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REPORT OF

Survey of Topsoil Borrow Resources for Riley Pass A&E Services- Abandonded Mine Reclamation Riley Pass Mining Area AG-0355-D-12-0021

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Survey of Topsoil Borrow Resources for Riley Pass A&E Services- Abandoned Mine Reclamation Riley Pass Mining Area AG-0355-D-12-0021

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1.0 INTRODUCTION

During May and September 2013, Tetra Tech completed a limited soil borrow resource assessment in the vicinity of the former Riley Pass uranium mining area, in the North Cave Hills of Harding County, South Dakota, within the Custer National Forest (Figure 1). This work was conducted in accordance with the *Order for Supplies or Services* Contract No. GS-10F-0208J for Riley Pass A&E Services. This assessment was conducted to identify and quantify potential soil borrow areas for reclaiming former uranium mine sites.

The specific objectives of the soil resource assessment included the following:

- Describe soil profiles and document soil characteristics;
- Map areas with similar borrow capabilities;
- Sample and analyze soils for physical and chemical properties within the project area; and
- Evaluate soil suitability for reclamation (i.e. as a growth medium), propose suitable salvage depths of the soil found in the project area, and identify limiting characteristics.

This report describes the methods used by Tetra Tech to achieve the survey objectives, as stated above, and presents results of the 2013 soil resources assessment. Supporting information is included in the appendices of this report.

2.0 METHODS

The methods employed to collect and analyze soil resource data were generally consistent with plans of study prepared for similar projects in the western U.S. The methods employed to conduct the survey are described below.

2.1 Data Review

The following information was reviewed prior to initiation of the soil assessment:

- Aerial photography and topographic mapping for the project area;
- Soil survey information from Harding County (USDA, 2010); and,
- Riley Pass soil borrow suitability criteria as developed by Millennium Science and Engineering (MSE, 2010) and adopted by the United States Forest Service (USFS) in the 2010 Statement of Work (USFS, 2010).

2.2 Field Investigations

This soil resource evaluation and inventory, including soil sample collection and laboratory analyses, were completed for potential borrow sites with suitable topsoil and subsoil chemical and physical characteristics for reclamation of adjacent disturbed areas. Due to the possibility of disturbing cultural resources, test pits were excavated only on privately owned lands near the site during May 2013. Following additional review by and coordination with the USFS archeologist, areas within the USFS boundary were investigated during September 2013. Areas surveyed and determined to be potential borrow areas included approximately 200 acres on privately owned land and 300 acres of USFS land. To reduce potential soil borrow transport costs, surveys were conducted proximal to the Bluffs B, C, D, E, G and H as shown on Figure 1.

Specific soil profile descriptions were conducted in general accordance with the guidelines provided by the *National Soil Survey Handbook* (USDA, 2003) and the *Soil Survey Manual, Handbook 18* (USDA, 1993). Map unit boundaries were identified by field observation and interpretation of aerial photographs, topographic maps, and other geographic models.

The potential soil borrow area was previously mapped by the USDA Natural Resource Conservation Service (NRCS) to a level of detail commensurate to an Order III Survey (USDA, 2010). The NRCS mapping is presented on Figure 2 and common soil series descriptions are presented in Appendix A. The databases and digital maps from these previous surveys were used to develop a conceptual model as discussed further in section 2.5. The conceptual model was used in combination with aerial photographs to identify likely changes in soil conditions (map units) within the project area. The locations of soil profiles were selected to be representative of a map unit or to help determine the composition of a map unit. These sites were identified through review of aerial photographs, topographic maps, and site inspection. A

skid steer mounted backhoe, hand auger and tile spade shovel were used to excavate the soil profile description sites. To mitigate potential impacts to cultural resources, all soil profile locations excavated were surveyed by an on-site USFS archeologist prior to excavation. Some test pits were also sieved by the USFS archeologist during September 2013 soil profile excavation and no heritage resources were discovered. No known significant cultural resources were encountered or impacted during soil profile excavations.

Soil profiles were generally described using methods and abbreviations identified in the *Field Book for Sampling and Describing Soils* (USDA, 2002). Complete or partial profile descriptions were recorded on field forms, which are included in Appendix B. Complete profile descriptions were recorded at the most representative locations as determined by the Soil Scientists, and selected sites were sampled for map unit representation and borrow material potential.

2.3 Sample Collection

A total of 49 soil samples were collected from 23 profile locations and delivered for laboratory analyses. These samples were selected in the field to be representative of soils in the area and to determine if the sampled horizon was acceptable as a borrow material. Selected soil samples were generally collected from profiles where the soil type was a dominant component of the soil borrow area. Soil samples were collected from horizons greater than three inches thick. Horizons less than three inches thick were described but not sampled. For horizons greater than 18 inches thick, soil samples were collected from the lower portion of the soil horizon.

2.4 Laboratory Analyses

Soil samples were transported under chain-of-custody protocol to Pace Analytical Laboratory (Pace), in Billings, Montana for laboratory analysis. In general, laboratory parameters were analyzed using the methods specified by the Wyoming Department of Environmental Quality (WDEQ) Topsoil and Overburden Guidelines (Guideline 1; WDEQ, 2004). Forty-three soil samples were analyzed to include some or all of the following parameters:

- Textural class (sand, silt, clay percentages)
- pH (acidity/alkalinity)
- Calcium (Ca), manganese (Mg) and sodium (Na)
- Specific conductance (SC)
- Sodium adsorption ratio (SAR)
- Arsenic (As), cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn).

The methods used for laboratory analyses are presented on the laboratory report included in Appendix C. Field estimates for physical soil conditions are documented on the field logs in Appendix B.

2.5 Soil Borrow Area Development

Preliminary borrow area boundaries identified in the field were supported by available data and site inspection. Boundaries of preliminary areas were further refined based on the results of profile descriptions and development of conceptual areas based primarily on depth of A and B horizon, soil texture and potential for elevated salinity concentrations. Many of the conceptual delineations were documented in the field for further refinement based on review of all available information, including laboratory results and final profile classifications.

Following completion of the field effort, color aerial photography was used to further assist in delineation refinement (Figures 3 through 9). These images revealed details related to vegetation communities, saline-sodic surfaces, rock outcrop patterns and geologic parent materials. Each borrow area within the project area was described by documenting soil profiles and salvage depths found in the borrow site, their relative composition, and their placement relative to one another. Borrow area nomenclature for this survey is as follows; for private and public land, the name consists of letters followed by numbers. Example KL 22 where the first letter K stands for the last name of the landowner (on private land only, there are no letters present for USFS land), L stands for the dominant soil texture of the borrow area (loam) and the number 22 stands for the average total soil salvage depth of that particular borrow area. Each area was composed primarily of similar soils, with the smallest borrow area encompassing approximately four acres. Areas identified as limited or no salvage potential during the field investigation portion of the survey, were not assigned a reference name and will not be discussed in this report. The methodology for determining potential suitability is discussed further below.

2.6 Soil Suitability for Reclamation

Field observations and laboratory test information from soil samples were evaluated to determine relative suitability of soil as a plant growth medium. Site specific soil suitability criteria were developed by the USFS and MSE (USDA, 2010; MSE, 2010) to define and classify suitability (Table 1). Soil profile characteristics and laboratory analyses are used to evaluate potential salvage depths for each soil type. Differences in suitability between soil horizons are reviewed to determine which soils are suitable topsoil or cover material.

The suitability criteria for cover soil, presented in Table 1, are similar to criteria used for previous reclamation in the Riley Pass area and similar sites in the western US. However, due to the various potential metal toxicity issues, the acidic pH number was elevated from an often used criterion of 5.5 to 6.5 (WDEQ, 2004). Soils with a pH of greater than 6.0 would also likely produce acceptable results. Therefore, we occasionally used an acceptance criterion of 6.0 assuming the soil horizon is less than a few inches thick, and higher pH soil is also likely going to be utilized. The potential presences of arsenic, cadmium, among other metals are more mobile at low pH and are able to enter the food chain via phyto-uptake. To remove the potential bio-uptake of these metals Tetra Tech recommends limiting the pH of potential borrow soils to a pH of 6.0 and greater. This recommendation was proposed by Tetra Tech and reviewed by the

USFS. The USFS concurred with this modification and Table 1 was amended to reflect this modification.

For the purposes of this investigation, it is anticipated that onsite organic materials (i.e. sod) and six inches of stripped topsoil would be replaced on the borrow locations. The replaced material would be topsoil, or upper A horizon, and the total depth of salvage to unsuitable borrow material was considered in determining the total salvage depth.

Table 1: 2013 Topsoil Suitability Criteria – Riley Pass Mining Area

Property	Suitable	Unsuitable
Depth (cover depth)	12-18 inches	<12 inches
USDA Texture (thickest layer 0-40 in.)	All Others	>45% Clay content and LS, S
Rock Fragments (by volume)	<45 (all fragments less than six inches diameter)	>45
Depth to High Water Table (feet)	---	Perennial wetness
Soil Acidity (pH 0-40 inches)	6.0 to 8.5	<6.0 or >8.5
Arsenic	<142 ppm	>142 ppm
Cadmium	< 4 ppm	> 4 ppm
Copper	< 100 ppm	> 100 ppm
Lead	< 100 ppm	>100 ppm
Zinc	< 250 ppm	>250 ppm
SAR	<12	>12
Specific conductance (entire depth of cover soil)	<6 dS/m	>6 dS/m

Legend: Depth of growth media above bedrock or unsuitable soils
USDA = US Department of Agriculture
SL = Sandy Loam, LS = Loamy sand, S = Sand, C = Clay
PPM = Parts per million
1 decisiemens per meter (dS/m) = 1 millimhos per centimeter (mmho/cm)

3.0 EXISTING SOIL MAPPING

Employing NRCS soil mapping data, several map units were selected as providing the highest potential for borrow material over the survey area as described in the Harding County soil survey (NRCS, 2010; Figure 2). Review of the NRCS soil survey was only used as a screening tool and borrow areas were chosen only by site specific investigations. Constrained by the local landscape, land ownership, and distance from the areas to be reclaimed, the survey was broken into four principle areas the USFS properties, northern, central and southern survey private land areas as shown in Figures 3 through 6 and 7 through 9, respectively. The northern and central private lands will be discussed concurrently as they are adjacent and can be accessed in the same manner.

