (calcareous) material ranges from 0 to 19 inches. Depth to layers with greater than 15 percent exchangeable sodium (SAR) is 4 to 15 inches. Gravel is typically less than 5 percent but ranges from 0 to 15 percent. Depth to sodic shale bedrock is usually around 60 inches.

Arvada Soil Suitability and Salvage Depth Recommendation: Topsoil 2"/Subsoil 11"

Arvada has previously been mapped and evaluated on the nearby Ramey project area. Based on previous information and NRCS data, Arvada typically encounters excessive salts at 13 inches and becomes strongly alkaline (pH 9.2) at 14 inches. The upper 2 inches of the surface soil can be salvaged as Topsoil, and the underlying 11 inches as Subsoil.

3.2 Map Unit ArA: Arvada silt loam, 0 to 3% slopes

Arvada silt loam (Map Unit ArA) is mapped on similar landscape positions as Arvada-Slickspots complex (Map Unit ArS) but without the presence of 'slickspots'. Arvada silt loam is mapped on only a few small delineations within proposed haul road corridors or projected associated disturbance areas, and was not sampled for laboratory characterization. As stated above, Arvada was mapped on the nearby Ramey project area. The soil suitability and salvage recommendation for Arvada silt loam in Map Unit ArA is the same as that in Map Unit ArS. The upper 2 inches of Arvada silt loam can be salvaged for use as Topsoil, and the underlying 11 inches as Subsoil.

3.3 Map Unit BtB: Broadhurst clay, 0 to 6% slopes

Broadhurst clay (Map Unit BtB) is a deep, well drained, fine-textured acid soil mapped on alluvial fans and terraces. Broadhurst is forming in clayey alluvium derived from acid shale. Broadhurst was mapped in only one delineation on a gently sloping alluvial fan south of the main shale ridge in the far eastern part of the project area. Broadhurst clay will not be disturbed by mining activities, is not crossed by any proposed haul road corridor, and therefore was not sampled for laboratory characterization.

Broadhurst has a light brownish gray (10YR 6/2) surface layer of heavy clay texture about 3 inches thick with moderately acid reaction (pH). The underlying 'C' horizon substratum is a grayish brown (10YR 5/2) clay that is very strongly acid. The lower part of the 'C' horizon, typically below about 40 inches, has common amounts of gypsum and other salts. Permeability is very slow and runoff is medium to very rapid.

Broadhurst Taxonomic Class: Broadhurst is classified as a "Very-fine, smectitic, acid, mesic Torrertic Ustorthent". Broadhurst is an established soil series of small extent mapped in western South Dakota. The most recent NRCS official soil series description, dated February 1999, is on file at ACC.

Broadhurst Typical Sample Pedon: This soil is similar to and fits within the Range of Characteristics of the most recent Official Soil Series Description, dated February 1999, which is on file at ACC. Broadhurst has also been mapped and evaluated for suitability in two nearby project areas, the Ramey Project and the Royal Claims.

Range in Characteristics: Color throughout the soil is largely inherited from its parent material. Broadhurst averages between 60 and 70 percent clay. When the soil is dry, cracks ½ to 1 inch wide and several feet long extend downward for up to 20 inches or more. The soil is typically strongly acid but ranges from moderately to extremely acid.

Broadhurst Soil Suitability and Salvage Depth Recommendation:
Topsoil 6"/Subsoil 11"

Although Broadhurst is not projected to be disturbed by mining operations, it was evaluated for soil suitability and salvage depth recommendation. Broadhurst is classified as very strongly acid at depth of 17 inches, and salts become excessive. If Broadhurst were to be disturbed on the Shear/Clarkson project area, the upper 6 inches could be salvaged as Topsoil, and the underlying 11 inches could be salvaged as Subsoil.

3.4 Map Unit DL: Disturbed Land

Disturbed Land (Map Unit DL) was mapped in two small delineations in Section 29 (T.10N., R.1E.) on the far west side of the project area. One delineation, located in a portion of the NW4SE4, is an old "shale pit" used by the rancher for gravel (shale) road base material. The other delineation, located in the SW4NE4, is an earthen embankment-berm enclosing the lower end of a small reservoir stock pond. Neither area of Disturbed Land has any soil available for salvage. The shale pit is proposed to be disturbed during mining activities, although the stock pond is not.

3.5 Map Unit GrE: Grummit clay, 3 to 25% slopes

Grummit clay (Map Unit GrE) is mapped on portions of shale ridgetops, knolls, and upper sideslopes scattered throughout the project area. Grummit is forming in clayey residuum from acid shale. Grummit is a very shallow to shallow (5 to 20 inches to shale bedrock), well drained soil and some of this map unit has been eroded by slight to moderate gullying.

Grummit has moderate permeability and very low available water holding capacity. The effective rooting depth is the depth of the profile to the shale contact, about 5 to 20 inches. Surface runoff is high, and the erosion hazard is high. The Range Site for Grummit is "Shallow Porous Clay".

Grummit Taxonomic Class: The taxonomic classification of Grummit was formerly "Clayey, smectitic, acid, mesic, shallow Ustic Torriorthent", but has been revised to "Clayey, smectitic, acid, mesic, shallow Aridic Ustorthent". Grummit is an established soil series of moderate extent mapped in northeastern Wyoming and western South Dakota. The most recent NRCS official soil series description is on file at ACC.

Grummit Typical Sample Pedons: Grummit was described and sampled at one representative site, **SC4**, in Map Unit GrE, and at one representative site, **SC8**, in Map Unit ShF (Shale Land-Grummit complex). Both Grummit soil profiles are described below.

Grummit Typical Site SC4 Soil Profile Description: 8% slope; north aspect; mixed grasses, occasional sagebrush, and prickly pear cactus vegetation; thin residuum from acid clay shale; rolling upland; slight erosion at sample site.

A horizon – 0 to 3 inches; light brownish gray (10YR 6/2) clay with 3% shale chips, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; soft, friable, sticky and plastic consistence; many fine and very fine, and few coarse and medium roots; noneffervescent; from lab data: pH=4.3 (extremely acid), EC=0.13 (nonsaline), SAR=1.27 (nonsodic), organic matter=1.3%; gradual smooth boundary.

Bw horizon – 3 to 10 inches; grayish brown (10YR 5/2) clay with 10% shale chips, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic consistence; many fine and very fine and few coarse and medium roots; noneffervescent; from lab data: pH=4.4 (extremely acid), EC=0.09 (nonsaline), SAR=1.28 (nonsodic), organic matter=1.2%; gradual wavy boundary.

C horizon – 10 to 17 inches; grayish brown (10YR 5/2) clay with 15% shale chips and fragments, dark grayish brown (10YR 4/2) moist; massive structure; hard, friable to firm, sticky and plastic consistence; few fine and very fine roots; noneffervescent; from lab data: pH=4.3 (extremely acid), EC=0.29 (nonsaline), SAR=2.91 (very slightly sodic), organic matter=1.0%; gradual wavy boundary.

Cr horizon (paralithic contact) 17+ inches; weathered, somewhat hard, gray (10YR 5/1) platy acid shale.

Grummit Typical Site SC8 Soil Profile Description: 8% slope; east aspect; Big sagebrush, mixed grasses vegetation; thin residuum from acid shale; sideslope of low ridge; moderate erosion in vicinity of sample site.

A horizon – 0 to 3 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium platy structure parting to moderate medium granular; slightly hard, friable, sticky and plastic consistence; common fine and very fine and few coarse and medium roots; noneffervescent; from lab data: pH=4.7 (very strongly acid), EC=0.46 (nonsaline), SAR=0.54 (nonsodic), organic matter=0.9%; gradual smooth boundary.

C1 horizon – 3 to 10 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic consistence; common fine and very fine and few coarse and medium roots; noneffervescent; from lab data; pH=4.2 (extremely acid), EC=2.64 (very slightly saline), SAR=0.48 (nonsodic), organic matter=0.8%; gradual wavy boundary.

C2 horizon – 10 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark gray (10YR 3/1) moist; massive structure; very hard, firm, sticky and plastic consistence; few fine and very fine roots; noneffervescent; from lab data: pH=4.2 (extremely acid), EC=3.86 (very slightly saline), SAR=3.44 (slightly sodic), organic matter=0.9%; gradual wavy boundary.

Cr horizon (paralithic contact) 18+ inches; weathered, hard, dark gray (10YR 4/1) acid shale.

Grummit Soil Suitability and Salvage Depth Recommendation:
Topsoil 6", Subsoil 11"

Grummit is entirely suitable for salvage and reapplication during reclamation activities even though soil reaction (pH) is very strongly acid to extremely acid. The native Grummit soil has sagebrush and mixed grasses vegetation growing on it, and therefore the pH is apparently not limiting for vegetative growth in its native state and should not be so in a reclaimed setting. Grummit is also nonsaline and nonsodic. The average depth of suitable soil for Map Unit GrE is 17 inches. The upper 6 inches can be salvaged as Topsoil. After the topsoil is salvaged, the remaining depth to shale bedrock (whether 11 inches or different depending on the depth to shale bedrock) can be salvaged as Subsoil.

3.6 Map Unit KiB: Kyle clay, 2 to 6% slopes

KiB clay (Map Unit KiB) is located on nearly level to gently sloping shale uplands scattered throughout the project area. The map unit will be disturbed by mining activities, and the soil was sampled for laboratory characterization at representative site SC2. Kyle

clay is a deep, well drained soil forming in clayey, slopewash alluvium and residuum weathered from neutral or alkaline shale. Soil texture is dominantly clay but can include heavy clay loam, silty clay loam, and silty clay.

Typically, Kyle has a surface layer that is a light brownish gray clay about 3 inches thick. The "Bw" cambic horizon subsoil layer, about 17 inches thick, is a dark grayish brown, calcareous clay that is very hard when dry and very firm when moist. The underlying material to the shale bedrock is a grayish brown, calcareous clay. Cracks that are ½ to 2 inches wide, several feet long, and extend downward for some distance are common when the soil is dry.

Kyle clay has very slow permeability and low to moderate available water capacity. The major rooting depth is about 18 inches. Surface runoff is medium, and the erosion hazard from wind and water is moderate. The Range Site (Ecological Site) is "Clayey, Pierre Shale Plains".

Kyle Taxonomic Classification: Kyle is classified as a "Very-fine, smectitic, mesic Aridic Haplustert". Kyle is an established soil series mapped in western South Dakota. The most recent NRCS official soil series description for Kyle, dated May 1996, is on file at ACC.

Kyle Typical Sample Pedon: In Map Unit KiB, Kyle clay was sampled for laboratory analysis at one representative site, **SC2**, located in the NW4NW4, Section 12, T.9N., R.1E. The soil is described below.

Kyle Typical Site SC2 Soil Profile Description: 8% slope; NNE aspect; mixed grasses vegetation (mixed grass prairie); local slopewash alluvium over residuum from shale; upland shale ridge backslope; stable surface with no erosion.

A horizon – 0 to 3 inches; pale brown (10YR 6/3) clay to silty clay with 2% small gravels, brown (10YR 4/3) moist; moderate medium granular structure over moderate medium angular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium and coarse roots; noneffervescent, from lab data: pH=6.4 (slightly acid), EC=0.48 (nonsaline), SAR=0.17 (nonsodic), organic matter=3.4%; gradual smooth boundary.

Bw horizon – 3 to 10 inches; grayish brown (10YR 5/2) clay with 2% small gravels, very dark grayish brown (10YR 3/2) moist; strong medium angular blocky structure; hard dry consistence, firm moist consistence, very sticky and very plastic wet consistence; common fine and very fine, and few medium and coarse roots; noneffervescent; from lab data: pH=7.2 (neutral), EC=0.34 (nonsaline), SAR=0.26 (nonsodic), organic matter=1.5%; gradual wavy boundary.

By horizon – 10 to 18 inches; grayish brown (10YR 5/2) clay to silty clay with 2% small gravels, very dark grayish brown (10YR 3/2) moist; massive structure; hard dry consistence, firm moist consistence, and very sticky and very plastic wet consistence; few fine and very fine roots; few fine and medium nests of gypsum; slightly effervescent; from lab data: pH=7.6 (slightly alkaline), EC=2.36 (very slightly alkaline), SAR=1.00 (nonsodic), organic matter=1.1%; gradual wavy boundary.

C1y horizon – 18 to 32 inches; gray (10YR 5/1) clay to silty clay with 2% small gravels, dark gray (10YR 4/1) moist; massive structure; very hard dry consistence, firm moist consistence, very sticky and very plastic moist consistence; few fine and medium nests of gypsum; slightly effervescent ; from lab data: pH=6.4 (slightly acid), EC=3.07 (very slightly saline), SAR=3.65 (slightly sodic), organic matter=1.1%; gradual wavy boundary.

C2 horizon - 32 to 46 inches; dark grayish brown (10YR 4/2) clay to silty clay, very dark grayish brown (10YR 3/2) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; noneffervescent; from lab data: pH=4.8 (very strongly acid), EC=2.75 (very slightly saline), SAR=4.22 (slightly sodic), organic matter=0.8%; gradual wavy boundary.

Kyle Clay (Map Unit KiB) Soil Suitability & Salvage Recommendation:
Topsoil 10"/Subsoil 22"

Kyle clay is entirely suitable throughout the profile depth to a depth of about 32 inches, at which depth the soil becomes very strongly acid. The soil is nonsaline to very slightly saline (EC ranges from 0.34 to 3.07), and nonsodic to slightly sodic (SAR ranges from 0.17 to 4.22). Organic matter content ranges from 3.4 percent in the surface layer to about 0.8 percent in the underlying material near the shale contact. Soil texture is dominantly clay to silty clay. The upper 10 inches can be salvaged for Topsoil, and the underlying 22 inches can be salvaged for Subsoil material.

3.7 Map Unit PeD: Penrose clay, 3 to 15% slopes

Penrose clay (Map unit PeD) is a shallow, well drained calcareous soil forming in place from chalky shale, weathered limestone, and interbedded limy materials. Soil texture is dominantly clay but can include clay loam, silty clay loam, and silty clay. Penrose is found on ridges, backslopes, sideslopes, and plains scattered across the project area. Penrose comprises a majority of the area proposed to be disturbed by mining activities and was sampled for laboratory analysis at several representative sites (SC3, SC6, SC9, and SC10). Penrose clay was mapped in both the West and East Areas of the Shear/Clarkson project area.

Penrose typically has a surface layer that is light brownish gray clay to silty clay loam about 3 inches thick. The underlying "Bw" and "C" horizon subsoil and substratum is a

light gray clay to silty clay that is slightly hard to hard when dry and firm when moist. Paralithic shale and interbedded limy materials are encountered from 10 to 20 inches in depth, with an average depth of 19 inches in the project area. The entire soil profile is calcareous.

Penrose clay has slow permeability and low to very low available water holding capacity. Permeability is moderately slow and runoff is rapid. The major rooting depth is about 10 to 20 inches. Erosion hazard from wind and water is moderate to severe. The Range Site (Ecological Site) is "Shallow, Pierre Shale Plains".

Penrose Taxonomic Class: Penrose is classified as a "Loamy, carbonatic, mesic Lithic Ustic Torriorthent". Penrose is an established soil series of large extent mapped in eastern Colorado, Wyoming, and western South Dakota. The most recent NRCS official series description for Penrose, dated June 2006, is on file at ACC.

Penrose Typical Sample Pedons: Penrose was sampled at four representative locations (SC3, SC6, SC9 and SC10). Typical pedon SC3 was described and sampled in the NE4SW4, Section 2, T.9N., R.1E. Typical pedon SC6 was described and sampled in the NW4SE4, Section 29, T.10N., R.1E. Typical pedon SC9 was described and sampled in the NW4NE4, Section 33, T.10N., R.1E. Typical pedon SC10 was described and sampled in the SW4NE4, Section 33, T.10N., R.1E. Penrose clay was also mapped, described, and sampled on previous nearby projects including the Kudlock and Ramey projects.

Penrose Typical Site SC3 Soil Profile Description: 4% slope; northeast aspect; mixed grasses vegetation; residuum from weathered shaly limestone; gentle slope of ridge upper backslope; slight erosion at sample site.

A horizon – 0 to 3 inches; grayish brown (10YR 5/2) clay with 3% small gravels, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard dry consistence, friable to firm moist consistence, sticky and plastic wet consistence; many to common medium, fine, and very fine roots; slightly effervescent; from lab data: pH=7.6 (slightly alkaline), EC=0.52 (nonsaline), SAR=0.72 (nonsodic), organic matter=4.3%; clear smooth boundary.

Bw horizon – 3 to 10 inches; dark grayish brown (10YR 4/2) clay with 3% small gravels, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; many to common medium, fine, and very fine roots; moderately effervescent; from lab data: pH=8.0 (moderately alkaline), EC=0.36 (nonsaline), SAR=1.46 (nonsodic), organic matter=2.4%; gradual wavy boundary.

C horizon – 10 to 18 inches; dark grayish brown (10YR 4/2) clay with 15% light brown sandy limestone gravels, very dark brown (10YR 2/2) moist; massive structure; hard dry consistence, friable moist consistence, sticky and plastic wet consistence; few medium, fine, and very fine roots; moderately effervescent; from lab data: pH=7.8 (slightly alkaline), EC=2.79 (very slightly saline), SAR=3.93 (slightly sodic), organic matter=1.6%; gradual wavy boundary.

R (lithic contact) 18+ inches; hard, slightly weathered limestone bedrock.

Penrose Typical Site SC6 Soil Profile Description: 3% slope; northeast aspect; mixed grasses and prickly pear cactus vegetation (mixed grass prairie); some slopewash alluvium over thin residuum from chalky shale; gently sloping lower backslope; no erosion at sample site.

A horizon – 0 to 3.5 inches; grayish brown (10YR 5/2) clay with 5% limestone chips, dark grayish brown (10YR 4/2) moist; strong medium granular structure; slightly hard dry consistence, friable moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium roots; slightly effervescent; from lab data: pH=7.4 (slightly alkaline), EC=0.58 (nonsaline), SAR=0.45 (nonsodic), organic matter=3.4%; gradual smooth boundary.

Bw horizon – 3.5 to 11 inches; grayish brown (10YR 5/2) clay with 5% limestone chips, dark grayish brown (10YR 4/2) moist; strong medium subangular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium roots; slightly effervescent; from lab data: pH=7.7 (slightly alkaline), EC=2.4 (very slightly saline), SAR=1.49 (nonsodic), organic matter=1.6%; gradual wavy boundary.

C horizon – 11 to 18 inches; gray (10YR 5/1) clay with 15% shale chips, dark gray (10YR 4/1) moist; massive structure; hard dry consistence, firm moist consistence, very sticky and very plastic wet consistence; few fine and very fine roots; slightly effervescent; from lab data: pH=7.8 (slightly alkaline), EC=4.4 (slightly saline), SAR=7.08 (slightly sodic), organic matter=1.1%; gradual wavy boundary.

Cr horizon (paralithic contact) 18+ inches; somewhat hard, weathered, dark gray clay shale bedrock.

Penrose Typical Site SC9 Soil Profile Description: 8% slope; southwest aspect; mixed grasses and prickly pear cactus vegetation (mixed grass prairie); thin residuum from calcareous clay shale and limestone; rolling upland; slight to moderate erosion.

A horizon – 0 to 3 inches; grayish brown (10YR 5/2) clay loam with 10% limestone fragments, dark grayish brown (10YR 4/2) moist; moderate medium granular structure;

slightly hard dry consistence, friable moist consistence, sticky and plastic wet consistence; many fine and very fine, and common medium roots; slightly effervescent; from lab data: pH=7.6 (slightly alkaline), EC=0.45 (nonsaline), SAR=0.19 (nonsodic), organic matter=5.7%; gradual smooth boundary.

Bw horizon – 3 to 12 inches; dark grayish brown (10YR 4/2) clay with 5% limestone fragments, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; many fine and very fine, and common medium roots; moderately effervescent; from lab data: pH=7.5 (slightly alkaline), EC=2.22 (very slightly saline), SAR=0.73 (nonsodic), organic matter=2.9%; gradual wavy boundary.

C horizon – 12 to 20 inches; pale brown (10YR 6/3) silty clay with 5% limestone fragments, brown (10YR 4/3) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic consistence; few fine and very fine roots; strongly effervescent; from lab data: pH=7.7 (slightly alkaline), EC=3.58 (very slightly saline), SAR=5.02 (slightly sodic), organic matter=1.7%; gradual wavy boundary.

Cr horizon (paralithic contact) 20+ inches; hard, weathered, dark gray clay shale bedrock.

Penrose Typical Site SC10 Soil Profile Description: 6% slope; north aspect; sparse mixed grasses and prickly pear cactus vegetation (mixed grass prairie); thin residuum from calcareous clay shale; rolling upland; slight erosion at sample site.

A horizon – 0 to 3 inches; light brownish gray (10YR 6/2) clay with 10% limestone fragments and chips, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard dry consistence, friable moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium and coarse roots; slightly effervescent; from lab data: pH=7.7 (slightly alkaline), EC=0.59 (nonsaline), SAR=0.17 (nonsodic), organic matter=3.5%; gradual smooth boundary.

Bw horizon – 3 to 12 inches; grayish brown (10YR 5/2) clay with 10% limestone fragments and chips, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium and coarse roots; moderately effervescent; from lab data: pH=7.8 (slightly alkaline), EC=0.49 (nonsaline), SAR=0.26 (nonsodic), organic matter=1.6%; gradual wavy boundary.

C horizon – 12 to 20 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; few fine and very fine roots; strongly effervescent; from lab data: pH=7.6 (slightly alkaline), EC=2.59 (very slightly saline), SAR=0.82 (nonsodic), organic matter=1.3%; gradual wavy boundary.

Cr horizon (paralithic contact) 20+ inches; hard, weathered, gray clay shale bedrock.

Penrose (Map Unit PeD) Soil Suitability and Salvage Depth Recommendation:
Topsoil 6"/Subsoil 13"

The entire soil profile to the lithic or paralithic contact is suitable for salvage. The total recommended salvage depth is 19 inches or the depth to the rock contact (R or Cr horizon) if different. The average depth to the paralithic contact in the study area is 19 inches. The upper 6 inches can be salvaged as Topsoil, and the underlying 13 inches, or the depth to the paralithic contact if different, can be salvaged as Subsoil.

3.8 Map Unit RLT: Reclaimed Land, Topsoiled

Reclaimed Land, Topsoiled (Map Unit RLT) is mapped on approximately 24 acres located in a portion of the West Permit, in the E2, Section 29 (T.10N., R.1E.). This area was previously mined and reclaimed in 1988 and released from bond in September, 1995. It will be re-mined for a deeper bed of clay. Map Unit RLT was dug in several locations and sampled at two representative sites, **SC5** and **SC7**, in order to determine average depth and suitability of reapplied topsoil.

Results indicate approximately 12 inches of suitable topsoil is present and available for re-salvage. A mix of soil and regarded overburden is present from 12 to 20 inches, but this material is not recommended for salvage (due to increased salinity, sodicity, clay content, and saturation percent) unless suitable topsoil quantity is limiting in other areas. The upper 6 inches of Map Unit RLT can be re-salvaged for use as Topsoil, and the underlying 6 inches re-salvaged for use as Subsoil. The following are soil descriptions for sample sites SC5 and SC7, both located in the E2, Section 29.

Reclaimed Land, Topsoiled, Typical Site SC5 Soil Profile Description: 12% slope; south aspect; mixed reclamation grasses; reapplied topsoil over graded overburden spoil; reclaimed sideslope; stable surface with no erosion observed at the sample site at the time of sampling; located within the NE4NW4SE4, Section 29, T.10N., R.1E.

AC horizon – 0 to 6 inches; grayish brown (10YR 5/2) clay with 10% shale chips and brown limestone fragments, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, and sticky and plastic consistence; common fine and very fine and few medium roots; slightly effervescent; from lab data: slightly alkaline (pH 7.6); EC=2.09 (very slightly saline); SAR=0.66 (nonsodic); organic matter=2.0%; gradual wavy boundary.

C horizon – 6 to 12 inches; grayish brown (10YR 5/2) clay with 10% shale chips and brown limestone fragments, dark grayish brown (10YR 4/2) moist; massive structure; slightly hard to hard, friable, and sticky and plastic consistence; common fine and very fine and few medium roots; slightly effervescent; from lab data: moderately alkaline (pH

7.9); EC=4.24 (slightly saline); SAR=6.43 (slightly sodic); organic matter=1.5%; gradual wavy boundary.

C/Cr horizon – 12 to 20 inches; mix of reapplied topsoil and regarded overburden spoil; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; massive structure; hard, firm, and very sticky and very plastic consistence; few fine and very fine roots; slightly effervescent; from lab data: moderately alkaline (pH 8.4); EC=10 (moderately saline); SAR=17.1 (sodic and 'unsuitable'); organic matter=1.4%; gradual wavy boundary.

Reclaimed Land, Topsoiled, Typical Site SC7 Soil Profile Description: 10% slope; northeast aspect; mixed reclamation grasses; reapplied topsoil over graded overburden spoil; reclaimed sideslope; stable surface with no erosion observed at the sample site at the time of sampling; located within the NE4SE4, Section 29, T.10N., R.1E.

AC horizon – 0 to 6 inches; light brownish gray (10YR 6/2) clay with 10% shale chips and channers, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable, and sticky and plastic consistence; common medium, fine, and very fine roots; slightly effervescent; from lab data: slightly alkaline (pH 7.7); EC=2.41 (very slightly saline); SAR=1.04 (nonsodic); organic matter=1.7%; gradual smooth boundary.

C horizon – 6 to 12 inches; brown (10YR 5/3) clay with 10% shale channers, dark brown (10YR 4/3) moist; massive structure; hard, firm, and sticky and plastic consistence; common medium, fine, and very fine roots; moderately to strongly effervescent; from lab data; slightly alkaline (pH 7.8); EC=3.29 (very slightly saline); SAR=4.76 (slightly sodic); organic matter=0.9%; gradual wavy boundary.

C/Cr horizon – 12 to 20 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; massive structure; hard, firm, and very sticky and very plastic consistence; few fine and very fine roots; slightly effervescent; from lab data: moderately alkaline (pH 7.9); EC=5.55 (slightly saline); SAR=10.9 (moderately to strongly sodic); organic matter=0.8%; gradual wavy boundary.

3.9 Map Unit ShF: Shale Land-Grummit complex, 15 to 45% slopes

Shale Land-Grummit complex (Map Unit ShF) is mapped on somewhat narrow, elongate, weathered shale ridges which occur throughout the project area. Map unit ShF is approximately 65 percent Shale Land and 35 percent Grummit clay. The Shale Land consists of eroding outcrops of slightly weathered acid shale which can contain small gullies. Grummit clay occupies those parts of the map unit which have become stabilized by vegetation. Runoff is very rapid on Shale Land, and erosion hazard from wind and water is severe.

Portions of Map Unit ShF are projected to be disturbed by mining activities, and Grummit clay was described and sampled at typical site SC8. Grummit soil profile SC8 was

previously described in Section 3.5, Grummit clay (Map Unit GrE). Bare Shale Land should be avoided during salvage. Grummit clay can be salvaged to the shale contact, an average of 17 inches on the project area. The upper 6 inches of Grummit can be salvaged as Topsoil, and the underlying 11 inches as Subsoil.

3.10 Map Unit ToB: Twotop clay, 0 to 9% slopes

Twotop clay (Map Unit ToB) is located on nearly level to gently sloping shale uplands scattered throughout the project area. Portions of Map Unit ToB are projected to be disturbed by mining activities, and Twotop clay was sampled for laboratory characterization at representative site SC1. Twotop clay is a deep, well drained soil forming in clayey, slopewash alluvium and residuum weathered from neutral or alkaline shale. Soil texture is dominantly clay but can include clay loam, silty clay loam, or silty clay.

Typically, Twotop has a grayish brown, calcareous clay surface layer about 3 or 4 inches thick. The underlying "B" horizon subsoil layers are grayish brown, calcareous clays to a depth of 22 to 35 inches. The lower part contains many streaks and spots of gypsum and other salts. The "C" horizon substratum is a grayish brown, calcareous clay to a depth of 40 inches or more.

Twotop clay has very slow permeability and low to moderate available water holding capacity. The major rooting is about 14 inches. Surface runoff is slow to rapid, and the erosion hazard from wind and water is moderate. The Range Site (Ecological Site) is "Dense Clay, Pierre Shale Plains".

Twotop Taxonomic Classification: Twotop is classified as a "Very-fine, smectitic, mesic, Aridic Haplustert". Twotop is an established soil series of moderate extent mapped in western South Dakota and eastern Wyoming. The most recent NRCS official soil series description for Twotop, dated June 2002, is on file at ACC.

Twotop Typical Sample Pedon: In Map Unit ToB, Twotop clay was sampled for laboratory analysis at one representative site, SC1, located in the NW4NW4, Section 2, T.9N., R.1E. The soil is described below.

Twotop Typical Site SC1 Soil Profile Description: 5% slope; north aspect; mixed grasses vegetation (mixed grass prairie); local slopewash alluvium over residuum from shale; mid to upper backslope of upland shale ridge; stable surface with no erosion.

A horizon – 0 to 4 inches; brown (10YR 5/3) clay to clay loam with <2% small gravels, dark brown (10YR 4/3) moist; thin granular layer over moderate medium subangular blocky structure; slightly hard dry consistence, friable moist consistence, sticky and plastic

wet consistence; common fine and very fine, and few medium roots; slightly effervescent; from lab data; pH=7.3 (neutral), EC=0.52 (nonsaline), SAR=0.30 (nonsodic), organic matter=5.4%; gradual smooth boundary.

Bw horizon – 4 to 14 inches; brown (10YR 5/3) clay with <2% small gravels, dark brown (10YR 4/3) moist; strong medium subangular blocky structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; common fine and very fine, and few medium roots; moderately effervescent; from lab data: pH=7.8 (slightly alkaline), EC=0.34 (nonsaline), SAR=2.59 (nonsodic), organic matter=2.1%; gradual wavy boundary.

BC horizon – 14 to 22 inches; grayish brown (10YR 5/2) clay with <2% small gravels, dark grayish brown (10YR 4/2) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; few fine and very fine roots; strongly effervescent; from lab data: pH=7.7 (slightly alkaline), EC=4.09 (slightly saline), SAR=7.19 (slightly to moderately sodic), organic matter=1.8%; gradual wavy boundary.

C1 horizon – 22 to 36 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; moderately effervescent; from lab data: pH=7.9 (moderately alkaline), EC=4.57 (slightly saline), SAR=10.3 (highly sodic), organic matter=1.5%; gradual wavy boundary.

C2 horizon – 36 to 48 inches; brown (10YR 4/3) clay, dark grayish brown (10YR 4/2) moist; massive structure; hard dry consistence, firm moist consistence, sticky and plastic wet consistence; slightly effervescent; from lab data: pH=7.8 (slightly alkaline), EC=5.9 (slightly saline), SAR=12.5 (highly sodic), organic matter=0.9%; gradual wavy boundary.

Twotop (Map Unit ToB) Soil Suitability & Salvage Recommendation:
Topsoil 10"/ Subsoil 12"

Twotop clay is suitable for salvage to a depth of 22 inches, at which depth the soil becomes highly sodic. Sodium Adsorption Ratio (SAR) increase to 10.3 at 22 inches, and 12.5 ("unsuitable") at 36 inches. All other parameters are suitable. The upper 10 inches of Twotop are recommended for salvage as Topsoil, and the underlying 12 inches as Subsoil. Soil material below 22 inches is not recommended for salvage due to high sodicity.

3.11 Water

One small stock water pond is present in the West Permit in the NE4SW4NE4, Section 29, T.10N., R.1E. There is no soil present here.

4.0 REFERENCES

American Colloid Company. 2003. Soil Survey Report, Kudlock Project, located in portions of Sections 17 and 18, Township 9 North, Range 2 East, Butte County, South Dakota. By Darren Howard. January 2003.

Johnson, Paul R. 1976. Soil Survey of Butte County, South Dakota. USDA-Soil Conservation Service. August 1976.

Montana Department of Environmental Quality-Permitting and Compliance Division, Industrial and Energy Minerals Bureau. 1998. Soil, Overburden and Regraded Spoil Guidelines. Helena, Montana. December 1994. Updated August 1998.

Schoeneberger, P.J., et.al. 2002. Field Book for Describing and Sampling Soils. Version 2.0. U.S.D.A.-Natural Resources Conservation Service-National Soil Survey Center. Lincoln, Nebraska.

Soil Survey Staff. 1993. Soil Survey Manual. Agricultural Handbook No.18. U.S.D.A.-Natural Resources Conservation Service.

Soil Survey Staff. 1999. Soil Taxonomy. Second Edition. Agricultural Handbook 436. U.S.D.A.-Natural Resources Conservation Service.

Wyoming Department of Environmental Quality-Land Quality Division. 1996. Guideline No.1, Topsoil and Overburden. Rules Update, August 1994; Selenium Update, 1996.

SOILS ..3LE 1

SHEAR/CLARKSON EAST AND WEST PERMIT AREAS
LIST OF MAP UNITS AND MINING AREA SOIL SALVAGE SUMMARY

Map Unit Symbol	Map Unit Name	Soil Sample Location Number	Total Soil Depth (In.)	Total Salvage Depth (In.)	Topsoil/ Subsoil Salvage (In.)	Limitations to Deeper Salvage
ArA	Arvada silt loam, 0 to 3% slopes	-	40+	13	2/11	Excessive salinity (EC) and sodicity (SAR) below 13"
ArS	Arvada-Slickspots complex, 0 to 3% slopes	-	40+	13	2/11	Excessive salinity (EC) and sodicity (SAR) below 13"
BtB	Broadhurst clay, 0 to 6% slopes	-	40+	17	6/11	very strongly acid
DL	Disturbed Land	-	0	0	0/0	No soil to salvage
GrE	Grummit clay, 3 to 25% slopes	SC4	5 to 20 ave=17	17	6/11	Salvage to shale, very strongly acid
KiB	Kyle clay, 2 to 6% slopes	SC2	40+	32	10/22	Very strongly acid below 32"
PeD	Penrose clay, 3 to 15% slopes	SC3, SC6, SC9, SC10	10 to 20 ave=19	19	6/13	Salvage to shale
RLT	Reclaimed Land, Topsoiled	SC5, SC7	12+	12	6/6	Excessive salinity (EC) and sodicity (SAR) below 12"
ShF	Shale Land-Grummit complex	Gr: SC8	Gr:10 to 20 ave=17	Gr: 17 Shale: 0	Gr: 6/11 Sh: 0/0	Salvage to shale, avoid shale outcrop
ToB	Twotop clay,	SC1	40+	22	10/12	Excessive sodicity (SAR) below 22"

SOIl 'ABLE 2

SHEAR/CLARKSON EAST AND WEST PERMITS
SUMMARY OF SOIL TYPES IN MINING AREA

Map Unit Symbol	Map Unit Name	Composition of Soil Type (Acres)	Composition of Soil Type (%)	Salvage Depth Topsoil/Subsoil (Inches)	Limitations
ArA	Arvada silt loam, 0 to 3% slopes	6.8	2%	2/11	Excessive salinity (EC) and sodicity (SAR) below 13"
ArS	Arvada-Slickspots complex, 0 to 3% slopes	9.2	3%	2/11	Excessive salinity (EC) and sodicity (SAR) below 13"
DL	Disturbed Land at Shale Pit	.4	<1%	0/0	No soil to salvage
GrE	Grummit clay, 3 to 25% slopes	36.8	10%	6/11	Salvage to shale, very strongly acidic
KiB	Kyle clay, 2 to 6% slopes	62.1	17%	10/22	Very strongly acidic below 32"
PeD	Penrose clay, 3 to 15% slopes	152.8	42%	6/13	Salvage to shale
RLT	Reclaimed Land, topsoiled	23.8	7%	6/6	Excessive salinity (EC) and sodicity (SAR) below 12"
ShF	Shale Land – Grummit complex	24.3	7%	GR: 6/11 SH: 0/0	Salvage to shale; avoid shale outcrop
ToB	Twotop clay	44.3	12%	10/12	Excessive sodicity (SAR) below 22"
	PROPOSED DISTURBANCE	**363.2**	**100%**		

counting 3.6 acres added by ACC in January, 2008

Inter·ff ain Laboratories, Inc.

Soil Analysis Report

American Colloid Company

P.O. Box 2010

BelleFourche, SD 57717

Report ID: S0607349001

Date: 8/18/2006

Work Order: S0607349

Project: Shear Clarkson JE 27/28

Date Received: 7/20/2006

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Calcium	Magnesium	Sodium	SAR	Organic Matter
		In.	s.u.	%	dS/m	meq/L	meq/L	meq/L		%
S0607349-001	SC1	0-4	7.3	68.9	0.52	3.11	0.53	0.40	0.30	5.4
S0607349-002	SC1	4-14	7.8	51.3	0.34	0.91	0.30	2.01	2.59	2.1
S0607349-003	SC1	14-22	7.7	54.1	4.09	15.3	4.44	22.6	7.19	1.8
S0607349-004	SC1	22-36	7.9	48.3	4.57	11.5	5.82	30.4	10.3	1.5
S0607349-005	SC1	36-48	7.8	49.7	5.90	15.1	7.58	42.0	12.5	0.9
S0607349-006	SC2	0-3	6.4	60.8	0.48	3.26	0.50	0.23	0.17	3.4
S0607349-007	SC2	3-10	7.2	58.1	0.34	2.21	0.34	0.29	0.26	1.5
S0607349-008	SC2	10-18	7.6	63.1	2.36	19.0	3.41	3.36	1.00	1.1
S0607349-009	SC2	18-32	6.4	67.2	3.07	12.1	9.29	11.9	3.65	1.1
S0607349-010	SC2	32-46	4.8	55.0	2.75	9.56	5.16	11.4	4.22	0.8
S0607349-011	SC3	0-3	7.6	62.5	0.52	2.93	0.64	0.86	0.72	4.3
S0607349-012	SC3	3-10	8.0	52.7	0.36	1.43	0.35	1.38	1.46	2.4
S0607349-013	SC3	10-16	7.8	51.6	2.79	13.4	3.95	11.6	3.93	1.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen Barten

Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
American Colloid Company
P.O. Box 2010
BelleFourche, SD 57717

Report ID: S0607349001
Date: 8/18/2006
Work Order: S0607349

Project: Shear Clarkson JE 27/28
Date Received: 7/20/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture
S0607349-001	SC1	0-4	37.0	25.0	38.0	Clay Loam
S0607349-002	SC1	4-14	30.0	25.0	45.0	Clay
S0607349-003	SC1	14-22	34.0	20.0	46.0	Clay
S0607349-004	SC1	22-36	42.0	14.0	44.0	Clay
S0607349-005	SC1	36-48	42.0	16.0	42.0	Clay
S0607349-006	SC2	0-3	16.0	28.0	56.0	Silty Clay
S0607349-007	SC2	3-10	12.0	27.0	61.0	Clay
S0607349-008	SC2	10-18	16.0	29.0	55.0	Silty Clay
S0607349-009	SC2	18-32	14.0	34.0	52.0	Clay
S0607349-010	SC2	32-46	7.0	35.0	58.0	Silty Clay
S0607349-011	SC3	0-3	29.0	26.0	45.0	Clay
S0607349-012	SC3	3-10	29.0	25.0	46.0	Clay
S0607349-013	SC3	10-18	38.0	21.0	41.0	Clay

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: _____
ren Barten, Soil Lab Supervisor

Inter-f tain Laboratories, Inc.