3.1 USFS Survey Areas

The far northern reach of the USFS surveyed area (Figures 3 and 4) contains the largest total area of high potential borrow soil identified on USFS property. These potential borrow sites are generally clustered in two distinct areas; at the mouth of Fuller Canyon (Figure 3) and in the vicinity of Sawmill Canyon (Figure 4).

Four separate areas (1SL24-A, 1SL24-B, CL30-A and 2SL24; Figure 3) of potential borrow soil are located at the mouth of Fuller Canyon and on the northern toe-slope of the bluff composing the western canyon wall (Figure 3). Three of these areas (1SL24-B, CL30-A and 2SL24) are either partially or entirely within the Shambo-Rodes loams (SmB) map unit (NRCS, 2010 Appendix A). Located on a gently sloping northerly facing stream terrace, the Shambo-Rodes loam is described as being deep, well drained, with moderate permeability. The A horizon in this series is typically nine inches thick. The fourth potential (1SL24-A) borrow source in this area is located above the flood plain on a northwest facing toe-slope mostly within the delineated soil map unit Amor-Cabba loams (AcC). The Amor series consist of approximately eight inches of an A horizon and the B horizon extending to a depth of approximately 34 inches. The Cabba soil is a shallow soil with minimal soil borrow salvage potential (NRCS, 2010; Appendix A).

The best prospective borrow site (SL20; Figure 4) is located north of Sawmill Canyon on a gently sloping terrace formed from the convergence of multiple alluvial fans. This terrace is west of and adjacent to a series of bluffs within the Shambo-Rodes loams (SmB) soil mapping unit (NRCS, 2010 Appendix A). The SL20 mapping unit is described as being deep, well drained, with moderate permeability. The A horizon in this series is typically nine inches thick. Another, somewhat smaller area of potential borrow soil (CL30-B; Figure 4) is located approximately 1.5 miles west on a gently sloping and erosionally dissected incised terrace directly north of Craig Pass. Borrow area CL30-B also consists of map unit SmB along with the Amor-Rhoades loams (AdC). The Amor series are described as being deep to very deep and moderate to well drained with moderate permeability due to the coarser parent material much like the Shambo series. The Rhodes series are typically deep well drained soils with very low

permeability. These soils are formed in stratified clayey materials derived from shale, siltstone, and mudstone (NRCS, 2010; Appendix A).

Another considerable acreage of potential borrow soil is located in the immediate vicinity of the reservoir at the southern end of Campbell Creek (Figure 6). A triangular area of borrow soil southeast of the reservoir (PLOW 35; Figure 6) is primarily comprised of map unit (RbB), Reeder loam, with a minor inclusion of map unit Amor-Rhodes loam (AdC). These soils are described above. The southern facing bench adjacent to the west shore of the reservoir which slopes gradually to the floodplain south of the reservoir (LS10, LS19, PLOW17; Figure 6) is another potential borrow source. The northern end of this borrow source (LS10) is within the delineated boundary of the RbB map unit while the remainder (LS19, PLOW17) are within the Rhoades-Daglum loams (RnB) map unit. The Rhoades series is a described above. The Daglum series are typically deep, well drained, clay rich soils formed in alluvium and residuum on foot slopes and swales on terraces and uplands.

Relatively minor areas of potential borrow soil were also identified on USFS land in the central portion of the USFS survey area in the vicinity of Schleichart Draw (Figure 5). Two of the areas (C16, SCL22-B; Figure 5) were present on toe-slopes while a third (SCL22-A; Figure 5) consisted of the top of a flat and broad bluff. Areas C16 and SCL22-A are primarily comprised of map unit RnB, (see above discussion). Borrow source SCL22-B is primarily comprised of the Cohagen fine sandy loam (CoE) series. The Cohagen series is described as being shallow, well to excessively drained. This soil formed from the weathering of sandstone. Based on in-field observations of soil texture and potential borrow depth all three areas qualify as potential borrow source However, due to their relative small acreage and the potential for disturbing archeologically significant resources no further investigation was conducted.

3.2 Northern and Central Private Land Survey Areas

The northern and central areas contained four high potential map units that were on land proximal to the Bluffs where landowners Craig Feist (Figure 7), Thomas Kalisiak (Figure 8), and Lex Burghduff (Figure 8) granted permission to survey through written agreements with the USFS. These include Reeder-Cabba loams (RcC), six to nine percent slope, Korchea-Archin complex (Km), zero to six percent slope, Amor-Cabba loams (AcC), nine to 25 percent slope, and Parshall fine sandy loam (PhA), three percent slope (NRCS, 2010; Appendix A). These soils series reported loam to sandy clay loam texture and other physical properties potentially making them suitable as borrow material. The target soils within these units are Archin, Parshall, Reeder, and Amor. The Cabba are general shallow, loamy soils with weathered bedrock at depths less than 20 inches below ground surface (bgs). However, where Cabba soils are deeper to bedrock they have potential as a borrow source. Additional NRCS map units were evaluated and descriptions are included in Appendix A. All potential borrow sources as identified through review of NRCS mapping were chosen based on site specific investigations.

The Archin and Parshall Series are deep soils. The Archin Series generally present suitable loamy textures that are slightly acid to neutral. However, although these soils are typically well drained, permeability is slow to very slow in the lower solum. Due to the limited movement of water within the soil profile these soil may accumulate salt as observed during soil survey activities. The Parshall series are very deep, well drained soils with thick, eight to 10 inch A horizons. These soils are typically cultivated for growing agronomic crops. The limiting physical properties for the Parshall series is the fine sandy loam texture and weak soil structure making these soil susceptible to wind and water erosion. The Reeder and Amor series are generally moderately deep, well developed, loamy soils with bedrock greater than 30 inches bgs. Reeder and Amor A horizons are generally equal to or greater than 8 inches thick.

3.3 Southern Private Land Survey Area

The soil investigation in the southern portion of the surveyed area contained three high potential map units proximal to the U.S. Forest Service boundary where landowner (William Rotenberger Figure 9) permission was granted to survey. These include Reeder-Cabba loams (RcC), six to nine percent slope, Korchea-Archin fine loamy complex (Km) zero to six percent slope, and Parchin-Bullock fine sandy loams (PbB) two to nine percent slope (NRCS, 2010; Appendix A).

As discussed above, the Reeder, Cabba, Korchea, and Archin Series all have the potential to provide suitable borrow locations. The Parchin consists of moderately deep, well-drained soils formed in residuum weathered from sandy and loamy sedimentary rocks. The depth to weathered soft-bedded sandstone bedrock is typically 25 to 30 inches but ranges from 20 to 40 inches. The Bullock series consists of moderately deep loamy soils on residuum weathered from soft sandstone or silty or clayey shales interbedded with soft sandstone. Bullock series soils have sandy clay loam and clay loam subsoils, and, like the Archin series, have the potential to accumulate salts making them not suitable for borrow material.

4.0 SOIL PROFILE RESULTS

A total of 87 soil pits were excavated from the northern, central, and southern extents of the survey area to characterize and quantify potential borrow material to serve as plant growth medium during reclamation efforts.

4.1 USFS Survey Areas

A total of 31 soil pits were hand excavated within the USFS portion of the survey area. Twelve distinct soil types were identified as potential borrow locations based primarily on field observations of textural class and A- and B-horizon thickness. Accessibility, cultural resource concerns, depth to bedrock, and soil saline site conditions were also considered when delineating these borrow areas.

Soil borrow area SL20 (Figure 4) is located north of Sawmill Canyon on a gently sloping terrace formed from the convergence of multiple alluvial fans. This terrace is west of and adjacent to a series of bluffs and extends eastward just beyond the gravel USFS road. Vegetation consists of dense crested wheatgrass, silver sage, and other scattered forbs such as Echinacea and asters. Soil profiles observed within this potential borrow area were relatively consistent and were characterized suitable texture: loamy sand to sandy loam textures to depths of around 20 inches. Textures became increasingly coarse (coarse sandy loams and coarse sands) at greater depths. A- and B-horizon clay content ranged from 10 to 15 percent at locations east of the road. Clay contents to the west of the road ranged from 25 to 33 percent suggesting that the soil transitions to finer textures at lower elevations closer to the saline draws and gullies observed in that area. Laboratory analysis indicates that about 45 percent of the sand content of these soils consists of very fine sand that may preclude use of this soil in erodible areas.

Soil borrow areas CL30-B and SCL10 (Figure 4) occupy the terrace directly north of Craig Pass. Vegetation in this area is primarily crested wheatgrass with some sage and other miscellaneous forbs. Borrow area CL30-B (Figure 4) consists of sandy clay loams and clay loams extending to a depth of about 30 inches bgs. Clay content and coarse fragment content (fine gravels and channers) increased with depth. The soil profile of potential borrow area SCL10 was similar to that of CL30-B except that sandier soil textures were present and the soil profile was considerably shallower. Below a depth of approximately 10 inches the profile consisted of greater than 50 percent fine gravels and channers which make this soil unsuitable at this depth. However, site SCL10 has been included as it may be a useful source of gravel for road building and other engineering needs.

Soils near the mouth of Fuller Canyon occurred in four different soil borrow areas; CL30-A, 1SL24-A, 1SL24-B and 2SL24 (Figure 3). As was the case for area CL30-B near Craig Pass (Figure 4), the topographic position of CL30-A in Fuller Canyon is a stream terrace on relatively flat ground along the canyon floor. Soil textures in the potential borrow areas (Cl-30-A, 1SL24-

A, 1SL24-B, and 2SL24) consist of clay loams with some isolated occurrences of sandier textures. Clay concentrations ranged from 25 to 45 percent and increased with depth.

Soil borrow areas 1SL24-A and 1SL24-B (Figure 3) occurs on the north to northeast facing toe-slopes of the bluff to the west of the canyon mouth. These soils consist of sandy loams and loamy sands with clay concentrations that abruptly decrease from about 20 percent at the surface to around five percent at a depth of around 22 inches. This map unit was delineated as two separate areas (1SL24-A and 1SL24-B) which are separated by landslide debris consisting of a colluvial deposit of loam, sandy clay, and clay with up to 25 percent cobbles. Areas of saline seeps exist topographically below, to the north, and to the south-east of the delineated map unit and are not suitable for reclamation use.

Map unit 2SL24 (Figure 3) is located in a similar landscape position as unit CL30 in Fuller Canyon but is farther from the canyon floor and creek. This map unit consists of sandy loam and sandy clay loam textures with clay concentrations ranging from about eight to 25 percent. Unlike map units 1SL24-A and 1SL24-B, clay concentrations within 2SL24 appear to increase with increasing depth.

Four borrow soil map units were delineated in the vicinity of the Campbell Creek reservoir (PLOW35, PLOW17, LS19, and LS10; Figure 6). This area was previously cultivated resulting in a well-defined plow layer (i.e. Ap horizon) from the 0 to 10-inch depth increment and little potential for intact cultural resource sites within the boundaries of the map units. However, significant cultural resource sites are present nearby. Vegetation is fairly consistent across the area and is comprised primarily of dense grasses (i.e. smooth brome, crested wheat, rye, and bluestem) with sage becoming more prevalent to the southeast.

Map unit PLOW35 is a triangular area delineated based on its position which is bounded by the reservoir outflow to the west, private property to the south, and significant cultural resources to the northeast. The 0 to 35-inch depth increment of this map unit consists of a mixture of sandy loam soils or loamy sand (five to 15 percent clay) in some areas with finer textured silty clay textures (35 to 45 percent clay) in others. At depths below about 35 inches a C-horizon consisting of sandy clay loam was encountered at both observation pits excavated in the map unit. The loamy sand texture is not a suitable texture based on Table 1. However, field observations determined the loamy sand texture to be a thin lens intercepted around 20 inches bgs with more suitable textures immediately adjacent. With the more suitable textures composing the major components in the soil profile this area qualifies as a suitable borrow source.

Map unit PLOW17 is the southern and topographically lowest portion of a low sloping ridge forming the western shore of the reservoir. The soil texture throughout the 52-inch excavation consisted of silty clay soils with clay concentrations ranging from about 35 to 45 percent. This map unit was very moist at the time of the visit suggesting that it is poorly drained. This location is elevated above the reservoir and there was no visible redoximorphic features common for a persistent water table. Based on field observations the wet soil conditions were likely the result

of rain water percolation. These conditions are likely not common and should not influence soil borrow qualification.

Immediately north of and adjacent to map unit PLOW17 is map unit L19, which is characterized by loamy textured soil with B-horizon depths extending to 22 inches in the southern portion of the map unit and decreasing to 16 inches in the northern portion.

Still farther to the north, in map unit LS10, soil thickness continues to decrease and textures become coarser. This map unit consists of sandy loam soils suitable for borrow to a depth of about 10 inches overlying minimally weathered sandstone residuum.

In the central portion of the survey area on USFS land (Figure 5), two relatively small map units were delineated; C16 and SCL22. Map unit C16 is located on the top of a flat broad bluff supporting a grass and sage vegetation community. The soil profile in this location consisted of the most clay-rich soil encountered during the survey of USFS land with clay loam to silty clay loam texture (30 percent clay) in the 0 to 5-inch depth increment and a marked increase to 50 percent or greater clay concentration at greater depths. Excavation of this soil pit was advanced from 16 inches bgs to a depth of 30 inches using a soil auger with no discernible change in soil texture and no indication that coarse fragments were encountered.

Map unit SCL22 occurred in two separate locations, both located at the toe-slope of low-lying bluffs supporting wheat, fescue, and brome grass species as well as scattered sage and forbs. B-horizon depths in these areas extended to about 22 inches bgs with sandy clay loam textures with clay concentrations ranging from about 22 to 27 percent. While the soil profiles are similar in each of the two SCL22 areas (SCL22-A and SCL22-B; Figure 5), the western location (SCL22-A) occurred in an area with deeply incised gullies and rock outcroppings. The eastern area (SCL22-B) was relatively flat with no rock outcroppings observed.

4.2 Northern and Central Private Land Survey Areas

A total of 43 soil pits were excavated within the northern and central private land survey areas. Seven areas were presented as potential borrow locations (Figures 7, 8 and 9) based on soil analytical data (Tables 2 and 3). However, there are areas adjacent to these borrow areas that need to be avoided during soil salvage activities. Map Unit FSCL60 is located the furthest from the Bluffs scheduled for excavation (Figure 7). This area is gently sloping rangeland. Soils in this area are clay loams on side slopes with salts visible to the surface at the base of the slopes which should be avoided.

Map unit 1KL22 (Figure 8) is a gently sloping hayed pastureland. Knolls within this pasture land should be avoided as the soils become too shallow. Soils in this area are loams and clay loams.

Map Units 2KL22 and KL21 (Figure 8) are in a similar physiographic position to Map Unit 1KL22. Soil profile DA 25 in Map Unit 2KL22 has elevated pH and SAR values. The SAR was elevated due to low calcium and magnesium values relative to sodium. However, the specific

conductance value (Table 2) was well below the suitability criteria in Table 1. The alkaline pH value of 8.7 potentially limits soil salvage depths to less than approximately 30-inches bgs. The pH in soil profile SM23 in map unit KL21 had a surface pH of 5.9 with pH increasing to 8.0 between eight to 20 inches bgs then returning to 5.9 at depths greater than 20 inches bgs. Due to metals mobility concerns this area should be mixed with the alkaline B horizon. Because of the limited volume of potential borrow profile associated with the much higher pH within the soil profile potential borrow soil will exceed 6.0 guidelines in table 1 of this report.

Map Unit KSL30 is comprised of a cultivated field on a gently to moderately sloping surface. Soils were again loams and clay loams with a depth of approximately 30 inches to the C horizon on the lower side of the field and shallower at the upper end.

Map Units BSCL41 and BCL50 are cultivated alfalfa fields. These fields are the closest to Bluff B and could provide significant soil borrow. Soil analytical data for map units BSCL41 and BCL50 indicate soil physical properties qualify these soils as potential borrow areas. Texturally these soils vary in percent sand and clay but are generally loamy and meet the suitability criteria outlined in Table 1. Low knolls adjacent to map unit BSCL41 should be avoided as these soils become too shallow. The erosional channel originating off of Bluff B also needs to be avoided to prevent exacerbating the active erosion occurring through this borrow area.

Chemically, soil profiles DA15, and JR02, within map unit BCL50, present elevated SC, SAR, and pH levels in all subsurface horizons, which exceed the suitability criteria in Table 1. Care should be taken when harvesting soil near DA15 and JR02 and toe slope areas to avoid salts in the subsurface horizons. This can be accomplished by staying away from the slope break down into the alluvial channels for both Map Units BSCL41 and BCL50.

4.3 Southern Private Land Survey Area

A total of 13 soil pits were excavated in the proposed borrow areas RSL19, RSCL44 and RSL23 (Figure 9). These areas are closer to Bluff H than most of the other potential borrow source areas which were reviewed. All three map units were in cultivated agricultural land (Figure 9). Texturally these soils vary in percent sand and clay but all meet the suitability criteria outlined in Table 1. Map unit RSCL19 and RSL23 presented sandy loam texture in the surface horizons extending to 22 inches bgs. Map unit RSCL44 presented sandy clay loam texture in the upper horizon extending to 28 inches bgs. These soils all presented thin A horizons. However, all three map units are currently sustaining agronomic crop production. Consequently, due to annual disturbance of the A horizon, and the shallow rooting nature of annual crops depleting the surface horizons, this could account for the reduction in A horizon depth.

5.0 LABORATORY ANALYTICAL RESULTS

The results of the soil physical and chemical laboratory analyses from this investigation are presented in Tables 2 and 3 and Appendix C. The following sections summarize the results of laboratory analyses and present interpretations relative to reclamation planning.

5.1 Soil Physical Properties

Soil textures in the project area are predominately sandy clay loams and clay loams with some loam, sand, clay and silt loams. Of the soil samples collected, clay content ranged from between five and 35 percent with an average of 23 percent (Table 2). Soils throughout the survey area have potential for use in reclamation due to their moderate clay content. However, the sandy and silty soils have low water-holding capacity which limits re-growth potential and promotes susceptibility to wind and water erosion. During soil placement, erosion mitigations strategies such as erosion fabric, crimped straw or compost, should be employed to abate potential soil erosional losses. The reclamation plan would provide a more complete explanation of potential erosion mitigation strategies

5.2 Soil Acidity and Alkalinity

The acidity and alkalinity of soils in the project area are closely tied to parent materials and topographic position. The pH of samples tested ranged from between 5.4 to 9.0, and averaged 7.6 (neutral pH = 7). Six soil samples were slightly acidic with pH levels of 5.4 to 6.3 (Table 3). However, these samples were all collected from relatively thin surface soil horizons. At all locations, the soil samples collected directly below the surface horizon had a pH in excess of 6.6.