Soil Analysis Report
American Colloid Company
P.O. Box 2010
BelleFourche, SD 57717

Report ID: S0609437001
Date: 10/26/2006
Work Order: S0609437

Project: American Colloid - Shear/Clarkson
Date Received: 9/25/2006

Lab ID	Sample ID	Depths in.	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR
S0609437-001	SC4	0-3	4.3	49.6	0.13	1.3	0.23	0.11	0.53	1.27
S0609437-002	SC4	3-10	4.4	58.6	0.09	1.2	0.14	0.08	0.42	1.28
S0609437-003	SC4	10-17	4.3	55.4	0.29	1.0	0.31	0.18	1.43	2.91
S0609437-004	SC5	0-6	7.6	62.3	2.09	2.0	18.9	1.35	2.09	0.66
S0609437-005	SC5	6-12	7.9	73.1	4.24	1.5	15.8	6.53	21.5	6.43
S0609437-006	SC5	12-20	8.4	91.2	10.0	1.4	13.1	24.7	74.5	17.1
S0609437-007	SC6	0-3.5	7.4	72.1	0.58	3.4	3.39	0.47	0.62	0.45
S0609437-008	SC6	3.5-11	7.7	60.5	2.40	1.6	20.0	1.94	4.95	1.49
S0609437-009	SC6	11-18	7.8	60.0	4.40	1.1	17.7	5.85	24.2	7.06
S0609437-010	SC7	0-6	7.7	63.1	2.41	1.7	20.6	3.38	3.60	1.04
S0609437-011	SC7	6-12	7.8	68.4	3.29	0.9	15.1	5.96	15.4	4.76
S0609437-012	SC7	12-20	7.9	77.6	5.55	0.8	13.1	8.41	35.6	10.9
S0609437-013	SC8	0-3	4.7	49.8	0.48	0.9	1.69	0.78	0.60	0.54
S0609437-014	SC8	3-10	4.2	58.5	2.64	0.8	19.7	6.90	1.74	0.48
S0609437-015	SC8	10-18	4.2	57.7	3.68	0.9	15.3	16.4	13.7	3.44
S0609437-016	SC9	0-3	7.6	76.8	0.45	5.7	3.02	0.27	0.24	0.19
S0609437-017	SC9	3-12	7.5	67.2	2.22	2.9	20.7	1.13	2.41	0.73
S0609437-018	SC9	12-20	7.7	72.7	3.58	1.7	19.0	2.17	16.3	5.02
S0609437-019	SC10	0-3	7.7	65.9	0.59	3.5	3.67	0.61	0.25	0.17
S0609437-020	SC10	3-12	7.8	60.5	0.49	1.8	3.10	0.73	0.36	0.26

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
Karen Barten, Soil Lab Supervisor

Soil Analysis Report
American Colloid Company
P.O. Box 2010
BelleFourche, SD 57717

Report ID: S0609437001
Date: 10/26/2006
Work Order: S0609437

Project: American Colloid - Shear/Clarkson
Date Received: 9/25/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture
S0609437-001	SC4	0-3	12.0	34.0	54.0	Clay
S0609437-002	SC4	3-10	12.0	36.0	52.0	Clay
S0609437-003	SC4	10-17	12.0	38.0	50.0	Clay
S0609437-004	SC5	0-6	20.0	28.0	52.0	Clay
S0609437-005	SC5	6-12	19.0	28.0	53.0	Clay
S0609437-006	SC5	12-20	12.0	34.0	54.0	Clay
S0609437-007	SC6	0-3.5	22.0	32.0	46.0	Clay
S0609437-008	SC6	3.5-11	19.0	29.0	52.0	Clay
S0609437-009	SC6	11-18	25.0	29.0	46.0	Clay
S0609437-010	SC7	0-6	18.0	31.0	51.0	Clay
S0609437-011	SC7	6-12	20.0	30.0	50.0	Clay
S0609437-012	SC7	12-20	18.0	29.0	53.0	Clay
S0609437-013	SC8	0-3	19.0	31.0	50.0	Clay
S0609437-014	SC8	3-10	19.0	33.0	48.0	Clay
S0609437-015	SC8	10-18	15.0	35.0	50.0	Clay
S0609437-016	SC9	0-3	35.0	27.0	38.0	Clay Loam
S0609437-017	SC9	3-12	23.0	29.0	48.0	Clay
S0609437-018	SC9	12-20	16.0	40.0	44.0	Silty Clay
S0609437-019	SC10	0-3	18.0	32.0	50.0	Clay
S0609437-020	SC10	3-12	15.0	31.0	54.0	Clay

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
aren Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
American Colloid Company
P.O. Box 2010
BelleFourche, SD 57717

Report ID: S0609437001
Date: 10/26/2006
Work Order: S0609437

Project: American Colloid - Shear/Clarkson
Date Received: 9/25/2006

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Organic Matter	Calcium	Magnesium	Sodium	SAR
		In.	s.u.	%	dS/m	%	meq/L	meq/L	meq/L	
S0609437-021	SC10	12-20	7.6	63.7	2.59	1.3	22.2	5.06	3.01	0.82

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
American Colloid Company
P.O. Box 2010
BelleFourche, SD 57717

Report ID: S0609437001
Date: 10/26/2006
Work Order: S0609437

Project: American Colloid - Shear/Clarkson
Date Received: 9/25/2006

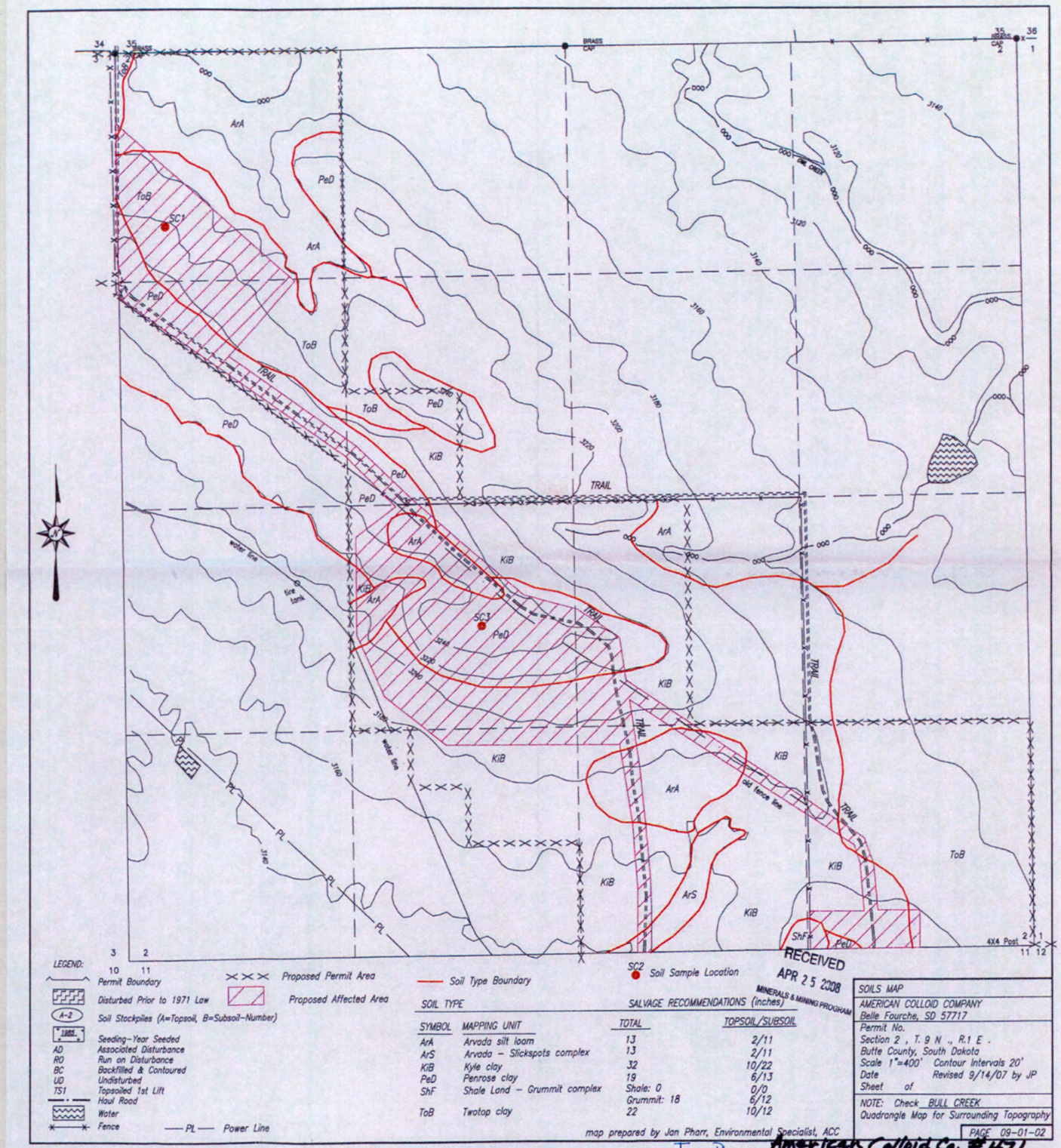
Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture
S0609437-021	SC10	12-20	15.0	29.0	56.0	Silty Clay

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
aren Barten, Soil Lab Supervisor

Soils Maps



SOIL TYPE

SYMBOL	MAPPING UNIT	SALVAGE RECOMMENDATIONS (inches) TOTAL	TOPSOIL/SUBSOIL
ArA	Arvada silt loam	13	2/11
ArS	Arvada – Slickspots complex	13	2/11
KiB	Kyle clay	32	10/22
PeD	Penrose clay	19	6/13
ShF	Shale Land – Grummit complex	Shale: 0	0/0
		Grummit: 18	6/12
ToB	Twotop clay	22	10/12

map prepared by Jan Pharr, Environmental Specialist, ACC

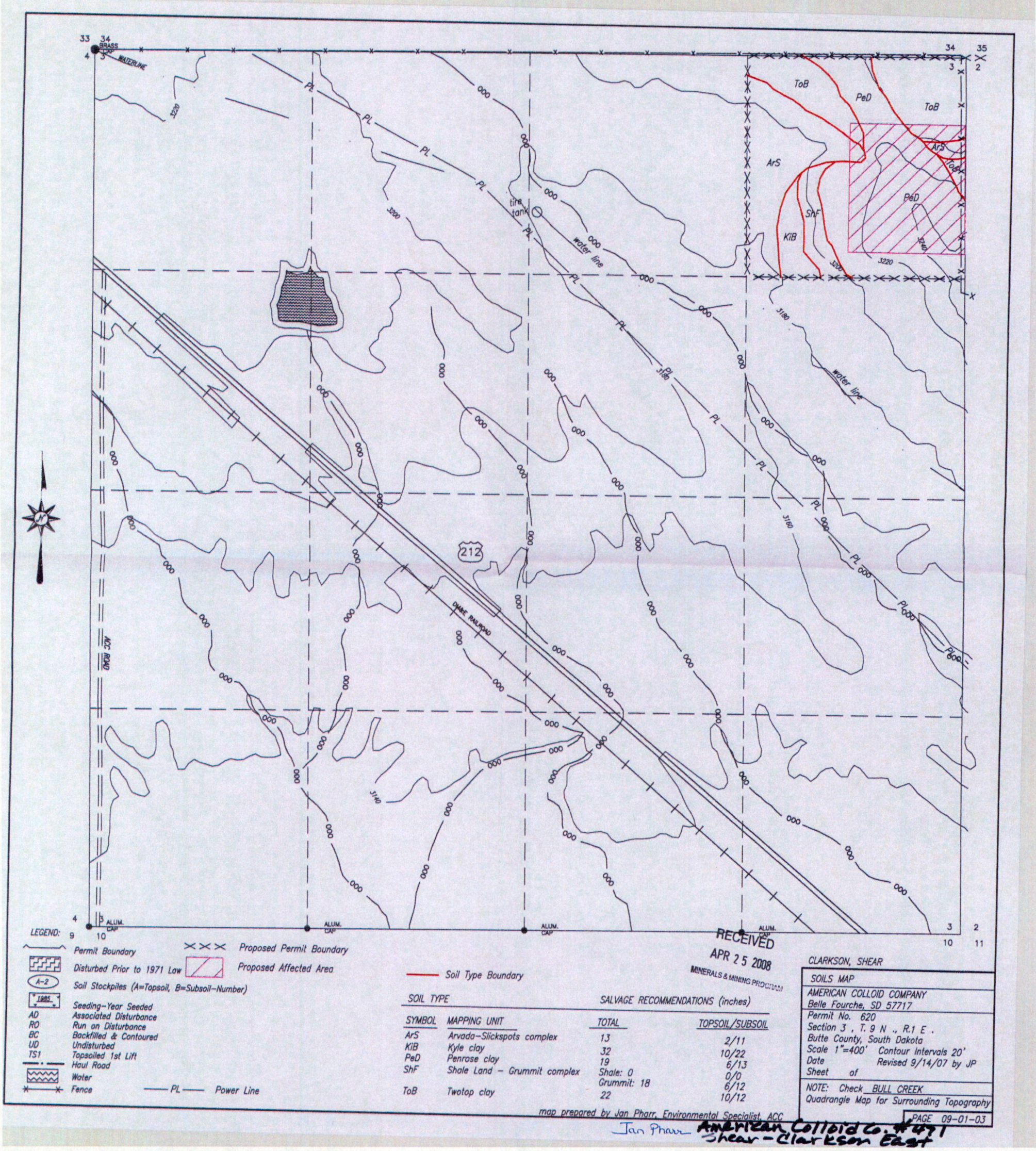
Jan Pharr

SOILS MAP
AMERICAN COLLOID COMPANY
Belle Fourche, SD 57717
Permit No.
Section 2 , T. 9 N ., R.1 E .
Butte County, South Dakota
Scale 1"=400' Contour Intervals 20'
Date Revised 9/14/07 by JP
Sheet of

NOTE: Check BULL CREEK Quadrangle Map for Surrounding Topography

PAGE 09-01-02

American Colloid Co. #471
Shear - Clarkson East



SOIL TYPE		SALVAGE RECOMMENDATIONS (inches)	
SYMBOL	MAPPING UNIT	TOTAL	TOPSOIL/SUBSOIL
ArS	Arvada-Slickspots complex	13	2/11
KiB	Kyle clay	32	10/22
PeD	Penrose clay	19	6/13
ShF	Shale Land - Grummit complex	Shale: 0	0/0
		Grummit: 18	6/12
ToB	Twotop clay	22	10/12

map prepared by Jan Pharr, Environmental Specialist, ACC

Jan Pharr

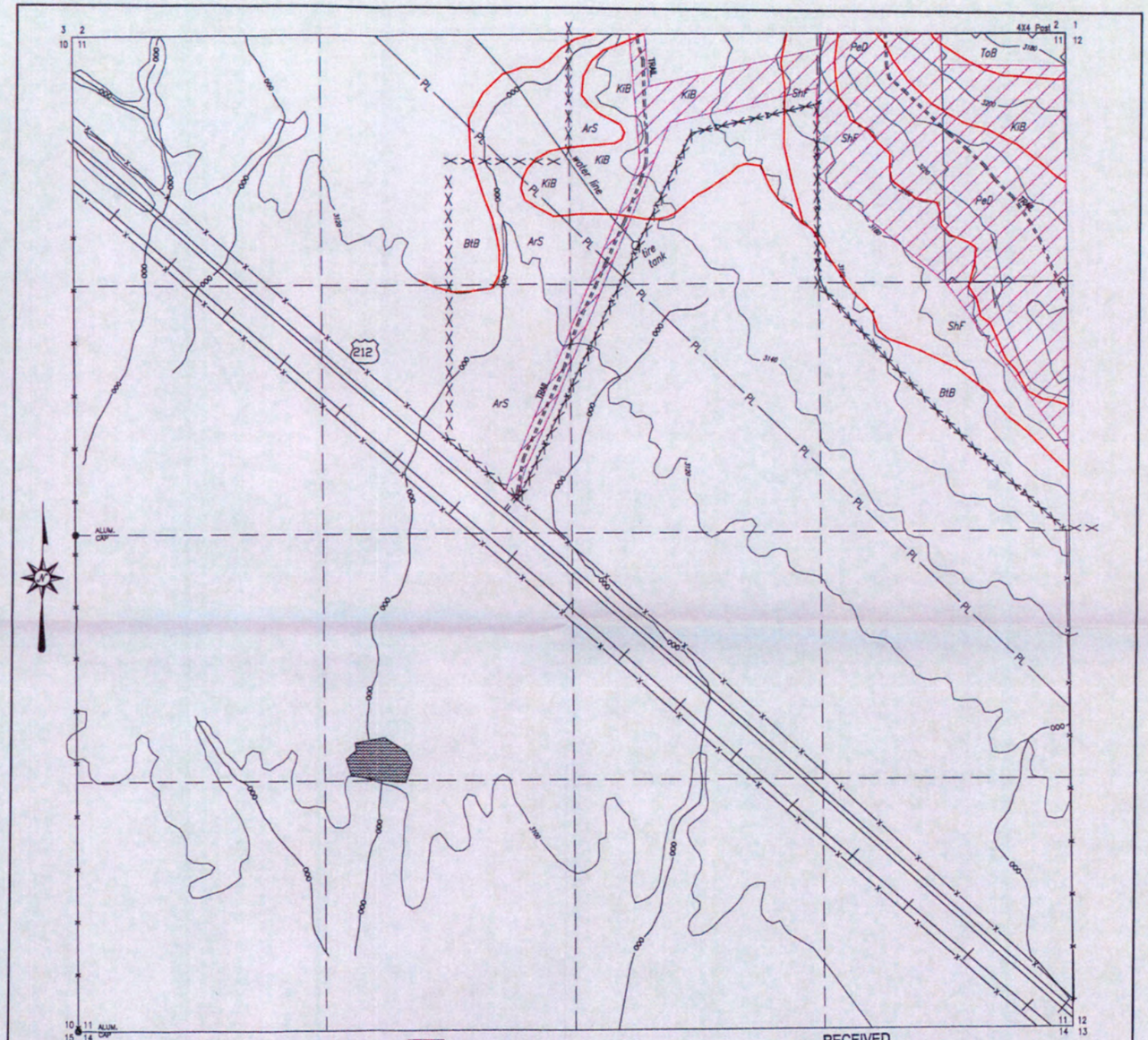
CLARKSON, SHEAR

SOILS MAP
AMERICAN COLLOID COMPANY
Belle Fourche, SD 57717
Permit No. 620
Section 3 , T. 9 N ., R.1 E .
Butte County, South Dakota
Scale 1"=400' Contour Intervals 20'
Date Revised 9/14/07 by JP
Sheet of

NOTE: Check BULL CREEK Quadrangle Map for Surrounding Topography

PAGE 09-01-03

American Colloid Co. #471
Shear - Clarkson East



LEGEND:

- Permit Boundary (old Permit #6)
- Disturbed Prior to 1971 Law
- A-2 — Soil Stockpiles (A=Topsoil, B=Subsoil-Number)
- 1985 — Seeding-Year Seeded
- AD — Associated Disturbance
- RO — Run on Disturbance
- BC — Backfilled & Contoured
- UD — Undisturbed
- TS1 — Topsoiled 1st Lift
- Haul Road
- Water
- Fence
- —PL— Power Line
- XXX Proposed Permit Boundary
- Proposed Affected Area
- Soil Type Boundary

SOIL TYPE		SALVAGE RECOMMENDATIONS (inches)	
SYMBOL	MAPPING UNIT	TOTAL	TOPSOIL/SUBSOIL
ArS	Arvada – Slickspots complex	13	2/11
BtB	Broadhurst clay	17	6/11
KiB	Kyle clay	32	10/22
PeD	Penrose clay	19	6/13
ShF	Shale Land – Grummit complex	Shale: 0 Grummit: 18	0/0 6/12
ToB	Twotop clay	22	10/12

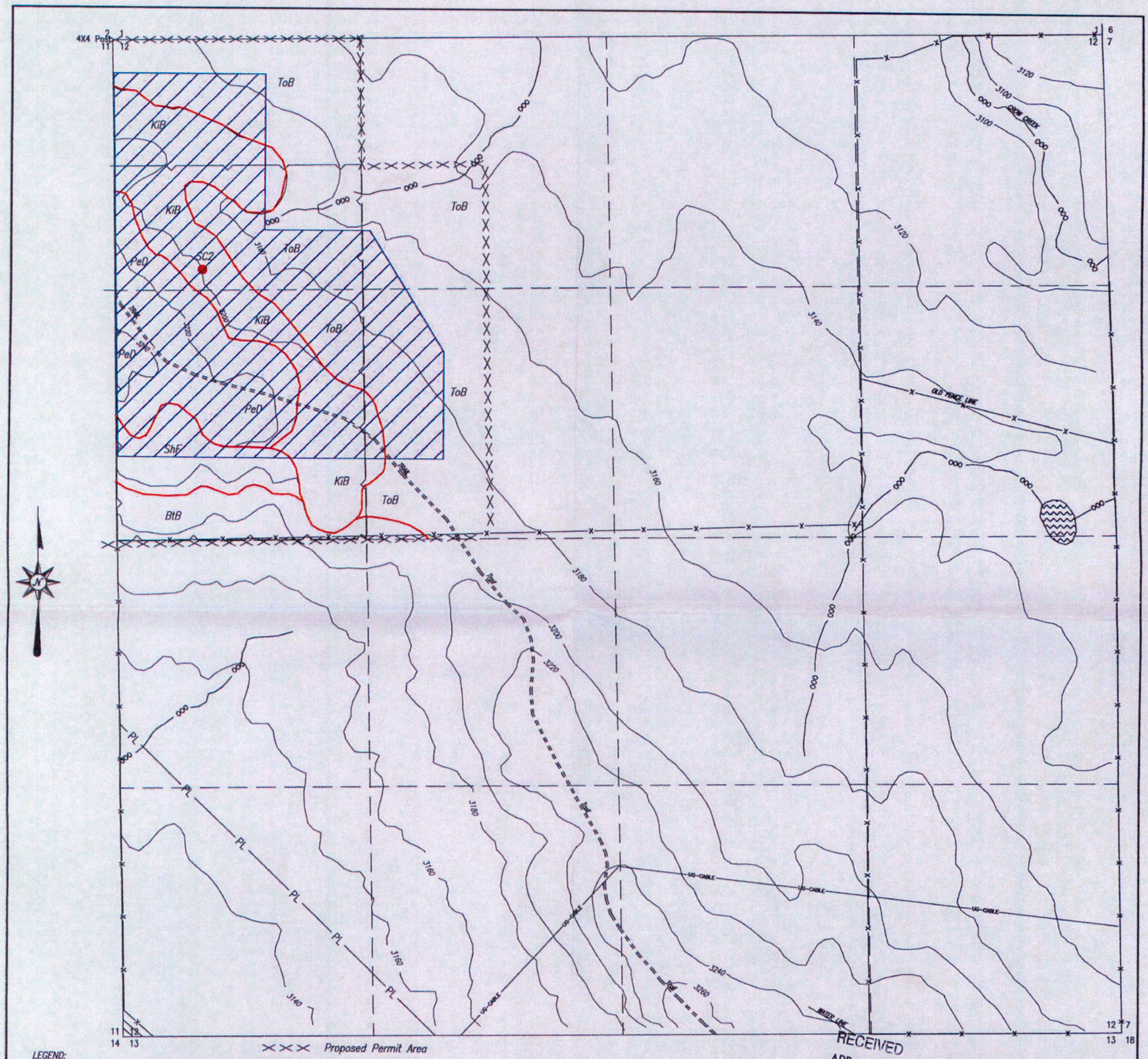
map prepared by Jan Pharr, Environmental Specialist, ACC

SOILS MAP
AMERICAN COLLOID COMPANY
Belle Fourche, SD 57717
Permit No. 6
Section 11, T. 9N ., R.1E .
Butte County, SD
Scale 1"=400' Contour Intervals 20'
Date 11-6-01 Revised 9/17/07 by JP
Sheet of

NOTE: Check BULL CREEK BUTTE Quadrangle Map for Surrounding Topography

PAGE 09-01-11

Jan Pharr American Colloid Co. #497
Shear-Clarkson East



LEGEND:

- Permit Boundary (old Permit #6)
- Disturbed Prior to 1969 Law
- A-2 — Soil Stockpiles (A=Topsoil, B=Subsoil–Number)
- 1985 / 75 — Seeding–Year Seeded / Percentage Released
- AD — Associated Disturbance
- RO — Run on Disturbance
- BC — Backfilled & Contoured
- UD — Undisturbed
- TS1 — Topsoiled 1st Lift
- Haul Road
- Water
- Fence
- —PL— Power Line
- Proposed Permit Area
- Proposed Affected Area
- Soil Type Boundary
- SC2 — Soil Sample Location

SOIL TYPE

SYMBOL	MAPPING UNIT	SALVAGE RECOMMENDATIONS (inches) TOTAL	TOPSOIL/SUBSOIL
BtB	Broadhurst clay	17	6/11
KiB	Kyle clay	32	10/22
PeD	Penrose clay	19	6/13
ShF	Shale Land – Grummit complex	Shale: 0	0/0
		Grummit: 18	6/12
ToB	Twotop clay	22	10/12

map prepared by Jan Pharr, Environmental Specialist, ACC

RIDGE CLAIMS, KUDLOCK

SOILS MAP

AMERICAN COLLOID COMPANY
Belle Fourche, SD 57717

Permit No. 620
Section 12, T. 9 N ., R.1 E .
Butte County, South Dakota
Scale 1"=400' Contour Intervals 20'
Date 6–6–02 Revised 9/17/07 by JP
Sheet of

NOTE: Check BULL CREEK BUTTE Quadrangle Map for Surrounding Topography

PAGE 09–01–12

Jan Pharr American Colloid Co. #620
Shear - Clarkson East

APPENDIX B

Sampled Soil Series Descriptions

(from the Natural Resources Conservation Service)

LOCATION ARVADA WY+CO KS MT NE SD

Established Series
MCS/JWW/CJH
12/2003

ARVADA SERIES

The Arvada series consists of very deep, well drained soils formed in alluvium and colluvium derived from sodic shale. Arvada soils are on alluvial fans, fan remnants, fan terraces and hillslopes. Slopes are 0 to 25 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine, smectitic, mesic Ustertic Natrargids

TYPICAL PEDON: Arvada fine sandy loam-rangeland. (Colors are for dry soil unless otherwise stated)

E--0 to 4 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; moderate very thin platy structure parting to moderate very fine granular; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary. (0 to 8 inches thick)

Btn--4 to 14 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium columnar structure parting to moderate medium angular blocky; extremely hard, firm, sticky and very plastic; common medium roots; many prominent clay films on faces of peds and in root channels; very strongly alkaline (pH 9.2); ESP is 20 percent; clear smooth boundary. (3 to 14 inches thick)

Btkn--14 to 20 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; extremely hard, firm, sticky and very plastic; few faint clay films on faces of peds and in root channels; strongly effervescent, few fine segregations of calcium carbonate in thin seams and streaks; strongly alkaline (pH 9.0); 20 percent exchangeable sodium; gradual smooth boundary. (0 to 17 inches thick)

Bkny--20 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, friable, sticky and plastic; violently effervescent, common medium soft masses of calcium carbonate and gypsum as crystals in thin seams and as filaments or threads; strongly alkaline (pH 8.8); 20 percent exchangeable sodium.

TYPE LOCATION: Sheridan County, Wyoming; 650 feet south and 200 feet west of the northeast corner of sec. 29, T. 55 N., R. 78 W. 44 degrees 43 minutes 7 seconds north latitude and 106 degrees 15 minutes 54 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to effervescent material ranges from 0 to 19 inches. Depth to layers with greater than 15 percent exchangeable sodium is 4 to 10 inches. The depth to the base of the Bt horizon is 15 inches or more. A thin A horizon occurs in some pedons. A light colored platy E horizon is generally present but is absent in some pedons. Gravel is typically less than 5 percent but ranges from 0 to 15 percent. The moisture control section is usually dry for 60 consecutive days during the 90 day period following the summer solstice. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 195 days. The soil has an aridic moisture regime that borders on ustic.

The E and A horizons have hue of 10YR, 2.5Y or 5Y, value of 4 to 7, 4 or 5 moist, and chroma of 2 to 4. Texture is fine sandy loam, loam, silt loam, clay loam or very fine sandy loam. Reaction ranges from neutral through strongly alkaline. EC ranges from 0 to 4 mmhos/cm.

The Btn horizon has hue of 7.5YR, 10YR, 2.5Y or 5Y, value of 4 to 6 dry, 4 or 5 moist, and chroma of 2 to 4. Texture is clay, clay loam, silty clay or silty clay loam and has 35 to 60 percent clay, 10 to 50 percent silt, and 5 to 45 percent sand. This horizon is strongly alkaline or very strongly alkaline (pH 8.8 to 10.0), has 15 to 34 percent exchangeable sodium, and an EC of 4 to 16 mmhos/cm. Some pedons when buffered by gypsum are moderately alkaline. The Btkn horizon, when present, has a calcium carbonate equivalent of 3 to 12 percent and an exchangeable sodium percent of 10 to 30. A thin Bt horizon is present above the Btn in some pedons. Some pedons have a Btkny horizon.

The Bkny horizon has hue of 7.5YR, 10YR or 2.5Y, value of 5 or 6 dry, 4 or 5 moist. Textures are clay, clay loam, silty clay or silty clay loam. Reaction ranges from strongly alkaline or very strongly alkaline (pH 8.6 to 10.0). This horizon contains 4 to 15 percent calcium carbonate equivalent. Some pedons when buffered by gypsum are moderately alkaline. Exchangeable sodium typically ranges from 10 to 30 percent but decreases with increasing depth. Electrical conductivity is 4 to 16 mmhos/cm. Some pedons have a C horizon.

Some pedons have a C horizon below 40 inches. It has properties similar to those of the Bkny horizon.

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: The Arvada soils are on alluvial fans, fan remnants, terraces and hillslopes. The soils formed in moderately fine textured alluvium and colluvium derived from sedimentary rocks. Slopes range from 0 to 25 percent. Elevations range from 2,600 to 6,000 feet. The average annual precipitation is about 12 inches but ranges from 9 to 14 inches with about half the precipitation occurring during April, May, and early June. The mean annual air temperature is about 43 to 53 degrees F., and the mean summer temperature is 63 degrees F. The frost-free season is estimated to range from 100 to 160 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are
the Absted, Bidman, Parmleed, Renohill and Ulm soils. Absted soils have less than 15 percent sodium in the upper part of the argillic horizon. Bidman, Parmleed, Renohill and Ulm soils lack natric horizons.

DRAINAGE AND PERMEABILITY: Well drained; high or very high runoff; very slow permeability.

USE AND VEGETATION: Rangeland and wildlife habitat. Native vegetation is alkali sacaton, Gardner saltbush, western wheatgrass, and scattered greasewood.

DISTRIBUTION AND EXTENT: Eastern Wyoming, eastern Colorado and parts of adjacent states. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Sheridan County, Wyoming; 1932.

REMARKS: Diagnostic horizons and features recognized in this pedon are: Albic horizon - 0 to 4 inches (E)

Natric horizon - 4 to 20 inches (Btn, Btkn)

SIR- WY1130

LRR- G

National Cooperative Soil Survey
U.S.A.

LOCATION KYLE SD+MT NE WY

Established Series

Rev. DLB-WJB-CJH

5/96

KYLE SERIES

The Kyle series consists of very deep and well drained soils formed in sediments weathered from clay shale on uplands. Permeability is very slow. Slopes range from 0 to 15 percent. Mean annual precipitation is about 16 inches, and mean annual air temperature is about 47 degrees F.

TAXONOMIC CLASS: Very-fine, smectitic, mesic Aridic Haplusterts

TYPICAL PEDON: Kyle clay - on a west-facing plane slope of 2 percent in native grass. (When described the soil was moist to 50 inches. Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium and fine granular structure; hard, firm, sticky and plastic; thin crust in upper 1/4 inch of light brownish gray (2.5Y 6/2); common fine roots; neutral; clear wavy boundary. (2 to 6 inches thick)

Bw--4 to 8 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse blocky structure parting to weak medium and fine blocky; very hard, very firm, sticky and plastic; common fine roots; strong effervescence; slightly alkaline; gradual wavy boundary.

Bss--8 to 16 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse blocky structure parting to weak medium blocky; extremely hard, very firm, very sticky and very plastic; few intersecting slickensides; few fine roots; strong effervescence; slightly alkaline; gradual wavy boundary. (Combined Bw and Bss horizons 8 to 28 inches thick)

BCss--16 to 24 inches; light olive gray (5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine blocky; extremely hard, very firm, very sticky and very plastic; few intersecting slickensides; few fine roots; strong effervescence; slightly alkaline; clear wavy boundary. (0 to 30 inches thick)

BCssy--24 to 40 inches; light olive gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; weak medium subangular blocky structure in upper part becoming massive in lower part; extremely hard, very firm, very sticky and very plastic; few intersecting slickensides; common fine and medium nests of gypsum; strong effervescence; slightly alkaline; gradual wavy boundary. (0 to 20 inches thick)

Cy--40 to 60 inches; pale olive (5Y 6/3) clay, olive (5Y 5/3) moist; massive; very hard, firm, sticky and plastic; few fine accumulations of carbonate and gypsum; strong effervescence; slightly alkaline.

TYPE LOCATION: Fall River County, South Dakota; about 6 miles east of Oelrichs; 450 feet west and 500 feet north of the southeast corner (fence), north side of U.S. Highway 18, sec. 12, T. 10 S., R. 8 E.

RANGE IN CHARACTERISTICS: The soil typically does not have carbonates to depths of 4 to 6 inches, but some pedons contain carbonates to the surface. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long extend downward through the solum. The control section averages 60 to 65 percent clay. The soil does not have a mollic epipedon but the upper 10 inches of the solum has an average organic carbon content between 0.6 and 1.7 percent. When the soil is dry, a porous surface crust 1/8 inch

to 1/2 inch thick with dry color value of 6 or 7 is typical. Gypsum and other salts are below depths of 20 inches.

The A horizon has hue of 10YR, 2.5Y or 5Y, value of 5 or 6 and 3 to 5 moist, and chroma of 1 to 3. It typically is clay but some is silty clay. It is neutral or slightly alkaline.

The Bw and Bss horizons have hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 to 4. Both dry and moist colors of the surface of peds range from 1/2 to 1 value darker than the crushed peds. They are extremely hard or very hard when dry and extremely firm or very firm when moist. They are slightly alkaline or moderately alkaline.

The BCss horizon has hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 to 4. It has few to common accumulations of gypsum and other salts in most pedons. It is slightly alkaline or moderately alkaline.

Some pedons have a Bk horizon that has colors similar to the BC horizon. It has few to common accumulations of carbonate. It is slightly alkaline or moderately alkaline.

The Cy horizon has hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 to 4. It is clay and some pedons contain up to 35 percent fragments of shale below 40 inches. It has few to many accumulations of gypsum or other salts. Unweathered shale typically is at depths greater than 5 feet but is as shallow as 40 inches in some pedons. It is slightly alkaline or moderately alkaline.

COMPETING SERIES: These are the McNary, Twotop and Wasa series. McNary soils occur above elevations of 6000 feet and do not have visible gypsum below depths of 20 inches. Twotop soils have salts between 10 and 20 inches and a weaker grade and coarser structure at the surface. Wasa soils have bedded shale within depths of 40 inches and salts within 8 inches of the surface.

GEOGRAPHIC SETTING: Kyle soils are nearly level to strongly sloping on uplands and colluvial fans. Slopes are plane to convex, and slope gradients range from 0 to 15 percent. Gilgai microrelief is in most areas. The soil formed in clayey sediments weathered from calcareous clay shale. Mean annual air temperature ranges from 45 to 53 degrees F, and mean annual precipitation ranges from about 12 to 19 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Twotop and Wasa soils and the Hisle, Lismas, Pierre, Samsil, Swanboy and Winler soils. Twotop, Wasa and Winler soils are on similar landscapes below the Kyle soils. Pierre soils are on landscapes above the Kyle soils. Pierre and Winler soils have bedded shale within depths of 40 inches. In addition, Winler soils have less carbonates and have a weaker grade of structure in the surface. Hisle soils are on similar landscapes with microrelief and have a natric horizon. The Lismas and Samsil soils are on steeper landscapes and have shale within depths of 20 inches. Swanboy soils are on fans and flats. They have salts within 10 inches of the dispersed surface.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is medium to very high depending on slope. Permeability is very slow, except after dry periods when the initial intake into cracks is rapid.

USE AND VEGETATION: Used primarily as rangeland. Wheat, sorghum, and alfalfa are the principal crops when cultivated. Native grasses are mostly western wheatgrass, green needlegrass, buffalograss, and blue grama.

DISTRIBUTION AND EXTENT: Western South Dakota, northwest Nebraska, and eastern Wyoming. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Butte County, South Dakota, 1970.

EMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface of the soil to a depth of 4 inches (A horizon); cambic horizon - the zone from 8 to 16 inches (Bw and Bss horizons).

National Cooperative Soil Survey

U.S.A.

LOCATION PENROSE CO+KS NE NM SD

Established Series
AJC/GB
06/2006

PENROSE SERIES

The Penrose series consists of shallow, well and somewhat excessively drained, moderate to slowly permeable soils formed in thin, calcareous, loamy materials weathered in place from limestone and interbedded limy materials. Penrose soils are on hills, plains, ridges, hogbacks, cuestas, and mesa tops. Slopes are 1 to 65 percent. Mean annual precipitation is about 13 inches and mean annual temperature is about 51 degrees F.

TAXONOMIC CLASS: Loamy, carbonatic, mesic Lithic Ustic Torriorthents

TYPICAL PEDON: Penrose channery loam - grassland. (Colors are for dry soil unless otherwise noted).

A--0 to 4 inches; light brownish gray (2.5Y 6/2) channery loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; 25 percent channers; calcareous; moderately alkaline; clear smooth boundary.

C--4 to 15 inches; light gray (2.5Y 7/2) channery loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent limestone channers; calcareous; moderately alkaline; abrupt smooth boundary.

R--15 inches; limestone bedrock.

TYPE LOCATION: Fremont County, Colorado; about 0.1 mile east of "K" Street and about 125 feet north of Highway No. 115 six feet from fence in the southeast quarter of Sec. 21, T. 18 S., R. 68 W.

RANGE IN CHARACTERISTICS:

Soil moisture: The soil moisture control section is moist intermittently April through August; aridic moisture regime bordering on ustic.
Mean annual soil temperature: 52 to 59 degrees F.
Mean summer soil temperature: 68 to 76 degrees F.
Depth to lithic contact: 10 to 20 inches to limestone
Depth to secondary calcium carbonate: 0 to about 5 inches and is not more than 1/4 the thickness of the control section
Gypsum content: 0 to 1.5 percent by weight
Calcium carbonate equivalent: 40 to 75 percent
Electrical conductivity: 0 to 14 millimhos/cm in a major part of the control section
Continuous subhorizons of secondary calcium carbonate and/or sulfate do not occur within the control section although some visible accumulation occurs in some pedons

Particle-size control section (weighted average):
Clay content: 18 to 35 percent
Sand content: 15 to 70 percent
Rock fragments: 0 to 35 percent, dominantly to 10 inches in diameter.

A horizon:
Hue: 7.5YR through 2.5Y
Value: 5 through 8, 3 through 6 moist
Chroma: 1 through 4.
Calcium carbonate equivalent: 35 to 70 percent
Reaction: mildly alkaline or moderately alkaline.
Rock fragments: 0 to 35 percent

C horizon:
Hue: 7.5YR through 2.5Y
Textures of the fine earth fraction: loam, silt loam, clay loam
Clay content: 18 to 35 percent
Rock fragments: 0 to 35
Calcium carbonate equivalent: 40 to 75 percent
Reaction: moderately alkaline or strongly alkaline.