Six soil samples exceeded the alkalinity screening limit of 8.5 (Table 3). These samples were collected at depths greater than twelve inches bgs. Five of the six samples were located in toe slope and potential saline seep areas, with the sixth, sample DA25 29-40 inches bgs (Figure 8), having an elevated pH in the C horizon. Sample JR01 at 16-24 inches bgs, had the highest pH value of 9.0 at a depth of 16 inches bgs (Table 3). This same sample had a SAR of 45.9. It is important to note that this sample was also collected near the toe of a piedmont slope near the break in slope of the drainage, and is a saline seep area. Soil samples SM10, collected within 400 feet of JR01, at the same elevation but away from the break in slope, reported SC values of 0.44 millimhos per centimeter (mmhos/cm) and SAR values of 5.0 at a depth of 21 inches bgs, respectively (Table 3). Another sample, JR02, collected near the break in slope but at a slightly higher gradient, reported elevated SC value of 6.2 mmhos/cm at 20 inches bgs (Table 3). This data suggest that care should be taken when salvaging borrow soil in map unit BSCL41 and the lower slope of BCL50 (Figure 8) at depths greater than 20 inches near the break in slopes where saline conditions come closer to the surface. We recommend a reclamation scientist be onsite during all soil salvage activities to identify saline soils by ocular (white crusting of salt participants) and field screening using specific conductance (SC).

Based on this information, we do not believe it is necessary to restrict any soil from this location for potential borrow due to acidic conditions. The alkaline soils associated with sodic conditions were not suitable as a borrow source. These soils were also located at the break in slope of the drainage representing possible saline seeps.

5.3 Specific Conductance (SC)

A soil's SC (often referred to as electrical conductivity or EC) is a measure of the salt content of the soil recorded in mmhos/cm and is directly related to osmotic potentials and soil water availability. Soils with an SC less than 8.0 mmhos/cm are generally considered non-limiting. The USFS borrow restriction value was given as 6.0 mmhos/cm (Table 1). Of the soils sampled in the project area, three soil profile description sites (JR 01, intervals 16-24", 24-40", 40-60", and JR02 interval 20-34" and DA15, 0-9", 9-14", 14-44") exceeded the USFS threshold value of 6.0 mmhos/cm (Table 3). Along with elevated SC concentrations, the SAR concentrations also exceeded the threshold indicating these soils are not adequate for borrow purposes.

The remainder of the samples had acceptable SC values. The average SC value was 2.9 mmhos/cm and therefore SC is not a notable limiting factor in most of the project area. However, due to the elevated saline conditions observed in lower elevations of map unit BSCL41 and BCL50 (Figure 8), removal of vegetation at the higher elevations has the potential to increase saline conditions at lower elevations since more soil water may be made available to transport salts through the subsoil profile. Thus the borrow site should be reclaimed and re-vegetated immediately following stripping operations.

5.4 Sodium Adsorption Ratio (SAR)

The SAR of soil is an indicator of the amount of the cation sodium in relation to calcium and magnesium in the soil and is commonly referred to as soil sodicity. Elevated sodium degrades soil structure and inhibits plant growth. SAR values exceeding 8.0 can be limiting to plant growth by limiting plant rooting through surface soil crusting. Levels above 12.0 are further limiting and may require amendment treatments to re-vegetate. The average SAR of soils sampled was 7.8, indicating numerous soil samples did contain SAR values above the desired concentration (Table 3). This indicates sodium concentrations are a concern at this site.

5.5 Metals

Soil samples were analyzed for arsenic, cadmium, copper, lead and zinc concentrations as part of this investigation. While elevated metals concentrations were occasionally observed, none of the samples exceeded the USFS threshold values and are not expected to limit regrowth.

5.6 Nutrient Content

The nutrient content of native soils was not analyzed as part of this investigation. However, organic matter content was generally observed to be low with depth in many of the soil profiles. Soil organic matter (OM) is a critical source of nutrients in native soils and often accounts for free nutrient levels. Additionally, it is anticipated that borrow may be removed to a depth of up to three feet bgs which is most often very low in OM. Addition of OM to borrowed soils through compost is recommended as outlined under the MSE and USFS suitability criteria as adopted in the 2010 Statement of Work (USFS, 2010). Similar to OM content, phosphorus, nitrate, and potassium concentrations are expected to be low with depth but adequate for the establishment and sustained growth for native vegetation. Given, that the top six inches of the A horizon will be repositioned over the borrow areas following soil salvage activities, we do not recommend composting these areas as part of borrow area reclamation. Other erosion control measures will be evaluated on a site specific basis depending on locations used.

5.7 Soil Erodibility

Soil erodibility is represented by hydrologic soil groups (HSGs) which were established to evaluate wind and water erodibility. Soil physical characteristics along with land use, management practices, and hydrologic condition; determine a soil's associated runoff curve number. Runoff curve numbers are used to estimate direct runoff from rain and snowmelt events. Assignments to the four common HSGs (A, B, C, and D) are based on climatic region, depth to a restrictive layer or shallow groundwater, ability to receive and transmit water, texture, structure, and degree of swelling when saturated (clay type and percent)(USDA, 2009). The A hydrologic group is the least erodible and the D group soils are the most erodible.

All of the soils being considered as borrow material met or exceeded the requirements for the C group (Table 2) and 24 percent met A group requirements. Despite this qualification, analytical results of soil texture indicate that the many soils within the survey area are fine textured and susceptible to erosion. Given these fine textures, loss of soil to runoff and wind erosion should be considered in both borrow areas and areas being reclaimed. Mitigating measures such as erosion control mats, addition of compost, crimped straw, straw waddles and appropriate seed application and species, should be in place to mitigate potential resource losses. These measures would be outlined as described more completely in the reclamation plan.

Table 2: Soil Physical Properties

Sample ID	Sample Interval (inches)	Clay Percent	Sand Percent	Silt Percent	Texture	Hydrologic Soil Group
USFWS Lands						
135 SM3	0-11	27.5	30.00	42.50	Clay Loam	B
	11-20	26.25	37.50	36.25	Loam	B
135 SM49	0-10	15	43.75	41.25	Loam	B
	10-22	20	57.5	22.5	Sandy Clay Loam	B
135 SM95	0-8	12.5	65	22.5	Sandy Loam	A
	8-24	12.5	70	17.5	Sandy Loam	A
Private Lands						
SM01	0-11	17.5	57.5	25	Sandy Clay Loam	B
	19-31	35	37.5	27.5	Clay Loam	C
SM02	9-18	27.5	45	27.5	Clay Loam	C
	18-31	22.5	50	27.5	Sandy Clay Loam	C
SM11	9-21	25	52.5	22.5	Sandy Clay Loam	C
	21-33	20	62.5	17.5	Sandy Clay Loam	B
SM12	7-19	12.5	27.5	60	Silt Loam	A
	19-31	32.5	40	27.5	Clay Loam	B
SM13	0-8	12.5	57.5	30	Sandy Loam	A
	19-27	15	50	35	Loam	A
SM14	0-9	22.5	42.5	35	Loam	C
	9-19	17.5	55	27.5	Sandy Loam	B
SM10	0-9	12.5	60	27.5	Sandy Loam	A
	9-21	22.5	65	12.5	Sandy Clay Loam	B
SM19	7-22	7.5	75		Sandy Loam	A
SM23	0-8	22.5	35	42.5	Loam	C
	8-20	5	27.5	67.5	Silt Loam	A
	20-28	27.5	30	42.5	Clay Loam	C
DA04	9-29	25	55	20	Sandy Clay Loam	C
DA10	6-20	32.5	17.5	50	Silty Clay Loam	D
DA12	14-24	32.5	32.5	35	Clay Loam	C
DA13	9-18	27.5	57.5	15	Sandy Clay Loam	C
	18-40	15	75	10	Sandy Loam	A
DA15	0-9	22.5	57.5	20	Sandy Clay Loam	C
	8-14	30	47.5	22.5	Sandy Clay Loam	C
	14-44	30	67.5	2.5	Sandy Clay Loam	B
DA17	8-28	25	50	25	Sandy Clay Loam	C
DA25	17-26	25	27.5	47.5	Loam	C/D
	29-40	20	30	50	Silt Loam	C

Table 2: Soil Physical Properties (continued)

Sample ID	Sample Interval (inches)	Clay Percent	Sand Percent	Silt Percent	Texture	Hydrologic Soil Group
Private Lands						
JR01	0-8	15	67.5	17.5	Sandy Loam	A
	8-16	22.5	52.5	25	Sandy Clay Loam	C
	16-24	10	77.5	12.5	Sandy Loam	A
	24-40	32.5	45	22.5	Clay Loam	C
	40-60	27.5	52.5	20	Sandy Clay Loam	C
JR02	0-9	17.5	60	22.5	Sandy Loam	B
	9-20	27.5	42.5	30	Clay Loam	C
	20-34	30	40	30	Clay Loam	C
JR03	4-12	30	37.5	32.5	Clay Loam	C/D
	12-20	27.5	37.5	35	Clay Loam	C
	20-30	20	37.5	42.5	Loam	C
	30-40	10	65	25	Sandy Loam	A
JR04	14-24	32.5	40	27.5	Clay Loam	C
	24-40	25	47.5	27.5	Sandy Clay Loam	C
Average		**22.6**	**48.6**	**28.4**	**N/A**	**N/A**

Legend:

Sample ID = Samples collected by Tetra Tech.
Sample Interval = Given in inches below ground surface.
HSG = Hydrologic Soil Group as defined by USDA, 2009 National Engineering Handbook-Hydrologic Soil Group (210-V1-NEH, NRCS, January), pp7-1-7-5.
NA = Not Applicable

Table 3: Soil Chemistry

SAMPLE ID	LAB ID	Sample Interval (inches)	Texture	pH	SC (mmhos/cm)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	SAR	As	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Suitability Criteria			NA	6.5-8.5	4-6	NA	NA	NA	12	142	4	100	100	250
USFS Lands														
135 SM3	10243013001	0-11	Clay Loam	8.3	0.19	1.5	1.1	0.33J	0.29	15.2	0.2	10.0	18.6	NA
	10243013002	11-20	Loam	8.0	0.25	0.79	0.72J	0.74	0.85	19.6	0.29	12.1	18.2	NA
135 SM49	10243013003	0-10	Loam	7.6	0.41	0.58	0.65J	1.5	1.9	8.2	0.20	6.0	11.0	NA
	10243013004	10-22	Sandy Clay Loam	8.2	0.63	10.4	24.1	50.0	**12.0**	12.6	0.20	7.0	12.6	NA
135 SM95	10243013005	0-8	Sandy Loam	7.3	0.18	0.82	0.49J	0.27J	0.34	10.4	0.14	4.6	10.3	NA
	10243013006	8-24	Sandy Loam	8.1	0.27	1.0	0.67J	0.63	0.68	11.2	0.13	4.6	10.7	NA
Private Land														
SM01	10227774001	0-11	Sandy Clay Loam	**6.0**	0.29	1.3	0.83	0.53	<0.85	11.0	<0.28	9.2	12.9	38.4
	10227774002	19-31	Clay Loam	7.9	0.61	1.4	1.7	2.4	1.9	14.2	0.33J	13.6	15.7	44.1
SM02	10227774003	9-18	Clay Loam	7.6	0.38	2.2	0.88	0.44	<0.85	16.9	<0.28	9.9	12.1	34.8
	10227774004	18-31	Sandy Clay Loam	8.0	1.0	1.7	1.9	5.8	4.3	12.2	<0.31	8.5	10.5	35.3
SM11	10227774005	9-21	Sandy Clay Loam	7.6	1.0	2.2	1.6	10.1	7.3	20.5	0.33J	8.1	11.3	45.6
	10227774006	21-33	Sandy Clay Loam	8.2	0.95	1.6	0.95	9.1	8.0	30.5	0.45J	7.6	9.7	38.3
SM12	10227774007	7-19	Silt Loam	6.7	0.54	2.3	1.8	0.86	<0.85	8.1	0.27J	13.0	15.2	54.2
	10227774008	19-31	Clay Loam	**8.8**	1.3	1.4	1.3	14.0	**12.1**	7.7	<0.28	19.0	19.0	60.3
SM13	10227774009	0-8	Sandy Loam	**5.5**	0.56	2.0	1.3	0.45	<0.85	9.6	<0.33	6.5	9.7	39.3
	10227774010	19-27	Loam	6.8	0.83	0.74	0.52J	4.8	6.1	9.6	<0.32	6.8	10.9	38.5
SM14	10227774011	0-9	Loam	**6.3**	0.36	1.6	1.1	0.76	<0.85	26.4	0.40J	8.3	12.8	45.7
	10227774012	9-19	Sandy Loam	6.7	0.65	2.7	2.2	1.0	<0.85	24.7	0.41J	8.7	11.2	42.6
SM10	10227774013	0-9	Sandy Loam	**5.4**	0.52	1.1	0.79J	2.4	2.5	15.3	<0.28	5.6	9.0	32.0
	10227774014	9-21	Sandy Clay Loam	7.2	0.44	0.86	0.48J	4.1	5.0	26.2	0.41J	9.3	13.5	55.3

Table 3: Soil Chemistry (continued)

SAMPLE ID	LAB ID	Sample Interval (inches)	Texture	pH	SC (mmhos/cm)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	SAR	As	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Suitability Criteria			NA	6.5-8.5	4-6	NA	NA	NA	12	142	4	100	100	250
Private Land														
SM19	10227774015	7-22	Sandy Loam	8.4	0.65	1.3	0.75J	5.4	5.2	26.3	<0.29	11.3	10.1	47.1
SM23	10227774016	0-8	Loam	**5.9**	0.30	1.3	0.79J	0.61	<0.85	10.8	<0.35	12.1	15.7	52.7
	10227774017	8-20	Silt Loam	8.0	1.0	1.5	2.3	6.9	5.0	10.3	0.28J	13.8	13.2	43.1
	10227774018	20-28	Clay Loam	**5.9**	0.31	1.2	0.78J	0.73	<0.85	9.0	<0.30	13.9	16.6	52.1
DA04	10227774019	9-29	Sandy Clay Loam	7.5	0.57	2.7	1.2J	1.5	<1.7	17.5	0.48J	7.5	13.5	72.4
DA10	10227774020	6-20	Silty Clay Loam	7.8	0.40	1.4	1.0	1.0	0.93J	12.7	0.39	11.8	11.8	56.0
DA12	10227774021	14-24	Clay Loam	7.5	0.44	2.3	1.6J	0.78J	<1.7	10.5	<0.33	13.2	14.1	55.2
DA13	10227774022	9-18	Sandy Clay Loam	7.1	0.76	2.6	2.1	2.6	<1.7	23.5	0.32J	7.7	11.2	40.7
	10227774023	18-40	Sandy Loam	8.0	0.51	0.97	0.79J	3.0	3.2	22.4	<0.31	4.6	7.3	29.8
DA15	10227774024	0-9	Sandy Clay Loam	7.9	**8.0**	4.4	7.7	64.3	**26.1**	19.1	0.31J	7.0	10.6	38.8
	10227774025	8-14	Sandy Clay Loam	8.0	**20.4**	21.1	97.6	192	**25.0**	28.3	0.43J	10.3	13.1	48.1
	10227774026	14-44	Sandy Clay Loam	**8.5**	**19.3**	19.9	79.7	193	**27.3**	28.6	0.45J	6.0	8.4	34.1
DA17	10227774027	8-28	Sandy Clay Loam	7.4	0.73	2.0	2.2	2.1	1.4J	15.4	0.28J	7.8	11.0	39.8
DA25	10227774028	17-26	Loam	7.7	0.61	2.0	1.4	1.7	1.3J	10.7	<0.34	12.3	12.7	43.8
	10227774029	29-40	Silt Loam	8.7	2.7	0.96	2.2	20.8	16.5	8.7	<0.35	11.5	10.8	47.3
JR01	10227774030	0-8	Sandy Loam	7.9	0.61	1.6	0.97	2.6	2.3	26.2	0.40J	5.2	9.6	35.1
	10227774031	8-16	Sandy Clay Loam	8.8	1.5	2.5	1.3	13.5	9.8	34.8	0.47J	6.8	7.9	36.2
	10227774032	16-24	Sandy Loam	9.0	9.9	1.3	7.4	95.7	45.9	22.7	0.37J	5.6	8.4	32.6
	10227774033	24-40	Clay Loam	8.8	14.3	3.3	20.8	144	41.5	29.7	0.44J	10.9	14.3	53.9
	10227774034	40-60	Sandy Clay Loam	8.4	22.6	20.0	59.2	250	39.8	18.0	<0.29	9.0	13.0	49.4

Table 3: Soil Chemistry (continued)

SAMPLE ID	LAB ID	Sample Interval (inches)	Texture	pH	SC (mmhos/cm)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	SAR	As	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
Suitability Criteria			NA	6.5-8.5	4-6	NA	NA	NA	12	142	4	100	100	250
Private Land														
JR02	10227774035	0-9	Sandy Loam	**5.9**	0.91	0.91	0.59J	3.6	4.1	14.1	<0.34	7.1	12.3	41.5
	10227774036	9-20	Clay Loam	8.0	1.3	1.3	0.96	8.8	8.3	13.7	<0.31	11.8	16.0	50.5
	10227774037	20-34	Clay Loam	7.9	**6.2**	10.6	15.5	37.9	10.5	12.6	0.39J	10.6	14.1	95.3
JR03	10227774038	4-12	Clay Loam	7.4	0.61	2.9	2.1	0.69	<0.85	21.9	<0.37	12.0	14.5	31.6
	10227774039	12-20	Clay Loam	7.8	0.38	1.7	1.4	0.69	<0.85	19.5	<0.33	9.8	12.1	31.2
	10227774040	20-30	Loam	8.2	0.40	0.61	1.8	1.1	1.0J	7.4	<0.29	9.3	9.1	37.4
	10227774041	30-40	Sandy Loam	8.4	0.50	0.53J	1.3J	3.0	3.2J	8.0	0.18	8.2	7.5	29.7
JR04	10227774042	14-24	Clay Loam	7.9	0.56	1.2	1.3J	3.0	2.7J	30.2	0.55	13.2	14.2	47.0
	10227774043	24-40	Sandy Clay Loam	8.1	0.71	1.0	1.1J	4.4	4.3	31.8	0.54	12.8	13.9	47.1
Averages				**7.6**	**2.9**	**3.2**	**7.5**	**26.1**	**7.8**	**21.4**	**0.1**	**12.0**	**14.4**	**50.6**

Legend: Sample ID = Samples collected by Tetra Tech.

Sample Interval = Given in inches below ground surface

mmhos/cm = Millimhos per centimeter

meq/L = milliequivalents per liter (saturated paste extract)

mg/Kg = milligrams per kilogram (dry basis)

pH = given in standard units

SC = Specific conductance (Electrical Conductivity) given in mmhos per centimeter (dS/m ; deciSiemens per meter) corrected for 25 degrees Centigrade

Ca = Calcium in milliequivalents per liter

Mg = Manganese in milliequivalents per liter

Na = Sodium in milliequivalents per liter

SAR = Sodium Adsorption Ratio

Cd = Cadmium

Cu = Copper

Pb = Lead

Zn = Zinc

Suitability Criteria = MSE, 2010. Riley Pass Removal Action Borrow Soil Test Trenching and Sampling, Sioux Ranger District. March 24.