COMPETING SERIES: These are presently no competing series in this family. Welring is similar, but in the loamy-skeletal family.

GEOGRAPHIC SETTING:
Parent material: residuum and slope alluvium derived from limestone and interbedded limy materials.
Landform: hills, mesas, and ridges
Slopes: 1 to 65 percent
Elevation: 3,000 to 6,500 feet
Mean annual temperature: 50 to 53 degrees F
Mean annual precipitation: 11 to 15 inches
Precipitation pattern: peak periods between April and August, dries between November and February
Frost-free period: 125 to 165 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Manvel and Minnequa soils. Manvel soils have no bedrock above a depth of 40 inches. Minnequa soils have bedrock at a depth of 20 to 40 inches.

DRAINAGE AND PERMEABILITY: well or somewhat exessivly drained, low through very rapid runoff, moderate or moderately slow permeability.

USE AND VEGETATION: These soils are used principally as grazing land. Native vegetation is pinyon, juniper, blue grama, cactus, and western wheatgrass.

DISTRIBUTION AND EXTENT: Eastern Colorado and southern Wyoming; LRR E, MLRA 69 and 67; large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Arkansas Valley Area, 1936.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Series control section: The zone from 0 to 15 inches.
Particle-size control section: The zone from 0 to 15 inches. (A and C horizons)
Ochric epipedon: The zone from 0 to 4 inches. (A horizon)
Lithic contact: The contact with limestone at 15 inches. (R horizons)
Other features: Carbonatic mineralogy

Remarks: This revision is a change to the semi tabular format.

Taxonomic Version: Ninth Edition, 2003

ADDITIONAL DATA: Laboratory pedons sampled; 96CO071005, 96CO071011

National Cooperative Soil Survey
U.S.A.

LOCATION GRUMMIT SD+MT WY

Established Series
Rev. KEC-CJH
10/97

GRUMMIT SERIES

The Grummit series consists of shallow, well drained soils formed in clayey residuum from acid shale on uplands. Permeability is moderate or moderately slow. Slopes range from 2 to 60 percent. Mean annual precipitation is about 15 inches, and mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Clayey, smectitic, acid, mesic, shallow Aridic Ustorthents

TYPICAL PEDON: Grummit clay - on a convex slope of 5 percent in native grass. When described, the soil was moist to bedded shale. (Colors are for dry soil unless otherwise stated)

A--0 to 3 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; loose, friable; many fine roots; many very fine fragments of shale; very strongly acid; clear smooth boundary. (2 to 6 inches thick)

C1--3 to 7 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; hard, friable; many fine roots; 25 percent very fine fragments of shale; extremely acid; gradual wavy boundary.

C2--7 to 17 inches; grayish brown (10YR 5/2) and gray (2.5Y 5/1) clay, dark grayish brown (10YR 4/2) and dark gray (2.5Y 4/1) moist; common distinct mottles of yellowish brown (10YR 5/6); weak coarse subangular blocky structure; hard, friable; partially weathered fragments of shale make up 35 percent by volume; common roots; extremely acid; clear smooth boundary.

Cr--17 to 40 inches; gray (10YR 6/1) brittle platy shale, dark gray (10YR 4/1) moist; common medium distinct stains of yellowish brown (10YR 5/8); very hard; extremely acid.

TYPE LOCATION: Butte County, South Dakota; about 4 miles west and 2 miles north of Belle Fourche; 200 feet east and 1800 feet north of the southwest corner of sec. 30, T. 9 N., R. 2 E.

RANGE IN CHARACTERISTICS: Depth to shale ranges from 10 to 20 inches. Colors throughout the soil are inherited from the shale. The horizons overlying the bedded shales typically average 50 to 65 percent clay but ranges from 35 to 65 percent clay. The low clay percentage is due to sand-size shale fragments. Consistence ranges from loose to hard when dry but is friable when moist. The soil ranges from strongly acid to extremely acid.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 and 3 or 4 moist, and chroma of 1 or 2 dry or moist. It typically is clay but is clay loam in some pedons. It has weathered fragments of shale that make up 5 to 35 percent by volume. The A horizon contains less than 1 percent more organic matter than the C.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6 and 3 or 4 moist; and chroma of 1 or 2. Weathered fragments of shale make up 20 to over 50 percent by volume of the C horizon.

The fissile shale is very hard and brittle and will not disperse in water or in sodium hexametaphosphate.

COMPETING SERIES: There are no other soils in the same family. Other competing soils are the Dupree, Lismas, and Samsil series. Dupree soils are more moist and have firm to extremely firm

consistence. Lismas soils are more alkaline and have a firmer consistence. Samsil soils contain carbonates and are alkaline.

GEOGRAPHIC SETTING: Grummit soils are gently sloping to very steep on uplands. Slope gradients range from 2 to 60 percent. The soil formed in clayey residuum weathered from acid shales. Mean annual temperature ranges from 43 to 50 degrees F, and mean annual precipitation is about 12 to 18 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Broadhurst, Graner, and Demar soils. All of these associated soils are deeper to bedded shale. The Broadhurst and Demar soils are on adjacent, nearly level to gently sloping fans and terraces. In addition, Demar soils have argillic horizons. Graner soils are on nearby undulating to rolling uplands. Grummit soils are also associated with rock outcrop.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is slow or medium. Permeability is moderate or moderately slow in the upper part and moderate in the underlying material.

USE AND VEGETATION: These soils are used primarily as native rangeland. Native vegetation typically is little bluestem, western wheatgrass, green needlegrass, blue grama, sideoats grama, and needleandthread. Short, limby, ponderosa pine is on some places.

DISTRIBUTION AND EXTENT: Western South Dakota and eastern Wyoming. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Butte County, South Dakota, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface of the soil to a depth of 3 inches (A horizon).

National Cooperative Soil Survey
U.S.A.

LOCATION TWOTOP SD+WY

Established Series
PRJ-KEC-CJH
06/2002

TWOTOP SERIES

The Twotop series consists of very deep, well drained soils formed in clayey alluvium on colluvial fans, hills, ridges and in upland valleys. These soils have very slow permeability. Slopes range from 0 to 9 percent. Mean annual precipitation is about 13 inches, and mean annual air temperature about 47 degrees F.

TAXONOMIC CLASS: Very-fine, smectitic, mesic Aridic Haplusterts

TYPICAL PEDON: Twotop clay - on a southeast-facing slope of 1 percent in native grass. When described the soil was moist to 26 inches. (Colors are for dry soil unless otherwise stated)

A--0 to 3 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; vesicular crust in upper 1/2 inch, weak medium and fine subangular blocky structure in lower part; very hard, very firm, sticky and plastic; common roots; slight effervescence; slightly alkaline; clear smooth boundary. (2 to 5 inches thick)

Bw--3 to 9 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; extremely hard, very firm, sticky and plastic; common roots; slight effervescence; slightly alkaline; clear smooth boundary.

Bss--9 to 16 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few intersecting slickensides; common roots; few fine accumulations of carbonate; slight effervescence; slightly alkaline; clear smooth boundary. (Combined Bw and Bss horizons 8 to 16 inches thick)

Bssyz--16 to 35 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak very coarse subangular blocky structure; extremely hard, very firm, sticky and plastic; few intersecting slickensides; few roots; many visible crystals of salt and gypsum; slight effervescence; slightly alkaline; gradual wavy boundary. (10 to 20 inches thick)

C1--35 to 45 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few fine prominent mottles of strong brown (7.5YR 5/8) moist; massive; extremely hard, very firm, sticky and plastic; slight effervescence; slightly alkaline; gradual wavy boundary.

C2--45 to 60 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, very firm, sticky and plastic; slightly alkaline.

TYPE LOCATION: Butte County, South Dakota; about 31 miles north and 4 miles east of Belle Fourche, South Dakota; 165 feet east and 1,155 feet south of northwest corner of sec. 4, T. 13 N., R. 3 E.

RANGE IN CHARACTERISTICS: Unweathered shale typically is at depths greater than 5 feet. Typically the soil is calcareous throughout but some pedons are leached to about 10 inches. The soil is neutral or slightly alkaline. Gypsum and other salts typically are between depths of 10 and 20 inches. Clay content of the control section ranges from 60 to 75 percent. When the soil is dry, cracks 1/2 inch to 2 inches more wide and several feet long extend downward through the solum. Rock fragments range from 0 to 5 percent.

The A horizon has hue of 2.5Y or 5Y, value of 4 to 6 and 3 to 5 moist, and chroma of 2 or 3. It is clay, silty clay, clay loam or silty clay loam.

The Bw and Bss horizons have hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 or 3. They have few accumulation of salts in the lower part of some pedons.

Some pedons have a Bk horizon and has color and texture of the Bw horizon. It typically has accumulation of gypsum and other salts.

The Bssyz horizon has hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist and chroma of 2 to 4. It has common to many accumulations of gypsum and other salts.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 and 4 or 5 moist, and chroma of 2 to 4. It typically is clay but some pedons have strata of silty clay.

COMPETING SERIES: These are the Catman, Kyle, Mcnary, Swanboy and Venzuni series. Catman soils are driest during April through June. Kyle soils have a stronger grade of structure in the surface and do not have salts within depths of 20 inches. Swanboy soils have visible salts within depths of 10 inches. Mcnary and Venzuni soils have hues redder than 2.5Y.

GEOGRAPHIC SETTING: Twotop soils are on nearly level to sloping, plane to concave surfaces on colluvial fans, hills, ridges in upland valleys and. Slope gradients range from 0 to 9 percent. Gilgai microrelief is in most areas. The soil formed in clay alluvium. Mean annual air temperature ranges from 45 to 48 degrees F, and mean annual precipitation ranges from 10 to 17 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Kyle and Swanboy soils and the Hisle, Lismas, Pierre, Wasa and Winler soils. Kyle and Swanboy soils are on similar landscapes. Hisle soils are in similar landscape and have a natric horizon. Lismas soils are on nearby steep landscapes and have shale within 20 inches of the surface. Pierre, Wasa, and Winler soils are on steeper landscapes above the Twotop soils. They have bedded shale within depths of 40 inches. In addition, Wasa soils have salts within 8 inches of the surface.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is medium to very high on sloping areas and low on nearly level areas. Permeability is very slow.

USE AND VEGETATION: Rangeland. Native vegetation is mainly western wheatgrass and montana wheatgrass. Green needlegrass is in some areas.

DISTRIBUTION AND EXTENT: Western South Dakota and eastern Wyoming. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Denver, Colorado

SERIES ESTABLISHED: Butte County, South Dakota, 1970.

REMARKS: Diagnostic and other features of this pedon are:

Vertic feature - intersecting slickensides and some gilgai microrelief.

Surface condition - granular surface mulch - surface is not covered with an understory of short vegetation but is exposed due to a nearly pure stand of wheatgrass.

Moisture regime - aridic-ustic

The classification has been changed from Typic Torrerts to Aridic Haplusterts based on precipitation.

National Cooperative Soil Survey
U.S.A.

APPENDIX C

Photographs

Figure C-1. SP-1 soil profile.

Figure C-2. SP-2 soil profile.

Figure C-3. SP-3 soil profile.

Figure C-4. SP-3 soil profile continued.

Figure C-5. SP-4 soil profile.

Figure C-6. SP-4 soil profile continued.

APPENDIX D

Field Soil Profile Descriptions

Pace Analytical
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Date: 8/18/2022

CLIENT: Bentonite Performance Minerals, LLC
Project: Baseline Soils
Lab Order: S2207488

CASE NARRATIVE

Report ID: S2207488001

Entire Report Reviewed by: Crystal Herman

Crystal Herman, Mining Supervisor

Samples SP-1, SP-2, SP-3 and SP-4 were received on July 29, 2022.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

^" Quality Control parameters met the acceptance criteria defined by EPA and Pace Analytical (Formerly Inter-Mountain boratories) except as indicated in this case narrative.

Qualifiers by sample

Control - Soil Texture Analysis/Clay - Spike Recovery outside accepted recovery limits
Control - Soil Texture Analysis/Sand - Spike Recovery outside accepted recovery limits
S2207488-008 - Saturated Paste Cations by EPA 200.7/Magnesium - RPD outside accepted recovery limits
S2207488-008 - Saturated Paste Cations by EPA 200.7/Sodium - RPD outside accepted recovery limits

Date: 8/18/2022

Definitions

RL	Reporting Limit

Qualifiers

*	Value exceeds Maximum Contaminant Level
A	Check MSA specifications
B	Analyte detected in the associated Method Blank
C	Calculated Value
D	Report limit raised due to dilution
E	Value above quantitation range
G	Analyzed at Pace Gillette, WY laboratory
H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits
L	Analyzed by another laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL
ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions
R	RPD outside accepted recovery limits
S	Spike Recovery outside accepted recovery limits
U	Analyte below method detection limit
X	Matrix Effect

Pace Analytical
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report

Bentonite Performance Minerals, LLC
554 U.S. HWY 212
Belle Fourche, SD 57717

Report ID: S2207488001

Project: Baseline Soils
Date Received: 7/29/2022

Date Reported: 8/18/2022
Work Order: S2207488

Lab ID	Sample ID	Depths in	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium PE meq/L	Magnesium PE meq/L	Sodium PE meq/L	SAR
S2207488-001	SP-1	0-2	6.0	65.0	1.40	3.2	10.7	2.02	1.01	0.40
S2207488-002	SP-1	2-10	5.9	65.5	2.85	1.8	27.5	3.13	0.94	0.24
S2207488-003	SP-1	10-18	6.4	67.6	3.09	1.4	29.1	5.00	1.70	0.41
S2207488-004	SP-2	0-1	6.0	60.4	2.11	3.4	14.1	4.13	3.97	1.32
S2207488-005	SP-2	1-9	6.9	61.3	4.55	1.5	35.9	8.15	11.5	2.45
S2207488-006	SP-2	9-22	6.5	65.1	5.88	1.2	25.4	12.9	35.9	8.20
S2207488-007	SP-2	22-30	5.0	75.2	4.02	1.1	17.5	8.95	23.7	6.51
S2207488-008	SP-3	0-2	7.3	74.0	2.21	3.1	25.9	0.84	1.06	0.29
S2207488-009	SP-3	2-13	6.9	71.1	7.18	1.2	50.8	13.6	35.5	6.26
S2207488-010	SP-3	13-20	8.2	97.7	8.19	1.2	16.1	26.3	78.2	17.0
S2207488-011	SP-3	20-40	8.0	94.1	10.4	1.1	19.4	29.3	98.6	19.8
S2207488-012	SP-3	40-60	7.6	91.8	10.5	1.3	23.9	27.8	101	19.9
S2207468-013	SP-4	0-7	6.7	65.0	4.79	2.2	30.2	5.90	18.0	4.23
S2207468-014	SP-4	7-16	7.2	74.1	6.16	1.4	30.7	7.70	42.6	9.73
S2207488-015	SP-4	16-25	7.6	74.3	5.53	1.2	19.3	9.33	45.6	12.1
S2207488-016	SP-4	25-31	6.7	75.0	6.24	1.1	20.3	16.2	53.3	12.5
S2207488-017	SP-4	31-38	4.0	68.9	6.55	0.7	18.5	25.0	56.3	12.1
S2207488-018	SP-4	38-60	3.8	84.1	6.27	0.7	15.7	23.9	51.6	11.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Crystal Herman
Crystal Herman, Mining Supervisor

Pace Analytical
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Soil Analysis Report

Bentonite Performance Minerals, LLC

554 U.S. HWY 212
Belle Fourche, SD 57717

Report ID: S2207488001

Project: Baseline Soils
Date Received: 7/29/2022

Date Reported: 8/18/2022
Work Order: S2207488

Lab ID	Sample ID	Depths in	Sand %	Silt %	Clay %	Texture	Coarse Fragment %	Boron ppm	Selenium ppm
S2207488-001	SP-1	0-2	2.7	34.6	62.7	Clay	0.3	1.0	<0.1
S2207488-002	SP-1	2-10	<0.1	28.3	71.7	Clay	0.2	1.9	<0.1
S2207488-003	SP-1	10-18	<0.1	30.3	69.7	Clay	1.5	4.2	<0.1
S2207488-004	SP-2	0-1	16.7	30.6	52.7	Clay	0.7	1.2	<0.1
S2207488-005	SP-2	1-9	19.7	28.6	51.7	Clay	0.4	1.9	<0.1
S2207488-006	SP-2	9-22	16.7	23.6	59.7	Clay	0.8	5.8	<0.1
S2207488-007	SP-2	22-30	11.7	35.6	52.7	Clay	5.9	4.5	<0.1
S2207488-008	SP-3	0-2	2.7	32.6	64.7	Clay	0.8	0.8	<0.1
S2207488-009	SP-3	2-13	8.7	38.6	52.7	Clay	0.2	2.7	0.1
S2207488-010	SP-3	13-20	6.7	4.6	88.7	Clay	0.6	12.4	0.7
S2207488-011	SP-3	20-40	11.7	11.6	76.7	Clay	0.2	6.3	0.6
S2207488-012	SP-3	40-60	12.7	1.6	85.7	Clay	0.2	3.1	0.4
S2207488-013	SP-4	0-7	13.7	32.6	53.7	Clay	0.4	1.3	<0.1
S2207488-014	SP-4	7-16	<0.1	32.3	67.7	Clay	0.2	1.8	<0.1
S2207488-015	SP-4	16-25	<0.1	31.3	68.7	Clay	0.4	2.1	<0.1
S2207488-016	SP-4	25-31	0.7	31.6	67.7	Clay	0.3	4.8	<0.1
S2207488-017	SP-4	31-38	6.2	34.1	59.7	Clay	<0.1	1.2	<0.1
S2207488-018	SP-4	38-60	13.2	34.1	52.7	Clay	0.1	1.0	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, TOC=Total Organic Carbon

Reviewed by: Crystal Herman

Crystal Herman, Mining Supervisor

Pace Analytical
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

ANALYTICAL QC SUMMARY REPORT

CLIENT: Bentonite Performance Minerals, LLC **Date:** 8/18/2022
Work Order: S2207488 **Report ID:** S2207488001
Project: Baseline Soils

Calcium Chloride Boron/Selenium Sample Type MBLK Units: ppm

CACL BLK (08/17/22 17:42)	RunNo: 202980						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Boron	ND	0.1					
Selenium	ND	0.1					

CACL BLK (08/17/22 18:49)	RunNo: 202980						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Boron	ND	0.1					
Selenium	ND	0.1					

Calcium Chloride Boron/Selenium Sample Type LCS Units: ppm

CACL QC (08/17/22 17:39)	RunNo: 202980						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Boron	0.3	0.1	0.57		60.3	50 - 150	
Selenium	0.1	0.1	0.09		121	70 - 130	

CACL QC (08/17/22 18:47)	RunNo: 202980						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Boron	0.5	0.1	0.57		79.1	50 - 150	
Selenium	ND	0.1	0.09		111	70 - 130	

Calcium Chloride Boron/Selenium Sample Type MS Units: ppm

S2207488-012A (08/17/22 18:23)	RunNo: 202980						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Boron	3.6	0.1	0.5	3.1	90.5	70 - 130	
Selenium	0.9	0.1	0.5	0.4	104	70 - 130	

Calcium Chloride Boron/Selenium Sample Type DUP Units: ppm

S2207488-008A (08/17/22 18:11)	RunNo: 202980						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Boron	0.6	0.1	0.8	33.3		62.9	
Selenium	ND	0.1	ND			20	

S2207488-018A (08/17/22 18:44)	RunNo: 202980						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Boron	1.1	0.1	1.0	11.5		62.9	
Selenium	ND	0.1	ND			20	

Electrical Conductivity - Soil Sample Type LCS Units: dS/m

CONTROL (08/16/22 12:30)	RunNo: 202936						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Electrical Conductivity	3.08	0.01	3.37		91.4	80 - 120	

Electrical Conductivity - Soil Sample Type DUP Units: dS/m

S2207488-008A (08/16/22 12:18)	RunNo: 202936						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Electrical Conductivity	2.16	0.01	2.21	2.29		20	

S2207488-018A (08/16/22 12:29)	RunNo: 202936						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Electrical Conductivity	5.84	0.01	6.27	7.10		20	

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1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

ANALYTICAL QC SUMMARY REPORT

CLIENT: Bentonite Performance Minerals, LLC **Date:** 8/18/2022
Work Order: S2207488 **Report ID:** S2207488001
Project: Baseline Soils

Soil Texture Analysis Sample Type LCS Units: %

CONTROL (08/17/22 08:36)	RunNo: 202974						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Sand	21.2	0.1	32.5		65.3	75 - 125	S
Silt	43.1	0.1	40.2		107	75 - 125	
Clay	35.7	0.1	27.2		131	75 - 125	S
Texture	Clay Loam	0					

Soil Texture Analysis Sample Type DUP Units: %

S2207488-008A (08/17/22 08:24)	RunNo: 202974						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Sand	2.7	0.1	2.7	0		23.9	
Silt	32.6	0.1	32.6	0		20	
Clay	64.7	0.1	64.7	0		20	
Texture	Clay	0	ND			0	

S2207488-018A (08/17/22 08:35)	RunNo: 202974						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Sand	12.2	0.1	13.2	7.86		23.9	
Silt	34.1	0.1	34.1	0		20	
Clay	53.7	0.1	52.7	1.88		20	
Texture	Clay	0	ND			0	

Organic Matter Sample Type LCS Units: %

CONTROL (08/12/22 16:25)	RunNo: 202834						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Organic Matter	2.7	0.1	2.75		97.5	80 - 120	

Organic Matter Sample Type DUP Units: %

S2207488-008A (08/12/22 16:04)	RunNo: 202834						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Organic Matter	3.1	0.1	3.1	1.29		67.3	

S2207488-018A (08/12/22 16:15)	RunNo: 202834						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Organic Matter	0.6	0.1	0.7	7.87		67.3	

pH-Soil Sample Type LCS Units: s.u.

CONTROL (08/16/22 09:15)	RunNo: 202936						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
pH	7.0	0.1	7.1		99.0	96 - 104	

pH-Soil Sample Type DUP Units: s.u.

S2207488-008A (08/16/22 09:03)	RunNo: 202936						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
pH	7.4	0.1	7.3	0.815		20	

S2207488-018A (08/16/22 09:14)	RunNo: 202936						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
pH	3.8	0.1	3.8	0.266		20	

Pace Analytical
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

ANALYTICAL QC SUMMARY REPORT

CLIENT: Bentonite Performance Minerals, LLC **Date:** 8/18/2022
Work Order: S2207488 **Report ID:** S2207488001
Project: Baseline Soils

Saturated Paste Cations by EPA 200.7 Sample Type MBLK Units: meq/L

SAR BLK (08/18/22 00:20)	RunNo: 202982						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Calcium	ND	0.05					
Magnesium	ND	0.05					
Sodium	ND	0.05					

Saturated Paste Cations by EPA 200.7 Sample Type LCS Units: meq/L

SAR QC (08/18/22 00:18)	RunNo: 202982						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Calcium	20.8	0.05	26		80.1	80 - 120	
Magnesium	11.1	0.05	13.4		83.1	80 - 120	
Sodium	14.1	0.05	17.2		82.3	80 - 120	

Saturated Paste Cations by EPA 200.7 Sample Type DUP Units: meq/L

S2207488-008AD (08/17/22 23:44)	RunNo: 202982						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Calcium	26.9	0.05	25.9	3.77		20	
Magnesium	0.57	0.05	0.84	39.4		20	R
Sodium	0.60	0.05	1.06	55.9		20	R

S2207488-018AD (08/18/22 00:15)	RunNo: 202982						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Calcium	14.6	0.05	15.7	7.71		20	
Magnesium	22.4	0.05	23.9	6.55		20	
Sodium	48.9	0.05	51.6	5.40		20	

Saturation Percent Sample Type LCS Units: %

CONTROL (08/17/22 07:56)	RunNo: 202952						
Analyte	Result	RL	Spike	Ref Samp	%REC	% Rec Limits	Qual
Saturation Percent	50.5	0.1	52		97.1	80 - 120	

Saturation Percent Sample Type DUP Units: %

S2207468-008A (08/17/22 07:26)	RunNo: 202952						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Saturation Percent	73.5	0.1	74.0	0.616		20	

S2207488-018A (08/17/22 07:39)	RunNo: 202952						
Analyte	Result	RL	Ref Samp	%RPD	%REC	% RPD Limits	Qual
Saturation Percent	67.3	0.1	64.1	4.86		20	

Pace Analytical

Pace Analytical Services, LLC

Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

Page 1 of 1

All shaded fields must be completed.
This is a legal document: any misrepresentation may be construed as fraud.

190679

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
Gustafson Performance Minerals	Bioslurry Soils		

Report Address	Contact Name	Email	Phone
on F.6	Michael Carr		

Invoice Address	Purchase Order #	Quote #
on F.6		

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	ANALYSES / PARAMETERS: Gasoline-16	Gasoline-16							REMARKS
1	3700488-	2/8/22	—	SP-1	SL	3	x								
2		"	—	SP-2	"	4	x								
3		"	—	SP-3	"	5	x								
4		2/8/22	—	SP-4	"	6	x								
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
	Chris Johnston	2/9/22	1025		2/9/22	10:26

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	WT	Check desired service	Compliance Monitoring? Y / N	
☐ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #	
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated? Y / N	
☐ Other ___	Other	OT	*Rush & Urgent Surcharges will be applie*	Sample Disposal: Lab / Client	

APPENDIX E

Soil Laboratory Analysis

SWCA®
ENVIRONMENTAL CONSULTANTS

Sheridan Office
1892 South Sheridan Avenue
Sheridan, WY 82801
Tel 307.673.4303 Fax 307.673.4505

Soil Profile Description

Hole #: SP-1 Sample Date: 7/27/22 Sampled By: [illegible]

Client ID: BPM

Parent Material (ALL, COL, RES, EOL): ~~Alluv~~/Res Analytical Sample: Yes [X] No [ ]

Physiography:

Weather: 85°F, Partly Cloudy

Vegetation: Native grasses & shrubs Land Cover/Use: Rangeland

Slope (%): Aspect: S

Erosion: Hillslope Profile Position (SU, SH, BS, FS, TS):

Additional Notes:

Depth (cm) (in) (ft)	Horizon	Matrix Color			Texture (s, si, c, l)	Structure (gr, abk, sbk, pl, pr, cpr, sg, m)	Effervescence (NE, VS, SL, ST, VE)	Rock Frags		Mottles		Comments
		Name	Dry	Moist				Size (f, m, c)	Rnd (VA, A, R)	Size (f, m, c)	% (f, c, m)	
0-2	A	Dark gray		10YR 4/1	scl/c	gr	NE	-	-	-	-	
2-10	Bt1	gray		10YR 5/1	c	sbk	NE	-	-	-	-	
10-18	Bt2	Dark gray		10YR 4/1	c	sbk	NE/VS	F/m	VA	F/m	F	Ca CO3 mottles Shale Frags
18→	weathered shale						VE	-	-	-	-	

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Soil Profile Description

Hole #: SP-2 Sample Date: 7/27/22 Sampled By: E

Client ID: BPM

Parent Material (ALL, COL, RES, EOL): Analytical Sample: Yes ☒ No ☐

Physiography:

Weather:

Vegetation: Land Cover/Use:

Slope (%): Aspect:

Erosion: Hillslope Profile Position (SU, SH, BS, FS, TS):

Additional Notes: Good rooting in 1-9" horizons

Depth (cm) (in) (ft)	Horizon	Matrix Color Name	Matrix Color Dry	Matrix Color Moist	Texture (s, sl, c, l)	Structure gr, sbk, abk, pl, pr, cpr, sg, m	Effervescence (NE, VS, SL, ST, VE)	Rock Frags Size (f, m, c)	Rock Frags Rnd (VA, A, R)	Mottles Size (f, m, c)	Mottles % (f, c, m)	Comments
0-1	A	Dark grayish brown		10YR 4/2	l	gr	NE	-	-	-	-	
1-9	Bt	grayish Brown		10YR 5/2	c	sbk	ST	-	-	-	-	
9-22	Btk	gray		10YR 6/1	c	"	VS	-	-	F/m	m	gypsum mottles CaCO3 mottles
22-30	Bk	gray		10YR 5/1 fine	c	"	NE	-	-	-	-	
30 +	weathered shale					m	NE	-	-	-	-	

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Soil Profile Description

Hole #: SP-3 Sample Date: 7 127 L2B Sampled By: S

Client ID: BPM

Parent Material (ALL, COL, RES, EOL): Analytical Sample: Yes ☒ No ☐

Physiography:

Weather:

Vegetation: Land Cover/Use:

Slope (%): 5-10% Aspect: S

Erosion: Hillslope Profile Position (SU, SH, BS, FS, TS):

Additional Notes: good rooting in 2-13" horizon

Depth (cm) (in) (ft)	Horizon	Matrix Color			Texture (s, sl, c, l)	Structure gr, sbk, abk, pl, pr, cpr, sg, m	Effervescence (NE, VS, SL, ST, VE)	Rock Frags		Mottles		Comments
		Name	Dry	Moist				Size (f, m, c)	Rnd (VA, A, R)	Size (f, m, c)	% (f, c, m)	
0-2	A				lcl	gr	NE	—	—	—	—	
2-13	Bky	gray	10yr 6/1	10yr 5/1	cl	sbk	SL	—	—	c	m	gypsum mottles 35% of matrix
13-20	Bc	"	10yr 4/1	"	c	sbk	SL	—	—	m	c	Gypsum mottles
(20-40" & 40-60") 20-60	Ck	grayish brown		10yr 5/2	c	sbk	ST	—	—	"	"	" "
60-69	B/C?		dark gray	10yr 4/1	c	sbk	SL	—	—	"	"	5% mottles & gypsum mottles & shale frags

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Soil Profile Description

Hole #: SP-4 Sample Date: 7/28/22 Sampled By: S

Client ID: BPM

Parent Material (ALL, COL, RES, EOL): All, Res Analytical Sample: Yes ☒ No ☐

Physiography:

Weather: Hazy, Sunny

Vegetation: grasses Land Cover/Use: Hayfield

Slope (%): 0-5% Aspect: SW

Erosion: Hillslope Profile Position (SU, SH, BS, FS, TS): FS

Additional Notes: good sorting through 16" horizon.

Depth (cm) (in) (ft)	Horizon	Matrix Color Name	Matrix Color Dry	Matrix Color Moist	Texture (s, sl, c, l)	Structure gr, sbk, abk, pl, pr, cpr, sg, m	Effervescence (NE, VS, SL, ST, VE)	Rock Frags Size (f, m, c)	Rock Frags Rnd (VA, A, R)	Mottles Size (f, m, c)	Mottles % (f, c, m)	Comments
0-7	Ap?	Dark grayish brown		10YR 4/2	scl	gr	NE	-	-	-	-	
7-16	Bt	Dark gray		10YR 4/1	c	sbk	SL/ST	-	-	-	-	
16-25	Bcy	Dark gray		10YR 4/1	[redacted]	sbk	SL	-	-	Fim	F	Gypsum mottles
25-31	Bcy	Dark grayish brown		10YR 4/2	[redacted]	sbk	SL	-	-	m	C	"
31-38	Bcy	"		"	scl	mkgr	VS	-	-	-	-	
38-60	Bk	"		"	scl	mkgr	VS	-	-	-	-	

APPENDIX 4

Baseline Wildlife Surveys and Vegetation Sampling Report for the Larsen Project, Butte County, South Dakota

Baseline Wildlife Surveys and Vegetation Sampling Report for the Larsen Project, Butte County, South Dakota

APRIL 2023

PREPARED FOR

Bentonite Performance Minerals, LLC

PREPARED BY

SWCA Environmental Consultants

BASELINE WILDLIFE SURVEYS AND VEGETATION SAMPLING REPORT FOR THE LARSEN PROJECT, BUTTE COUNTY, SOUTH DAKOTA

Prepared for

Bentonite Performance Minerals, LLC
554 U.S. Highway 212
Belle Fourche, South Dakota 57717

Prepared by

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April 2023

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1 INTRODUCTION

1.1 Project Description

On behalf of Bentonite Performance Minerals, LLC (BPM), SWCA Environmental Consultants (SWCA) conducted baseline wildlife surveys and vegetation sampling for the proposed Larsen Project (project) permit area. Wildlife surveys were also conducted within 0.5 mile of the permit area (the study area). The permit area is located on private lands in the southwestern portion of Butte County, South Dakota, approximately 7.0 miles northwest of Belle Fourche in Sections 2, 3, and 11, Township 9 North, Range 1 East along U.S. Highway 212. The permit area encompasses 310.29 acres (Figure 1). BPM proposes to submit a permit application to the South Dakota Department of Agriculture and Natural Resources (SDDANR) to surface mine bentonite within the permit area (the project).

From October 2004 through May 2007, Jones & Stokes conducted baseline wildlife surveys and vegetation sampling in two areas for the American Colloid Company's (ACC) Shear/Clarkson Permitting Project: Shear/Clarkson West and Shear/Clarkson East. General observations were recorded for all species, and species-specific surveys were conducted for greater sage-grouse (*Centrocercus urophasianus*), nesting raptors, lagomorphs, big game, and wintering bald eagle (*Haliaeetus leucocephalus*); additional observations were provided by ACC environmental personnel. The findings from the Jones & Stokes report have been incorporated into this report to provide additional information about the permit area's wildlife species (Jones & Stokes 2007). The Larsen Project permit area is located within Shear/Clarkson East; however, observations for some wildlife species include findings for both Shear/Clarkson West and East unless otherwise specified.

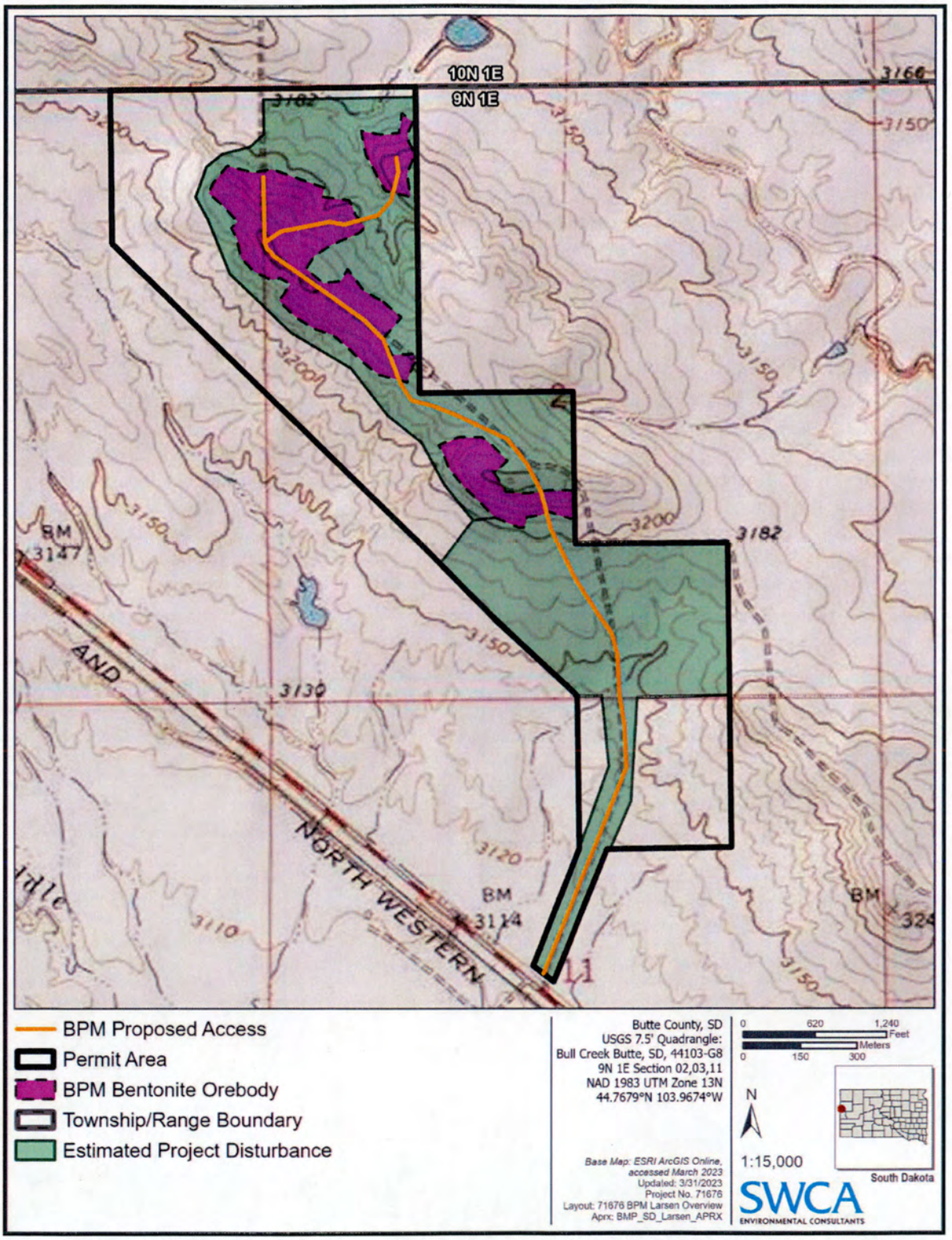

Figure 1. BPM Larsen Project permit area, disturbance, and orebody overview.

1.2 Survey Parameters and Protocol Development

Because the permit area is located within a greater sage-grouse core area, consultation with the SDDANR and South Dakota Game, Fish & Parks (SDGFP) was conducted to develop a standard and adequate vegetation and wildlife sampling protocol for the project. An initial on-site field inspection was conducted on March 31, 2022, with BPM's Michael Barr and SDGFP's Stan Michals. A second field inspection was conducted on May 4, 2022, with SDGFP's Travis Runia and Stan Michals, SWCA's Paige Colburn, and BPM's Michael Barr and Jennifer Hartman. Recommendations made by the agencies during these two field inspections were used to draft the vegetation and wildlife field sampling protocol used to conduct the baseline monitoring for the project. The approved protocol is presented in Appendix A.

Baseline wildlife surveys included bald eagle winter roost surveys; raptor nest surveys; greater sage-grouse habitat assessment, use, and lek surveys; and additional surveys for other species of concern. Incidental observations of all wildlife species were recorded during the previously noted surveys; however, additional targeted surveys for specific species were not conducted.

Vegetation sampling adhered to the sampling protocol methods detailed in a study conducted by Lindsay Anne Parsons (Parsons 2019) to maintain consistency with procedures used to define South Dakota's sage-grouse core areas. Three sampling points were established within each of the two plant communities present in the permit area to quantify the attributes of each. Each sampling point consisted of three 50-meter (m)-long transects, for a total of six sampling points and 18 transects. At each sampling point, species diversity and composition, canopy cover estimations, sagebrush height, and sagebrush density were assessed, and transects photographs were taken. In addition to vegetation sampling, the surveyors used geographic information system (GIS) tools to field verify and map the boundaries of the two plant communities as well as document any occurrence of invasive or noxious weed species.

2 ENVIRONMENTAL SETTING

According to the Natural Resources Conservation Service (NRCS), the study area lies entirely within the Pierre Shale Plains Major Land Resource Area (MLRA) 60A, which is in unglaciated portions of the Missouri Plateau in the Great Plains province of the Interior Plains. Old plateaus and terraces that have been deeply eroded are an important component of this area. Average annual precipitation in MLRA 60A is 13 to 21 inches. Most of the rainfall occurs early in the growing season (May and June) as frontal storms and later in the season (July and August) as high-intensity convective thunderstorms. Precipitation in the winter occurs mainly as snow accompanied by drift-forming high winds. The average annual temperature is 43 to 49 degrees Fahrenheit (°F) with a freeze-free period averaging approximately 140 days (125–155 days) (NRCS 2022a).