Red and underlined values = Exceed suitability screening criteria

6.0 SOIL SALVAGE CONCLUSIONS AND RECOMMENDATIONS

Soil salvage at the Riley Pass mining area will be affected by the topsoil physical and chemical characteristics, physiographic position on the landscape, and equipment available for salvage. The topsoil horizons exhibit more loamy textures, fewer coarse fragments, higher organic matter content, and higher nutrient concentrations than subsurface horizons. These soils can be expected to promote vegetative growth, hydrologic function, long-term nutrient cycling, and erosional stability in the reclaimed landscape relative to deeper materials or on-site mine-impacted materials. We recommend that the A horizon and B horizons be salvaged and stored separately when possible. This will allow the more nutrient rich top soil and the less nutrient rich subsoil to be handled and replaced separately. Ideally, only A horizon soils are placed on the reclaimed surfaces.

To determine potential borrow depths, each of the soil profile descriptions were reviewed to determine the optimum and maximum salvage depth at each location. These depths were then used to identify the observed range and average salvage depth for each of the soils in the project area. The general site specific soil suitability criteria developed by the USFS to define and classify suitability (Table 1) appear appropriate with modifications as discussed in section 2.6.

Previous reclamation prescriptions in the Riley Pass area has called for six inches of soil borrow plus 1.5-inches of compost on reclaimed areas (USFS, 2010). Erosion losses are not anticipated on borrow area, however, each site needs to be evaluated on a location specific basis. It is recommended that where possible the top six inches be handled separately and replaced on borrow sites to promote the quickest revegetation of these newly disturbed locations. This will help minimize potential saline and/or sodic impacts at lower elevations from the borrow source areas. When possible any remaining A horizon soils which are salvaged below a depth of six-inches should be handled separately and placed on the surface of reclaimed areas.

Approximately 1.5 million cubic yards of soil borrow were found during this investigation (Figures 3, through 9; Table 4). This volume will be increased due to a swell factor and bulking due to the addition of compost. An estimated 320,000 cubic yards of cover material (both topsoil and cover material) will be needed for the Tronox bluffs reclamation, dependent upon final reclamation design, which is ongoing as of November 2013. This estimate is based on a vegetation topsoil cover six inches deep covering 185 acres on mine-impacted bluffs. Additionally, significant subsoil borrow material can be salvaged from within the project boundary for the non-topsoil cover material if needed.

An additional approximately 80,000 cubic yards is necessary for non-Tronox Bluffs I and G. However, some of the Non-Tronox work has been completed and a separate borrow source area was previously identified for this area.

Tetra Tech also recommends the development of a reclamation plan addressing the soils erodibility versus the proposed final location of the borrow soil placement. This will assist to ensure that erodible soils are not placed in areas susceptible to wind or water erosion. In addition, this plan would address location specific erosion mitigation techniques (i.e. erosion matting, straw mulch), soil nutrient deficiencies, and revegetation options (i.e. species selection, seeding options), constructed individually based on landscape position for both the reclaimed and borrow locations.

Table 4: Soil Borrow Volumes

Borrow Area Map Unit	Land Owner	Figure	Average Total Depth (feet)	Average Total Depth (minus 0.5 feet)	Acres	Area (square feet)	Approximate Volume of Top Soil (cubic yards)	Approximate Volume of A Horizon (cubic yards)	Approximate Volume of B Horizon (cubic yards)
USFS Land									
1SL24A	USFS	3	1.5	1.00	10.5	458,100	8,483	2,828	25,450
1SL24B	USFS	3	1.5	1.00	6.8	295,829	5,478	1,826	16,435
CL30A	USFS	3	1.6	1.08	20.4	890,149	16,484	8,242	52,200
2SL24	USFS	3	1.2	0.67	7.0	302,812	5,608	3,738	13,084
SCL10	USFS	4	No topsoil borrow salvage		18.7	815,874	No topsoil salvage - Gravel borrow potential		
CL30B	USFS	4	1.6	1.08	31.1	1,355,853	25,108	12,554	79,510
SL20	USFS	4	1.2	0.67	63.4	2,761,706	51,143	0	119,333
SCL22A	USFS	5	1.5	1.00	12.0	521,815	9,663	1,611	28,990
SCL22B	USFS	5	1.5	1.00	11.6	505,409	9,359	1,560	28,078
C16	USFS	5	0.9	0.42	26.7	1,161,127	17,919	0	39,421
PLOW17	USFS	6	0.6	0.08	11.8	514,064	9,520	7,933	11,106
L19	USFS	6	1.0	0.50	16.3	709,978	13,148	8,765	26,295
LS10	USFS	6	2.6	2.08	21.8	950,403	17,600	11,733	90,934
PLOW35	USFS	6	1.7	1.17	28.4	1,237,084	22,909	19,091	76,363
USFS Totals			**1.4**	**0.90**	**287**	**12,480,203**	**212,422**	**79,881**	**607,200**
Public Land									
FSCL60	R. Fiest	7	5.0	4.51	19.9	868,779	16,100	24,000	120,500
1KL22	T Kalisiak	8	1.8	1.33	11.9	520,266	9,700	16,000	9,600
2KL22	T Kalisiak	8	1.8	1.33	3.8	165,436	3,100	5,000	3,000
KL21	T Kalisiak	8	1.8	1.25	13.0	565,955	10,500	13,000	13,000
KSL30	T Kalisiak	8	2.5	2.00	8.6	373,265	6,900	12,600	14,800
BSCL41	L. Burghduff	8	3.4	2.89	16.2	703,979	13,100	18,700	56,500
BCL50	L. Burghduff	8	4.1	3.65	71.1	3,098,481	57,322	76,506	344,276
RSL19	W Rotenberger	9	1.6	1.08	17.6	765,888	14,200	18,800	15,300
RSCL44	W Rotenberger	9	3.7	3.23	22.0	956,936	17,700	23,600	90,600

Table 4: Soil Borrow Volumes (continued)

Borrow Area Map Unit	Land Owner	Figure	Average Total Depth (feet)	Average Total Depth (minus 0.5 feet)	Acres	Area (square feet)	Approximate Volume of Top Soil (cubic yards)	Approximate Volume of A Horizon (cubic yards)	Approximate Volume of B Horizon (cubic yards)
Public Land									
RSL23	W Rotenberger	9	1.9	1.35	16.7	728,701	13,500	22,400	13,900
Private Totals			**2.8**	**2.26**	**201**	**8,747,686**	**162,122**	**230,606**	**681,476**
Totals			**2.1**	**1.53**	**487**	**21,227,889**	**374,544**	**310,487**	**1,288,676**
								Grand Total Borrow	**1,599,163**

Notes:

Total Depth: Assumes top six inches not used except for replacement at borrow site.

6.1 USFS Survey Areas

Significantly more topsoil borrow was identified on adjacent private lands than USFS controlled property. However, approximately 700,000 cubic yards of topsoil borrow resources on USFS lands were identified. Several additional potential borrow source areas were not investigated due to the potential for these areas to be culturally significant areas. Soils delineated as potential borrow material within USFS land appear well suited for reclamation use with the following possible exceptions;

- The loamy sand texture of map unit SCL10 is considered unsuitable based on the criteria listed in Table 1 but could provide a valuable gravel source. Prior to extraction and use as gravel, sampling and testing should be conducted to ensure this material is erionite free. Such sampling and testing is beyond the contracted scope of this soil borrow investigation.

- Analytical data for map unit L19 suggest that the B-horizon of this soil may also be unsuitable based on an SAR value of 12 which is equal to the soil suitability cut-off criteria.

- Map unit C16 has an excessively high clay concentration, greater than 50 %, at depths below 5 inches. However this material may provide an excellent source for capping material.

Aside from these limitations, no soil suitability criteria were exceeded by soils evaluated on USFS lands. Assuming the top six inches of soil is stripped and either temporarily stored and replaced, or direct-hauled to adjacent borrow areas approximate stripping depths of 18 to 29 inches are available from most delineated soil borrow mapping units. Because the soil borrow areas vary with respect to clay and very fine soil concentrations, consideration should be given to their placement following a determination of which soil borrow areas are used

6.2 Northern and Central Private Land Survey Areas

The primary limiting soil borrow salvage concern in the Northern and Central surveyed areas was elevated SC and sodium concentrations versus other cation concentrations as measured by a soil's SAR. As stated above, these sodic soils are also occasionally saline (SC measurements); severely limiting those as potential borrow areas. Generally, suitable borrow depths of up to 30 inches are available in several map units equating to approximately 750,000 cubic yards of soil which could be salvaged for borrow. All potential soil borrow salvage volumes assume six inches of topsoil will be stripped prior to salvage, stockpiled, and replaced on the borrow site. Table 4 presents the individual borrow area volumes. Occasional deeper pockets of suitable soil may be encountered during salvage operations and may be appropriate for salvage upon review and approval of a reclamation scientist.

6.3 Southern Private Land Survey Area

Generally, borrow depths of up to 26 inches are available in all three map units. Assuming the top six inches of soil is stripped and either temporarily stored and replaced, or direct-hauled to adjacent salvage areas, a total salvage volume of approximately 200,000 cubic yards appears to be available in this area (Table 4).

7.0 REFERENCES

MSE, 2010. Riley Pass Removal Action Borrow Soil Test Trenching and Sampling, Sioux Ranger District. March 24.

USDA. 1993. Soil Survey Manual. Handbook Number 18. Soil Conservation Service. U.S. Government Printing Office. Washington, D.C.

_____2002. Field Book for Sampling and Describing Soils. Version 2.0. National Soil Survey Center, NRCS. September.

_____2003. National Soil Survey Handbook: Title 430-VI. Soil Survey Staff, Natural Resources Conservation Service (NRCS).