2.1 General Vegetation Characteristics

MLRA 60A primarily supports native vegetation characteristic of mixed natural prairies, consisting mostly of grasses and forbs with some trees and shrubs occurring along streams. Grass species found here generally include western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), and blue grama (*Bouteloua gracilis*), with big bluestem (*Andropogon gerardii*) growing along streams and little bluestem (*Schizachyrium scoparium*), buffalograss (*Bouteloua dactyloides*), and sideoats grama (*Bouteloua curtipendula*) primarily found growing on shallow soils. Common forbs found in this MRLA include purple coneflower (*Echinacea* sp.), prairie coneflower (*Ratibida* sp.), American vetch (*Viam americana*), dotted gayfeather (*Liatris punctata*), Missouri goldenrod (*Solidago missouriensis*), breadroot scurfpea (*Psoralea esculenta*), silverleaf scurfpea (*Pediomelum argophyllum*), scarlet globemallow

(*Sphaeralcea coccinea*), heath aster (*Symphyotrichum ericoides*), desert biscuitroot (*Lomatium foeniculaceum*), and cudweed sagewort (*Artemisia ludoviciana*). In clayey soils, common shrubs include silver sagebrush (*Artemisia cana*), western snowberry (*Symphoricarpos occidentalis*), and leadplant (*Amorpha canescens*). Sandy soils are dominated by sand sagebrush (*Artemisia filifolia*), with big sagebrush (*Artemisia tridentata*) commonly found in the driest areas of this MRLA as well as areas that extend into Wyoming. Along streams and drainageways, principal tree species include boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and plains cottonwood (*Populus deltoides* ssp. *monilifera*) (NRCS 2022a).

2.2 Soils

The permit area is composed of eight different soil map units according to the NRCS Web Soil Survey. Percentages of these in the permit area are 34.8% Kyle clay (2 to 6 percent slopes), 19.3% Grummit-Rock outcrop complex (6 to 40 percent slopes), 19.2% Enning-Minnequa silty clay loams (3 to 15 percent slopes), 8.7% Slickspots-Demar complex (0 to 6 percent slopes), 8.5% Arvada-Slickspots complex (0 to 3 percent slopes), 8.3% Arvada silt loam (0 to 3 percent slopes), 1.1% Broadhurst clay (0 to 6 percent slopes), and 0.1% Water. There are 14 different ecological sites that fall under these soil map units: Thin Claypan, Loamy 16-18" P.Z., Clayey Overflow, Closed Depression, Dense Clay, Porous Clay, Saline Lowland, Clayey 16-18" P.Z., Shallow Loamy, Thin Upland, Loamy Terrace, Shallow Porous Clay, Very Shallow, and Claypan (NRCS 2022b).

2.3 Hydrology

According to the National Wetlands Inventory and National Hydrography Dataset, two NHD flowlines and one wetland feature (Freshwater Emergent Wetland) are in the permit area (Figure 2) (U.S. Fish and Wildlife Service [USFWS] 2022a; USGS 2022b). Watersheds identified in association with the permit area are the Middle Creek-Belle Fourche River and the Lower Crow Creek watersheds. The Middle Creek-Belle Fourche River watershed south of the permit area contains four water quality monitoring locations, whereas the Lower Crow Creek watershed north of the permit area contains five water quality monitoring locations and one permitted discharge that is associated with the City of Belle Fourche. No waterbodies within either watershed have been assessed against U.S. Environmental Protection Agency–approved water quality standards or thresholds (U.S. Environmental Protection Agency 2022).

2.4 Land Use

The study area lies in a rural, undeveloped setting used primarily for grazing livestock. Development consists of two-track roads and fences throughout the permit area, U.S. Highway 212 to the south, and a strip of reclaimed vegetation in the southeasternmost portion of the permit area. Notably, there is mining activity related to bentonite southeast of the permit area in Section 11.

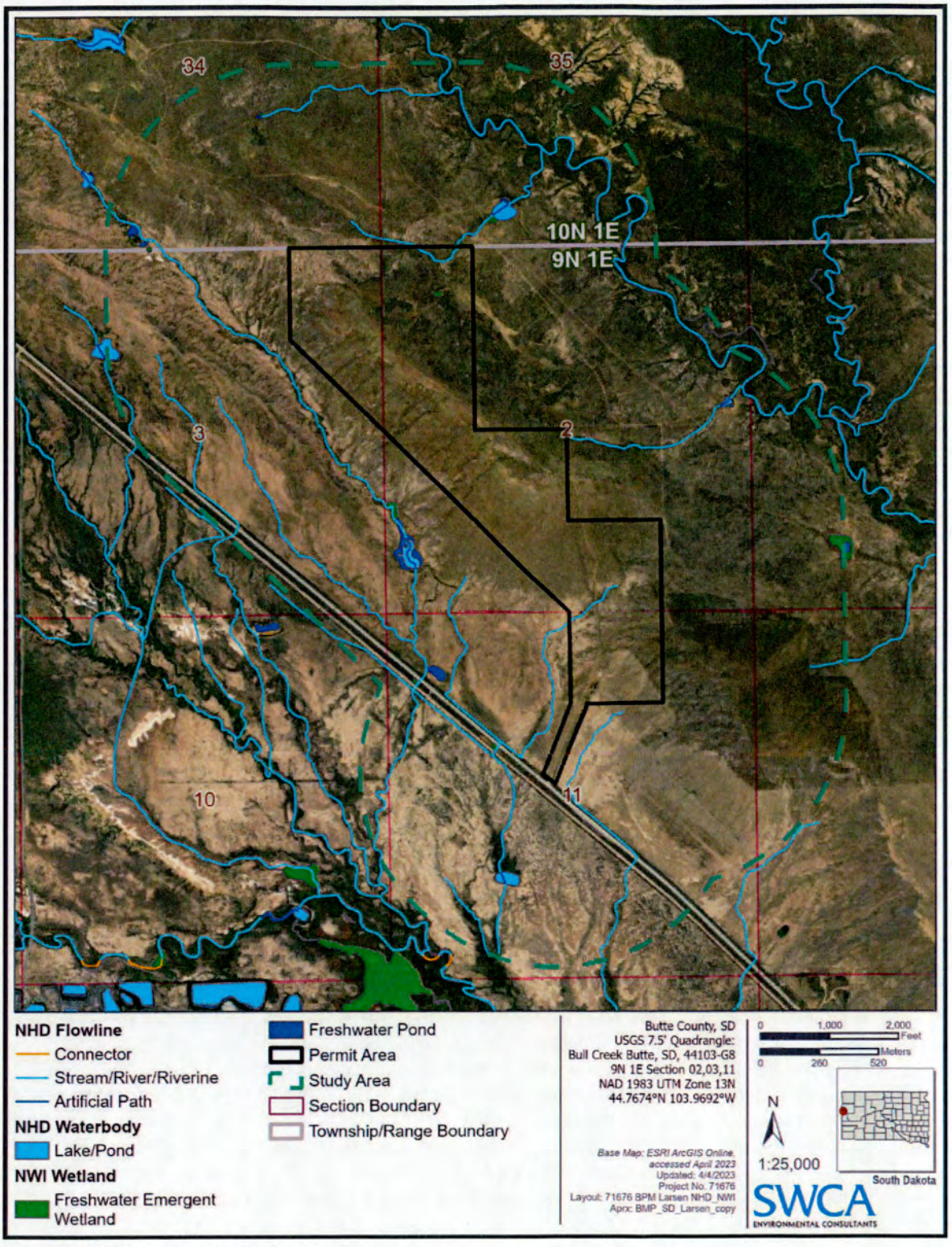

Figure 2. BPM Larsen Project hydrology overview.

3 METHODS AND RESULTS

3.1 Desktop Analysis

The desktop analysis was completed using a combination of existing information obtained from available public sources, including reports, published literature, online databases, and geographic information system (GIS) data. The following publicly available data resources were accessed prior to the initiation of surveys to determine potentially suitable habitat assessment areas and identify biological resources within the permit area.

- Google Earth Pro (2022)
- USGS National Topographic Map Database (USGS 2022a)
- USGS National Hydrography Dataset (USGS 2022b)
- USFWS National Wetlands Inventory (USFWS 2022a)
- USFWS Information for Planning and Consultation (IPaC) (USFWS 2022b)
- *South Dakota Wildlife Action Plan* (SWAP) (SDGFP 2014)
- SDGFP Threatened and Endangered Species (SDGFP 2022a)
- SDGFP SWAP Explorer (SDGFP 2022b)
- South Dakota Natural Heritage Program Environmental Review Report (SDGFP 2022c)
- Cornell Lab of Ornithology (2022)
- eBird (2022)
- *American Colloid Company Shear/Clarkson Permitting Project Wildlife Baseline Inventory* (Jones & Stokes 2007)

3.1.1 Critical Resources

Per South Dakota requirements, SWCA assessed the study area for critical resources (South Dakota Codified Laws 45-6B-92(1) and (3)). The critical resources for vegetation include riparian zones, mountain meadows, wetlands, and threatened or endangered species. Critical resources for wildlife include critical deer winter range, threatened or endangered species, and any other critical wildlife resource identified by the SDGFP (South Dakota Legislative Research Council 2023).

Qualified biologists were provided a critical resource list and were instructed to document any such critical resources, or signs of such resources, present within the permit area. For vegetation critical resources, no riparian zones, mountain meadows, wetlands, or threatened or endangered species were observed in the permit area. Additionally, no critical resources were observed for wildlife in terms of critical deer winter range or observations of threatened or endangered species. The study area is located in the southern extent of the area SDGFP identified and mapped as sage-grouse core areas in the state of South Dakota. However, based on observations made in the Parsons (2019) study about sage-grouse preferential site selection and subsequently comparing those environmental variables with SWCA's vegetation sampling results, the permit area itself is unlikely to be used by greater sage-grouse individuals.

3.2 Baseline Wildlife Surveys

SWCA conducted baseline wildlife surveys in accordance with SDGFP's *Bentonite and Prairie Mining Project Wildlife and Vegetation Baseline Study Guidelines* (SDGFP 2016). These guidelines were used to develop the sampling protocol provided to SDGFP (personal communication, Stan Michals, May 18, 2022) and SDDANR (personal communication, Eric Holm, May 17, 2022). Both agencies approved the protocol. The purpose of the wildlife surveys is to document which wildlife species are using the study area and to provide information necessary to determine the effects of the proposed mining and reclamation operations on these species.

In 2022, qualified SWCA biologists conducted the baseline wildlife surveys on April 18, May 21, and June 9, and made incidental wildlife observations from July 13 through July 14 during the vegetation sampling. During these efforts, the ground ranged from mostly dry, with patches of snow and mud to completely saturated as a result of scattered precipitation events. The temperature ranged from 23°F to 42°F, and the sky was partly cloudy to overcast. Variable winds primarily remained under 10 miles per hour (mph) across survey dates, with gusts reaching up to 20 mph on May 21.

In 2023, a qualified SWCA biologist returned to the site to complete bald eagle winter roost surveys and to continue to assess the area for any sign of greater sage-grouse use or other incidental wildlife activity. These surveys occurred during predetermined winter roost protocol survey windows on January 6, February 1, and March 2. During these surveys, the ground was frozen and ranged from dry to partially snow covered. The temperature ranged from 12°F to 40°F, and weather conditions were mostly clear to foggy. Variable winds primarily remained under 10 mph across survey dates, with gusts reaching up to 13 mph on February 1.

In addition to SWCA's survey efforts, BPM personnel were approved to conducted greater sage-grouse lek surveys. Three observation points were established for these surveys. Two points were established within the permit area itself, and one was established southwest of the permit area across U.S. Highway 212 to monitor Middle Creek lek activity, which is the closest known lek to the permit area (Figure 3). The lek surveys in the permit area occurred just before or after sunrise on March 29, April 18, April 28, and May 6, 2022. The Middle Creek lek surveys were conducted just after sunrise on March 28, April 11, April 15, and April 27, 2022. During these surveys, temperatures ranged from 20°F to 40°F at survey start, and wind speeds remained at or below 10 mph.

The baseline wildlife surveys included ground-truthing wildlife habitat and plant communities previously mapped for the Shear/Clarkson Permitting Project, documenting where plant communities provide potential habitat for species of concern, inspecting areas of potential habitat for species of concern noted during the desktop analysis, documenting readily observable features that may attract wildlife, and recording incidental wildlife observations. Based on the approved sampling protocol, SWCA conducted surveys using the specific methods discussed in Appendix A and recorded incidental observations of all wildlife species observed while on-site (Figure 4).

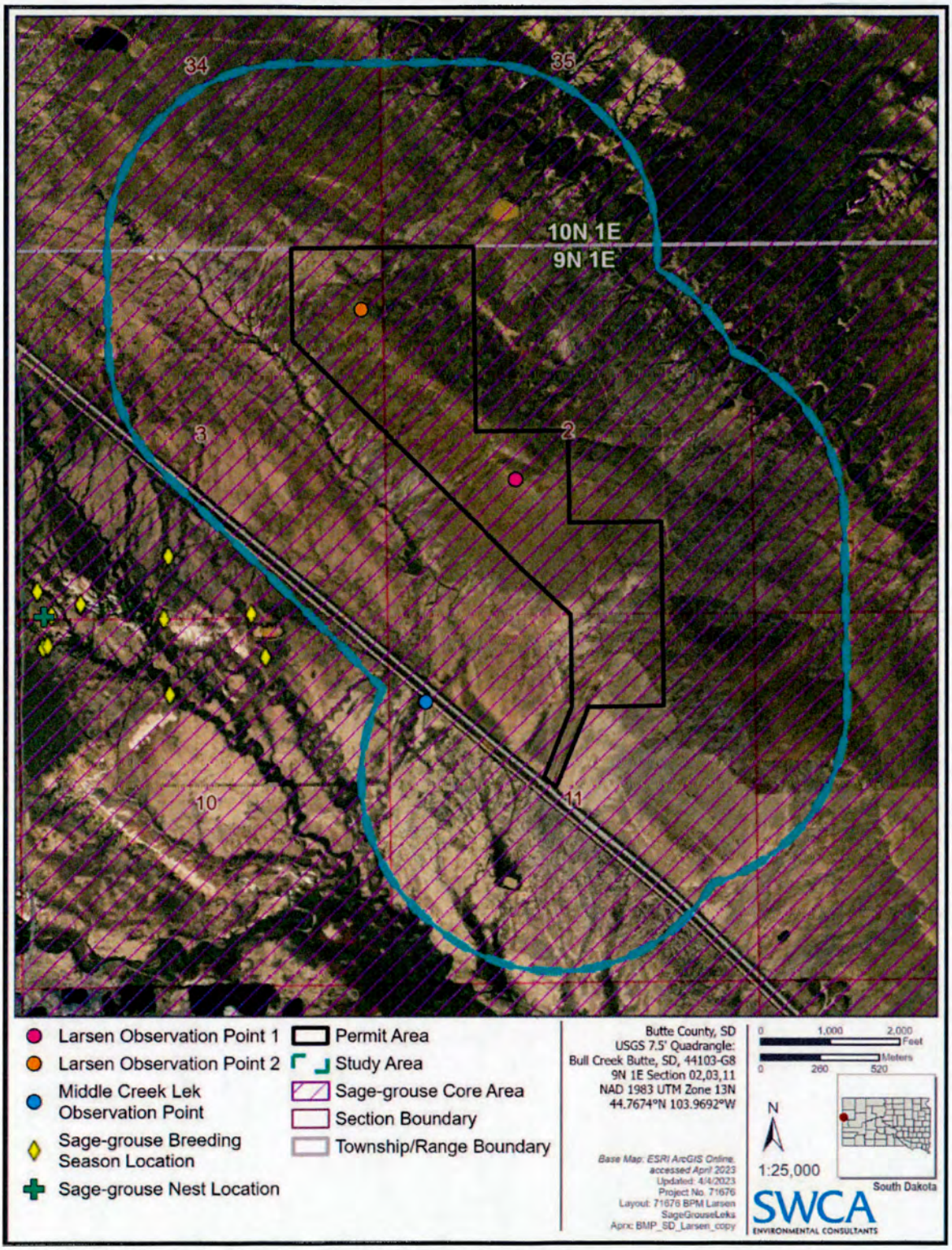

Figure 3. BPM Larsen Project greater sage-grouse overview.

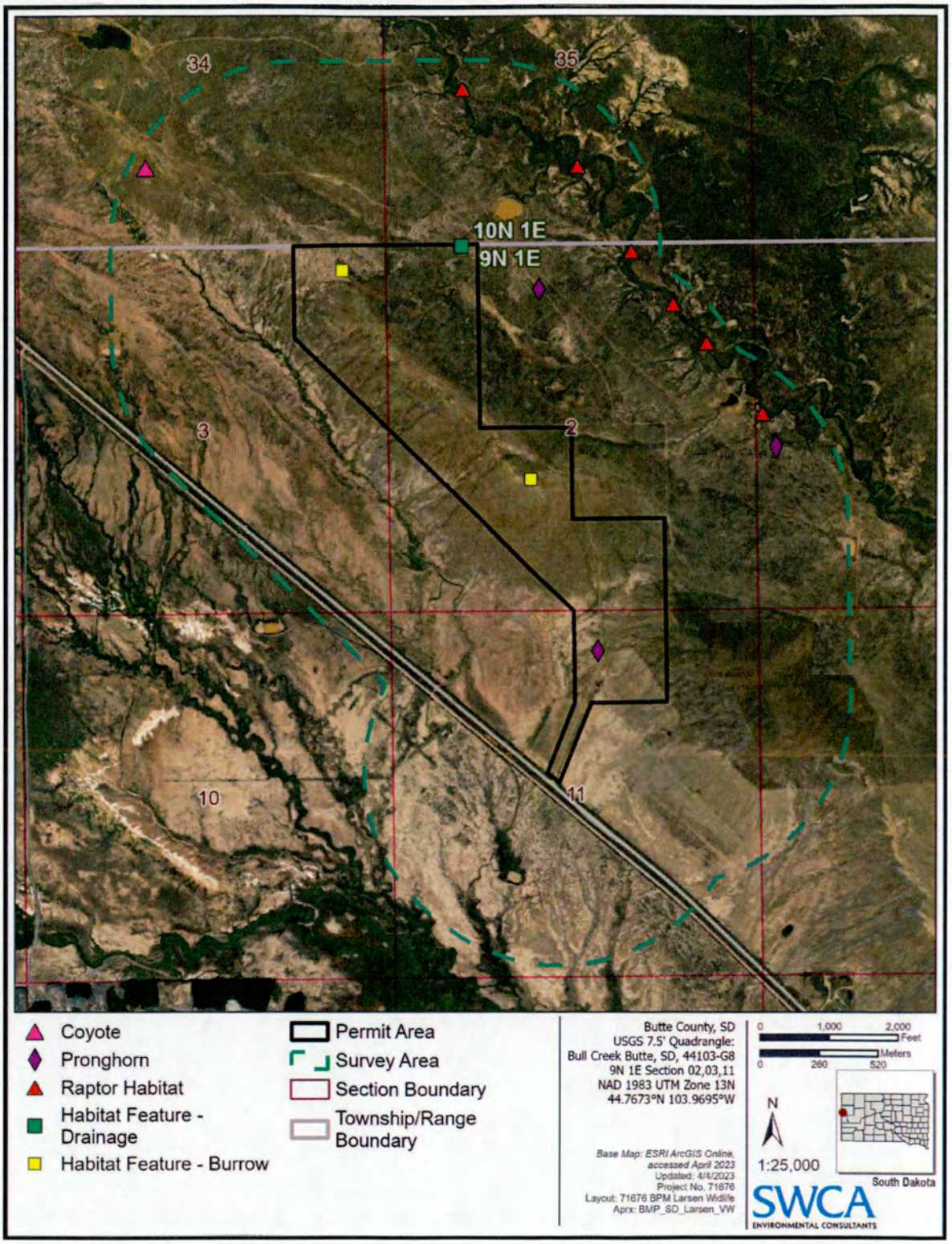

Figure 4. BPM Larsen Project wildlife observations.

Wildlife species of concern for the project are defined as follows:

- Threatened and endangered species pursuant to the Endangered Species Act of 1973 (ESA), Section 4, as amended.
- Species designated by the USFWS as proposed, candidate, species of concern, and nonessential experimental populations.
- Threatened and endangered species as designated by the State of South Dakota.
- Species of greatest conservation need according to the SWAP.
- Bald eagle and golden eagle (*Aquila chrysaetos*), which are protected under the Bald and Golden Eagle Protection Act (BGEPA) of 1940.
- Non-eagle raptors.
- Greater sage-grouse, although not officially listed, is protected as a candidate species under the ESA in lieu of a 2010 decision by the USFWS.
- Birds of Conservation Concern (BCC) as listed by the USFWS (2021) and defined as "species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973."

Other wildlife species considered for the project are as follows:

- Upland game bird species
- Small mammals
- Reptiles and amphibians
- Fish
- Waterfowl and shorebirds
- Big game species

The potential for occurrence of each species of concern was classified according to the categories listed below. Because not all species are accommodated precisely by a given category (i.e., category definitions may be too restrictive), an expanded rationale for each category assignment was provided for some species.

Potential for occurrence categories are as follows:

- Known: The species has been documented in the permit area by a reliable observer.
- Likely: The permit area is within the species' known range and suitable habitat is present, but the species has not been documented in the permit area.
- Possible: The permit area is peripheral to the species' known range and suitable habitat may be present, or the permit area is within the species' known range, but suitable habitat may not be present.
- Unlikely: The permit area is outside of the species' known range or does not contain suitable habitat. Wayward individuals and other atypical occurrences (e.g., storm system–caused vagrancy) are not evidence of potential for occurrence since those occasions constitute unforeseeable anomalies.

3.2.1 U.S. Fish and Wildlife Service Threatened, Endangered, Proposed, or Candidate Species

The IPaC planning tool provides information regarding federally threatened, endangered, proposed, and candidate species within a given area. If a proposed project overlaps the area of influence of an ESA-listed species, then the IPaC planning tool will indicate that potential project impacts should be assessed for that species. The IPaC planning tool indicates that the permit area is within the ranges of one ESA candidate species and two ESA threatened species (Table 1) (USFWS 2022b). The USFWS *Threatened and Endangered Species Active Critical Habitat Report* indicates that critical habitat for threatened and endangered species has not been designated in Butte County, South Dakota (USFWS 2022c). Table 1 lists the USFWS listed species for the area, their ESA status, and the likelihood of their occurrence in the permit area. SWCA reviewed the range and distribution of these species to identify the likelihood of their occurrence in the study area. These species and their potential to occur in the permit area are discussed further in the following sections.

Table 1. U.S. Fish and Wildlife Service Threatened, Endangered, Proposed, or Candidate Species with Ranges Overlapping the Permit Area

Common Name	Scientific Name	Endangered Species Act Status	Potential to Occur in the Permit Area
Birds			
Rufa red knot	*Calidris canutus rufa*	Threatened	Unlikely
Insects			
Monarch butterfly	*Danaus plexippus*	Candidate	Possible
Mammals			
Northern long-eared bat	*Myotis septentrionalis*	Threatened	Unlikely

Source: USFWS (2022a, 2022b).

3.2.1.1 NORTHERN LONG-EARED BAT

The USFWS proposed a new ruling in the *Federal Register* on March 23, 2022, that the northern long-eared bat (*Myotis septrionalis*) be reclassified from a federally threatened species to a federally endangered species. If this ruling is finalized as proposed, the northern long-eared bat's species-specific 4(d) rule will be removed, and it will be reclassified as an endangered species on the list of endangered and threatened wildlife (USFWS 2022d). The State of South Dakota, however, has not yet assigned a state status to this species (SDGFP 2022a).

During the warmer periods of the year, the northern long-eared bat occupies a wide range of rocky and forested habitats. Suitable winter habitat includes large caves and subterranean mines (USFWS 2015). Summer day roosts include abandoned buildings, bridges, hollow trees, stumps, areas under loose bark, and spaces within rock fissures (Jones and Choate 1978). The USFWS (2022e) shows the entirety of South Dakota as lying within the range for this species, and there are seven known hibernacula in the Black Hills, located approximately 15 miles south of the permit area, where hibernating northern long-eared bats have been documented (South Dakota Bat Working Group 2004).

The study area is within the known range for this species (USFWS 2022e); however, no caves or mines that would provide suitable winter habitat are in or surrounding the permit area. Additionally, no large tracts of contiguous forested habitat occur in or surrounding the permit area. No northern long-eared bat

were observed during the baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.1.2 RUFA RED KNOT

The rufa red knot (*Calidris canutus rufa*) was listed as federally threatened on January 12, 2015 (USFWS 2014). The State of South Dakota has not yet assigned a state status to this species (SDGFP 2022a).

The rufa red knot is a medium-sized shorebird that breeds in the central Canadian Arctic and migrates to wintering grounds on the U.S. Gulf Coast, the western Gulf of Mexico, both coasts of Central America, and in South America. The species generally occurs along the ocean coasts during migration, but available data suggest that 1) inland saline lakes of the Northern Great Plains may be used by rufa red knots as stopover sites and that 2) along inland migration corridors, small numbers of them may even use anthropogenic freshwater habitats. There are little data to indicate a preference for inland freshwater habitats during migration, but available data suggest further study may be warranted. Nesting locations typically occur on dry windswept slopes with little vegetation in slightly elevated tundra locations and within 600 feet of a freshwater wetland. The population of rufa red knots studied so far is small and localized to one island; given this, a greater diversity of nesting and foraging habitats may be possible across the breeding range and has yet to be documented (USFWS 2022f).

The study area is within the known range for this species but does not contain any of the concrete suitable habitat types that have been studied thus far (USFWS 2022f). No rufa red knot were observed during the baseline wildlife surveys or during previous surveys or during the 2004–2007 surveys; however, only the red knot (*Calidris canutus*), and not the rufa red knot, was specifically surveyed for in 2004–2007 (Jones & Stokes 2007).

3.2.1.3 MONARCH BUTTERFLY

Because of the decline in North American populations as a result of habitat reduction and fragmentation, in December 2020, the USFWS announced that listing the monarch butterfly (*Danaus plexippus*) as endangered or threatened under the ESA is warranted but precluded by higher-priority listing actions. The monarch butterfly remains a candidate for listing under the ESA at this time. The range of monarch butterfly stretches across the lower 48 states, with main migratory routes occurring through the central plains (USFWS 2022g).

Monarchs are present in many regions throughout the lower 48 states, where the breeding season occurs year-round. Monarch butterfly populations that are found in temperate regions begin a fall migration in September and October and a spring migration in February and March where they may fly over 1,800 miles. Once adult monarchs complete their summer roosting in central Mexico, individuals undertake the same flight northward through breeding grounds where their offspring begin the migration cycle again. Suitable foraging and breeding habitat for this species takes the form of native warm-season grass fields and pastures where milkweeds (*Asclepias* spp.) may exist to serve as larval host plants (USFWS 2022g).

Monarch Watch's (2022) tag monitoring program did not recover any tagged individuals between 2017 and 2021 in Butte County. However, in 2021, there were two tag recoveries made in Lawrence County, which is adjacent to and south of Butte County (Monarch Watch 2022).

The study area is within the known range for this species (USFWS 2022g); however, potentially suitable habitat in the study area is marginal at best. Although some warm-season grass species do occur, the permit area is primarily dominated by cool-season grasses. No monarch butterfly or milkweed species were observed during the baseline wildlife surveys or during the 2004–2007 surveys; however, it should be noted that this species was not specifically surveyed for in 2004–2007 (Jones & Stokes 2007).

3.2.2 South Dakota Threated and Endangered Species

There are 21 species listed under South Dakota's Endangered and Threatened Species Law (South Dakota Codified Laws Chapter 34A-8) (SDGFP 2022a). SWCA reviewed the range and distribution of these species, and Table 2 identifies state-listed species, their state listing status, and the likelihood of their occurrence in the study area.

Bird species that are unlikely to occur in the study area could pass through the area but would be unlikely to feed, nest, or rest there. Species that have potential to occur based on range and habitat associations are further discussed in the following sections.

Table 2. State of South Dakota Endangered and Threatened Species

Common Name	Scientific Name	State of South Dakota Status	Potential to Occur
Fish			
Banded killifish	*Fundulus diaphanus*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Blacknose shiner	*Notropis heterolepis*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Finescale dace	*Chrosomus neogaeus*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediata permit area.
Longnose sucker	*Catostomus catostomus*	Threatened	Unlikely. The study area falls within the probable distribution of this species in Butte County, but no suitable habitat is present in the immediate permit erea.
Northern pearl dace	*Margariscus nachtriebi*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Northern redbelly dace	*Chrosomus eos*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Pallid sturgeon	*Scaphirhynchus albus*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Sicklefin chub	*Macrhybopsis meeki*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Sturgeon chub	*Macrhybopsis gelida*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Reptiles and Amphibians			

Common Name	Scientific Name	State of South Dakota Status	Potential to Occur
Eastern hognose snake	*Heterodon platirhinos*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
False map turtle	*Graptemys pseudogeographica*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Lined snake	*Tropidoclonion lineatum*	Endangered	Unlikely. Only known from southeastern South Dakota.
Birds			
American dipper	*Cinclus mexicanus*	Threatened	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Eskimo curlew	*Numenius borealis*	Endangered	Unlikely. No records of this species in South Dakota. Species is possibly extinct.
Least tern	*Sterna antillarum*	Endangered	Unlikely. The study area is outside the species' known range, and no suitable habitat is present in the immediate permit area.
Osprey	*Pandion haliaetus*	Threatened	Possible. No suitable habitat is present in the immediate permit area; however, potentially suitable hunting or nesting habitat (Crow Creek) is within the 0.5-mile study area. The species may occur as a rare migrant.
Peregrine falcon	*Falco peregrinus*	Threatened	Possible. No suitable nesting habitat is in the immediate permit area; however, potentially suitable hunting habitat is within the 0.5-mile raptor nest survey buffer. The species may occur as a rare migrant.
Piping plover	*Charadrius melodus*	Threatened	Unlikely. No suitable habitat is present in the immediate permit area. The species may occur as a rare migrant.
Whooping crane	*Grus americana*	Endangered	Unlikely. Historic observations occur in Butte County; however, no suitable breeding or stopover habitat is present in the immediate permit area, and the study area is outside of the core migration corridor.
Mammals			
Black-footed ferret	*Mustela nigripes*	Endangered	Unlikely. No prairie dog colonies large enough to support this species exist near the immediate permit area. No species occurrences in the area have been documented.
Swift fox	*Vulpes velox*	Threatened	Likely. The study area is within species range and contains suitable mixed-grass prairie habitat. Documented in Butte County, but not documented in the permit area during baseline wildlife surveys.

Sources: Amphibians and Reptiles of South Dakota (2022); eBird (2022); SDGFP (2018, 2022a, 2022b).

3.2.2.1 SWIFT FOX

The swift fox (*Vulpes velox*) is found mainly in southwestern South Dakota, including Butte County (SDGFP 2018). This species has been reintroduced on the Bad River Ranch in central South Dakota approximately 192 miles southeast of the permit area, but no viable populations exist there. A native remnant population in Fall River County has mixed with reintroduced animals from Badlands National Park and Pine Ridge Reservation. Fall River County is approximately 90 miles south of the permit area, and Badlands National Park and Pine Ridge Reservation are approximately 135 miles southeast of the permit area. The swift fox inhabits open and gently rolling shortgrass or mixed-grass prairies with high visibility of the surrounding area. In South Dakota, this species can be found in the central and westernmost counties of the state with the exception of the Black Hills (SDGFP 2022b).

The study area is located within the known range for this species year-round and contains suitable habitat (SDGFP 2022b). However, no swift fox individuals or dens were observed during the baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.2.2 OSPREY

In South Dakota, osprey (*Pandion haliaetus*) nest in the Black Hills and on the Big Stone Power Plant property in the northeastern part of the state. Additionally, osprey have been reintroduced along the Missouri River, in Clay and Yankton Counties specifically. This species migrates along rivers and large wetlands and primarily inhabits lakes, rivers, and coastal bays (SDGFP 2022b).

The study area is within the known migratory range for the osprey; however, the nearest identified summer range for this species in South Dakota is in the Black Hills and the extreme northeastern corner of the state (SDGFP 2022b). Trees suitable for nesting are present along Crow Creek within the 0.5-mile study area. However, no trees suitable for nesting or large bodies of water that could serve as a potential prey base occur within the permit area. No osprey individuals or nests were observed during the baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.2.3 PEREGRINE FALCON

Peregrine falcons (*Falco peregrinus*) have a statewide migratory range but are uncommon during the winter months and historically have a very limited nesting distribution in western South Dakota. In South Dakota, a total of three reintroduction projects have taken place, with the most extensive one located in downtown Rapid City and occurring from 2011 to 2013 (SDGFP 2022b). This species primarily prefers to nest on cliff faces but has also been known to use anthropogenic structures as well as the abandoned nests of other bird species in areas lacking cliffs (Cornell Lab of Ornithology 2022).

The study area is within the known migratory range for the peregrine falcon; however, the nearest identified summer range for this species is located in the Black Hills (SDGFP 2022b). No peregrine falcon individuals, suitable cliff habitat, or nests were observed during the baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3 South Dakota Species of Greatest Conservation Need

The SWAP provides a list of 101 species of greatest conservation need in South Dakota (SDGFP 2014). SWCA reviewed the range and distribution of all species listed in the SWAP to determine the likelihood of their occurrence in the study area. Table 3 identifies the species of greatest conservation need that have a "Possible" or "Likely" potential to occur within the study area based on known ranges and preferred habitats. In addition to the identification of these species, Table 3 also provides their listing status (federal

and state) and rank (global and state). Definitions for global and state ranking classes are publicly available for review in Chapter 2 of the SWAP, Species of Greatest Conservation Need (SDGFP 2014).

Bird species that were determined as "Unlikely" to occur in the study area could pass through the area but would be unlikely to feed, nest, or rest there. Species that have potential to occur based on range and habitat associations are further discussed in the following sections.

Table 3. South Dakota Species of Greatest Conservation Need with "Possible" or "Likely" Potential to Occur in the Study Area, as Updated for the 2014 *South Dakota Wildlife Action Plan*

Common Name	Scientific Name	Federal Status	State Status	Global Rank	State Rank	Potential to Occur
Mammals						
Swift fox	*Vulpes velox*	–	T	G3	S1	Likely
Townsend's big-eared bat	*Corynorhinus townsendii*	–	–	G3G4	S2S3	Possible
Birds						
Baird's sparrow	*Ammodramus bairdii*	–	–	G4	S2B	Likely
Bald eagle	*Haliaeetus leucocephalus*	–	T	G5	S1B, S2N	Likely
Black tern	*Chlidonias niger*	–	–	G4	S3B	Possible
Burrowing owl	*Athene cunicularia*	–	–	G4	S3S4B	Possible
Chestnut-collared longspur	*Calcarius ornatus*	–	–	G5	S4B	Likely
Ferruginous hawk	*Buteo regalis*	–	–	G4	S4B	Likely
Greater prairie-chicken	*Tympanuchus cupido*	–	–	G4	S4	Possible
Greater sage-grouse	*Centrocercus urophasianus*	C	–	G3G4	S2	Likely
Lark bunting	*Calamospiza melanocorys*	–	–	G5	S5B	Likely
Long-billed curlew	*Numenius americanus*	–	–	G5	S3B	Known
Marbled godwit	*Limosa fedoa*	–	–	G5	S5B	Likely
Osprey	*Pandion haliaetus*	–	T	G5	S1B	Possible
Peregrine falcon	*Falco peregrinus*	–	T	G4	SXB	Possible
Sprague's pipit	*Anthus spragueii*	C	–	G4	S2B	Likely
Willet	*Tringa semipalmata*	–	–	G5	S5B	Possible
Wilson's phalarope	*Phalaropus tricolor*	–	–	G5	S4B	Possible
Amphibians and Reptiles						
Greater short-horned lizard	*Phrynosoma hernandesi*	–	–	G5	S2	Likely
Terrestrial Insects						
Iowa skipper	*Atrytone arogos iowa*	–	–	G3T3	S2	Possible
Ottoe skipper	*Hesperia ottoe*	–	–	G3G4	S2	Possible
Regal fritillary	*Speyeria idalia*	–	–	G3	S3	Possible

Sources: Amphibians and Reptiles of South Dakota (2022); eBird (2022); SDGFP (2014, 2022b).
Federal Status - C = Candidate for federal listing
State Status - T = Threatened

3.2.3.1 SWIFT FOX

See Section 3.2.2.1 of this report.

3.2.3.2 TOWNSEND'S BIG-EARED BAT

Primarily preferring caves (natural or human-made), rocky outcrops, and subterranean mines (abandoned or active) for roosting and hibernacula, the Townsend's big-eared bat (*Corynorhinus townsendii*) may use sagebrush-grasslands and riparian areas for foraging purposes. In South Dakota, this species only occurs in the westernmost edge of the state year-round (SDGFP 2022b).

The study area is within the known range for this species year-round and contains suitable foraging habitat (SDGFP 2022b). However, no caves, mines, or rocky outcrops that would provide suitable roosting or winter habitat are known to occur in the study area. No Townsend's big-eared bat were observed during baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.3 BAIRD'S SPARROW

The Baird's sparrow (*Ammodramus bairdii*) can be found breeding almost entirely within undisturbed mixed-grass or tallgrass prairies. Outside of breeding season, this sparrow has a secretive nature, and there is little known regarding their habitat preference the rest of the year. In winter, they are often seen in open grasslands with loosely dispersed shrubs (Cornell Lab of Ornithology 2022). In South Dakota, they prefer areas with low shrub cover and minimal woody vegetation within lightly grazed native grass ecosystems and wetland meadows (SDGFP 2022b).

The study area is within the primary summer range for the Baird's sparrow (SDGFP 2022b); however, potentially suitable habitat in the permit area exhibits evidence of heavy grazing rendering it unsuitable to marginally suitable at best for this species. No Baird's sparrow were observed during baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.4 BALD EAGLE

See Section 3.2.6 of this report.

3.2.3.5 BLACK TERN

Preferring to nest in wetlands associated with the edges of shallows lakes found in open prairies or forested habitats, black terns (*Chlidonias niger*) will typically select wetlands that are 50 acres or more before nesting (Cornell Lab of Ornithology 2022). In South Dakota, this species' range is statewide, except for the Black Hills, and they can be found occupying wetlands, rivers, lakeshores, and wet meadows that have a combination of open water and emergent vegetation (SDGFP 2022b).

The study area is within the primary summer range for the black tern (SDGFP 2022b). No wetlands or perennial waterbodies that would provide suitable habitat were identified in the permit area. A freshwater pond approximately 522 feet outside the permit area may provide suitable nesting habitat for this species; however, it is less than 50 acres. No black tern were observed during baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.6 BURROWING OWL

The burrowing owl (*Athene cunicularia*) prefers open habitats with gently sloping terrain and low, sparse vegetation. They are often found in association with high densities of burrowing animals such as tortoises,

prairie dogs, and other ground squirrels (Cornell Lab of Ornithology 2022). In South Dakota, this species' primary summer range is statewide, with the exception of the Black Hills and some eastern portions of the state (SDGFP 2022b).

The study area is within the primary summer range for this species (SDGFP 2022b). Four individuals of this species and a corresponding nest location were documented during the 2004–2007 surveys in Shear/Clarkson West (Township 10 North, Range 1 East, Section 33, NW ¼ NE ¼), which is 1.25 miles northwest of the Larsen Project permit area (Appendix B) (Jones & Stokes 2007). SWCA observed two occurrences of small mammal burrows within the northwest and central portion of the permit area (see Figure 4). These burrows may provide suitable nesting habitat for the burrowing owl; however, high densities of commonly associated species were not observed within the study area. Additionally, no burrowing owl were observed during the baseline wildlife surveys.

3.2.3.7 CHESTNUT-COLLARED LONGSPUR

Commonly found breeding in the shortgrass and mixed-grass prairies of the northern Great Plains, the chestnut-collared longspur (*Calcarius ornatus*) has an affinity for short statured grasses and can typically be found in areas where the grass is less than 1 foot in height. This species is most abundant in grasslands that have been recently grazed, and, to a reduced degree, in areas that have been burned or mowed. Migration for this species occurs across shortgrass prairie ecosystems, black-tailed prairie dog (*Cynomys ludovicianus*) towns, cropland, and fallowed fields (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that extends across most of the state, except for the Black Hills, and in select areas in the southern and southeastern part of the state in which only migratory sightings have occurred (SDGFP 2022b).

The study area is within the primary summer range for this species and contains suitable habitat (SDGFP 2022b). During the 2004–2007 surveys, this species was not observed in Shear/Clarkson, but it was recorded within 1 mile of Shear/Clarkson at least once during this time (Jones & Stokes 2007). No chestnut-collared longspur were observed during SWCA's 2022 baseline wildlife surveys.

3.2.3.8 FERRUGINOUS HAWK

Preferring open, rolling country with an ample prey base of small mammals, ferruginous hawks (*Buteo regalis*) breed in a variety of habitats such as grasslands, sagebrush steppes, alkaline shrublands, and edges of pinyon-juniper forests. They will often elect to breed and nest in habitats that contain features such as rocky outcrops, cliffs, buttes, cut banks, human-made structures, and shrubs or trees (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that extends across most of the state, with the exception of the southeastern portion of the state where they do not occur and the Black Hills where sightings have only been associated with migration (SDGFP 2022b).

The study area is within the primary summery range for this species and contains suitable habitat (SDGFP 2022b). During the 2004–2007 surveys, this species was observed in Shear/Clarkson West, which is 1.25 miles northwest of the Larsen Project permit area (Appendix B) (Jones & Stokes 2007). During the 2022 baseline wildlife surveys, SWCA did not observe any ferruginous hawk individuals or nests.

3.2.3.9 GREATER PRAIRIE CHICKEN

Prime habitat for the greater-prairie chicken (*Tympanuchus cupido*) consists of a combination of extensive prairie seasoned with small patches of oak woodland. Because of habitat fragmentation, however, this species mostly inhabits mixed-grass or tallgrass prairies with relatively sparse tree coverage and cropland interspersed throughout. Dense patches of brush provide protection from the elements and

predators and are a critical resource for this species when nesting (Cornell Lab of Ornithology 2022). With the exception of the Black Hills, in South Dakota, this species' primary range consists of the central to south-central region of the state. Extending out to the north, east, and west from the primary range, occurrence is reduced incrementally (SDGFP 2022b).

The study area is located within a region of the state where occurrence of the greater-prairie chicken is rare (SDGFP 2022b). Grasses within the permit area are short-statured, and areas with sagebrush scrub consist primarily of diffusely arrayed shrubs that are relatively small in size. Given this, suitable nesting and foraging habitat for this species is unsuitable to marginally suitable at best within the permit area. No greater prairie chicken were observed during baseline wildlife surveys or during the 2004–2007 surveys; however, it should be noted that this species was not specifically surveyed for in 2004–2007 (Jones & Stokes 2007).

3.2.3.10 GREATER SAGE-GROUSE

See Section 3.2.5 of this report.

3.2.3.11 LARK BUNTING

An endemic species to grasslands and shrub-steppes in North America, the lark bunting (*Calamospiza melanocorys*) can be found occupying large extents of native grassland vegetation, particularly areas where wheatgrass, blue grama, needle-and-thread (*Hesperostipa comata*), and big sagebrush are present and flourishing. When nesting, this species avoids bare ground, heavily grazed shortgrass habitats, prairie dog towns, and fields that have been burned. Instead, they prefer shortgrass habitats with vegetation of low to moderate stature and small shrubs or cacti that the birds can construct nests near the base of (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that extends across most of the state, with the exception of the southeastern portion of the state where they do not occur at all or occur sporadically (SDGFP 2022b).

The study area is within the primary summer range for this species and contains suitable habitat (SDGFP 2022b). During the 2004–2007 surveys, this species was recorded within 1 mile of Shear/Clarkson (Jones & Stokes 2007). During the 2022 baseline wildlife surveys, SWCA did not observe any lark bunting.

3.2.3.12 LONG-BILLED CURLEW

During the summer in western North America, the long-billed curlew (*Numenius americanus*) favors shortgrass prairies, mixed-grass prairies, and agricultural fields for nesting. This species can be observed in areas with taller and denser grasses after their young leave the nest. While migrating to their wintering grounds along the coastal regions of the United States and across Mexico, this species can be commonly found in prairies, alkali lakes, wet pastures, agricultural fields, and tidal mudflats (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that encompasses most of the western side of the state with the exception of the Black Hills (SDGFP 2022b).

The study area is within the primary summer range for this species and contains suitable habitat (SDGFP 2022b). During the 2004–2007 surveys, this species was recorded within 1 mile of Shear/Clarkson (Jones & Stokes 2007). During the 2022 baseline wildlife surveys, SWCA observed three long-billed curlew individuals flying over the permit area.

3.2.3.13 MARBLED GODWIT

Preferring to breed in native shortgrass prairie habitats that are intermixed with wetlands for foraging purposes, the marbled godwit (*Limosa fedoa*) tends to avoid areas with tall vegetation. Native grassland species the marbled godwit is commonly associated with include green needlegrass, western wheatgrass, blue grama, little bluestem, and needle-and-thread (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that extends across most of the state, with the exception the Black Hills where they do not occur and in the southeastern portion of the state where sightings have only been associated with migration (SDGFP 2022b).

The study area is within the primary summer range for this species and contains suitable habitat (SDGFP 2022b). Although no wetlands were identified within the permit area, a freshwater pond approximately 522 feet outside the permit area may have a wetland fringe. Although not officially delineated due to its location, the potential presence of a wetland fringe could provide suitable foraging habitat for this species and increase the subsequent suitability of the surrounding mixed-grass prairie, which contains some commonly associated cool- and warm-season grass species. No marbled godwit were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.14 OSPREY

See Section 3.2.2.2 of this report.

3.2.3.15 PEREGRINE FALCON

See Section 3.2.2.3 of this report

3.2.3.16 SPRAGUE'S PIPIT

Preferring to breed primarily in mixed-grass prairies where native vegetation is no more than 6 to 12 inches tall, the Sprague's pipit (*Anthus spragueii*) is an endemic nester to the northern Great Plains. They are tolerant of some grazing but will not nest in overgrazed areas, cropland, or nonnative grasslands. Ideal nesting habitat consists of scattered shrubs with minimally exposed bare ground. Associate plant species include various species of wheatgrass, blue grama, prairie junegrass (*Koeleria macrantha*), foxtail barley (*Hordeum jubatum*), threadleaf sedge (*Carex filifolia*), and many other native grass species (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that comprises the northwestern corner and north-central portion of the state. This species does not occur in the Black Hills or across most of the eastern side of the state, with its presence in the southeastern and south-central consisting of migratory sightings only (SDGFP 2022b).

The study area is within the primary summer range for this species (SDGFP 2022b). Although some commonly associated plant species are present, the presence of nonnative plant species and existing evidence of a heavy livestock grazing pressure have depreciated the quality of suitable habitat within the permit area. No Sprague's pipit were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.17 WILLET

The willet (*Tringa semipalmata*) is a large shorebird with two subpopulations that have distinct nesting preferences: the eastern willet and the western willet. During the breeding season, the western willet prefers habitats near fresh water and occurs far inland nesting near marshes, prairie pothole ponds, wet fields, wetlands, and grasslands and/or sagebrush shrublands near ponds. The eastern willet prefers to

breed in saltmarshes, barrier beaches, and barrier islands (Cornell Lab of Ornithology 2022). In South Dakota, this species prefers shallow water with short-statured shoreline vegetation and will nest on the ground in short grasses or areas lacking in vegetation entirely. This species has a primary summer range that extends across most of the state, with the exception the Black Hills where they do not occur and in the southeastern portion of the state where sightings have only been associated with migration (SDGFP 2022b).

The study area is within the primary summer range for this species (SDGFP 2022b). Although no wetlands, perennial waterbodies, or other suitable freshwater habitats were identified within the permit area, there is a freshwater pond approximately 522 feet outside the permit area. This pond is near grasslands and sagebrush shrublands, including those within the permit area, that may provide suitable nesting and foraging habitat for this species. No willet were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.18 WILSON'S PHALAROPE

During breeding season, the Wilson's phalarope (*Phalaropus tricolor*) favors wetlands, marshes, and roadside ditches that are adjacent to upland grassland and/or shrubland. During migration, individuals will use stopover habitat that consists of coastal marshes, sewage ponds, and most especially, saline lakes in western North America (Cornell Lab of Ornithology 2022). In South Dakota, this species has a primary summer range that extends across most of the state, with the exception the Black Hills where they do not occur and in the far southeastern portion of the state where sightings have only been associated with migration (SDGFP 2022b).

The study area is within the primary summer range for this species (SDGFP 2022b). Although no wetlands or roadside ditches were identified within the permit area, a freshwater pond IS approximately 522 feet outside the permit area. Although not officially delineated due to its location, the pond is likely to have a wetland fringed and is adjacent to upland grassland and shrubland ecosystems. Given these conditions, the possible wetland fringe may provide suitable habitat for this species. However, the project is not expected to impact this freshwater pond or any potentially associated wetlands. No Wilson's phalarope were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.19 GREATER SHORT-HORNED LIZARD

The greater short-horned lizard (*Phrynosoma hernandesi*) is a small ground-dwelling lizard that can be found in numerous habitats such as shortgrass prairies, sagebrush shrublands, and open forests. Because loose soils are considered necessary for thermoregulation, this species typically prefers areas that are rocky or sandy with sparse vegetation over areas with dense vegetation (Amphibians and Reptiles of South Dakota 2022). In South Dakota, this species can be found year-round in the northwestern and southwestern corners of the state (SDGFP 2022b).

The study area is within the known range for this species year-round (SDGFP 2022b). However, the permit area is dominated by clay soils, not loose soils with sandy characteristics. Given this, suitable habitat for this species in the permit area is not present. No greater short-horned lizard were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.3.20 IOWA SKIPPER

The Iowa skipper (*Artyrtone arogos iowa*) is a small yellow-orange butterfly with black wing margins that can be found in undisturbed short- to tall-statured native grasslands. This species breeds from late

June to late July and prefers to lay its eggs under the leaves of hostplants such as big bluestem, little bluestem, and sideoats grama. In South Dakota, this species has a distribution of local and uncommon to rare and can be found year-round in select counties across the state (SDGFP 2022b).

The study area is not located within the known range for this species but is peripheral to two counties (Lawrence and Meade) in which it is known to occur year-round (SDGFP 2022b). The permit area is subject to livestock grazing, and there is a small portion of surface area that has been historically disturbed and reclaimed. Given these conditions and that the Iowa skipper expresses a preference for undisturbed grasslands, potential habitat within the permit area is unsuitable. No Iowa skipper were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys(Jones & Stokes 2007); however, it should be noted that this species was not specifically surveyed for in 2004–2007.

3.2.3.21 OTTOE SKIPPER

The Ottoe skipper (*Hesperia ottoe*) is a small butterfly with bright orange presenting on the upper sides of its wings and a pale orange underside of the hindwings. Males have forewings with narrow black margins and stigma, and females have bright wing margins, with their forewings accented by yellow and white spots. This species breeds from mid-June to August, peaking in mid-July, and favors relatively undisturbed mixed-grass to tall-grass prairies with plentiful sources of nectar and native prairie grasses to act as larval host plants. In South Dakota, this species has a distribution of local and generally uncommon to rare and can be found year-round in select counties across the state, a majority of those being in the western half of the state (SDGFP 2022b).

The study area is not located within the known range for this species but is peripheral to three counties (Harding, Lawrence, and Perkins) in which it is known to occur year-round (SDGFP 2022b). The permit area is subject to livestock grazing, and there is a small portion of surface area that has been historically disturbed and reclaimed. Given these conditions and that the Ottoe skipper expresses a preference for undisturbed grasslands, potential habitat within the permit area is unsuitable. No Ottoe skipper were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007); however, it should be noted that this species was not specifically surveyed for in 2004–2007.

3.2.3.22 REGAL FRITILLARY

The regal fritillary (*Argynnis idalia*) is a large butterfly with orange and black coloration that can sometimes cause it to become conflated with the monarch butterfly. This species breeds from June 12 to mid-September and favors undisturbed native mixed-grass to tall-grass prairie sites that are near marshes and contain species of violets to serve as larval host plants. In South Dakota, this species has an overall distribution that is declining and restricted to areas where native grasslands are still intact. However, it can be found year-round across the entire state (with the exception of three counties) and is most common in northeastern South Dakota (SDGFP 2022b).

The study area is within the known range for this species year-round (SDGFP 2022b). Although no marshes or wetlands were identified in the permit area, there is a freshwater pond approximately 522 feet outside the permit area. Although not officially delineated due to its location, the pond is likely to have a wetland fringe that may increase the possibility of this species using the surrounding mixed-grass prairie, including that which is within the permit area. However, although the vegetation species surrounding the nearby freshwater pond are not known, no violet species were observed during vegetation sampling in the permit area, and these forbs serve as larval host plants for this species (SDGFP 2022b). In addition, the permit area is subject to livestock grazing, and there is a small portion of surface area that has been historically disturbed and reclaimed. Given these conditions and that the regal fritillary expresses a preference for undisturbed grasslands, potential habitat in the permit area is unsuitable. No regal fritillary

were observed during the 2022 baseline wildlife surveys or during the 2004–2007 surveys (Jones & Stokes 2007); however, it should be noted that this species was not specifically surveyed for in 2004–2007.

3.2.4 South Dakota Natural Heritage Program Special-Status Species

A South Dakota Natural Heritage Program's Environmental Review Report is generated by request and provides information regarding sensitive species records originating from the South Dakota Natural Heritage Database. This database tracks rare species as well as certain biological communities and habitats that are at risk in the state of South Dakota. If a proposed project overlaps an area within the known range or within proximity to database records for special-status species, the environmental review report will indicate that potential project impacts should be assessed for that species. The environmental review report generated for the project indicates that the permit area is within the known range of one special-status species, the golden eagle. The South Dakota Natural Heritage Database indicates that this species has been documented within 1 mile of the permit area (SDGFP 2022c). The golden eagle is further discussed in Section 3.2.6.

3.2.5 Greater Sage-Grouse

The greater sage-grouse is the largest grouse in North America and is listed as a species of greatest conservation need in the SWAP. They are considered sagebrush obligate "landscape species," which means they need large, connected expanses of sagebrush steppe habitat for populations to persist. Sage-grouse populations range-wide have steadily declined due to contributing factors such as the loss or degradation of sagebrush, improper livestock grazing, fire, invasive plant species, over hunting, anthropogenic encroachment, West Nile virus (WNV), and oil and gas development (Knick and Connelly 2011). In the state of South Dakota, sage-grouse primarily inhabit portions of Butte and Harding. However, at one time, sage-grouse populated the western third of the state outside the Black Hills (SDGFP 2021).

Sage-grouse in South Dakota are at the eastern edge of the overall sage-grouse and sagebrush distribution, a natural transition zone between sagebrush and grassland species. Sagebrush communities in South Dakota are unique in that they are short in stature and possess a lower percent canopy cover than anywhere else throughout the sage-grouse's range (Parsons 2019). Although greater sage-grouse rely on sagebrush to survive, especially in the winter months, the Parsons (2019) study found that sagebrush suitability could not be differentiated based on height or canopy cover with the data that are currently available. Instead, to infer suitability, Parsons looked at a number of variables at the local and landscape scale that were biologically relevant to sage-grouse nest and brood-rearing habitat selection (Parsons 2019).

Nest success has been determined to be the primary driver of sage-grouse population dynamics, thereby making nest site selection a particularly important area of interest. Predation has been the leading cause of nest failure and may be driving nest-site selection as a result. It has been shown that sage-grouse will select nest sites that provide greater visual cover to potentially help mitigate this issue (Parsons 2019). The Parsons (2019) study observed a trend in which sage-grouse were preferentially selecting for vegetative characteristics at a small scale (within 16 feet of nest). In particular, sage-grouse were displaying a preference for taller shrubs, taller maximum grass height, and an increased percent shrub cover, while avoiding areas with high grass cover and high annual grass cover (Parsons 2019).

Nest survival was shown to increase alongside increasing percent undisturbed (unplowed) land with increased road density and with proximity to forests. This is likely because heterogeneous habitat patches

characteristic of undisturbed land often result in a less efficient search effort by predators, roads potentially displace many predators, and areas near forests may possess a changing predator community as the landscape transitions. Nest survival displayed an overall decrease near leks, which might be explained in that the aspects that create an optimal lek may also create an optimal opportunity for certain nest predators. Local-scale vegetation components did not impact nest survival (Parsons 2019).

The Parsons (2019) study set out to determine habitat selection preferences of brood-rearing females by looking at data at two scales: local (within 164 feet) and landscape (148–21,129 feet). At a local scale, variables of interest included vegetative visual obstruction readings, grass height, canopy cover estimates, sagebrush density, and arthropod communities by order. At a landscape scale, variables of interest included sagebrush, forest, water, roads, ruggedness, active oil and gas wells, and unplowed land. Locally, brooding hens displayed a preference for higher numbers of Coleopterans (beetles) and "other" arthropods (not including Hymenopterans and Orthopterans). In addition, hens seemed to select areas with a greater percentage of sagebrush cover and taller grass, while avoiding areas with high grass and litter cover. On a landscape scale, brooding hens displayed preferential selection for areas near water and avoided areas near forests and roads, with undisturbed lands yielding mixed responses (Parsons 2019).

In addition to looking at nesting and brood-rearing dynamics, the Parsons (2019) study also set out to define priority management areas for greater sage-grouse in South Dakota based on a number of variables. Variables of interest included lek locations, sagebrush, forest, water, roads, ruggedness, and unplowed land. During spring and summer, it was discovered that sage-grouse were selecting for areas in proximity to active leks (≥ 1 male observed displaying), water, and sagebrush and were avoiding forested areas, roads (~2 miles), and rugged terrain. In winter, sage-grouse primarily selected for areas near sagebrush and avoided areas with high road densities (1,850 feet) and rugged terrain. These positively correlated selection behaviors can be partially explained by changing dietary needs during different times of the year. In the winter, sage-grouse exclusively consume sagebrush, whereas in the spring and summer, female sage-grouse consume forbs and arthropods in addition to sagebrush. The avoidance of roads by sage-grouse may be attributed to noise, risk of vehicle collision, proximity to infrastructure that provides suitable raptor perches, and/or the likelihood that roads serve as corridors for cursorial predators; although, the avoidance of forested areas and rugged terrain is consistent with research conducted outside of South Dakota through multiple seasons and life stages (Parsons 2019).

SWCA completed opportunistic field surveys within the study area for greater sage-grouse individuals and sign during the nesting, brooding, and winter seasons. All surveys outside of lek surveys were conducted in conjunction with other scheduled survey activities. BPM personnel conducted protocol-level lek surveys for greater sage-grouse between late March and early May with approval from SDGFP. Three observation points were established for these lek surveys. Two points were established within the permit area itself, and one was established southwest of the permit area across U.S. Highway 212 to monitor Middle Creek lek activity, which is the closest known lek to the permit area (see Figure 3).

Efforts to document incidental sage-grouse use were conducted in conjunction with other project surveys. To coincide with the sage-grouse nesting season, SWCA evaluated incidental greater sage-grouse use during the baseline wildlife surveys on April 18, May 21, and June 9, 2022. Two additional surveys occurred in mid-July in tandem with the vegetation sampling to document incidental bird use during the brood-rearing season. In winter 2023, surveys were conducted in conjunction with the bald eagle winter roost survey effort on January 6, February 1, and March 2 to assess potential use of applicable greater sage-grouse winter concentration areas. Surveyors used binoculars from high vantage points to scan suitable habitat for individuals and walked meandering transects within areas identified as suitable habitat. Surveyors were instructed that any and all observations of sage-grouse individuals or sage-grouse sign (e.g., scat, cecal tar, feathers, nesting signs) were to be documented and recorded.

During previous lek surveys conducted by Jones & Stokes and/or the Northern Hills Bird Club from 1998 through April 2007, one to 10 male sage-grouse individuals were recorded displaying and flushing within 1 mile of Shear/Clarkson East at the known lek location in Section 10 (Middle Creek lek) (see Appendix B). However, no sage-grouse individuals were ever observed in Shear/Clarkson during this time (Jones & Stokes 2007). Across all survey efforts conducted by BPM and SWCA in 2022 and 2023, no sage-grouse individuals were observed in the study area or at the Middle Creek lek location. Middle Creek lek surveys conducted by SDGFP confirm the last known lek attendance was in 2020 and BLM surveys show the last known attendance in 2018. Additionally, no evidence of sage-grouse use or sign was detected. Although the study area is within South Dakota's sage-grouse core area, the permit area is unlikely to be favored by sage-grouse individuals for nesting, brooding, or winter use.

In terms of nesting potential, the permit area contains short-statured sagebrush on average (see Tables 14 and 15 in Section 3.3.4), which is not compensated for by favorable tall-statured grasses because grasses have been heavily grazed. In addition, sage-grouse tend to avoid areas with high grass cover, and both the mixed-grass prairie and big sagebrush shrubland habitat types within the permit area yield grass cover as their highest percent canopy cover category on average (see Tables 12 and 13 in Section 3.3.3). Given this, it is unlikely that hens will use the permit area for nesting purposes. Brooding potential is low because hens in South Dakota will typically select areas near water that have a greater percentage of sagebrush cover and taller grasses, none of which are well represented in the permit area (see Figure 2; see Tables 12 and 13 in Section 3.3.3). Additionally, the permit area is less than 0.5 mile from U.S. Highway 212 and a powerline running parallel on the north side of Highway 212, brood-rearing hens are known to actively avoid using areas near roads and powerlines. In the winter, sage-grouse select areas near sagebrush because it is their main source of food at that time. There is some potential for sage-grouse use within the permit area in the winter; however, given the overall lack of sagebrush height (and therefore potential to be a plentiful resource above the snow's surface) and given the reduced sagebrush cover in relation to other recorded growth forms (grasses, forbs, etc.), that potential is low overall. This assumption is further bolstered by the overall lack in detectable evidence of sage-grouse use and presence across all survey efforts in 2022 and 2023 and during the 2004–2007 surveys (Jones & Stokes 2007).

3.2.5.1 GREATER SAGE-GROUSE MITIGATION MEASURES

To mitigate possible impacts to sage-grouse due to mining activities, the following mitigation measures will be incorporated into the mine and reclamation plan.

- Areas mapped as big sagebrush shrubland (Figure 5) will generally be avoided by future mining activity.
- No new surface disturbance will take place between March 15 to July 15.
- New and existing fences within the permit boundary will be marked to reduce potential sage-grouse collisions.
- Water tanks ladders will be installed in tanks within the permit boundary. BPM will work with the landowner and provide ladders for other stock tanks near the permit boundary.
- A weed monitoring plan will be initiated to control noxious weeds.
- Areas disturbed by mining activity will be reseeded with an approved DANR native grass seed mix. Sagebrush will also be seeded opportunistically in areas with the best chance of success.

3.2.6 Bald and Golden Eagles

Bald eagles traditionally nest near rivers, reservoirs, marshes, and large lakes where there is an adequate food supply and good areas to perch. They typically nest in large trees but also nest on cliffs and the ground, and with the spread of human development, they occasionally nest on artificial structures such as communication towers (USFWS 2022h). In South Dakota, the bald eagle has a primary summer range across most of the state, with the exception of the Black Hills and counties adjacent to and intersected by the Missouri River, in which it can be found year-round.

Golden eagles prefer habitat characterized by open grasslands, woodland brushlands, forested areas, and even arid deserts. Usually, golden eagles will establish their nests in cliff faces, or in the largest tree of a forest stand that provides an unhindered viewshed of the surrounding area (USFWS 2011). The golden eagle's known range in the state of South Dakota is bisected by the Missouri River. The primary winter range for this species is east of the Missouri River, but it can be found year-round in the portion of the state west of the Missouri River (SDGFP 2022b).

From within the permit area, SWCA biologists conducted a ground-based 0.5-mile line-of-sight survey for individual eagle species and eagle nests. From high vantage points, biologists used binoculars and/or spotting scopes to survey ridgetops, vertical exposures, large trees, and small shrubs for eagle nests. Biologists were instructed to document the presence or absence of eagle nest locations within the study area by noting species, activity status (when possible), and nest condition, and by recording the locations using a global positioning system (GPS) unit. Nests more than 0.5 mile from the permit area were not surveyed.

The study area is within the primary summer range for the bald eagle and within the known range for the golden eagle year-round (SDGFP 2022b). During the 2004–2007 surveys, golden eagles were documented in and within 1 mile of Shear/Clarkson East and West (see Appendix B). In addition, although bald eagle individuals were not observed in Shear/Clarkson East and West, they were recorded within 1 mile of Shear/Clarkson East and West (see Appendix B) (Jones & Stokes 2007). Large deciduous trees primarily associated with Crow Creek to the northeast, ground/hillsides, and human-made structures were identified within 0.5 mile of the permit area; these all could provide suitable nesting substrate for eagles (see Figure 4). No potentially suitable nesting habitat was identified in the permit area. During surveys conducted in 2022 and 2023, SWCA did not observe any eagles or eagle nests in the study area.

3.2.6.1 BALD EAGLE WINTER ROOST SURVEYS

Ground-based bald eagle winter roost surveys were conducted once per month from January through March 2023. Surveys occurred on January 6, February 1 and March 2, and were conducted in the morning from 0.5 hour before local sunrise to one hour after local sunrise, or in the evening from one hour before local sunset to 0.5 hour after local sunset. A qualified SWCA biologist conducted these surveys from high vantage points within the permit area and used binoculars to scan for and target stands of old growth trees within the study area to confirm the presence or absence of roosting bald eagles. SWCA's biologist recorded all incidental bald eagle observations if they occurred, including those made during other wildlife surveys.

No bald eagle roosts were detected within the study area during eagle winter roost surveys. However, potential habitat that could be used by roosting eagles was observed within the study area, primarily to the southwest, north, and northeast of the permit area associated with Crow Creek (see Figure 4).

3.2.7 Non-Eagle Raptors

Non-eagle raptor species nest in a variety of substrates, including ground/hillsides, trees, rock outcrops, cliff faces, and human-made structures. From within the permit area, SWCA biologists conducted a ground-based 0.5-mile line-of-sight survey for individual non-eagle raptors, nests, and nesting habitat (bald and golden eagles are discussed in Section 3.2.5 Bald and Golden Eagles). From high vantage points, biologists used binoculars and/or spotting scopes to survey ridgetops, vertical exposures, large trees, and small shrubs for raptor nests. Biologists were instructed to document the presence or absence of raptor nest locations in the study area by noting species, activity status (when possible), nest condition, and by recording the locations using a GPS unit. SWCA conducted raptor surveys once per month from April through June, with surveys occurring on April 18, May 21, and June 9, 2022. These raptor surveys were conducted in tandem with the baseline wildlife survey. SWCA's biologists recorded all incidental raptor observations, including those made during other scheduled survey activities.

During the 2004–2007 surveys, American kestrel (*Falco sparverius*) and prairie falcon (*Falco mexicanus*) were documented in or within 1 mile of Shear/Clarkson East and West (see Appendix B) (American kestrel in Shear/Clarkson East and West and prairie falcon in Shear/Clarkson East). Ferruginous hawks were observed in Shear/Clarkson West, whereas great horned owl (*Bubo virginianus*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), and turkey vulture (*Cathartes aura*) individuals were documented within 1 mile of Shear/Clarkson East (see Appendix B). Although nesting burrowing owls were observed within a prairie dog colony in Shear/Clarkson West, the Larsen Project permit area is located in Shear/Clarkson East where no historical observations of this species were documented (see Appendix B) (Jones & Stokes 2007).

Raptor species that were observed in the study area during all wildlife surveys included two turkey vultures and one red-tailed hawk. Previously documented non-eagle raptor nests by Jones & Stokes are no longer present (see Appendix B). No new active or inactive raptor nests were observed in the study area during the baseline wildlife survey. However suitable nesting habitat was observed, primarily northeast of the permit area in the form of large deciduous trees associated with Crow Creek (see Figure 4). In addition, ground/hillsides, creek banks, and human-made structures within the study area could also provide suitable nesting substrate for non-eagle raptors. Outside of suitable nesting habitat, the entire study area could be used by foraging raptors, including the regular status raptor species listed in Table 4.

Table 4. Regular Status Raptor Species in South Dakota

Common Name	Scientific Name
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Barn owl	*Tyto alba*
Barred owl	*Strix varia*
Broad-winged hawk	*Buteo platypterus*
Burrowing owl	*Athene cunicularia*
Cooper's hawk	*Accipiter cooperii*
Eastern screech-owl	*Megascops asio*
Ferruginous hawk	*Buteo regalis*
Golden eagle	*Aquila chrysaetos*
Great horned owl	*Bubo virginianus*

Common Name	Scientific Name
Gyrfalcon	*Falco rusticolus*
Long-eared owl	*Asio otus*
Merlin	*Falco columbarius*
Northern goshawk	*Accipiter gentilis*
Northern harrier	*Circus cyaneus*
Northern saw-whet owl	*Aegolius acadicus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Sharp-shinned hawk	*Accipiter striatus*
Short-eared owl	*Asio flammeus*
Snowy owl	*Bubo scandiacus*
Swainson's hawk	*Buteo swainsoni*
Turkey vulture	*Cathartes aura*

Source: SDGFP (2022b).

3.2.8 Breeding Bird Surveys

Consultation with the SDGFP determined that it was not necessary for BPM to conduct breeding bird surveys and that the use of Jones & Stokes's data would suffice for the baseline wildlife surveys. The following is an overview of Jones & Stokes's methodology and results for habitat types relevant to the Larsen Project permit area.

In early June 2007, Jones & Stokes conducted breeding bird surveys using belt transects in four habitat types: shrubland, mixed-grass prairie, rough breaks, and prairie dog colony. Discussion of habitat types that are irrelevant to the Larsen Project (rough breaks and prairie dog colony) have been omitted for the purposes of this report. The number of transects in each habitat was determined by its availability and scope: mixed-grass prairie had two transects and shrubland had one. Transects were 328.1 feet wide × 3,280.8 feet long and were surveyed by walking slowly down the center of each line. Every 164.0 feet the surveyor would stop to watch and listen for bird species, primarily passerines. Breeding bird individuals that were observed while the surveyor was walking were also noted, and efforts were made to avoid counting them twice. Transects were surveyed the mornings of June 1 through June 3, 2007, and surveys were initiated in a different habitat type each morning to reduce bias. Surveys lasted 3 hours and began between dawn and sunrise. Weather conditions were favorable across all survey dates. Incidental observations included flyovers and birds seen and heard beyond transect boundaries, and these were not included in Jones & Stokes's analysis (Jones & Stokes 2007).

Eight bird species were counted during Jones & Stokes's belt transect surveys across the shrubland and mixed-grass prairie habitat types, and an additional five species were recorded as flyovers (Table 5). The horned lark (*Eremophila alpestris*) and the western meadowlark (*Sturnella neglecta*) were the two most common species observed during these surveys (see Table 5) (Jones & Stokes 2007).

Table 5. American Colloid Company Breeding Bird Survey Results

Common Name	Scientific Name	Average Numbers of Birds per Habitat Type	
		Shrublands	Mixed-Grass Prairie
Horned lark	*Eremophila alpestris*	10.0	9.8
Western meadowlark	*Sturnella neglecta*	7.3	7.3
Vesper sparrow	*Pooecetes gramineus*	4.0	1.3
Grasshopper sparrow	*Ammodramus savannarum*	–	4.3
Killdeer	*Charadrius vociferus*	0.3	0.7
Upland sandpiper	*Bartramia longicauda*	–	0.5
Brewer's blackbird	*Euphagus cyanocephalus*	–	–
Lark bunting	*Calamospiza melanocorys*	1.0	–
American kestrel	*Falco sparverius*	0.3	–
Brown-headed cowbird	*Molothrus ater*	IF	–
European starling	*Sturnus vulgaris*	–	IF
Red-winged blackbird	*Agelaius phoeniceus*	–	IF
American robin	*Turdus migratorius*	–	IF
Northern harrier	*Circus hudsonius*	–	IF
Mourning dove	*Zenaida macroura*	–	–
Prairie falcon	*Falco mexicanus*	–	–
Northern mockingbird	*Mimus polyglottos*	–	–
Average Number of Birds per Transect		23.0	24.0
Birds per Meter		0.023	0.024
Total Species		6	6

Source: Jones & Stokes (2007).
IF = Incidental flyover, not counted in totals.

3.2.9 Other Species Considered

No systematic surveys were conducted for upland game bird species, small mammals, reptiles and amphibians, fish, waterfowl, shorebirds, or big game. Incidental observations of all wildlife species, including these other species concern, were recorded during all scheduled site visits regardless of overall survey objectives during a given visit. Additionally, SWCA used the results of the desktop analysis to identify habitats within the study area that may harbor species of concern; those habitats were visited during the wildlife surveys to determine suitability and to increase the likelihood of species observations.

3.2.9.1 UPLAND GAME BIRDS

Nine upland game birds are known to occur in South Dakota (Table 6). During the 2004–2007 surveys, American crow (*Corvus brachyrhynchos*) were documented in and within 1 mile of Shear/Clarkson (East or West not specified) (see Appendix B). During surveys conducted from 1998 to April 2007 by Jones & Stokes or the Northern Hills Bird Club, one to ten male greater sage-grouse individuals were recorded displaying and flushing within 1 mile of the permit area at the known lek location in Section 10 (Middle Creek lek). However, no sage-grouse individuals were ever observed in Shear/Clarkson East or West during this time (see Appendix B) (Jones & Stokes 2007). The study area falls within the designated core

area for greater sage-grouse in the state of South Dakota (SDGFP 2023a). This species and its potential to occur are discussed in greater detail in Section 3.2.4. of this report.

Habitat and range potential for upland game bird species is further discussed in Table 6. None of these species were observed during baseline wildlife surveys; however, with the exception of those conducted for the greater sage-grouse, no systematic surveys were conducted.

Table 6. Upland Game Birds in South Dakota

Common Name	Scientific Name	Habitat and Range Potential
American crow	*Corvus brachyrhynchos*	Suitable habitat for this species is present in the permit area.
Chukar partridge	*Alectoris chukar*	No wild populations of this species are known to occur in South Dakota. Suitable habitat may be present within the permit area.
Gray partridge	*Perdix perdix*	Suitable habitat for this species is present in the permit area.
Greater prairie chicken	*Tympanuchus cupido*	Occurrence is rare in Butte County. See Section 3.3.3.9 of this report.
Greater sage-grouse	*Centrocercus urophasianus*	See Section 3.3.4
Northern bobwhite	*Colinus virginianus*	This species' range occurs outside the study area in the southeastern portion of the state.
Ring-necked pheasant	*Phasianus colchicus*	Occurrence is few to locally common in Butte County. Suitable habitat may be present in the permit area.
Ruffed grouse	*Bonasa umbellus*	This species occurs in the northern Black Hills where aspen is present. No suitable habitat is present within the permit area.
Sharp-tailed grouse	*Tympanuchus phasianellus*	The study area is within this species primary range. Suitable summer foraging habitat is present within the permit area.

Sources: SDGFP (2022b, 2023b); ebird (2022); Cornell Lab of Ornithology (2022).

3.2.9.2 WATERFOWL AND SHOREBIRDS

During the 2004–2007 surveys, killdeer (*Charadrius vociferus*) and upland sandpiper (*Bartramia longicauda*) were documented in and within 1 mile of Shear/Clarkson. Although Canada goose (*Branta canadensis*), great blue heron (*Ardea Herodias*), black-crowned night heron (*Nycticorax nycticorax*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), American wigeon (*Mareca americana*), redhead (*Aythya americana*), common merganser (*Mergus merganser*), sandhill crane (*Antigone canadensis*), and long-billed curlew were recorded within 1 mile of Shear/Clarkson (see Appendix B). Permit areas (East or West) were only specified by Jones & Stokes for rare, threatened, and endangered species tracked by the South Dakota Natural Heritage Program and SDGFP during this time (Jones & Stokes 2007).

The study area is within the known ranges and contains suitable habitat for certain individuals belonging to this species group (SDGFP 2022b). Additionally, although no wetlands or perennial waterbodies were identified within the permit area, there is a freshwater pond approximately 522 feet outside the permit area that may provide suitable habitat for waterfowl and/or shorebird species. Waterfowl and shorebird species observed in the permit area during baseline wildlife surveys included one upland sandpiper (*Bartramia longicauda*), one ring-billed gull (*Larus delawarenis*), and three long-billed curlews; however, no systematic surveys were conducted.

3.2.9.3 SMALL MAMMALS

During the 2004–2007 surveys, white-tailed jackrabbit (*Lepus townsendii*), cottontail species (*Sylvilagus* ssp.), thirteen-line ground squirrel (*Ictidomys tridecemlineatus*), and northern pocket gopher (*Thomomys talpoides*) were documented in and within 1 mile of Shear/Clarkson. Eastern deer mouse (*Peromyscus maniculatus*) and northern grasshopper mouse (*Onychomys leucogaster*) were observed in Shear/Clarkson, whereas porcupine (*Erethizon dorsatum*), racoon (*Procyon lotor*), and beaver (*Castor canadensis*) were recorded within 1 mile of Shear/Clarkson. Shear/Clarkson East or West are not specified for these species. Black-tailed prairie dogs (*Cynomys ludovicianus*) were observed within a prairie dog colony located in Shear/Clarkson West, which is 1.25 miles northwest of the Larsen Project permit area (see Appendix B) (Jones & Stokes 2007).

The study area is within the known ranges and contains suitable habitat for certain individuals belonging to this species group (SDGFP 2022b). SWCA observed two occurrences of burrows, likely belonging to some kind of small ground dwelling mammal, within the northwest and central portion of the permit area. It was unclear at the time of survey if these burrows were actively being used. No small mammals were observed in the study area during baseline wildlife surveys; however, no systematic surveys were conducted.

3.2.9.4 BIG GAME

Nine big game species are known to occur in South Dakota (Table 7). During the 2004–2007 surveys, pronghorn (*Antilocapra americana*) were documented in and within 1 mile of Shear/Clarkson East and West (see Appendix B). Mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) were recorded within 1 mile of Shear/Clarkson East and West (see Appendix B) (Jones & Stokes 2007).

The study area is within the known range for five big game species. These species include pronghorn, mule deer, white-tailed deer, elk (*Cervus canadensis*), and wild turkeys (*Meleagris gallopavo*) (SDGFP 2022b, 2023c). Habitat and range potential for all big game species is further discussed in Table 7. Pronghorn was the only big game species observed in the study area during the 2022 baseline wildlife surveys (see Table 3); however, no systematic surveys were conducted. At this time, the SDGFP has not outlined critical big game winter ranges for Butte County (personal communication, Stan Michals, December 16, 2022).