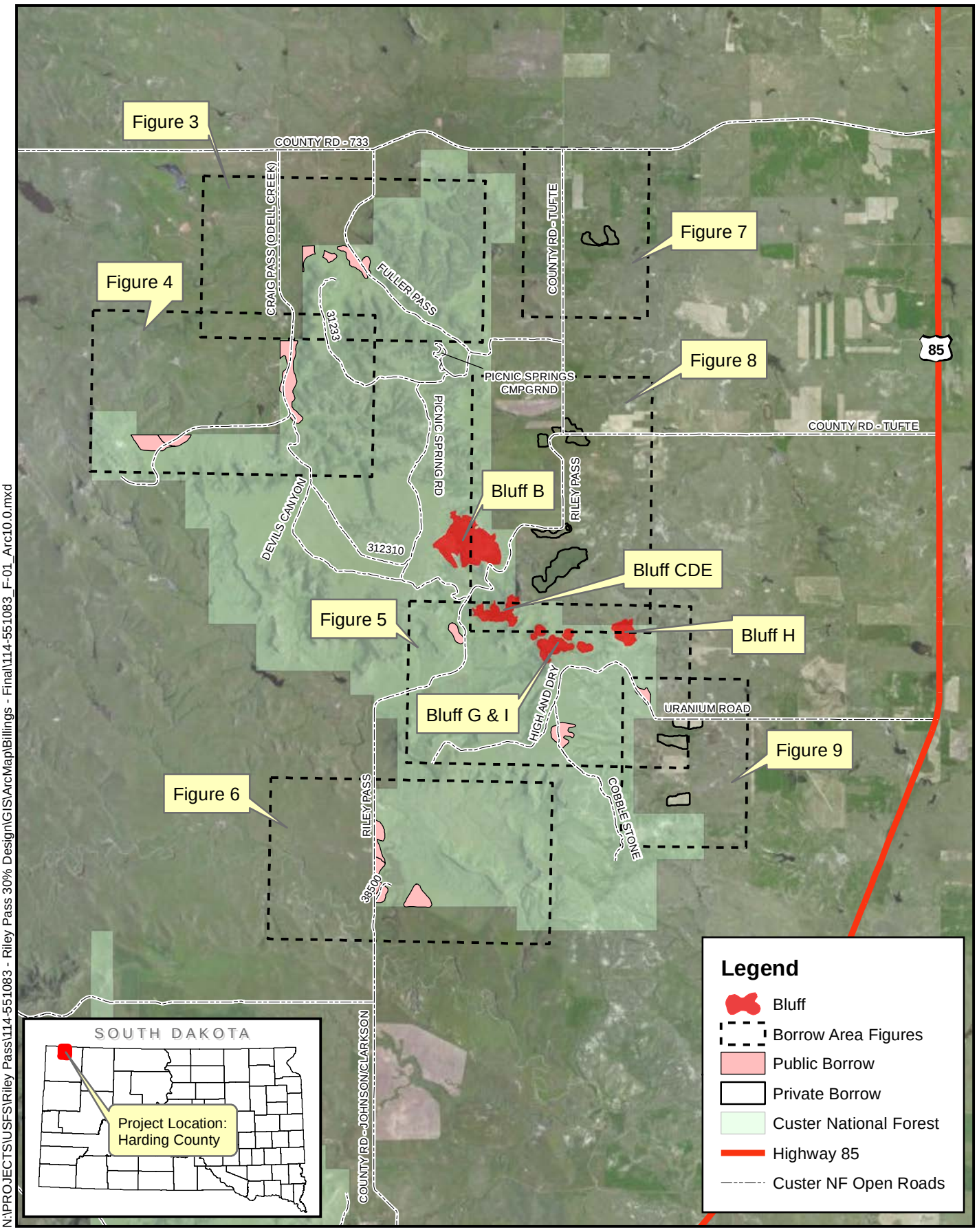
_____2009. National Engineering Handbook-Hydrologic Soil Group (210-V1-NEH, NRCS, January), pp7-1-7-5.

_____2010. Soil Survey of Harding County, South Dakota. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

USFS. 2010. Statement Of Work, Riley Pass Removal Action Borrow Soil Characterization, Bluff A and Bluff I Sioux Ranger District, Custer NF, Harding County, SD. July 4.

WDEQ. 2004. Guideline 1: Topsoil and Overburden. Wyoming Department of Land Quality Division. August.

FIGURES



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Datum: NAD83 State Plane South Dakota North

Identified Private & Public Lands Soil Borrow Resource Locations
Riley Pass
Harding County, South Dakota
FIGURE 1

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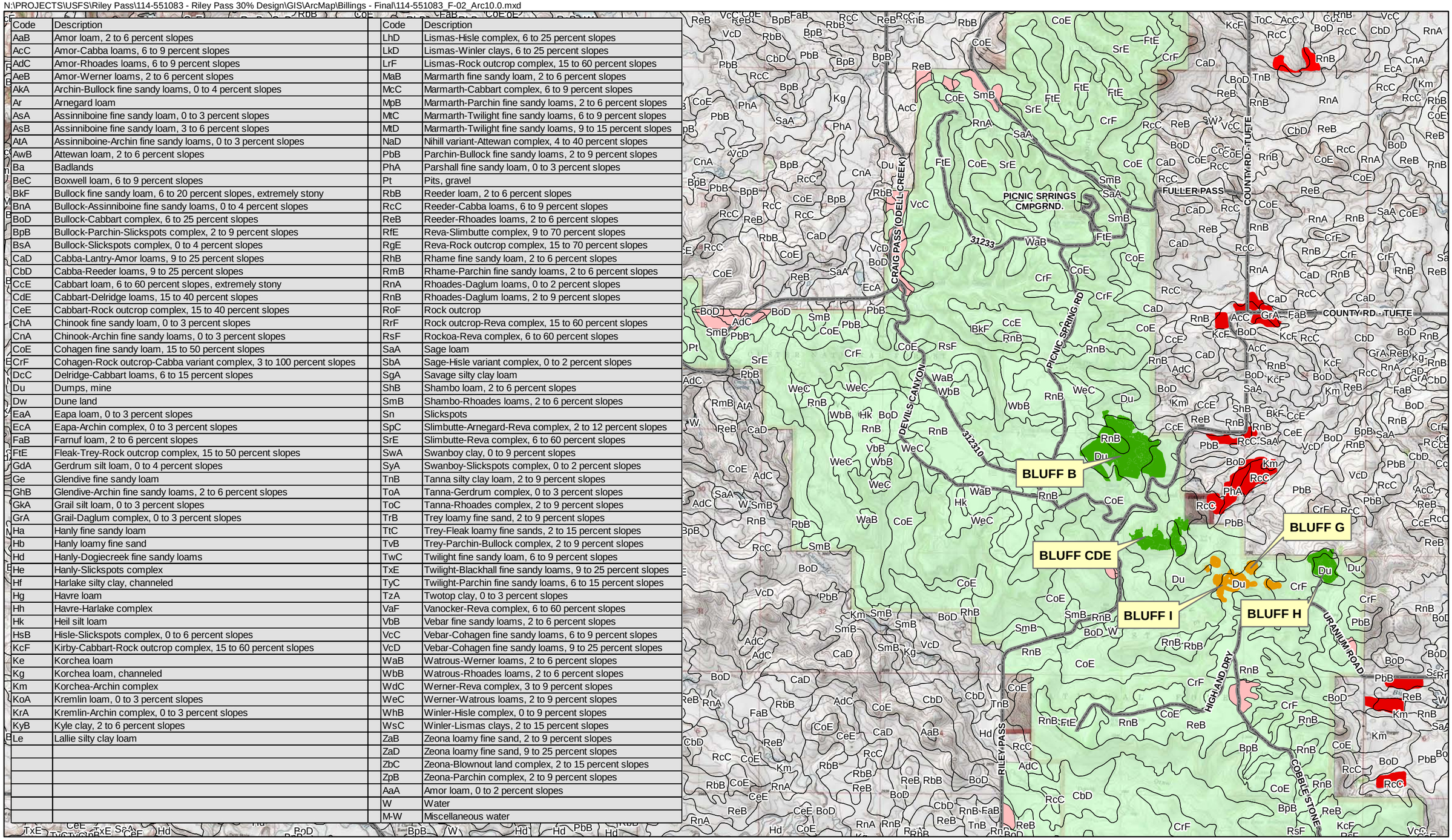
Code	Description	Code	Description
AaB	Amor loam, 2 to 6 percent slopes	LhD	Lismas-Hisle complex, 6 to 25 percent slopes
AcC	Amor-Cabba loams, 6 to 9 percent slopes	LkD	Lismas-Winler clays, 6 to 25 percent slopes
AdC	Amor-Rhoades loams, 6 to 9 percent slopes	LrF	Lismas-Rock outcrop complex, 15 to 60 percent slopes
AeB	Amor-Werner loams, 2 to 6 percent slopes	MaB	Marmarth fine sandy loam, 2 to 6 percent slopes
AkA	Archin-Bullock fine sandy loams, 0 to 4 percent slopes	McC	Marmarth-Cabbart complex, 6 to 9 percent slopes
Ar	Arnegard loam	MpB	Marmarth-Parchin fine sandy loams, 2 to 6 percent slopes
AsA	Assinniboine fine sandy loam, 0 to 3 percent slopes	MtC	Marmarth-Twilight fine sandy loams, 6 to 9 percent slopes
AsB	Assinniboine fine sandy loam, 3 to 6 percent slopes	MtD	Marmarth-Twilight fine sandy loams, 9 to 15 percent slopes
AtA	Assinniboine-Archin fine sandy loams, 0 to 3 percent slopes	NaD	Nihill variant-Attewan complex, 4 to 40 percent slopes
AwB	Attewan loam, 2 to 6 percent slopes	PbB	Parchin-Bullock fine sandy loams, 2 to 9 percent slopes
Ba	Badlands	PhA	Parshall fine sandy loam, 0 to 3 percent slopes
BeC	Boxwell loam, 6 to 9 percent slopes	Pt	Pits, gravel
BkF	Bullock fine sandy loam, 6 to 20 percent slopes, extremely stony	RbB	Reeder loam, 2 to 6 percent slopes
BnA	Bullock-Assinniboine fine sandy loams, 0 to 4 percent slopes	RcC	Reeder-Cabba loams, 6 to 9 percent slopes
BoD	Bullock-Cabbart complex, 6 to 25 percent slopes	ReB	Reeder-Rhoades loams, 2 to 6 percent slopes
BpB	Bullock-Parchin-Slickspots complex, 2 to 9 percent slopes	RfE	Reva-Slimbutte complex, 9 to 70 percent slopes
BsA	Bullock-Slickspots complex, 0 to 4 percent slopes	RgE	Reva-Rock outcrop complex, 15 to 70 percent slopes
CaD	Cabba-Lantry-Amor loams, 9 to 25 percent slopes	RhB	Rhame fine sandy loam, 2 to 6 percent slopes
CbD	Cabba-Reeder loams, 9 to 25 percent slopes	RmB	Rhame-Parchin fine sandy loams, 2 to 6 percent slopes
CcE	Cabbart loam, 6 to 60 percent slopes, extremely stony	RnA	Rhoades-Daglum loams, 0 to 2 percent slopes
CdE	Cabbart-Delridge loams, 15 to 40 percent slopes	RnB	Rhoades-Daglum loams, 2 to 9 percent slopes
CeE	Cabbart-Rock outcrop complex, 15 to 40 percent slopes	RoF	Rock outcrop
ChA	Chinook fine sandy loam, 0 to 3 percent slopes	RrF	Rock outcrop-Reva complex, 15 to 60 percent slopes
CnA	Chinook-Archin fine sandy loams, 0 to 3 percent slopes	RsF	Rockoa-Reva complex, 6 to 60 percent slopes
CoE	Cohagen fine sandy loam, 15 to 50 percent slopes	SaA	Sage loam
CrF	Cohagen-Rock outcrop-Cabba variant complex, 3 to 100 percent slopes	SbA	Sage-Hisle variant complex, 0 to 2 percent slopes
DcC	Delridge-Cabbart loams, 6 to 15 percent slopes	SgA	Savage silty clay loam
Du	Dumps, mine	ShB	Shambo loam, 2 to 6 percent slopes
Dw	Dune land	SmB	Shambo-Rhoades loams, 2 to 6 percent slopes
EaA	Eapa loam, 0 to 3 percent slopes	Sn	Slickspots
EcA	Eapa-Archin complex, 0 to 3 percent slopes	SpC	Slimbutte-Arnegard-Reva complex, 2 to 12 percent slopes
FaB	Farnuf loam, 2 to 6 percent slopes	SrE	Slimbutte-Reva complex, 6 to 60 percent slopes
FtE	Fleak-Trey-Rock outcrop complex, 15 to 50 percent slopes	SwA	Swanboy clay, 0 to 9 percent slopes
GdA	Gerdrum silt loam, 0 to 4 percent slopes	SyA	Swanboy-Slickspots complex, 0 to 2 percent slopes
Ge	Glendive fine sandy loam	TnB	Tanna silty clay loam, 2 to 9 percent slopes
GhB	Glendive-Archin fine sandy loams, 2 to 6 percent slopes	ToA	Tanna-Gerdrum complex, 0 to 3 percent slopes
GkA	Grail silt loam, 0 to 3 percent slopes	ToC	Tanna-Rhoades complex, 2 to 9 percent slopes
GrA	Grail-Daglum complex, 0 to 3 percent slopes	TrB	Trey loamy fine sand, 2 to 9 percent slopes
Ha	Hanly fine sandy loam	TtC	Trey-Fleak loamy fine sands, 2 to 15 percent slopes
Hb	Hanly loamy fine sand	TvB	Trey-Parchin-Bullock complex, 2 to 9 percent slopes
Hd	Hanly-Dogiecreek fine sandy loams	TwC	Twilight fine sandy loam, 6 to 9 percent slopes
He	Hanly-Slickspots complex	TxE	Twilight-Blackhall fine sandy loams, 9 to 25 percent slopes
Hf	Harlake silty clay, channeled	TyC	Twilight-Parchin fine sandy loams, 6 to 15 percent slopes
Hg	Havre loam	TzA	Twotop clay, 0 to 3 percent slopes
Hh	Havre-Harlake complex	VaF	Vanocker-Reva complex, 6 to 60 percent slopes
Hk	Heil silt loam	VbB	Vebar fine sandy loams, 2 to 6 percent slopes
HsB	Hisle-Slickspots complex, 0 to 6 percent slopes	VcC	Vebar-Cohagen fine sandy loams, 6 to 9 percent slopes
KcF	Kirby-Cabbart-Rock outcrop complex, 15 to 60 percent slopes	VcD	Vebar-Cohagen fine sandy loams, 9 to 25 percent slopes
Ke	Korchea loam	WaB	Watrous-Werner loams, 2 to 6 percent slopes
Kg	Korchea loam, channeled	WbB	Watrous-Rhoades loams, 2 to 6 percent slopes
Km	Korchea-Archin complex	WdC	Werner-Reva complex, 3 to 9 percent slopes
KoA	Kremlin loam, 0 to 3 percent slopes	WeC	Werner-Watrous loams, 2 to 9 percent slopes
KrA	Kremlin-Archin complex, 0 to 3 percent slopes	WhB	Winler-Hisle complex, 0 to 9 percent slopes
KyB	Kyle clay, 2 to 6 percent slopes	WsC	Winler-Lismas clays, 2 to 15 percent slopes
Le	Lallie silty clay loam	ZaB	Zeona loamy fine sand, 2 to 9 percent slopes
		ZaD	Zeona loamy fine sand, 9 to 25 percent slopes
		ZbC	Zeona-Blownout land complex, 2 to 15 percent slopes
		ZpB	Zeona-Parchin complex, 2 to 9 percent slopes
		AaA	Amor loam, 0 to 2 percent slopes
		W	Water
		M-W	Miscellaneous water