Table 7. Big Game Species in South Dakota

Common Name	Scientific Name	Habitat and Range Potential
American bison, trophy/non-trophy	*Bison bison*	The study area is outside of this species' known range: Custer State Park, Wind Cave and Badlands National Parks, Samuel H. Ordway Jr. Memorial Preserve, and tribal lands. Although suitable habitat may be present in the study area, no free-ranging bison herds occur in South Dakota.
Bighorn sheep	*Ovis canadensis*	The study area is not within this species' known range and does not contain suitable habitat.
Elk	*Cervus canadensis*	The elk core population occurs in higher elevations of the Black Hills; however, Butte County prairie landscapes in and surrounding the study area hold limited herds of elk.
Mountain goat	*Oreamnos americanus*	The study area is not within this species' known range and does not contain suitable habitat.
Mountain lion	*Puma concolor*	The study area is within this species' known range year-round but does not contain suitable habitat.

Common Name	Scientific Name	Habitat and Range Potential
Mule deer	*Odocoileus hemionus*	The study area is within this species' primary range and contains suitable habitat.
Pronghorn	*Antilocapra americana*	The study area is within this species' primary range and contains suitable habitat.
White-tailed deer	*Odocoileus virginianus*	The study area is within this species' known range where occurrences are fair to locally good and contains suitable habitat.
Wild turkey	*Meleagris gallpavo*	The study area is within this species' known range where occurrences are few to locally fair. However, suitable habitat is not present for this species.

Sources: SDGFP (2022b, 2023c, 2023d, 2023e, 2023f).

3.2.9.5 REPTILES AND AMPHIBIANS

Ten reptile and amphibian species are known to occur in Butte County (Table 8). During the 2004–2007 surveys, boreal chorus frog (*Pseudacris maculata*), northern leopard frog (*Rana pipiens*), painted turtle (*Chrysemys picta*), and plains gartersnake (*Thamnophis radix*) were recorded occurring within 1 mile of Shear/Clarkson (East or West not specified). However, no reptile or amphibian species were documented in Shear/Clarkson (Jones & Stokes 2007).

The study area is within the known range of species listed in Table 8, and suitable habitat for some of these species is present. No reptiles or amphibians were observed in the study area during the 2022 baseline wildlife surveys; however, no systematic surveys were conducted.

Table 8. Amphibians and Reptile Species that May Occur in Butte County

Common Name	Scientific Name
Boreal chorus frog	*Pseudacris maculata*
Gophersnake	*Pituophis catenifer*
North American racer	*Coluber constrictor*
Northern leopard frog	*Rana pipiens*
Painted turtle	*Chrysemys picta*
Plains gartersnake	*Thamnophis radix*
Prairie rattlesnake	*Crotalus viridis*
Snapping turtle	*Chelydra serpentina*
Western tiger salamander	*Ambystoma mavortium*
Woodhouse's toad	*Anaxyrus woodhousii*

Source: Amphibians and Reptiles of South Dakota (2021).

3.2.9.6 FISH

No perennial waterbodies were identified within the permit area. The nearest perennial waterbody is a freshwater pond located approximately 522 feet outside the permit area that may provide suitable habitat for fish species. However, it is unlikely that project activities will impact this pond or potential fish species residing within it.

3.2.9.7 OTHER INCIDENTAL WILDLIFE OBSERVATIONS

During the 2022 baseline wildlife surveys, one coyote was observed in the northwest corner of the study area. This species is an unrestricted furbearer in the state of South Dakota and is located throughout the state in most every habitat. No other incidental wildlife observations were made.

3.3 Baseline Vegetation Sampling

Previous vegetation mapping completed for the Shear/Clarkson Permitting Project indicated that the permit area largely consists of mixed-grass prairie vegetation intermixed with areas of big sagebrush shrubland (Figure 5). The approved sample plan established three sampling points within each of the two mapped plant communities to quantify the attributes of each community. The sampling protocol employed follows the methods detailed in the Parsons (2019) study for consistency with the methods used to define South Dakota's sage-grouse core areas.

During vegetation sampling, SWCA measured the following nine vegetation variables:

- Total cover (%)
- Grass cover (%)
- Annual grass cover (%)
- Forb cover (%)
- Shrub cover (%)
- Litter cover (%)
- Sagebrush density (%)
- Sagebrush canopy height (centimeters [cm])
- Species diversity

A set of photographs for each individual sampling point (i.e., one photograph per transect) was taken at the time of survey, and additional photographs were taken as needed to document habitat variables. The photo points correspond with the sampling points and were recorded on electronic data forms.

In addition to the vegetation sampling, surveyors used GIS tools to field verify and map the boundaries of the major plant communities, including riparian or mesic areas, within the permit area. Occurrences of invasive or noxious weeds were documented and recorded as they were encountered.

Ground conditions were dry, and skies were mostly clear to partly cloudy during the baseline vegetation sampling effort that took place July 13 and 14, 2022. Temperatures ranged from 68°F to 97°F and variable winds mostly remained under 10 mph, with sporadic gusts reaching up to 18 mph on July 14. A small population of desert princesplume (*Stanleya pinnata*) was observed incidentally in the northern portion of the permit area (Figure 5). This species is a selenium indicator and was observed independently of the baseline vegetation sampling locations.

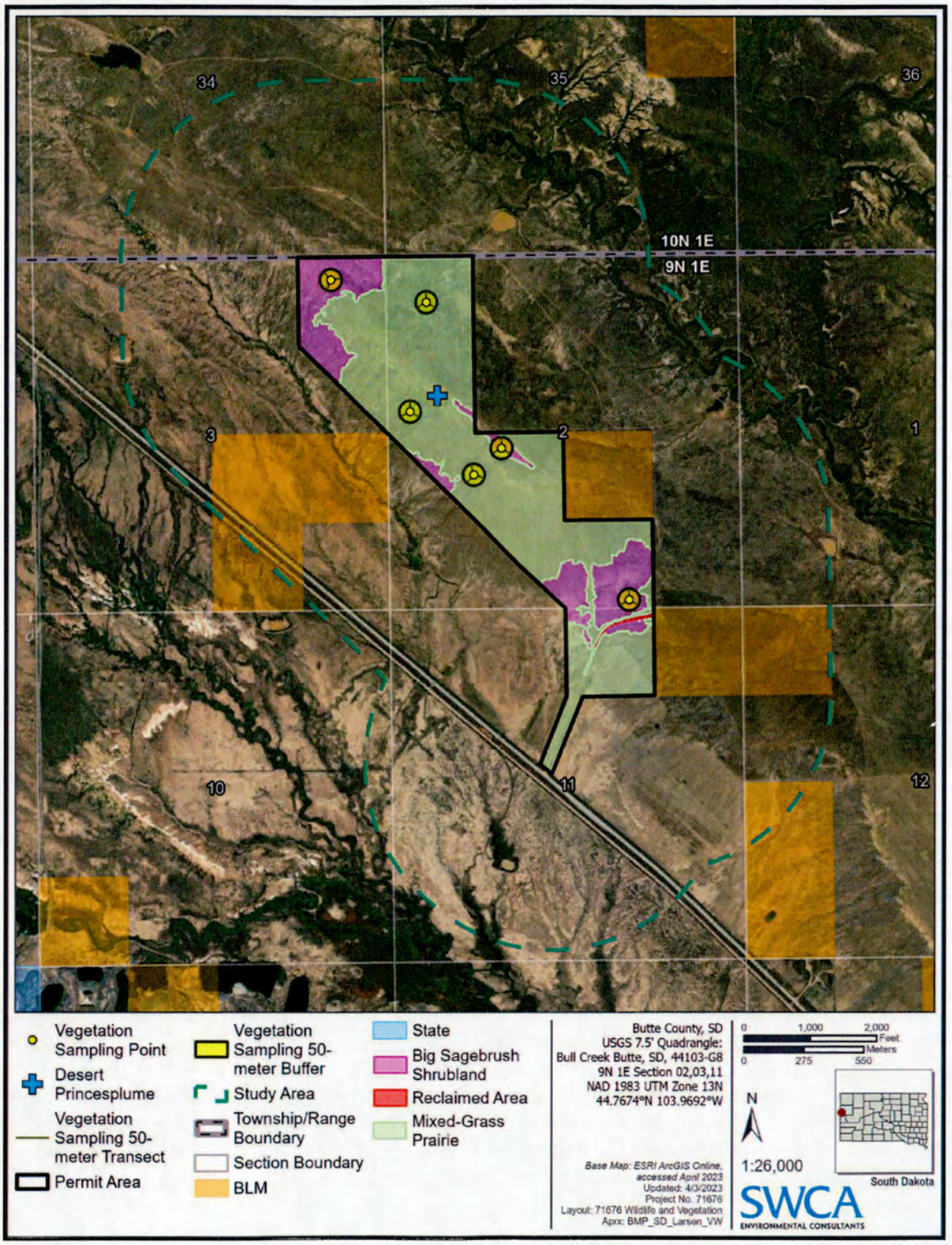

Figure 5. Vegetation sampling transect locations and mapped plant communities within the permit area.

3.3.1 Plant Community Types

SWCA completed a desktop analysis of the permit area to identify plant community types. The plant communities were then verified and delineated during surveys. Table 9 identifies plant community types and acreages within the permit area.

Table 9. Plant Community Types in the Permit Area

Plant Community	Acreage
Big sagebrush shrubland habitat	68.36
Mixed-grass prairie habitat	239.05
Reclaimed habitat	1.90

The big sagebrush shrubland community makes up 68.36 acres or 22% of the permit area, and the mixed-grass prairie community (see Table 9) makes up 239.05 acres or 77% of the permit area. During surveys, SWCA verified that the big sagebrush shrubland portion of the permit area had a canopy cover that was primarily dominated by grasses, forbs, shrubs, and litter (see Table 12 in Section 3.3.3) and the mixed-grass prairie portion of the permit area had a canopy cover that was primarily dominated by grasses, forbs, and litter (see Table 13 in Section 3.3.3). Sagebrush density findings in the big sagebrush shrubland community consisted of an overall average distance of 1.2 m, average mean area of 1.9 m^2, average sagebrush density of 4.5, and average height of 20.0 cm (see Table 14 in Section 3.3.4). Species composition and diversity for the big sagebrush shrubland community comprised native perennial forbs, native annual/biennial forbs, native cool-season perennial grasses, native shrubs, and introduced annual/biennial forbs yielding the highest ($\geq$ 2) mean number of species per 50-m radius (see Table 15 in Section 3.3.5). Native functional groups that occurred with 100% frequency included cool-season perennial grasses, warm-season perennial grasses, annual grasses, perennial forbs, annual/biennial forbs, cacti, and shrubs (see Table 15), whereas introduced functional groups that occurred with 100% frequency included cool-season perennial grasses, annual grasses, and annual/biennial forbs (see Table 15). Species composition and diversity for the mixed-grass prairie community comprised native perennial forbs, native cool-season perennial grasses, native annual/biennial forbs, and introduced annual/biennial forbs yielding the highest ($\geq$ 2) mean number of species per 50-m radius (see Table 16 in Section 3.3.5). Native functional groups that occurred with 100% frequency included cool-season perennial grasses, warm-season perennial grasses, perennial forbs, annual/biennial forbs, and cacti (see Table 16). Introduced functional groups that occurred with 100% frequency included annual grasses and annual/biennial forbs (see Table 16).

In addition to these two community types, SWCA biologists noted a strip of reclaimed vegetation in the southeastern portion of the permit area, comprising approximately 1.9 acres or approximately 1% of the area within the permit area. Due to the limited extent of this reclaimed area, it was not sampled as part of the baseline vegetation surveys. Figures 6 and 7 are representative photographs of the main community types (mixed-grass prairie and big sagebrush shrubland) present within the permit area.

3.3.1.1 BIG SAGEBRUSH SHRUBLAND HABITAT DESCRIPTION

The big sagebrush shrubland habitat component within the permit area consisted of interspersed islands of sagebrush inlaid into a mosaic of mixed-grass prairie. In terms of native grasses, thickspike wheatgrass (*Elymus lanceolatus*) and slender wheatgrass (*Elymus trachycaulus*) were the most common cool-season perennial grasses; buffalograss was the most common warm-season perennial grass; and sixweeks fescue (*Vulpia octoflora*) was the most common annual grass. Among native perennial forbs, the most common

species were common yarrow (*Achillea millefolium*), American vetch (*Vicia americana*), and biscuitroot species (*Lomatium* spp.). The most common and only native cacti species was plains pricklypear (*Opuntia polyacantha*), and the most common native shrub species was big sagebrush (*Artemisia tridentata*). Crested wheatgrass (*Agropyron cristatum*), field brome (*Bromus arvensis*), and pale madwort (*Alyssum alyssoides*) were the most common introduced species for this habitat type. Table 10 contains a complete list of all species observed in the big sagebrush shrubland plant community during 2022 baseline monitoring efforts.

Figure 6. Representative photograph of big sagebrush shrubland habitat.

Table 10. Big Sagebrush Shrubland Species Observed in 2022

Common Name	Scientific Name
Alfalfa	*Medicago sativa**
American bird's-foot trefoil	*Lotus unifoliolatus*
American vetch	*Vicia americana*
Bastard toadflax	*Comandra umbellata*
Big sagebrush	*Artemisia tridentata*
Blue grama	*Bouteloua gracilis*
Broom snakeweed	*Gutierrezia sarothrae*
Buffalograss	*Bouteloua dactyloides*
Canada bluegrass	*Poa compressa**
Clustered broomrape	*Orobanche fasciculata*
Columbia needlegrass	*Achnatherum nelsonii*
Common dandelion	*Taraxacum officinale**
Common pepperweed	*Lepidium densiflorum*

Common Name	Scientific Name
Common yarrow	*Achillea millefolium*
Crested wheatgrass	*Agropyron cristatum**
Desert biscuitroot	*Lomatium foeniculaceum*
Dotted blazing star	*Liatris punctata*
Douglas' knotweed	*Polygonum douglasii*
Fernleaf biscuitroot	*Lomatium dissectum*
Fewflower buckwheat	*Eriogonum pauciflorum*
Field brome	*Bromus arvensis**
Field chickweed	*Cerastium arvense*
Field pennycress	*Thlaspi arvense**
Gardner's saltbush	*Atriplex gardneri*
Herb sophia	*Descurainia sophia**
Pale madwort	*Alyssum alyssoides**
Plains pricklypear	*Opuntia polyacantha*
Prairie Junegrass	*Koeleria macrantha*
Prairie thermopsis	*Thermopsis rhombifolia*
Purple threeawn	*Aristida purpurea*
Rough false pennyroyal	*Hedeoma hispida*
Rubber rabbitbrush	*Ericameria nauseosa*
Sandberg bluegrass	*Poa secunda*
Scarlet globemallow	*Sphaeralcea coccinea*
Seaside arrowgrass	*Triglochin maritima*
Silverleaf Indian breadroot	*Pediomelum argophyllum*
Sixweeks fescue	*Vulpia octoflora*
Slender wheatgrass	*Elymus trachycaulus*
Slimpod Venus' looking-glass	*Triodanis leptocarpa*
Smooth brome	*Bromus inermis**
Stiff sunflower	*Helianthus pauciflorus*
Thickspike wheatgrass	*Elymus lanceolatus*
Threadleaf sedge	*Carex filifolia*
Wavyleaf thistle	*Cirsium undulatum*
Western wheatgrass	*Pascopyrum smithii*
Woolly plantain	*Plantago patagonica*
Yellow salsify	*Tragopogon dubius**

* Species is a nonnative plant species.

3.3.1.2 MIXED-GRASS PRAIRIE HABITAT DESCRIPTION

Most of the permit area contains a rolling mosaic of mostly unbroken mixed-grass prairie, interrupted occasionally by isolated stands of sagebrush. In terms of native grasses, thickspike wheatgrass, slender wheatgrass, western wheatgrass, and Sandberg bluegrass (*Poa secunda*) were the most common cool-

season perennial grasses, whereas blue grama was the most common warm-season perennial grass. Among native perennial and annual/biennial forbs, the most common species were American vetch, scarlet globemallow, and woolly plantain (*Plantago patagonica*). The most common and only native cacti species was plains pricklypear. Field brome, black medick (*Medicago lupulina*), and pale madwort were the most common introduced species for this habitat type. Table 11 contains a complete list of all species observed in the mixed-grass prairie plant community during 2022 baseline monitoring efforts.

Figure 7. Representative photograph of mixed-grass prairie habitat.

Table 11. Mixed-Grass Prairie Species Observed in 2022

Common Name	Scientific Name
Alfalfa	*Medicago sativa**
American vetch	*Vicia americana*
Bastard toadflax	*Comandra umbellata*
Black medick	*Medicago lupulina**
Blue grama	*Bouteloua gracilis*
Broom snakeweed	*Gutierrezia sarothrae*
Buffalograss	*Bouteloua dactyloides*
Canada bluegrass	*Poa compressa**
Columbia needlegrass	*Achnatherum nelsonii*
Common dandelion	*Taraxacum officinale**
Common pepperweed	*Lepidium densiflorum*
Common yarrow	*Achillea millefolium*
Desert biscuitroot	*Lomatium foeniculaceum*

Common Name	Scientific Name
Field brome	*Bromus arvensis**
Field chickweed	*Cerastium arvense*
Field pennycress	*Thlaspi arvense**
Forget-me-not	*Myosotis* sp.
Herb sophia	*Descurainia sophia**
Matted sandmat	*Chamaesyce serpens*
Pale madwort	*Alyssum alyssoides**
Plains pricklypear	*Opuntia polyacantha*
Povertyweed	*Iva axillaris*
Rough false pennyroyal	*Hedeoma hispida*
Sandberg bluegrass	*Poa secunda*
Scarlet globemallow	*Sphaeralcea coccinea*
Silverleaf Indian breadroot	*Pediomelum argophyllum*
Silverscale saltbush	*Atriplex argentea*
Sixweeks fescue	*Vulpia octoflora*
Sleepy silene	*Silene antirrhina*
Slender wheatgrass	*Elymus trachycaulus*
Smooth brome	*Bromus inermis**
Stiff sunflower	*Helianthus pauciflorus*
Thickspike wheatgrass	*Elymus lanceolatus*
Threadleaf sedge	*Carex filifolia*
Western wheatgrass	*Pascopyrum smithii*
Woolly plantain	*Plantago patagonica*
Woollypod milkvetch	*Astragalus purshii*
Yellow salsify	*Tragopogon dubius**

* Species is a nonnative plant species.

3.3.2 Sample Point Selection

Each sampling point consists of three 50-m-long radial transects, with each transect approximated and established 120 degrees from its neighboring transect in a spoke formation (Figure 8). All three transects associated with a given sampling point were established entirely within the vegetation community being targeted as shown in Figure 5. Three sampling points were placed in each vegetation community type, resulting in a total of six sampling points and 18 transects. The sagebrush communities cover approximately 68.36 acres within the permit area, and per discussions with SDGFP, SWCA placed one sampling point within each of the three discrete sagebrush communities that were identified and delineated. This resulted in approximately one transect per 7.6 acres of sagebrush community. Each big sagebrush shrubland sampling point was microsited in the field so that the point was placed on the nearest shrub, and similarly, each mixed-grass prairie sampling point was microsited in the field so that the point was placed on the nearest grass or forb bunch.

Figure 8. Example of three 50-meter transects radiating out from sampling center points.

3.3.3 Canopy Cover Sampling

To estimate vegetative canopy cover, SWCA used the Daubenmire method (Daubenmire 1959). Quadrats for canopy cover sampling measured 20 cm × 50 cm and were placed along each of the three transect tapes per sampling point at 0 m, 1 m, 5 m, 10 m, 30 m, and 50 m. Within each quadrat, SWCA estimated the following categories: total cover, total grass, forb, litter, shrub (sagebrush and non-sagebrush), and annual grass cover. The total cover estimation category included an overview of both litter and vegetation. Canopy coverages for each quadrat were recorded as one of six cover classes (1 = 0%–5%, 2 = 5%–25%, 3 = 25%–50%, 4 = 50%–75%, 5 = 75%–95%, and 6 = 95%–100%). Midpoint values of each cover class were assigned and used for analysis. Tables 12 and 13 summarize the vegetative canopy cover data by life form and feature. See Appendix C for canopy cover monitoring data.

Table 12. Big Sagebrush Shrubland Canopy Cover Summary

Life Form/Feature	Canopy Cover (%)
Vegetative Cover	
Grasses	32.0
Annual grasses	4.8
Forbs	14.0
Shrubs	13.9
Litter	11.9
Total Cover*	56.4

* Assessed as its own cover category, not a representative total of other life form or feature categories.

Table 13. Mixed-Grass Prairie Canopy Cover Summary

Life Form/Feature	Canopy Cover (%)
Vegetative Cover	
Grasses	56.3
Annual grasses	5.2
Forbs	18.8
Shrubs	2.5
Litter	19.5
Total Cover*	81.3

* Assessed as its own cover category, not a representative total of other life form or feature categories.

3.3.4 Sagebrush Density

SWCA estimated sagebrush density using the point-centered quarter method (Cottam and Curtis 1956). At each sample point, sagebrush sample quads were placed at every 10 m along each transect, starting at the 10-m mark (n = 12 quads per sample point). At each sagebrush sampling quad, four quadrats were delineated, and the distance to the nearest sagebrush in each quadrat was measured to a distance of 5 m from the sagebrush sampling location. For those sagebrush quadrats whose nearest shrub is more than 5 m away, a default value of 5 m was assigned. The height of the nearest sagebrush present within each quadrat was measured and recorded unless it was more than 5 m away. Sagebrush heights were averaged for each site. No sagebrush was recorded within 5 m for any quadrats sampled within the mixed-grass prairie community. Therefore, sagebrush density calculations were not performed for the mixed-grass prairie community because they were not significant. SWCA collected data from six sample points, each comprising three transects, for a total of 18 transects and 72 quads; however, calculations were only performed for the big sagebrush shrubland community. Table 14 summarizes the average distance, area, density, and height of sagebrush by sample point for the big sagebrush shrubland community. See Appendix D for sagebrush density monitoring data.

Table 14. Big Sagebrush Shrubland Sagebrush Density Summary

Sample Point ID	Average Distance (m)	Mean Area* (m^2)	Averege Density	Average Height (cm)
SB-01	1.1	1.6	6.7	13.8
SB-02	1.0	1.1	4.2	23.1
SB-03	1.6	3.0	2.5	23.0
Average across all sites	1.2	1.9	4.5	20.0

* Mean area is another way to consider density as it is the average space available to each plant.

3.3.5 Species Diversity and Composition

SWCA measured species diversity at each sampling point by setting up a circular inventory plot within a 50-m radius of the sampling point. Personnel systematically and uniformly searched the inventory plot for 15 minutes to detect all plant species within the plot. All species observed within the plot were recorded and documented, and any unknown species were marked with a pin flag for later identification. The species inventory was completed after the sampling described above was completed to minimize

trampling of vegetation. Tables 15 and 16 summarize these data by functional group. See Appendix E for species diversity and composition monitoring data and calculations.

Table 15. Sagebrush Shrubland Species Diversity and Composition Overview by Functional Group

Functional Group	Mean Number of Species per 50-m Radius	Frequency (%)
Native Species		
Cool-season perennial grass	4.7	100
Warm season perennial grass	1.3	100
Annual grass	1	100
Other graminoids	0.7	33
Perennial forb	6.3	100
Annual/Biennial forb	5	100
Cacti	1	100
Subshrub	0.3	33
Shrub	2.3	100
Trees	–	–
Introduced Species		
Cool-season perennial grass	1.7	100
Warm season perennial grass	–	–
Annual grass	1	100
Other graminoids	–	–
Perennial forb	0.7	67
Annual/Biennial forb	2	100
Cacti	–	–
Subshrub	–	–
Shrub	–	–
Trees	–	–

Table 16. Mixed-Grass Prairie Species Diversity and Composition Overview by Functional Group

Functional Group	Mean Number of Species per 50-m Radius	Frequency (%)
Native Species		
Cool-season perennial grass	4.3	100
Warm-season perennial grass	1.7	100
Annual grass	0.3	33
Other graminoids	0.7	67
Perennial forb	5.3	100
Annual/Biennial forb	3.3	100

Functional Group	Mean Number of Species per 50-m Radius	Frequency (%)
Cacti	1	100
Subshrub	0.3	33
Shrub	–	–
Trees	–	–
Introduced Species		
Cool-season perennial grass	0.7	67
Warm-season perennial grass	–	–
Annual grass	1	100
Other graminoids	–	–
Perennial forb	0.7	67
Annual/Biennial forb	3.3	100
Cacti	–	–
Subshrub	–	–
Shrub	–	–
Trees	–	–

3.3.6 Tree Documentation

No trees were documented in the permit area proper. The larger study area contains few trees, with those present associated mainly with riparian areas. Deciduous trees species such as the eastern cottonwood (*Populus deltoides*) were documented by a reliable observer and may provide suitable raptor nesting and roosting habitat. The field verifications that SWCA conducted included areas where trees were observed as part of the raptor nest and bald eagle winter roost survey efforts.

3.3.7 State and County Noxious Plant Species

The State of South Dakota currently lists 25 plant species as noxious (U.S. Department of Agriculture [USDA] 2023a) and eight species approved by the State Weed and Pest Control Commission as locally noxious in Butte County (SDDANR 2023) (Table 17). Two locally listed noxious weed species are also state-listed species: musk thistle (*Carduus nutans*) and plumeless thistle (*Carduus acanthoides*). Poison hemlock (*Conium maculatum*) does not appear in Table 17 because its locally noxious designation expired on December 31, 2022 (SDDANR 2023). Table 17 provides an overview of South Dakota state-listed noxious weed species and those that are locally listed as noxious for Butte County.

SWCA did not record or observe any state- or county-listed noxious plant species during baseline vegetation surveys conducted on July 13 and 14, 2022.

Table 17. State-Listed and Butte County Noxious Weeds

Common Name	Scientific Name
Canada thistle	*Cirsium arvense*
Common crupina	*Crupina vulgaris*
Common mullein	*Verbascum thapsus**

Common Name	Scientific Name
Common tansy	*Tanacetum vulgare**
Dalmatian toadflax	*Linaria dalmatica*
Diffuse knapweed	*Centaurea diffusa*
Dodder	*Cuscuta* sp.
Eurasian water milfoil	*Myriophyllum spicatum*
European common reed	*Phragmites australis* ssp. *australis**
Field bindweed	*Convolvulus arvensis*
Gypsyflower	*Cynoglossum officinale**
Hoary cress	*Cardaria draba*
Johnsongrass	*Sorghum halepense*
Leafy spurge	*Euphorbia esula*
Leafy spurge	*Euphorbia esula* var. *esula*
Lesser burdock	*Arctium minus**
Multiflora rose	*Rosa multiflora*
Musk thistle	*Carduus nutans**
Perennial pepperweed	*Lepidium latifolium*
Perennial sowthistle	*Sonchus arvensis*
Plumeless thistle	*Carduus acanthoides**
Purple loosestrife	*Lythrum salicaria*
Purple loosestrife	*Lythrum virgatum*
Rush skeletonweed	*Chondrilla juncea*
Russian knapweed	*Acroptilon repens*
Salt cedar	*Tamarix* sp.
Scotch thistle	*Onopordum acanthium**
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*
St. Johnswort	*Hypericum perforatum*
Yellow starthistle	*Centaurea solstitialis*
Yellow toadflax	*Linaria vulgaris*

Sources: SDDANR (2023); USDA (2023a).
* Butte County locally listed noxious weed species.

3.3.8 Wetlands

No wetlands were observed or recorded during baseline vegetation surveys. According to the National Wetlands Inventory and National Hydrography Dataset, two NHD flowlines and one wetland feature (Freshwater Emergent Wetland) are in the permit area (see Figure 2) (USFWS 2022a; USGS 2022b). Surveys confirmed that these features did not exhibit wetland characteristics and therefore they were not delineated.

Although not officially delineated due to its location, there is a freshwater pond approximately 522 feet outside the permit area that is likely to have a wetland fringe.

3.3.9 Federally Listed Threatened and Endangered Species

No federally listed plant species are listed by the U.S. Fish and Wildlife Service (USFWS) as occurring in Butte County (USFWS 2022b).

3.3.10 South Dakota Listed Threatened and Endangered Species

Two plant species are currently listed under South Dakota's Endangered and Threatened Species Law (South Dakota Codified Laws Chapter 34A-8). Table 19 identifies the state-listed species from the SDGFP (2022a), their listing status, and the likelihood of their occurrence in the study area. SWCA reviewed the range and distribution of these species to identify the likelihood of their occurrence.

Table 18. State-Listed Threatened and Endangered Species in Butte County, South Dakota

Common Name	Scientific Name	State Listing Status	Habitat	Potential to Occur
Leedy's stonecrop	*Rhodiola integrifolia* ssp. *leedyi*	Threatened	Cool, wet groundwater-fed limestone cliffs. In South Dakota, the subspecies occurs in the Black Hills National Forest on a cliff approximately 7,000 feet above sea level.	None. No suitable habitat is within the permit area. There are no known occurrences in the study area. There was a single occurrence in South Dakota on granite in the central Black Hills.
Great Plains white fringed orchid	*Platanthera praeclara*	Threatened	Moist tallgrass prairies and sedge meadows. Commonly found with sedges, reedgrass, and rushes or where those plants meet tallgrasses.	None. No suitable habitat is within the permit area. There are no known occurrences in the study area. Was last collected in eastern South Dakota in 1916.

Sources: SDGFP (2022a, 2023g); USDA (2023b).

4 CONCLUSION

4.1 Wildlife

Baseline wildlife surveys were conducted to provide information necessary to determine the potential effects of the project's mining and reclamation operations on wildlife species. A desktop analysis was performed, and field verified, for potential habitat or presence of federally or state-listed species or other species of concern. Results are summarized below:

- No federally threatened or endangered species were observed in the study area.
- No South Dakota state–listed endangered or threatened species were observed in the study area.
- Thirteen bird species were observed within Shear/Clarkson during the 2007 breeding bird surveys; none of these are federally or state listed. The project is unlikely to have population-level impacts on the observed species.
- No bald eagle roosts or active raptor nests were observed in the study area; however, suitable habitat is located within 0.5 mile of the permit area.
- Two non-eagle raptor species were observed in the study area during wildlife surveys.

- Across all survey efforts conducted by BPM and SWCA in 2022 and 2023, no sage-grouse individuals or sign were observed in the study area or at the Middle Creek lek location. Middle Creek lek surveys conducted by SDGFP confirm the last known lek attendance was in 2020 and BLM surveys show the last known attendance in 2018. The project is not anticipated to negatively impact populations of greater sage-grouse because the permit area is not ideal in terms of nesting, brood-rearing, or winter use site selection. Sage-grouse mitigation measures as outlined in Section 3.2.5.1 will be incorporated into the mine and reclamation plan.
- No other upland game birds, waterfowl and shorebirds, small mammals, reptiles, or big game species are expected to be negatively impacted by the project.
- The project is not anticipated to negatively impact populations of amphibians or fish species because no aquatic habitats are present in the permit area.

4.2 Vegetation

The permit area was surveyed for baseline vegetation information in support of BPM's proposed Larsen Project for the SDDANR permit application. Baseline vegetation survey results are summarized below:

- The dominant plant community types were big sagebrush shrubland (22%) and mixed-grass prairie (77%).
- No wetlands were observed.
- No state- or county-designated noxious weeds were observed.
- No threatened or endangered species, or their suitable habitat, were observed in the permit area.

4.2.1 Canopy Cover

As discussed in Section 3.3.1 and 3.3.3, the dominant plant cover category observed across both community types in permit area was grass. Mean absolute total cover across big sagebrush shrubland transects (nine 50-m transects) was 56.4% (see Table 12). Mean absolute total cover across mixed-grass prairie transects (nine 50-m transects) was 81.3% (see Table 13).

4.2.2 Sagebrush Density

As discussed in Section 3.3.1 and 3.3.4, sagebrush belonging to the big sagebrush shrubland community had an overall average distance of 1.2 m, average mean area of 1.9 m^2, average sagebrush density of 4.5, and average height of 20.0 cm (see Table 14).

4.2.3 Species Diversity and Composition

As discussed in Section 3.3.1 and 3.3.5, native perennial forbs, native annual/biennial forbs, native cool-season perennial grasses, native shrubs, and introduced annual/biennial forbs had the highest (≥ 2) mean number of species per 50-m radius for the big sagebrush shrubland habitat type. Cool-season perennial grasses, native warm-season perennial grasses, annual grasses, native perennial forbs, annual/biennial forbs, native cacti, and native shrubs occurred in approximately 100% of transects. Introduced perennial forbs occurred in approximately 67% of transects, and other native graminoids (not grasses) and native subshrubs occurred in approximately 33% of transects.

For the mixed-grass prairie portion of the permit area, native perennial forbs, native cool-season perennial grasses, native annual/biennial forbs, and introduced annual/biennial forbs functional groups had the

highest (≥ 2) mean number of species per 50-m radius. Native cool-season perennial grasses, native warm-season perennial grasses, native perennial forbs, annual/biennial forbs, native cacti, and introduced annual grasses occurred in approximately 100% of transects. Other native graminoids (not grasses), introduced cool-season perennial grasses, and introduced perennial forbs occurred in approximately 67% of transects. Native annual grasses and native subshrubs occurred in approximately 37% of transects.

4.3 Critical Resources

Per South Dakota requirements, SWCA assessed the study area for critical resources (South Dakota Codified Laws 45-6B-92(1) and (3)). As discussed in Section 3.1.1, no critical resources were observed for vegetation or wildlife in terms of critical deer winter range or observations of threatened or endangered species during the 2022–2023 baseline surveys. The study area is located in areas SDGFP identified and mapped as sage-grouse core areas in the state of South Dakota. However, based on observations made in the Parsons (2019) study about sage-grouse preferential site selection and subsequently comparing those environmental variables with SWCA's vegetation sampling results, the permit area itself is unlikely to be used by greater sage-grouse individuals.

5 LITERATURE CITED

Amphibians and Reptiles of South Dakota. 2022. Available at: https://www.sdherps.org/. Accessed November 2022.

Cornell Lab of Ornithology. 2022. All About Birds. Available at: https://www.birds.cornell.edu /landtrust/all-about-birds/. Accessed November 2022.

Cottam, G., and J.T. Curtis. 1956. The use of distance measures in phytosociological sampling. *Ecology* 37:451–460.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. *Northwest Science* 33:43–64.

eBird. 2022. eBird: An Online Database of Bird Distribution and Abundance. Ithaca, New York: Cornell Lab of Ornithology. Available at: http://www.ebird.org. Accessed November 2022.

Environmental Protection Agency (EPA). 2022. How's My Waterway. Available at: https://mywaterway .epa.gov/community/-103.969495%C2%B0%E2%80%8E,%2044.769768 %C2%B0%E2%80 %8E/overview. Accessed November 2022.

Google Earth Pro. 2022. Retrieved from Google Earth. Available at: https://www.google.com/earth /versions/. Accessed November 2022.

Jones, J., and J.R. Choate. 1978. Distribution of two species of long-eared bats of the genus *Myotis* on the Northern Great Plains. *Prairie Naturalist* 10(2):49–52.

Jones & Stokes. 2007. *American Colloid Company Shear/Clarkson Permitting Project Wildlife Baseline Inventory.* Submitted to American Colloid Company. Prepared for South Dakota Department of Game, Fish and Parks.

Knick S. T. and J.W. Connelly (editors). 2011 Greater Sage-Grouse: ecology and conservation of a landscape species and its habitat. Studies in Avian Biology 38. University of California Press, Berkeley.

Monarch Watch. 2022. Monarch Tag Recovery Program. 2017-2021. Available at: https://www .monarchwatch.org/index.html#recoveries. Accessed November 2022.

Natural Resources Conservation Service (NRCS). 2022a. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. Available at: https://www.nrcs.usda.gov/resources/data-and-reports/major-land-resource-area-mlra. Accessed November 2022.

———. 2022b. Web Soil Survey. Available at: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey .aspx. Accessed November 2022.

Parsons. 2019. Greater sage-grouse survival, breeding ecology, resource selection, and West Nile virus prevalence on the eastern fringe of their range. Ph.D. dissertation, Natural Resource Management, South Dakota State University, Brookings.

South Dakota Department of Agriculture and Natural Resources (SDDANR). 2023. *South Dakota Locally Noxious Weed Pest List*. Available at: https://danr.sd.gov/Conservation/PlantIndustry/WeedPest/docs/noxiousweeds.pdf#:~:text=SOUTH%20DAKOTA%20LOCALLY%20NOXIOUS%20WEED%20PEST%20LIST%20County,Dalmation%20Toadflax%202019%202023%20Common%20Mullein%202020%202024. Accessed March 2023.

South Dakota Department of Game, Fish and Parks (SDGFP). 2014. *South Dakota Wildlife Action Plan*. Available at: https://gfp.sd.gov/wildlife-action-plan/. Accessed November 2022.

———. 2016. *Bentonite and Prairie Mining Project Wildlife and Vegetation Baseline Study Guidelines*. Provided by South Dakota Department of Game, Fish and Parks, August 31, 2020.

———. 2018. *State T&E Species Status Reviews Approved by SDGFP Commission 5 April 2018*. Available at: https://gfp.sd.gov/UserDocs/nav/status-reviews.pdf. Accessed November 2022.

———. 2021. *Management of Greater Sage-Grouse in South Dakota*. Wildlife Division Report 2021-16. Available at: https://gfp.sd.gov/UserDocs/docs/management_of_sage_grouse_november_2021.pdf. Accessed March 2023.

———. 2022a. *Threatened and Endangered Species*. Available at: https://gfp.sd.gov/threatened-endangered/. Accessed November 2022.

———. 2022b. South Dakota Wildlife Action Plan Explorer. Available at: http://apps.sd.gov/gf43wap/. Accessed November 2022.

———. 2022c. Natural Heritage Program. Available at: https://gfp.sd.gov/natural-heritage-program/. Accessed July 2022.

———. 2023a. South Dakota Environmental Review Tool. Available at: https://ert.gfp.sd.gov/content/map. Accessed March 2023.

———. 2023b. Gray Partridge and Chukar. Available at: https://gfp.sd.gov/partridge/. Accessed March 2023.

———. 2023c. Elk. Available at: https://gfp.sd.gov/elk. Accessed January 2023.

———. 2023d. Big Game. Available at: https://gfp.sd.gov/big-game/. Accessed March 2023.

———. 2023e. Mountain Goat. Available at: https://gfp.sd.gov/mountain-goat/. Accessed March 2023.

———. 2023f. Bighorn Sheep. Available at: https://gfp.sd.gov/bighorn-sheep/. Accessed March 2023.

———. 2023g. Rare Plants of South Dakota. Available at: https://gfp.sd.gov/rare-plants/. Accessed March 2023.

South Dakota Legislative Research Council. 2023. Codified Laws 45-6B-92. Available at: https://sdlegislature.gov/Statutes/Codified_Laws/2066416. Accessed March 2023.

U.S. Department of Agriculture (USDA). 2023a. South Dakota State-listed Noxious Weeds. Available at: https://plantsorig.sc.egov.usda.gov/java/noxious?rptType=State&statefips=46. Accessed March 2023.

———. 2023b. PLANTS Database. Available at: https://plants.usda.gov/home. Accessed March 2023.

U.S. Environmental Protection Agency. 2022. How's My Waterway. Available at: https://mywaterway.epa.gov/community/-103.969495%C2%B0%E2%80%8E,%2044.769768%C2%B0%E2%80%8E/overview. Accessed November 2022.

U.S. Fish and Wildlife Service (USFWS). 2011. *Golden Eagles Status Fact Sheet*. Available at https://www.fws.gov/sites/default/files/documents/golden-eagle-fact-sheet.pdf. Accessed November 2022.

———. 2014. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot. *Federal Register* 79(238):73705.

———. 2015. *Northern Long-Eared Bat – Myotis septentrionalis*. Available at: https://fws.gov/sites/default/files/documents/508_NLEB%20fact%20sheet.pdf. Accessed November 2022.

———. 2021. *Availability of Birds of Conservation Concern 2021*. Available at: https://www.fws.gov/federal-register-file/availability-birds-conservation-concern-2021. Accessed November 2022.

———. 2022a. National Wetlands Inventory (NWI). 2022. Available at: https://www.fws.gov/wetlands/. Accessed November 2022.

———. 2022b. IPaC Information for Planning and Consultation. Available at: http://ecos.fws.gov/ipac/. Accessed November 2022.

———. 2022c. *USFWS Threatened and Endangered Species Active Critical Habitat Report*. Available at: http://ecos.fws.gov/crithab/. Accessed November 2022.

———. 2022d. Endangered and Threatened Wildlife and Plants; Endangered Species Status for Northern Long-Eared Bat. *Federal Register* 87(56):16442.

———. 2022e. Species Profile for Northern Long-eared Bat (*Myotis septentrionalis*). Available at: https://ecos.fws.gov/ecp/species/9045. Accessed November 2022.

———. 2022f. *Rufa Red Knot*. Available at: https://www.fws.gov/species/rufa-red-knot-calidris-canutus-rufa. Accessed November 2022.

———. 2022g. Species Profile for Monarch Butterfly (*Danaus plexippus*). Available at: https://ecos.fws.gov/ecp/species/9743. Accessed November 2022.

———. 2022h. Bald Eagle. Available at: https://www.fws.gov/species/bald-eagle-haliaeetus-leucocephalus. Accessed November 2022.

U.S. Geological Survey (USGS). 2022a. USGS National Topographic Map Database. topoView Interactive Map Viewer and Downloader. Available at: https://ngmdb.usgs.gov/maps/Topoview/viewer/#4/40.00/-100.00. Accessed May 2022.

———. 2022b. National Hydrography Dataset (NHD). Available at: http://nhd.usgs.gov/. Accessed December 2022.

APPENDIX A

Larsen Vegetation and Wildlife Field Monitoring Protocol (Scope of Work)

SCOPE OF WORK

SWCA Environmental Consultants (SWCA) will conduct vegetation sampling, a greater sage-grouse habitat (*Centrocercus urophasianus*) assessment and wildlife surveys to help Bentonite Performance Minerals (BPM) prepare the South Dakota Department of Agriculture and Natural Resources permit applications necessary for the Larsen Project (project). The proposed location of the project (project area) is on private lands north of U.S. Highway 212 between Colony, Wyoming, and Belle Fourche, South Dakota, in Butte County, South Dakota. Specifically, the project area covers a total of approximately 307 acres in the NE¼ NE¼ and SE¼ NE¼, Section 3; NW¼ NW¼, SW¼ NW¼, NW¼ SW¼, NE¼ SW¼, SE¼ SW¼, and SW¼ SE¼, Section 2; and the NW¼ NE¼ and SE¼ NW¼ (proposed location of the access road) Section 11, Township 9 North, Range 1 East (Figure 1).

PHASE 1. GREATER SAGE-GROUSE HABITAT ASSESSMENT

SWCA reviewed the existing documentation for the project and referenced previous conversations with the South Dakota, Game, Fish and Parks (SDGFP) to develop a strategy for assessing the greater sage-grouse habitat within the project area and to develop potential best management practices and mitigation techniques for the project.

TASK 1. VEGETATION SAMPLING

Previous vegetation mapping completed for Permit 471 indicates that the project area largely consists of mixed-grass prairie vegetation intermixed with areas of big sagebrush shrubland (see Figure 1). The sampling protocol will follow the methods detailed in Parsons 2019[1] for consistency with the methods used to define South Dakota's Sage-grouse Core Areas.

SWCA will establish three sampling points within each mapped vegetation community to quantify the attributes of each for a total of six sampling points for the project. The sagebrush communities cover approximately 78 acres within the project area. Per discussions with SDGFP, SWCA will place one sampling point within each of the three discrete sagebrush communities in the project area. From each sampling point will radiate three 50-meter-long transects, and the transects will lie fully within the target vegetation community, as shown in Figure 2. This will result in approximately one transect per 9 acres of sagebrush community. Two sampling points will be placed within areas not covered by Permit 471. Each shrubland sampling point will be microsited in the field so that the point is placed on the nearest shrub; each grassland sampling point will be microsited in the field so that the point is placed on the nearest grass or forb bunch.

[1] Parsons, Lindsay Anne, 2019. *Greater Sage-Grouse Survival, Breeding Ecology, Resource Selection, and West Nile Virus Prevalence on the Eastern Fringe of their Range*. Electronic Theses and Dissertations. 3385. Available at: https://openprairie.sdstate.edu/etd/3385.

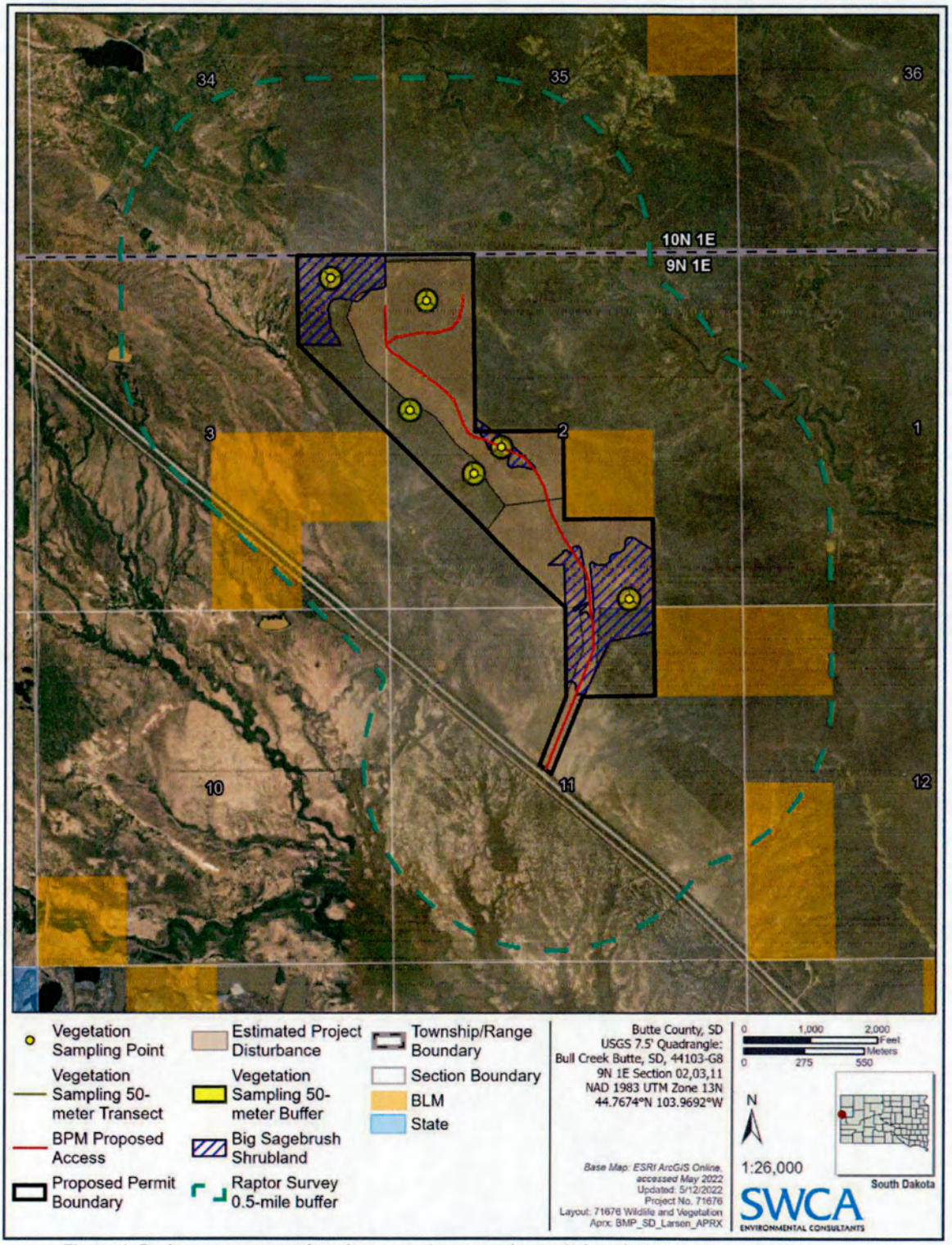

Figure 1. Project area, vegetation classes and proposed sample locations.

Figure 2. Example of three 50-meter transects radiating out from sampling center points. Each transect is fully within the targeted vegetation community.

SWCA will measure seven vegetation variables during field data collection:

- Sagebrush canopy cover (%)
- Sagebrush density (%)
- Sagebrush canopy height (centimeters [cm])
- Non-sagebrush shrub cover (%)
- Perennial grass cover (%)
- Annual grass cover (%)
- Species diversity

To estimate canopy cover, SWCA will use the Daubenmire method (Daubenmire 1959[2]). Quadrats will measure 20 cm x 50 cm and be placed along each transect tape at 0 meters (m), 1 m, 5 m, 10 m, 30 m, and 50 m. Within each quadrat, SWCA will estimate the following: total cover, total grass, forb, litter, shrub, and annual grass cover. Canopy coverages for each quadrat will be recorded as one of six cover classes (1 = 0%–5%, 2 = 5%–25%, 3 = 25%–50%, 4 = 50%–75%, 5 = 75%–95%, 6 = 95%–100%). Midpoint values of each cover class will be assigned and used for analysis.

SWCA will estimate sagebrush density using the point centered quarter method (Cottam and Curtis 1956[3]). Sagebrush sample locations will be placed at the sampling point center and at every 10 m along each transect (n = 21). At each sagebrush sampling location, four quadrats will be delineated, and the distance to the nearest sagebrush in each quadrat will be measured to a distance of 5 m from the sagebrush sampling location. For those quadrats whose nearest shrub is > 5 m away,

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[2] Daubenmire, Rexford. 1959. A Canopy-coverage method of vegetational analysis. *Northwest Science* 33:43-64.

[3] Cottam, G., and J. T. Curtis. 1956. The use of distance measures in phytosociological sampling. *Ecology* 37:451-460.

a default value of 5 m will be assigned for calculations. The nearest sagebrush present within each quadrat will also have a height measured and recorded. Sagebrush heights will be averaged for each site.

SWCA will measure species diversity at each sampling point by setting up a circular inventory plot within a 50-m radius of the sampling point. Personnel will systematically and uniformly search the inventory plot for 15 minutes to detect all plant species within the plot. All species observed within the plot will be recorded and documented, and any unknown species will be marked with a pin flag for later identification. The species inventory will be completed after the sampling described above is complete to minimize trampling of vegetation.

SWCA will take a set of photos for each individual sampling point (i.e., one photo per transect). Additional photos may be required to document habitat variables. The photo points will correspond with the sampling points and be recorded on electronic data forms.

In addition to the vegetation sampling, the surveyors will use geographic information system (GIS) tools to field verify and map the boundaries of the major vegetation communities, including riparian or mesic areas, within the project area. Occurrences of invasive or noxious weeds will also be documented and recorded.

TASK 2. SAGE-GROUSE FIELD SURVEYS

SWCA will complete opportunistic field surveys within the project area for sage-grouse individuals and sign during the brood and winter season. These surveys will be conducted in conjunction with other scheduled survey activity. Up to three surveys, separated by at least 1 week, will be conducted between mid-June and August, with an emphasis on July, to document bird use during the brood-rearing season. Up to three surveys separated by at least 1 week will be conducted between December and mid-February in all suitable habitats within potential sage grouse winter concentration areas. The surveyors will use binoculars from a high vantage point to scan suitable sage-grouse habitat for individuals and will walk meandering transects within areas identified as suitable habitat during the vegetation sampling. All observations of sage-grouse individuals or sage-grouse sign (e.g., scat, cecal tar, feathers, nesting signs) will be documented and recorded. In addition to sage-grouse observation data, other observations, including nests or sign, of game birds will be recorded.

PHASE 3. RAPTOR NEST SURVEYS

SWCA biologists will conduct a 0.5-mile line-of-sight survey for individual raptors and raptor nests. From high points throughout the project area, the biologists will use binoculars and/or spotting scopes to survey ridgetops, vertical exposures, large trees, and small shrubs for raptor nests. The biologists will document raptor nest locations in the project area and within the 0.5-mile line-of-sight area by noting species, activity status (when possible), and nest condition and by recording the locations using a global positioning system (GPS) unit. SWCA will conduct the raptor surveys once per month from April through June. Raptor winter roost surveys will take place once per month from January through March. Site visits will be at least 1 week apart. Incidental observations of other wildlife species will also be recorded and noted.

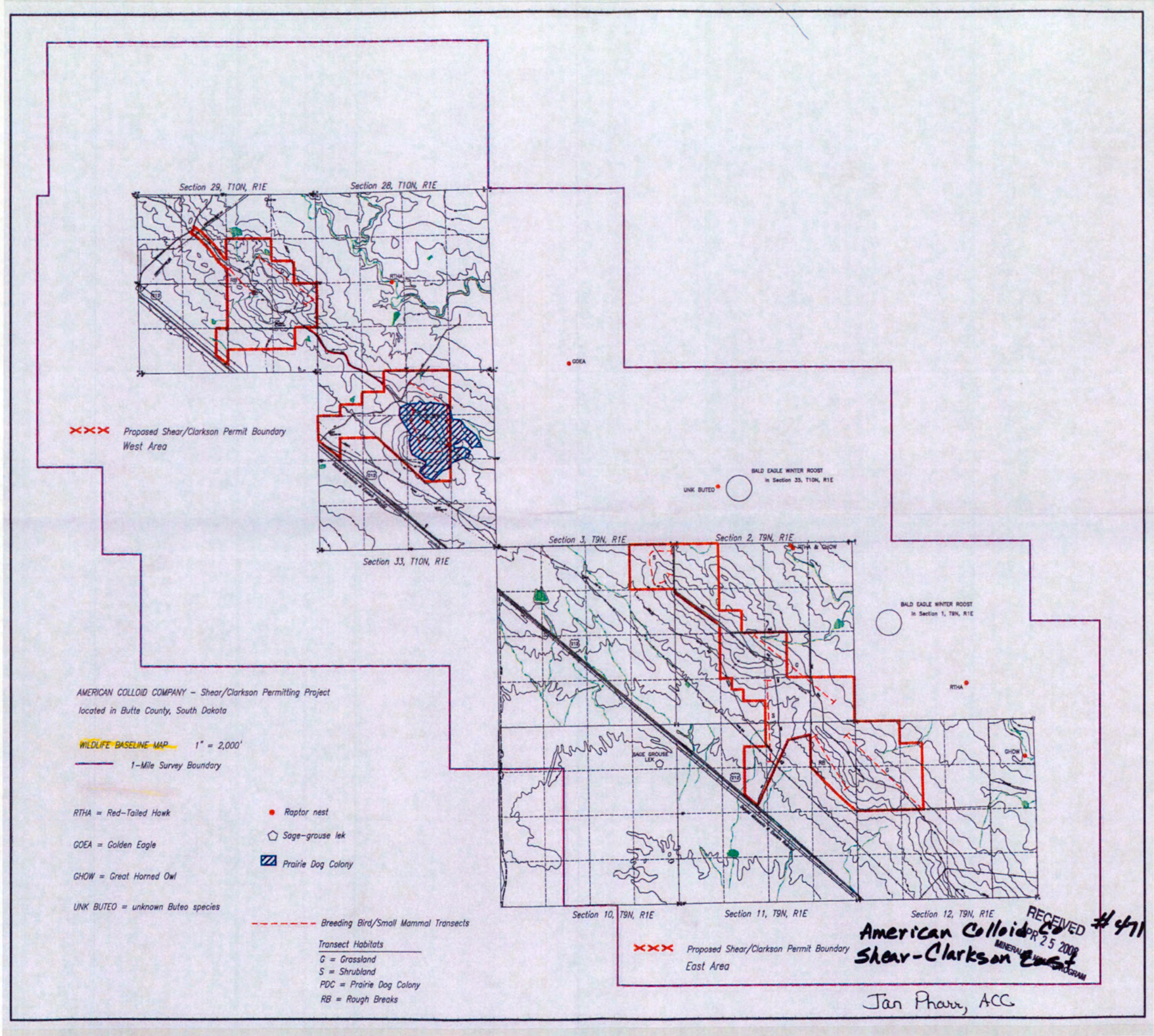
PHASE 4. VEGETATION AND WILDLIFE REPORTING

SWCA will describe the methods for and compile results of the vegetation sampling, sage-grouse habitat assessment and surveys, and raptor nest surveys as well as incidental sightings of other wildlife in a project vegetation and wildlife survey report. The report will contain information relevant to sage-grouse,

including a list of the vegetation attributes present at each sampling point in the sagebrush community, a summary of the suitability of each vegetation community for sage-grouse habitat, an evaluation of potential mining impacts to sage-grouse, any relevant observations of sage-grouse individuals or sign, and potential mitigation techniques or best management practices that BPM can implement. The report will also include a potential species list that could occur within the project area and a list of the species that were documented from sightings, sign or other methods. Raptor nest locations, a description of habitats and fauna present in the area, a discussion regarding the potential occurrence of threatened and endangered species or Natural Heritage Program species, an evaluation of potential mining impacts to those species, and the qualifications of the SDGFP-approved biologists who conducted the field surveys will also be included. SWCA will also provide BPM with a geodatabase of the spatial data recorded during the vegetation sampling and wildlife surveys.

APPENDIX B

American Colloid Company's Wildlife Baseline Map



American Colloid Co #471
Shear-Clarkson East

Jan Pharr, ACC

APPENDIX C

Canopy Cover Data

BIG SAGEBRUSH SHRUBLAND

Table C-1. Big Sagebrush Shrubland Canopy Cover Data

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
SB-01	5–25	0–5	0–5	50–75	0–5	50–75
SB-01	0–5	5–25	5–25	25–50	0–5	25–50
SB-01	5–25	0–5	5–25	0–5	0–5	25–50
SB-01	25–50	5–25	5–25	0–5	5–25	75–95
SB-01	5–25	0–5	25–50	0–5	5–25	25–50
SB-01	25–50	0–5	0–5	0–5	5–25	50–75
SB-01	5–25	5–25	5–25	25–50	5–25	50–75
SB-01	25–50	0–5	25–50	0–5	0–5	50–75
SB-01	5–25	0–5	0–5	25–50	0–5	50–75
SB-01	25–50	0–5	25–50	0–5	0–5	25–50
SB-01	0–5	0–5	25–50	0–5	5–25	25–50
SB-01	5–25	0–5	5–25	5–25	5–25	50–75
SB-01	5–25	5–25	0–5	0–5	5–25	50–75
SB-01	5–25	0–5	0–5	0–5	0–5	5–25
SB-01	50–75	0–5	5–25	0–5	5–25	75–95
SB-01	5–25	0–5	5–25	25–50	5–25	50–75
SB-01	0–5	0–5	5–25	0–5	0–5	5–25
SB-01	5–25	0–5	25–50	0–5	5–25	25–50
SB-02	5–25	0–5	5–25	25–50	0–5	25–50
SB-02	0–5	0–5	0–5	5–25	5–25	5–25
SB-02	0–5	0–5	0–5	25–50	5–25	25–50
SB-02	0–5	0–5	5–25	5–25	5–25	5–25
SB-02	25–50	0–5	5–25	5–25	25–50	50–75
SB-02	5–25	0–5	0–5	0–5	0–5	25–50

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
SB-02	0–5	0–5	0–5	25–50	0–5	25–50
SB-02	5–25	0–5	25–50	0–5	5–25	50–75
SB-02	25–50	0–5	5–25	0–5	5–25	25–50
SB-02	25–50	0–5	5–25	5–25	5–25	25–50
SB-02	50–75	0–5	5–25	0–5	5–25	50–75
SB-02	25–50	0–5	5–25	0–5	5–25	50–75
SB-02	0–5	0–5	0–5	25–50	0–5	25–50
SB-02	5–25	5–25	0–5	25–50	0–5	25–50
SB-02	25–50	0–5	5–25	0–5	25–50	75–95
SB-02	5–25	0–5	5–25	0–5	5–25	50–75
SB-02	25–50	0–5	5–25	5–25	5–25	50–75
SB-02	25–50	0–5	25–50	0–5	25–50	75–95
SB-03	25–50	0–5	5–25	25–50	5–25	50–75
SB-03	50–75	0–5	5–25	0–5	5–25	50–75
SB-03	25–50	0–5	0–5	0–5	5–25	25–50
SB-03	5–25	0–5	0–5	50–75	0–5	50–75
SB-03	5–25	0–5	5–25	0–5	5–25	5–25
SB-03	25–50	0–5	5–25	0–5	5–25	50–75
SB-03	50–75	5–25	0–5	0–5	5–25	50–75
SB-03	5–25	0–5	5–25	25–50	5–25	75–95
SB-03	25–50	0–5	5–25	0–5	5–25	50–75
SB-03	50–75	0–5	5–25	0–5	0–5	75–95
SB-03	25–50	0–5	5–25	0–5	5–25	50–75
SB-03	25–50	0–5	0–5	25–50	0–5	50–75
SB-03	75–95	5–25	5–25	0–5	5–25	75–95
SB-03	50–75	5–25	0–5	0–5	5–25	50–75
SB-03	75–95	0–5	0–5	0–5	0–5	95–100
SB-03	75–95	5–25	5–25	0–5	0–5	95–100

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
SB-03	75–95	0–5	5–25	0–5	0–5	75–95
SB-03	75–95	5–25	5–25	0–5	5–25	95–100

MIXED-GRASS PRAIRIE

Table C-2. Mixed-Grass Prairie Canopy Cover Data

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
MGP-01	50–75	0–5	5–25	0–5	5–25	95–100
MGP-01	75–95	0–5	5–25	0–5	5–25	95–100
MGP-01	75–95	0–5	5–25	0–5	5–25	95–100
MGP-01	50–75	0–5	5–25	0–5	25 - 50	95–100
MGP-01	50–75	0–5	25–50	0–5	5–25	95–100
MGP-01	75–95	0 – 5	25–50	0–5	5–25	95–100
MGP-01	75–95	0–5	0–5	0–5	0–5	95–100
MGP-01	75–95	5–25	5–25	0–5	5–25	75–95
MGP-01	75–95	0–5	0–5	0–5	5–25	75–95
MGP-01	95–100	5–25	0–5	0–5	5–25	95–100
MGP-01	75–95	0–5	0–5	0–5	25 - 50	95–100
MGP-01	75–95	0–5	5–25	0–5	25 - 50	95–100
MGP-01	95–100	0–5	5–25	0–5	0–5	95–100
MGP-01	75–95	0–5	5–25	0–5	5–25	95–100
MGP-01	50–75	0–5	5–25	0–5	25–50	95–100
MGP-01	95–100	0–5	5–25	0–5	5–25	95–100
MGP-01	50–75	0–5	25–50	0–5	25–50	95–100
MGP-01	75–95	0–5	5–25	0–5	0–5	95–100
MGP-02	50–75	0–5	5–25	0–5	5–25	50–75

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
MGP-02	25–50	5–25	5–25	0–5	5–25	50–75
MGP-02	50–75	0–5	5–25	0–5	5–25	75–95
MGP-02	50–75	0–5	5–25	0–5	5–25	50–75
MGP-02	50–75	0–5	5–25	0–5	5–25	50–75
MGP-02	50–75	0–5	5–25	0–5	25–50	75–95
MGP-02	25–50	0–5	25–50	0–5	25–50	50–75
MGP-02	25–50	0–5	5–25	0–5	5–25	50–75
MGP-02	25–50	0–5	5–25	0–5	5–25	50–75
MGP-02	50–75	0–5	5–25	0–5	5–25	75–95
MGP-02	5–25	0–5	75–95	0–5	5–25	95–100
MGP-02	25–50	0–5	25–50	0–5	5–25	75–95
MGP-02	25–50	0–5	5–25	0–5	5–25	75–95
MGP-02	25–50	0–5	5–25	0–5	5–25	50–75
MGP-02	25–50	0–5	0–5	0–5	5–25	50–75
MGP-02	25–50	0–5	5–25	0–5	5–25	50–75
MGP-02	25–50	0–5	5–25	0–5	5–25	50–75
MGP-02	5–25	0–5	0–5	0–5	5–25	25–50
MGP-03	5–25	5–25	25–50	0–5	25–50	95–100
MGP-03	25–50	0–5	25–50	0–5	5–25	75–95
MGP-03	25–50	0–5	5–25	0–5	5–25	50–75
MGP-03	50–75	0–5	5–25	0–5	5–25	75–95
MGP-03	50–75	0–5	5–25	0–5	5–25	75–95
MGP-03	25–50	5–25	5–25	0–5	5–25	50–75
MGP-03	50–75	5–25	25–50	0–5	5–25	95–100
MGP-03	25–50	5–25	5–25	0–5	25–50	75–95
MGP-03	50–75	0–5	5–25	0–5	5–25	75–95
MGP-03	25–50	0–5	5–25	0–5	25–50	50–75
MGP-03	50–75	0–5	0–5	0–5	0–5	50–75

Sample Point ID	Grass Cover (%)	Annual Grass Cover (%)	Forb Cover (%)	Shrub Cover (%)	Litter Cover (%)	Total Cover (%)
MGP-03	50–75	25–50	25–50	0–5	25–50	95–100
MGP-03	25–50	5–25	25–50	0–5	25–50	95–100
MGP-03	25–50	0–5	5–25	0–5	5–25	50–75
MGP-03	25–50	0–5	0–5	0–5	5–25	50–75
MGP-03	25–50	5–25	25–50	0–5	5–25	95–100
MGP-03	25–50	0–5	0–5	0–5	25–50	50–75
MGP-03	25–50	0–5	5–25	0–5	5–25	50–75

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APPENDIX D

Sagebrush Density Data

BIG SAGEBRUSH SHRUBLAND

Table D-1. Big Sagebrush Shrubland Sagebrush Density Data

Sample Point ID	Transect #	Quad	Quadrat One – Northwest		Quadrat Two – Northeast		Quadrat Three – Southeast		Quadrat Four – Southwest	
			Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)
SB-01	Transect 1	1	0	8	1	12	0	9	1	13
SB-01	Transect 1	2	1	9	2	18	1	10	1	9
SB-01	Transect 1	3	1	9	2	10	1	8	0	11
SB-01	Transect 1	4	1	15	1	13	0	10	1	10
SB-01	Transect 2	5	1	8	0	20	1	15	1	9
SB-01	Transect 2	6	1	8	1	10	1	10	0	7
SB-01	Transect 2	7	1	14	0	17	1	18	1	21
SB-01	Transect 2	8	0	18	0	11	3	24	1	14
SB-01	Transect 3	9	1	18	0	15	1	22	1	12
SB-01	Transect 3	10	2	19	3	17	4	13	3	27
SB-01	Transect 3	11	1	13	3	14	2	12	1	13
SB-01	Transect 3	12	0	17	0	16	1	15	1	20
SB-02	Transect 1	1	1	43	0	22	1	25	1	17
SB-02	Transect 1	2	1	25	1	16	1	11	1	21
SB-02	Transect 1	3	1	49	1	14	1	20	1	21
SB-02	Transect 1	4	1	12	1	13	1	18	1	22
SB-02	Transect 2	5	1	21	1	19	1	22	1	18
SB-02	Transect 2	6	1	17	1	13	1	20	0	14
SB-02	Transect 2	7	1	48	1	18	1	34	1	15
SB-02	Transect 2	8	2	13	1	19	1	11	1	8
SB-02	Transect 3	9	1	52	1	57	1	44	1	39
SB-02	Transect 3	10	2	50	1	19	1	18	2	28
SB-02	Transect 3	11	1	17	1	22	1	18	1	14

Sample Point ID	Transect #	Quad	Quadrat One – Northwest		Quadrat Two – Northeast		Quadrat Three – Southeast		Quadrat Four – Southwest	
			Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)
SB-02	Transect 3	12	1	17	1	16	1	17	1	21
SB-03	Transect 1	1	1	31	2	33	2	20	1	33
SB-03	Transect 1	2	1	20	0	29	2	32	1	28
SB-03	Transect 1	3	1	13	1	14	1	18	1	20
SB-03	Transect 1	4	3	17	3	16	2	19	3	8
SB-03	Transect 2	5	0	20	2	22	2	43	1	23
SB-03	Transect 2	6	2	27	2	27	1	20	1	17
SB-03	Transect 2	7	1	19	1	24	1	14	0	12
SB-03	Transect 2	8	10	25	1	40	1	32	0	19
SB-03	Transect 3	9	2	18	0	9	2	22	1	11
SB-03	Transect 3	10	1	35	1	26	2	27	1	26
SB-03	Transect 3	11	1	26	3	36	2	30	3	20
SB-03	Transect 3	12	0	20	3	26	1	17	2	21

MIXED-GRASS PRAIRIE

Table D-2. Mixed-Grass Prairie Sagebrush Density Data

Sample Point ID	Transect #	Quad	Quadrat One - Northwest		Quadrat Two – Northeast		Quadrat Three – Southeast		Quadrat Four – Southwest	
			Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m).	Height (cm)	Distance (m)	Height (cm)
MGP-01	Transect 1	1	5	–	5	–	5	–	5	–
MGP-01	Transect 1	2	5	–	5	–	5	–	5	–
MGP-01	Transect 1	3	5	–	5	–	5	–	5	–
MGP-01	Transect 1	4	5	–	5	–	5	–	5	–
MGP-01	Transect 2	5	5	–	5	–	5	–	5	–
MGP-01	Transect 2	6	5	–	5	–	5	–	5	–

Sample Point ID	Transect #	Quad	Quadrat One - Northwest		Quadrat Two – Northeast		Quadrat Three – Southeast		Quadrat Four – Southwest	
			Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)
MGP-01	Transect 2	7	5	–	5	–	5	–	5	–
MGP-01	Transect 2	8	5	–	5	–	5	–	5	–
MGP-01	Transect 3	9	5	–	5	–	5	–	5	–
MGP-01	Transect 3	10	5	–	5	–	5	–	5	–
MGP-01	Transect 3	11	5	–	5	–	5	–	5	–
MGP-01	Transect 3	12	5	–	5	–	5	–	5	–
MGP-02	Transect 1	1	5	–	5	–	5	–	5	–
MGP-02	Transect 1	2	5	–	5	–	5	–	5	–
MGP-02	Transect 1	3	5	–	5	–	5	–	5	–
MGP-02	Transect 1	4	5	–	5	–	5	–	5	–
MGP-02	Transect 2	5	5	–	5	–	5	–	5	–
MGP-02	Transect 2	6	5	–	5	–	5	–	5	–
MGP-02	Transect 2	7	5	–	5	–	5	–	5	–
MGP-02	Transect 2	8	5	–	5	–	5	–	5	–
MGP-02	Transect 3	9	5	–	5	–	5	–	5	–
MGP-02	Transect 3	10	5	–	5	–	5	–	5	–
MGP-02	Transect 3	11	5	–	5	–	5	–	5	–
MGP-02	Transect 3	12	5	–	5	–	5	–	5	–
MGP-03	Transect 1	1	5	–	5	–	5	–	5	–
MGP-03	Transect 1	2	5	–	5	–	5	–	5	–
MGP-03	Transect 1	3	5	–	5	–	5	–	5	–
MGP-03	Transect 1	4	5	–	5	–	5	–	5	–
MGP-03	Transect 2	5	5	–	5	–	5	–	5	–
MGP-03	Transect 2	6	5	–	5	–	5	–	5	–
MGP-03	Transect 2	7	5	–	5	–	5	–	5	–
MGP-03	Transect 2	8	5	–	5	–	5	–	5	–

Sample Point ID	Transect #	Quad	Quadrat One - Northwest		Quadrat Two – Northeast		Quadrat Three – Southeast		Quadrat Four – Southwest	
			Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)	Distance (m)	Height (cm)
MGP-03	Transect 3	9	5	–	5	–	5	–	5	–
MGP-03	Transect 3	10	5	–	5	–	5	–	5	–
MGP-03	Transect 3	11	5	–	5	–	5	–	5	–
MGP-03	Transect 3	12	5	–	5	–	5	–	5	–

Note: Default value of 5 automatically applied for calculations if nearest sagebrush was more than 5 m away. Heights were not recorded for sagebrush greater then 5 m away, nor was a default value assigned for calculations.

APPENDIX E

Species Diversity and Composition Data

BIG SAGEBRUSH SHRUBLAND

Table E-1. Big Sagebrush Shrubland Species Diversity and Composition Data

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-01	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	Present
SB-01	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	–
SB-01	AGCR	*Agropyron cristatum*	Crested wheatgrass	Cool-season perennial grass	Introduced	Present
SB-01	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
SB-01	ARPU9	*Aristida purpurea*	Purple threeawn	Cool-season perennial grass	Native	–
SB-01	ARTR2	*Artemisia tridentata*	Big sagebrush	Shrub	Native	Present
SB-01	ATGA	*Atriplex gardneri*	Gardner's saltbush	Shrub	Native	Present
SB-01	BODA2	*Bouteloua dactyloides*	Buffalograss	Warm-season perennial grass	Native	Present
SB-01	BOGR2	*Bouteloua gracilis*	Blue grama	Warm-season perennial grass	Native	-
SB-01	BRAR5	*Bromus arvensis*	Field brome	Annual grass	Introduced	Present
SB-01	BRIN2	*Bromus inermis*	Smooth brome	Cool-season perennial grass	Introduced	Present
SB-01	CAFI	*Carex filifolia*	Threadleaf sedge	Other graminoid	Native	Present
SB-01	CEAR4	*Cerastium arvense*	Field chickweed	Perennial forb	Native	–
SB-01	CIUN	*Cirsium undulatum*	Wavyleaf thistle	Annual/biennial forb	Native	–
SB-01	COUM	*Comandra umbellata*	Bastard toadflax	Perennial forb	Native	–
SB-01	DESO2	*Descurainia sophia*	Herb sophia	Annual/biennial forb	Introduced	–
SB-01	ELLA3	*Elymus lanceolatus*	Thickspike wheatgrass	Cool-season perennial grass	Native	Present
SB-01	ELTR7	*Elymus trachycaulus*	Slender wheatgrass	Cool-season perennial grass	Native	Present
SB-01	ERNA10	*Ericameria nauseosa*	Rubber rabbitbrush	Shrub	Native	Present
SB-01	ERPA9	*Eriogonum pauciflorum*	Fewflower buckwheat	Perennial forb	Native	Present
SB-01	GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Subshrub	Native	Present
SB-01	HEHI	*Hedeoma hispida*	Rough false pennyroyal	Annual/biennial forb	Native	Present
SB-01	HEPA19	*Helianthus pauciflorus*	Stiff sunflower	Perennial forb	Native	–
SB-01	KOMA	*Koeleria macrantha*	Prairie Junegrass	Cool-season perennial grass	Native	Present

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-01	LEDE	*Lepidium densiflorum*	Common pepperweed	Annual/biennial forb	Native	Present
SB-01	LIPU	*Liatris punctata*	Dotted blazing star	Perennial forb	Native	–
SB-01	LODI	*Lomatium dissectum*	Fernleaf biscuitroot	Perennial forb	Native	Present
SB-01	LOFO	*Lomatium foeniculaceum*	Desert biscuitroot	Perennial forb	Native	–
SB-01	LOUN	*Lotus unifoliolatus*	American bird's-foot trefoil	Annual/biennial forb	Native	Present
SB-01	MESA	*Medicago sativa*	Alfalfa	Perennial forb	Introduced	–
SB-01	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
SB-01	ORFA	*Orobanche fasciculata*	Clustered broomrape	Annual/biennial forb	Native	Present
SB-01	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial gress	Native	–
SB-01	PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	–
SB-01	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	Present
SB-01	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	–
SB-01	PODO4	*Polygonum douglasii*	Douglas' knotweed	Annual/biennial forb	Native	Present
SB-01	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	–
SB-01	SPCO	*Sphaeralcea coccinea*	Scarlet globemallow	Perennial forb	Native	–
SB-01	TAOF	*Taraxacum officinale*	Common dandelion	Perennial forb	Introduced	–
SB-01	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	–
SB-01	THRH	*Thermopsis rhombifolia*	Prairie thermopsis	Perennial forb	Native	Present
SB-01	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	–
SB-01	TRLE3	*Triodanis leptocarpa*	Slimpod Venus' looking-glass	Annual/biennial forb	Native	Present
SB-01	TRMA20	*Triglochin maritima*	Seaside arrowgrass	Other greminoid	Native	Present
SB-01	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
SB-01	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	Present
SB-02	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	Present
SB-02	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	–
SB-02	AGCR	*Agropyron cristatum*	Crested wheatgrass	Cool-season perennial grass	Introduced	Present
SB-02	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
SB-02	ARPU9	*Aristida purpurea*	Purple threeawn	Cool-season perennial gress	Native	–

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-02	ARTR2	*Artemisia tridentata*	Big sagebrush	Shrub	Native	Present
SB-02	ATGA	*Atriplex gardneri*	Gardner's saltbush	Shrub	Native	Present
SB-02	BODA2	*Bouteloua dactyloides*	Buffalograss	Warm-season perennial grass	Native	Present
SB-02	BOGR2	*Bouteloua gracilis*	Blue grama	Warm-season perennial grass	Native	–
SB-02	BRAR5	*Bromus arvensis*	Field brome	Annual grass	Introduced	Present
SB-02	BRIN2	*Bromus inermis*	Smooth brome	Cool-season perennial grass	Introduced	–
SB-02	CAFI	*Carex filifolia*	Threadleaf sedge	Other graminoid	Native	–
SB-02	CEAR4	*Cerastium arvense*	Field chickweed	Perennial forb	Native	–
SB-02	CIUN	*Cirsium undulatum*	Wavyleaf thistle	Annual/biennial forb	Native	–
SB-02	COUM	*Comandra umbellata*	Bastard toadflax	Perennial forb	Native	–
SB-02	DESO2	*Descurainia sophia*	Herb sophia	Annual/biennial forb	Introduced	–
SB-02	ELLA3	*Elymus lanceolatus*	Thickspike wheatgrass	Cool-season perennial grass	Native	Present
SB-02	ELTR7	*Elymus trachycaulus*	Slender wheatgrass	Cool-season perennial grass	Native	Present
SB-02	ERNA10	*Ericameria nauseosa*	Rubber rabbitbrush	Shrub	Native	–
SB-02	ERPA9	*Eriogonum pauciflorum*	Fewflower buckwheat	Perennial forb	Native	–
SB-02	GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Subshrub	Native	–
SB-02	HEHI	*Hedeoma hispida*	Rough false pennyroyal	Annual/biennial forb	Native	–
SB-02	HEPA19	*Helianthus pauciflorus*	Stiff sunflower	Perennial forb	Native	–
SB-02	KOMA	*Koeleria macrantha*	Prairie Junegrass	Cool-season perennial grass	Native	–
SB-02	LEDE	*Lepidium densiflorum*	Common pepperweed	Annual/biennial forb	Native	Present
SB-02	LIPU	*Liatris punctata*	Dotted blazing star	Perennial forb	Native	–
SB-02	LODI	*Lomatium dissectum*	Fernleaf biscuitroot	Perennial forb	Native	Present
SB-02	LOFO	*Lomatium foeniculaceum*	Desert biscuitroot	Perennial forb	Native	–
SB-02	LOUN	*Lotus unifoliolatus*	American bird's-foot trefoil	Annual/biennial forb	Native	-
SB-02	MESA	*Medicago sativa*	Alfalfa	Perennial forb	Introduced	Present
SB-02	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
SB-02	ORFA	*Orobanche fasciculata*	Clustered broomrape	Annual/biennial forb	Native	–
SB-02	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial grass	Native	Present

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-02	PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	–
SB-02	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	–
SB-02	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	–
SB-02	PODO4	*Polygonum douglasii*	Douglas' knotweed	Annual/biennial forb	Native	Present
SB-02	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	Present
SB-02	SPCO	*Sphaeralcea coccinea*	SCARLET globemallow	Perennial forb	Native	Present
SB-02	TAOF	*Taraxacum officinale*	common dandelion	Perennial forb	Introduced	–
SB-02	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	Present
SB-02	THRH	*Thermopsis rhombifolia*	Prairie thermopsis	Perennial forb	Native	–
SB-02	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	–
SB-02	TRLE3	*Triodanis leptocarpa*	Slimpod Venus' looking-glass	Annual/biennial forb	Native	–
SB-02	TRMA20	*Triglochin maritima*	Seaside arrowgrass	Other graminoid	Native	–
SB-02	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
SB-02	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	Present
SB-03	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	Present
SB-03	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	Present
SB-03	AGCR	*Agropyron cristatum*	Crested wheatgrass	Cool-season perennial grass	Introduced	Present
SB-03	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
SB-03	ARPU9	*Aristida purpurea*	Purple threeawn	Cool-season perennial grass	Native	Present
SB-03	ARTR2	*Artemisia tridentata*	Big sagebrush	Shrub	Native	Present
SB-03	ATGA	*Atriplex gardneri*	Gardner's saltbush	Shrub	Native	–
SB-03	BODA2	*Bouteloua dactyloides*	Buffalograss	Warm-season perennial grass	Native	Present
SB-03	BOGR2	*Bouteloua gracilis*	Blue grama	Warm-season perennial grass	Native	Present
SB-03	BRAR5	*Bromus arvensis*	Field brome	Annual grass	Introduced	Present
SB-03	BRIN2	*Bromus inermis*	Smooth brome	Cool-season perennial grass	Introduced	–
SB-03	CAFI	*Carex filifolia*	Threadleaf sedge	Other graminoid	Native	–
SB-03	CEAR4	*Cerastium arvense*	Field chickweed	Perennial forb	Native	Present
SB-03	CIUN	*Cirsium undulatum*	Wavyleaf thistle	Annual/biennial forb	Native	Present

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-03	COUM	*Comandra umbellata*	Bastard toadflax	Perennial forb	Native	Present
SB-03	DESO2	*Descurainia sophia*	Herb sophia	Annual/biennial forb	Introduced	Present
SB-03	ELLA3	*Elymus lanceolatus*	Thickspike wheatgrass	Cool-season perennial grass	Native	Present
SB-03	ELTR7	*Elymus trachycaulus*	Slender wheatgrass	Cool-season perennial grass	Native	Present
SB-03	ERNA10	*Ericameria nauseosa*	Rubber rabbitbrush	Shrub	Native	Present
SB-03	ERPA9	*Eriogonum pauciflorum*	Fewflower buckwheat	Perennial forb	Native	–
SB-03	GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Subshrub	Native	–
SB-03	HEHI	*Hedeoma hispida*	Rough false pennyroyal	Annual/biennial forb	Native	Present
SB-03	HEPA19	*Helianthus pauciflorus*	Stiff sunflower	Perennial forb	Native	Present
SB-03	KOMA	*Koeleria macrantha*	Prairie Junegrass	Cool-season perennial grass	Native	Present
SB-03	LEDE	*Lepidium densiflorum*	Common pepperweed	Annual/biennial forb	Native	Present
SB-03	LIPU	*Liatris punctata*	Dotted blazing star	Perennial forb	Native	Present
SB-03	LODI	*Lomatium dissectum*	Fernleaf biscuitroot	Perennial forb	Native	–
SB-03	LOFO	*Lomatium foeniculaceum*	Desert biscuitroot	Perennial forb	Native	Present
SB-03	LOUN	*Lotus unifoliolatus*	American bird's-foot trefoil	Annual/biennial forb	Native	Present
SB-03	MESA	*Medicago sativa*	Alfalfa	Perennial forb	Introduced	–
SB-03	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
SB-03	ORFA	*Orobanche fasciculata*	Clustered broomrape	Annual/biennial forb	Native	–
SB-03	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial grass	Native	Present
SB-03	PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	Present
SB-03	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	Present
SB-03	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	Present
SB-03	PODO4	*Polygonum douglasii*	Douglas' knotweed	Annual/biennial forb	Native	Present
SB-03	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	Present
SB-03	SPCO	*Sphaeralcea coccinea*	Scarlet globemallow	Perennial forb	Native	Present
SB-03	TAOF	*Taraxacum officinale*	Common dandelion	Perennial forb	Introduced	Present
SB-03	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	–
SB-03	THRH	*Thermopsis rhombifolia*	Prairie thermopsis	Perennial forb	Native	Present

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
SB-03	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	Present
SB-03	TRLE3	*Triodanis leptocarpa*	Slimpod Venus' looking-glass	Annual/biennial forb	Native	–
SB-03	TRMA20	*Triglochin maritima*	Seaside arrowgrass	Other graminoid	Native	–
SB-03	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
SB-03	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	Present

MIXED-GRASS PRAIRIE

Table E-2. Mixed-Grass Prairie Species Diversity and Composition Data

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
MGP-01	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	Present
MGP-01	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	Present
MGP-01	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
MGP-01	ASPU9	*Astragalus purshii*	Woollypod milkvetch	Perennial forb	Native	–
MGP-01	ATAR2	*Atriplex argentea*	Silverscale saltbush	Annual/biennial forb	Native	–
MGP-01	BODA2	*Bouteloua dactyloides*	Buffalograss	Warm-season perennial grass	Native	Present
MGP-01	BOGR2	*Bouteloua gracilis*	Blue grama	Warm-season perennial grass	Native	Present
MGP-01	BRAR5	*Bromus arvensis*	Field brome	Annual grass	Introduced	Present
MGP-01	BRIN2	*Bromus inermis*	Smooth brome	Cool-season perennial grass	Introduced	–
MGP-01	CAFI	*Carex filifolia*	Threadleaf sedge	Other graminoid	Native	–
MGP-01	CEAR4	*Cerastium arvense*	Field chickweed	Perennial forb	Native	Present
MGP-01	CHSE4	*Chamaesyce serpens*	Matted sandmat	Annual/biennial forb	Native	–
MGP-01	COUM	*Comandra umbellata*	Bastard toadflax	Perennial forb	Native	–
MGP-01	DESO2	*Descurainia sophia*	Herb sophia	Annual/biennial forb	Introduced	–
MGP-01	ELLA3	*Elymus lanceolatus*	Thickspike wheatgrass	Cool-season perennial grass	Native	Present
MGP-01	ELTR7	*Elymus trachycaulus*	Slender wheatgrass	Cool-season perennial grass	Native	Present

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
MGP-01	GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Subshrub	Native	–
MGP-01	HEHI	*Hedeoma hispida*	Rough false pennyroyal	Annual/biennial forb	Native	Present
MGP-01	HEPA19	*Helianthus pauciflorus*	Stiff sunflower	Perennial forb	Native	–
MGP-01	IVAX	*Iva axillaris*	Povertyweed	Perennial forb	Native	Present
MGP-01	LEDE	*Lepidium densiflorum*	Common pepperweed	Annual/biennial forb	Native	Present
MGP-01	LOFO	*Lomatium foeniculaceum*	Desert biscuitroot	Perennial forb	Native	–
MGP-01	MELU	*Medicago lupulina*	Black medick	Annual/biennial forb	Introduced	Present
MGP-01	MESA	*Medicago sativa*	Alfalfa	Perennial forb	Introduced	–
MGP-01	MYOSO	*Myosotis* sp.	Forget-me-not	Annual/biennial forb	Native	Present
MGP-01	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
MGP-01	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial grass	Native	Present
MGP-01	PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	–
MGP-01	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	Present
MGP-01	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	Present
MGP-01	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	Present
MGP-01	SIAN2	*Silene antirrhina*	Sleepy silene	Annual/biennial forb	Native	Present
MGP-01	SPCO	*Sphaeralcea coccinea*	Scarlet globemallow	Perennial forb	Native	Present
MGP-01	TAOF	*Taraxacum officinale*	Common dandelion	Perennial forb	Introduced	Present
MGP-01	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	Present
MGP-01	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	Present
MGP-01	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
MGP-01	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	–
MGP-02	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	–
MGP-02	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	–
MGP-02	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
MGP-02	ASPU9	*Astragalus purshii*	Woollypod milkvetch	Perennial forb	Native	Present
MGP-02	ATAR2	*Atriplex argentea*	Silverscale saltbush	Annual/biennial forb	Native	Present
MGP-02	BODA2	*Bouteloua dactyloides*	Buffalograss	Warm-season perennial grass	Native	–

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
MGP-02	BOGR2	*Bouteloua gracilis*	Blue grama	Warm-season perennial grass	Native	Present
MGP-02	BRAR5	*Bromus arvensis*	Field brome	Annual grass	Introduced	Present
MGP-02	BRIN2	*Bromus inermis*	Smooth brome	Cool-season perennial grass	Introduced	Present
MGP-02	CAFI	*Carex filifolia*	Threadleaf sedge	Other graminoid	Native	Present
MGP-02	CEAR4	*Cerastium arvense*	Field chickweed	Perennial forb	Native	–
MGP-02	CHSE4	*Chamaesyce serpens*	Matted sandmat	Annual/biennial forb	Native	Present
MGP-02	COUM	*Comandra umbellata*	Bastard toadflax	Perennial forb	Native	Present
MGP-02	DESO2	*Descurainia sophia*	Herb sophia	Annual/biennial forb	Introduced	–
MGP-02	ELLA3	*Elymus lanceolatus*	Thickspike wheatgrass	Cool-season perennial grass	Native	Present
MGP-02	ELTR7	*Elymus trachycaulus*	Slender wheatgrass	Cool-season perennial grass	Native	Present
MGP-02	GUSA2	*Gutierrezia sarothrae*	Broom snakeweed	Subshrub	Native	Present
MGP-02	HEHI	*Hedeoma hispida*	Rough false pennyroyal	Annual/biennial forb	Native	–
MGP-02	HEPA19	*Helianthus pauciflorus*	Stiff sunflower	Perennial forb	Native	Present
MGP-02	IVAX	*Iva axillaris*	Povertyweed	Perennial forb	Native	–
MGP-02	LEDE	*Lepidium densiflorum*	Common pepperweed	Annual/biennial forb	Native	Present
MGP-02	LOFO	*Lomatium foeniculaceum*	Desert biscuitroot	Perennial forb	Native	Present
MGP-02	MELU	*Medicago lupulina*	Black medick	Annual/biennial forb	Introduced	Present
MGP-02	MESA	*Medicago sativa*	Alfalfa	Perennial forb	Introduced	–
MGP-02	MYOSO	*Myosotis* sp.	Forget-me-not	Annual/biennial forb	Native	–
MGP-02	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
MGP-02	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial grass	Native	Present
MGP-02	PEAR6	*Padiomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	Present
MGP-02	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	Present
MGP-02	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	–
MGP-02	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	Present
MGP-02	SIAN2	*Silene antirrhina*	Sleepy silene	Annual/biennial forb	Native	–
MGP-02	SPCO	*Sphaeralcaa coccinea*	Scarlet globemallow	Perennial forb	Native	Present
MGP-02	TAOF	*Taraxacum officinale*	Common dandelion	Perennial forb	Introduced	–

Sample Point ID	USDA Symbol	Scientific Name	Common Name	Functional Group	Native Status	Presence
MGP-02	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	–
MGP-02	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	–
MGP-02	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
MGP-02	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	–
MGP-03	ACMI2	*Achillea millefolium*	Common yarrow	Perennial forb	Native	–
MGP-03	ACNE9	*Achnatherum nelsonii*	Columbia needlegrass	Cool-season perennial grass	Native	–
MGP-03	ALAL3	*Alyssum alyssoides*	Pale madwort	Annual/biennial forb	Introduced	Present
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MGP-03	CEAR4	*Carastium arvense*	Field chickweed	Perennial forb	Native	–
MGP-03	CHSE4	*Chamaesyce serpens*	Matted sandmat	Annual/biennial forb	Native	–
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MGP-03	OPPO	*Opuntia polyacantha*	Plains pricklypear	Succulent	Native	Present
MGP-03	PASM	*Pascopyrum smithii*	Western wheatgrass	Cool-season perennial grass	Native	Present
MGP-03	PEAR6	*Pediomelum argophyllum*	Silverleaf Indian breadroot	Perennial forb	Native	Present
MGP-03	PLPA2	*Plantago patagonica*	Woolly plantain	Annual/biennial forb	Native	Present
MGP-03	POCO	*Poa compressa*	Canada bluegrass	Cool-season perennial grass	Introduced	–
MGP-03	POSE	*Poa secunda*	Sandberg bluegrass	Cool-season perennial grass	Native	Present
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MGP-03	THAR5	*Thlaspi arvense*	Field pennycress	Annual/biennial forb	Introduced	Present
MGP-03	TRDU	*Tragopogon dubius*	Yellow salsify	Annual/biennial forb	Introduced	–
MGP-03	VIAM	*Vicia americana*	American vetch	Perennial forb	Native	Present
MGP-03	VUOC	*Vulpia octoflora*	Sixweeks fescue	Annual grass	Native	Present

APPENDIX 5

Baseline Hydrology Report for the Larsen Project, Butte County, South Dakota

Baseline Hydrology Report for the Larsen Project, Butte County, South Dakota

MARCH 2024

PREPARED FOR

Bentonite Performance Minerals, LLC

PREPARED BY

SWCA Environmental Consultants

BASELINE HYDROLOGY REPORT FOR THE LARSEN PROJECT, BUTTE COUNTY, SOUTH DAKOTA

Prepared for

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SWCA Project No. 71676

March 2024

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Figure

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INTRODUCTION

Bentonite Performance Minerals, LLC, proposes to establish a bentonite mine in Butte County, South Dakota, referred to as the Larsen Project (project). The project area lies between Colony, Wyoming, to the west and Belle Fourche, South Dakota, to the east. The project is on private lands in the southwestern portion of Butte County, South Dakota, approximately 7 miles northwest of Belle Fourche in portions of Sections 2, 3, and 11, Township 9 North, Range 1 East along U.S. Highway 212. The project encompasses approximately 307 acres (Figure 1).

Both historical and active bentonite mining has taken place for many years in this area between Colony, Wyoming, and Belle Fourche, South Dakota. The project lies in an upland area between two streams along Crow Creek and Middle Creek.

South Dakota Department of Agriculture and Natural Resources (SD DANR) was consulted regarding the need to conduct site-specific surface water or groundwater sampling. SD DANR confirmed that baseline water sampling would not be required for this project (personal communication, email from Roberta Hudson, Engineer Manager, SD DANR, to Michael Barr, Bentonite Performance Minerals, LLC, April 29, 2022).

WATER RESOURCES

Surface Water

The project has two National Hydrography Dataset (NHD) flowlines and one wetland feature (freshwater emergent wetland) within in the project (see Figure 1), according to the National Wetlands Inventory and NHD (U.S. Fish and Wildlife Service 2022; U.S. Geological Survey 2022). The project lies in an upland area between Middle Creek and Crow Creek. Both of these streams flow generally from northwest to southeast and are tributaries to the Belle Fourche River. Watersheds identified in association with the project are the Middle Creek-Belle Fourche River and the Lower Crow Creek watersheds. No waterbodies within either watershed have been assessed against U.S. Environmental Protection Agency (EPA)–approved water quality standards or thresholds (EPA 2023).

Crow Creek is to the north of the project and is an order 4 stream. The stream is approximately 1,100 feet from the closest point of the project boundary and has an annual mean flow of 6 cubic feet per second in that area (EPA 2023). South Dakota surface water quality standards assigned to this stream include warmwater marginal fish life propagation waters, limited-contact recreation waters, fish and wildlife propagation, recreation and stock watering waters, and irrigation waters (SD DANR 2023).

Middle Creek is an order 3 stream that lies south of the project. The stream is approximately 1,700 feet from the closest point of the project boundary and has an annual mean flow of 2 cubic feet per second in that area (EPA 2023). There have been no South Dakota surface water quality standards assigned to this stream.

Mining impacts to surface water resources in the area should be minimal. There will be no direct mining impacts to either Middle Creek or Crow Creek.

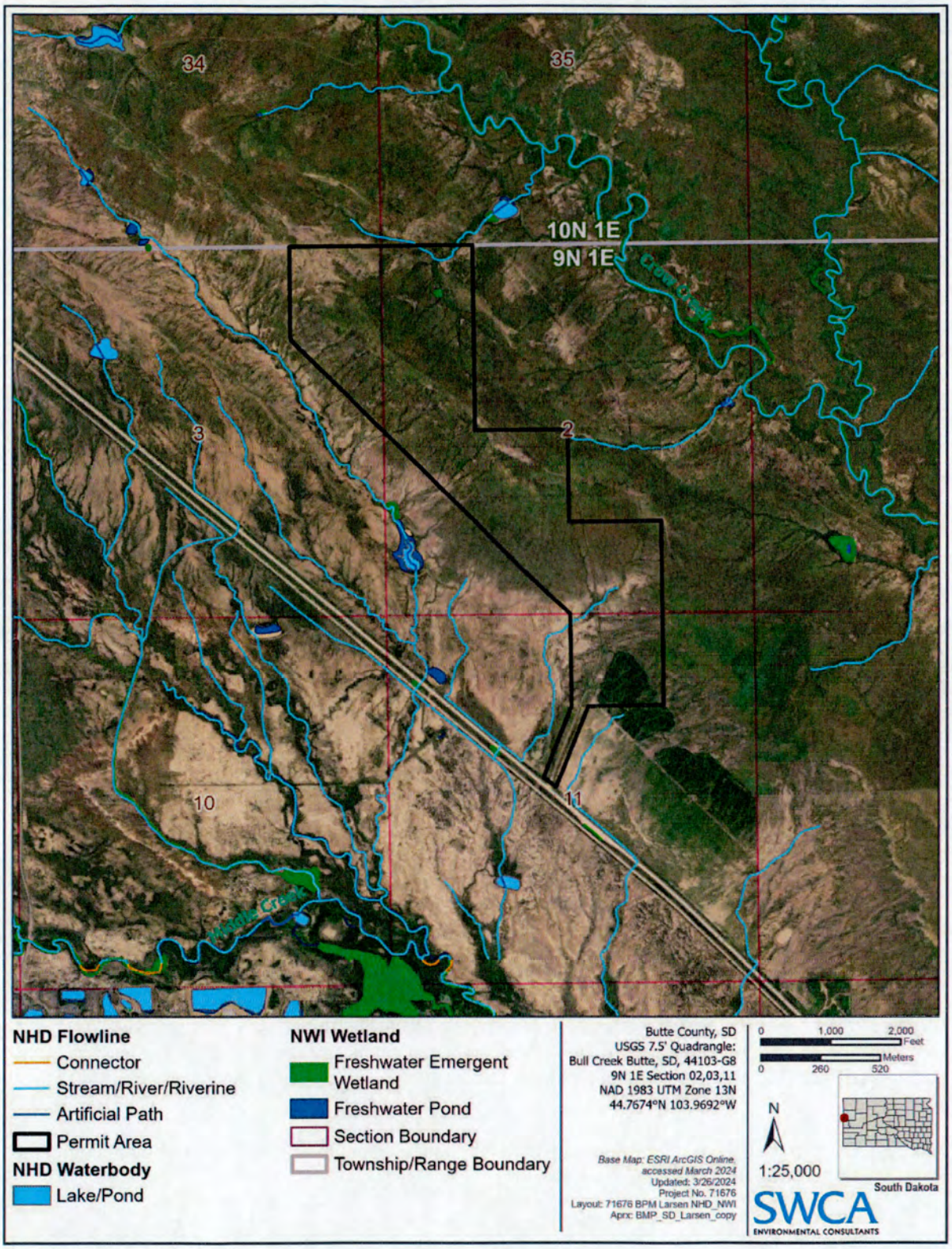

Figure 1. Project hydrology.

Groundwater

Mining impacts to groundwater resources in the area should be minimal. Exploration drilling was conducted in 2021. Drilling did not exceed 50 feet below the drilling surface, and no water was encountered. Drilling showed that the overburden is between 18 and 29 feet thick, and the clay bed is between 2 and 3 feet thick; therefore, surface mining operations are not expected to be deeper than 50 feet, and no groundwater impacts are expected.

Water Rights

There are no valid surface or groundwater rights within 1 mile of the project boundary (SD DANR 2024).

Wetlands

The National Wetlands Inventory and NHD identified the possibility of one freshwater emergent wetland within the project (see Figure 1). However, no wetlands were observed or recorded during baseline surveys conducted in 2022 and 2023 (SWCA Environmental Consultants [SWCA] 2023).

Critical Water Resources

The water resources in the project do not meet the requirements as outlined in South Dakota Codified Law 46-6B-33.3. The mining operations will not directly impact either Middle or Crow Creek adjacent to the project area. Bentonite mining has been conducted historically within the regional area. Groundwater resources will not be impacted by the mining operations, as there are no groundwater wells within or near the project, and surface mining is not expected to exceed 50 feet below ground surface. Exploration activities did not encounter groundwater at depths of 50 feet below ground surface.

LITERATURE CITED

South Dakota Department of Agriculture and Natural Resources (SD DANR). 2023. South Dakota Surface Water Quality Standards. Available at: https://sdgis.sd.gov/portal/apps/experiencebuilder/experience/?id=60c4f285d6c1458db0f6eac2b4f26c04. Accessed December 2023.

———. 2024. Interactive GIS Maps. Available at: https://danr.sd.gov/Press/DataAndMapping.aspx. Accessed March 2024.

SWCA Environmental Consultants (SWCA). 2023. *Baseline Wildlife Surveys and Vegetation Sampling Report for the Larsen Project, Butte County, South Dakota.* Sheridan, Wyoming: SWCA Environmental Consultants.

U.S. Environmental Protection Agency (EPA). 2023. National Hydrography Dataset Plus (NHDPlus). Available at: https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus. Accessed December 2023.

U.S. Fish and Wildlife Service. 2022. National Wetlands Inventory. 2022. Available at: https://www.fws.gov/wetlands/. Accessed November 2022.

U.S. Geological Survey. 2022. National Hydrography Dataset (NHD). Available at: http://nhd.usgs.gov/. Accessed December 2022.

APPENDIX 6

Socioeconomic Report for Bentonite Performance Minerals, LLC, Larsen Project, Butte County, South Dakota

Socioeconomic Assessment for the Larsen Mine Project, Butte County, South Dakota

MAY 2024

PREPARED FOR

Bentonite Performance Minerals, LLC

PREPARED BY

SWCA Environmental Consultants

RECEIVED
JUN 20 2024
MINERALS & MINING PROGRAM

SOCIOECONOMIC ASSESSMENT FOR THE LARSEN MINE PROJECT , BUTTE COUNTY, SOUTH DAKOTA

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May 2024

CONTENTS

Tables

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1 INTRODUCTION

This report examines the socioeconomic effects of the mine operation proposed by Bentonite Performance Minerals, LLC (BPM). The Larsen Project (Project) lies between Colony, Wyoming, to the west and Belle Fourche, South Dakota, to the east. The project is located on private lands in southwestern Butte County, approximately 7 miles northwest of Belle Fourche along U.S. Highway 212. The project is in portions of Sections 2, 3, and 11, Township 9 North, Range 1 East and encompasses approximately 307 acres.

The parcel would be developed such that bentonite ore could be extracted and transported to BPM's processing facility in Colony, Wyoming. The intent of the project is to supplement BPM's bentonite ore resources without modifying the overall scale or intensity of their operation. Essentially, ore produced as part of the project would replace production from the Security, Killinger, and Purple sites. Security is currently being permitted; Killinger and Purple were permitted in 2014 and reclaimed in 2020.

The proposed project aligns with the South Dakota Codified Laws for large-scale mining projects, specifically adhering to the requirements of South Dakota Codified Law 45-6B-33.1. Beyond the Security, Killinger, and Purple sites in Butte County, BPM possesses mining permits in adjacent regions, including near Colony in Crook County, Wyoming, and Carter County, Montana. Like the Butte County locations, the bentonite ore from both the existing and proposed projects, as well as from the Wyoming and Montana sites, is destined for BPM's processing facility in Colony, Wyoming.

The project, scheduled to span 10 years from the first quarter of 2022 to the first quarter of 2032, is divided into three main phases: site preparation, mining and processing, and reclamation. Phase 1 (site preparation) is expected to last 2 years and includes acquiring mineral and surface access, exploration, and permitting. Phase 2, extending over 7 years, is dedicated to mining, hauling, concurrent reclamation and off-site processing. The project concludes with Phase 3, which entails final reclamation tasks such as grading and seeding.

This report reviews existing socioeconomic conditions in Butte County and discusses the socioeconomic and fiscal impacts likely to be brought about by the project. The report also provides a comprehensive overview of BPM's contribution to the local and regional socioeconomic landscape. Of the 800 full-time equivalent (FTE) employees involved in regional BPM production, approximately 28 are allocated seasonally at the project for which this permit is being considered. Notably, 75% of these employees reside in Butte County, South Dakota, with the remainder coming from neighboring counties in South Dakota and Wyoming.

2 POPULATION, HOUSING, AND EMPLOYMENT

Table 1 provides population and housing information for Butte County and the state of South Dakota. From 2000 to 2023, the county's population increased by 14.0%, while the state saw a slightly more robust growth of 17.8%. With a median age of 40, the county has a marginally older population than the state with a median of 38. This observation is consistent with the higher proportion of residents aged 65 and over (19.6%) compared to the state average (17.3%) (Headwaters Economics 2024a, 2024b). The county is associated with a higher proportion of homeownership, with 80.2% of occupied housing units being owner-occupied in the county relative to 68.4% for the state. The median value of owner-occupied housing units in Butte County, at $189,000, is more affordable than the state's median. These factors combined depict a small, stable, rural, aging community.

Table 1: Selected Demographic Characteristics

	Butte County	Percent of total	South Dakota	Percent of total
Population, 2000	9,093	–	755,844	–
Population, 2023	10,369	–	890,342	–
Percent change in population: 2000–2023	14.0%	–	17.8%	–
Under 18 years	2,424	23.4%	216,612	24.3
65 years and over	2,033	19.6%	153,979	17.3
Median age	40	–	38	–
Total Housing Units	4,725	–	396,623	–
Occupied	4,112	87%	351,182	88.5
Owner occupied	3,296	80.2%	240,328	68.4
Renter occupied	816	19.8%	110,854	31.6
Vacant	613	13%	45,441	11.5
Average household size	2.49	–	2.44	–
Median Value	$189,000	–	$219,500	–

Source: Headwaters Economics (2024a, 2024b, 2024c).

As shown in Table 2, employment trends followed a similar pattern to population growth, with Butte County experiencing a 17.9% increase in employment compared to a 26.5% growth statewide. The per capita income in Butte County grew by 33.5%, from $35,782 in 2000 (adjusted to 2022 dollars) to $47,783 in 2022, only marginally higher than the statewide growth of 33.3% from $48,659 to $64,856. Despite comparable growth rates, Butte County residents earn a significantly lower per capita income (Headwaters Economics 2024c, 2024d). Overall, unemployment in Butte County is 1.7%. This is the lowest unemployment rate in the county over the last 50 years.

Table 2: Population, Employment, and Income Trends, 2000–2022

	Butte County	South Dakota
Employment, 2000	4,724	512,377
Employment, 2022	5,571	647,960
Percent change in employment: 2000–2022	17.9%	26.5%
Per capita income, 2000 (2022 dollars)	$35,782	$48,659
Per capita income, 2022 (2022 dollars)	$47,783	$64,656
Percent change in per capita income: 2000–2022	33.5%	33.3%

Source: Headwaters Economics (2024c, 2024d).

2.1 Butte County Communities

Belle Fourche is the most populous city in Butte County and is home to approximately 52.6% of the county's total population of 10,774 (Headwaters Economics 2024e). It contains most of the county's working-age population, positioning it as a center for employment, commerce, and social services within the region. The next largest communities in the county are Newell, Nisland, and Fruitdale, which account for 4.5%, 2.2%, and 1.2% of the county population, respectively (Headwaters Economics 2024f, 2024g,

2024h). Fruitdale and Nisland are characterized by much older populations, with a significant portion of residents over the age of 65.

3 EMPLOYMENT AND INCOME BY INDUSTRY

3.1 Employment by Industry

Employment rates across industries in Butte County, as outlined in Table 3, are broadly similar to the state. A notable exception is in the agriculture, forestry, fishing, hunting, and mining sector. In Butte County, this sector accounts for approximately 16.9% of total employment, which is significantly higher than the state's average of 6.3%. This notable difference is indicative of the importance of mining to the county's economy.

Table 3: Employment by Industry

	Butte County	Percent of total	South Dakota	Percent of total
Civilian employees > 16 years, 2022*	5,109	–	453,504	–
Agriculture, forestry, fishing and hunting, mining	862	16.9%	28,690	6.3%
Construction	399	7.8%	32,320	7.1%
Manufacturing	522	10.2%	45,679	10.1%
Wholesale trade	184	3.6%	11,788	2.6%
Retail trade	544	10.7%	51,598	11.4%
Transport, warehousing, and utilities	167	3.3%	20,204	4.5%
Information	7	0.1%	6,759	1.5%
Finance, insurance, and real estate	274	5.4%	32,564	7.2%
Professional, management, administration, and waste management	221	4.3%	30,733	6.8%
Education, health care, and social assistance	1,109	21.7%	111,602	24.6%
Arts, entertainment, recreation, accommodations, and food	341	6.7%	39,547	8.7%
Other services, except public administration	249	4.9%	20,214	4.5%
Public administration	230	4.5%	21,806	4.8%

Source: U.S. Census Bureau (2022a).

3.2 Income by Industry

Table 4 reports average earnings by sector. Earnings in in Butte County generally fall below the South Dakota state average, with two important exceptions. The mining, quarrying, oil, and gas extraction sector, with an average income of $66,806, along with the transport, warehousing, and utilities sector at $62,321, not only surpass the county's overall average income of $37,734 but also exceed state averages in these industries (U.S. Census Bureau 2022b). This demonstrates the substantial economic contributions of these sectors to Butte County, driven by the area's strong natural resource base and existing infrastructure.

Table 4: Average Per Capita Income by Industry

	Butte County	South Dakota
Overall	37,734	42,278
Agriculture, forestry, fishing and hunting, and mining:	58,162	45,232
Agriculture, forestry, fishing and hunting	39,231	43,449
Mining, quarrying, and oil and gas extraction	66,806	62,730
Construction	39,805	47,326
Manufacturing	46,000	47,728
Wholesale trade	47,969	55,814
Retail trade	24,826	28,433
Transport, warehousing, and utilities	62,321	56,558
Information	–	44,963
Finance, insurance, and real estate	42,344	50,998
Professional, management, administration, & waste management	34,964	47,242
Edu, health care, & social assistance	35,065	43,101
Arts, entertainment, recreation, accommodations, & food	7,345	19,300
Other services, except public administration	37,066	34,600
Public administration	51,853	53,306

Source: U.S. Census Bureau (2022b).

4 FISCAL IMPACTS

4.1 Property Tax

As detailed in Table 5, over 55% of Butte County property tax revenue is sent to school districts, whereas county government itself uses just over 28% of property tax revenue to funding a broad spectrum of county operations. Nearly all of the remaining property tax revenue goes to cities within the county.

Table 5: Butte County Property Tax Allocation

	Allocated	Percent of total
County	$4,094,269.59	28.3%
School	$8,088,643.64	55.9%
City	$2,216,522.89	15.3%
Other	$78,179.12	0.5%
Total	$14,477,615.24	100%

Source: South Dakota Department of Revenue (2022).

More than 89% of property tax revenue comes from the City of Belle Fourche (City of Belle Fourche 2023; South Dakota Department of Revenue 2022). This significant share underscores Belle Fourche's economic prominence within the county.

While BPM does not pay property taxes on the specific parcel for this permit, it does pay property taxes on other parcels in the region where it owns the surface. Additionally, BPM employees contribute to the property tax base through their ownership and rental of residential properties in the county. While the exact amount of this indirect contribution is not quantified, those property tax revenues support public services and infrastructure development in Butte County and the neighboring counties where employees reside.

4.2 Sales and Gross Receipts Tax

Sales taxes are an important source of revenue, supporting the provision of municipal services and state fiscal resources. Belle Fourche and the state of South Dakota both impose sales taxes, with the city levying a 2% general sales tax on most goods and services plus a 1% gross receipts tax on specific items such as prepared food, beverages, and lodging. The state sales tax rate is 4.5%.

For BPM's proposed operation, the combined projected sales taxes arising from expenditures on materials and equipment is estimated to be $15,000 in Phase 1, $300,000 in Phase 2, and $10,000 in Phase 3. In addition to this direct sales tax revenue, BPM employees are expected to spend a portion of their wages locally, resulting in additional contributions to sales tax revenue.

5 SOCIOECONOMIC IMPACTS

5.1 Direct Impacts of Mining in Butte County

Butte County has a long and robust mining history. Originally a gold rush destination, Belle Fourche, the county's most populous city, has more recently emerged as a leader in the bentonite mining sector, with most mining employees in the county working for one of the two leading bentonite mining and processing firms: American Colloid Company and BPM. With around 330 individuals employed in this sector in 2022, bentonite mining constitutes approximately 12% of the county's total workforce of 2,736 wage and salary workers (Headwaters Economics 2024c).

The total compensation for all wage and salary workers in Butte County was approximately $110.56 million in 2022. BPM's contribution to this total was significant, with $11.3 million paid to its employees, most of whom are Butte County residents.

- For the proposed operation, BPM plans to make significant investments across various project phases. In Phase 1, the company will invest $600,000 in wages, benefits, and materials and equipment procurement. Investment will increase in Phase 2 with planned expenditures of $4 million, followed by an additional $300,000 in Phase 3.
- The project will maintain an FTE average of 5.1 throughout its lifetime. Fluctuating seasonally and according to work demand, the employment projections for the proposed operation in each phase make up the 5.1 FTE average, with 3 individuals in Phase 1, 12 in Phase 2, and 4 in Phase 3. These figures are part of the approximately 150 FTE workers employed by BPM across all mining and milling activities in its regional operations.

BPM's direct involvement in various project phases not only marks a substantial fiscal contribution to the county but also highlights its commitment to the ongoing economic development in the region. Through strategic investments such as those associated with the project, BPM continues to play a pivotal role in reinforcing the economic framework of Butte County, ensuring its growth and stability for the future.

5.2 Economic Impacts Induced by Mining

Mining not only stimulates the Butte County economy through direct employment and purchases made from local vendors; those expenditures induce other economic activity. For example, a mining operation's demand for inputs from other industries increases business for those sectors and leads to job creation. Additionally, the circulation of mining wages, when spent locally, further stimulates job growth across various local businesses, magnifying the sector's overall economic impact due to the comparatively high wages in mining.

To evaluate the magnitude of these "economic ripples," the Regional Input-Output Modeling System developed by the Bureau of Economic Analysis embodies a set of multipliers for mining activities. Specifically, for the broader Butte, Lawrence, Meade, and Pennington counties region, the model indicates that every dollar earned in the mining industry generates an additional $0.546 in other local industries, and every mining job supports an additional 1.027 jobs elsewhere in the economy (U.S. Bureau of Economic Analysis 2019).

In the context of the proposed operation, the direct employment of 19 individuals across three phases is anticipated to induce approximately 20 additional jobs in other industries. Furthermore, BPM's planned expenditure of $4.9 million on wages, benefits, materials, and equipment is expected to generate an additional $2,672,400 in the local economy over the 10 years of the project. Thus, the total regional economic impact of BPM's proposed operations is estimated to be 38.5 employment positions and $7.6 million in total economic output.

5.3 Other Socioeconomic Impacts

5.3.1 Housing

In 2022, the mean housing price in Butte County was $189,000, notably lower than the state average of $219,500 in South Dakota. While the median monthly mortgage cost in Butte County was $1,490, slightly lower than the state's median of $1,557, the median monthly gross rent in Butte County stood at $885, marginally higher than the state's median of $878.

Given BPM's long-standing presence in the Butte County community and the relative stability of employment in the mining sector, project-related disruptions to the housing market are not anticipated. Instead, BPM's continued operations are expected to solidify employment prospects, potentially influencing workers connected to the bentonite mining industry to consider more permanent housing solutions, which could put limited upward pressure on housing prices and limited downward pressure on rental prices.

5.3.2 Recreation

The land subject to this proposal is presently used for grazing and wildlife habitat. Direct, material disruptions to the county's recreational activities are not anticipated. The indirect effect of the stable, mining-related employment brought about by the Project would likely bring about a minor increase in demand for recreational opportunities in Butte County.

5.3.3 Public Services

Due to the relative stability of Butte County's labor market, the Project is not expected to bring about a material increase in demand for public services such as public education, fire and police protection, solid

waste disposal, and water and sanitary sewer systems. Similarly, the traffic related to equipment transport and worker commuting is expected to have no significant impact on traffic or road conditions, given the limited number of workers and the infrequency of equipment transport.

The only potential minor impact on public services is associated with road usage during the transportation of bentonite ore to processing facilities in Colony, Wyoming. While some transport may also use a private road paralleling Highway 212 toward Colony, Wyoming, up to 7 miles of Highway 212 in South Dakota, and an additional 6 miles in Wyoming would be used. Specifically, bentonite transport is projected to occur on approximately 20 to 30 days per year, during which BPM plans to use up to six trucks. Each truck will make about seven trips, resulting in around 42 truckloads on the highway each of these days, continuing annually over a 10-year period until the ore is depleted. This would represent a minor traffic increase.

6 REFERENCES

City of Belle Fourche. 2023. City of Belle Fourche, South Dakota Annual Report. Belle Fourche, South Dakota.

Headwaters Economics. 2024b. A Demographic Profile, Butte County, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024b. A Demographic Profile, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024c. A Profile of Socioeconomic Trends, Butte County, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024d. A Profile of Socioeconomic Trends, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024e. A Demographic Profile, Belle Fourche, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024f. A Demographic Profile, Fruitdale, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024g. A Demographic Profile, Newell, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

———. 2024h. A Demographic Profile, Nisland, South Dakota. Available at: https://headwaterseconomics.org/eps. Accessed May 2024.

South Dakota Department of Revenue. 2022. *Recapitulation for Taxes Payable 2022*. Available at: https://dor.sd.gov/media/1ghfcgql/recap22.pdf. Accessed May 2024.

U.S. Bureau of Economic Analysis. 2019. Regional Input-Output Multipliers II (RIMS II). Available at: https://apps.bea.gov/regional/rims/rimsii/. Accessed May 2024.

U.S. Census Bureau. 2022a. Industry by Sex for the Civilian Employed Population 16 Years and Over. Available at: https://data.census.gov/table/ACSST5Y2022.S2403?q=Butte%20County,%20South%20Dakota&t=Employment:Income%20and%20Poverty:Industry. Accessed May 2024.

———. 2022b. Industry by Median Earnings in the Past 12 Months (in 2022 Inflation-Adjusted Dollars) for the Civilian Employed Population 16 Years and Over. American Community Survey, ACS 5-Year Estimates Detailed Tables. Available at: https://data.census.gov/table/ACSDT5Y2022.B24031?q=Butte County, South Dakota&t=Employment:Income and Poverty:Industry&g=040XX00US46. Accessed May 2024.