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Datum: NAD83 State Plane South Dakota North

CoE NRCS Soil Map Unit - http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Private Potential Borrow Areas

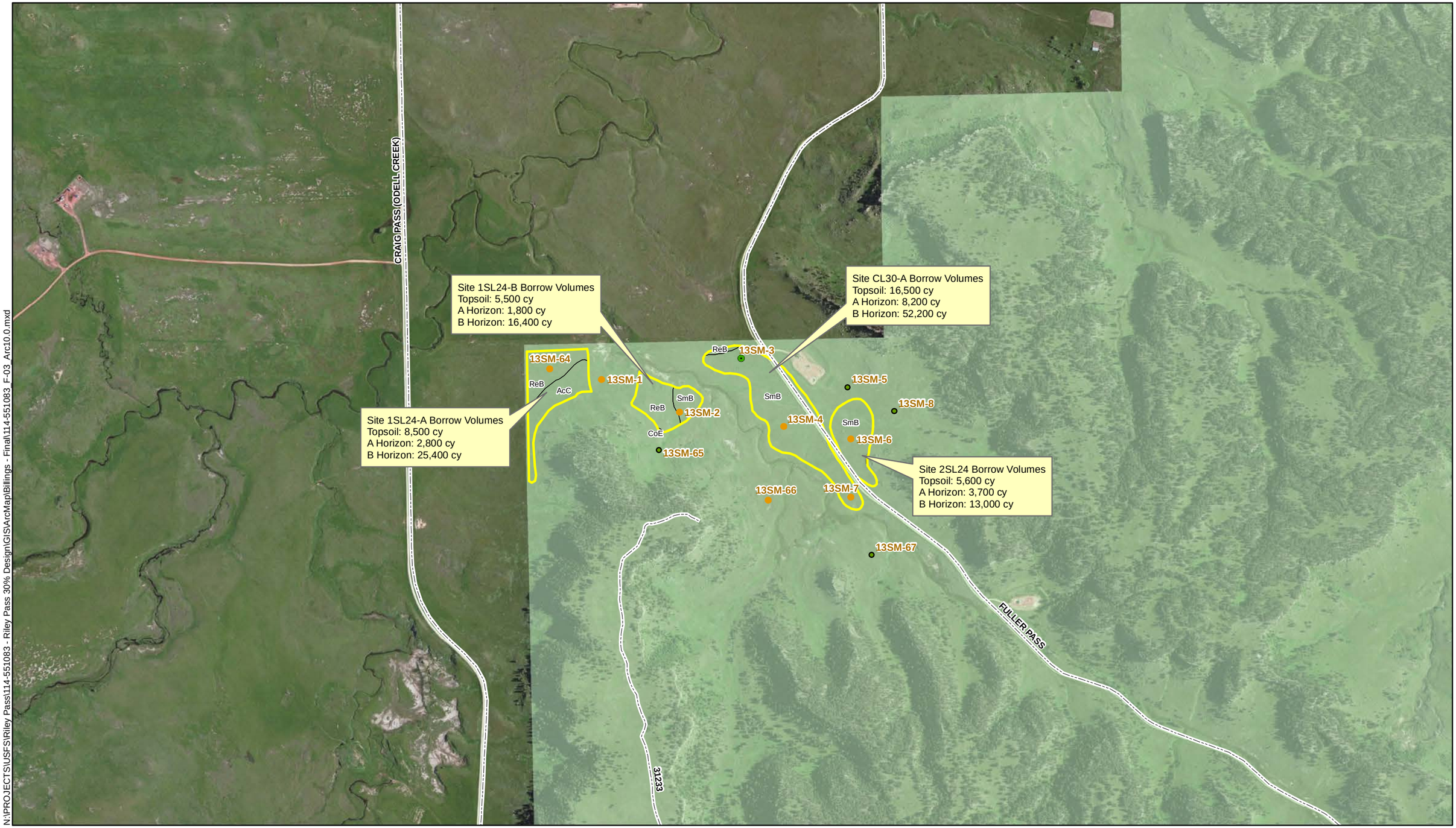
Public Potential Borrow Areas

County Roads

Tronox Reclamation Sites

Non-Tronox Reclamation Sites

NRCS Soils Map
Riley Pass Area
Harding County, South Dakota
FIGURE 2



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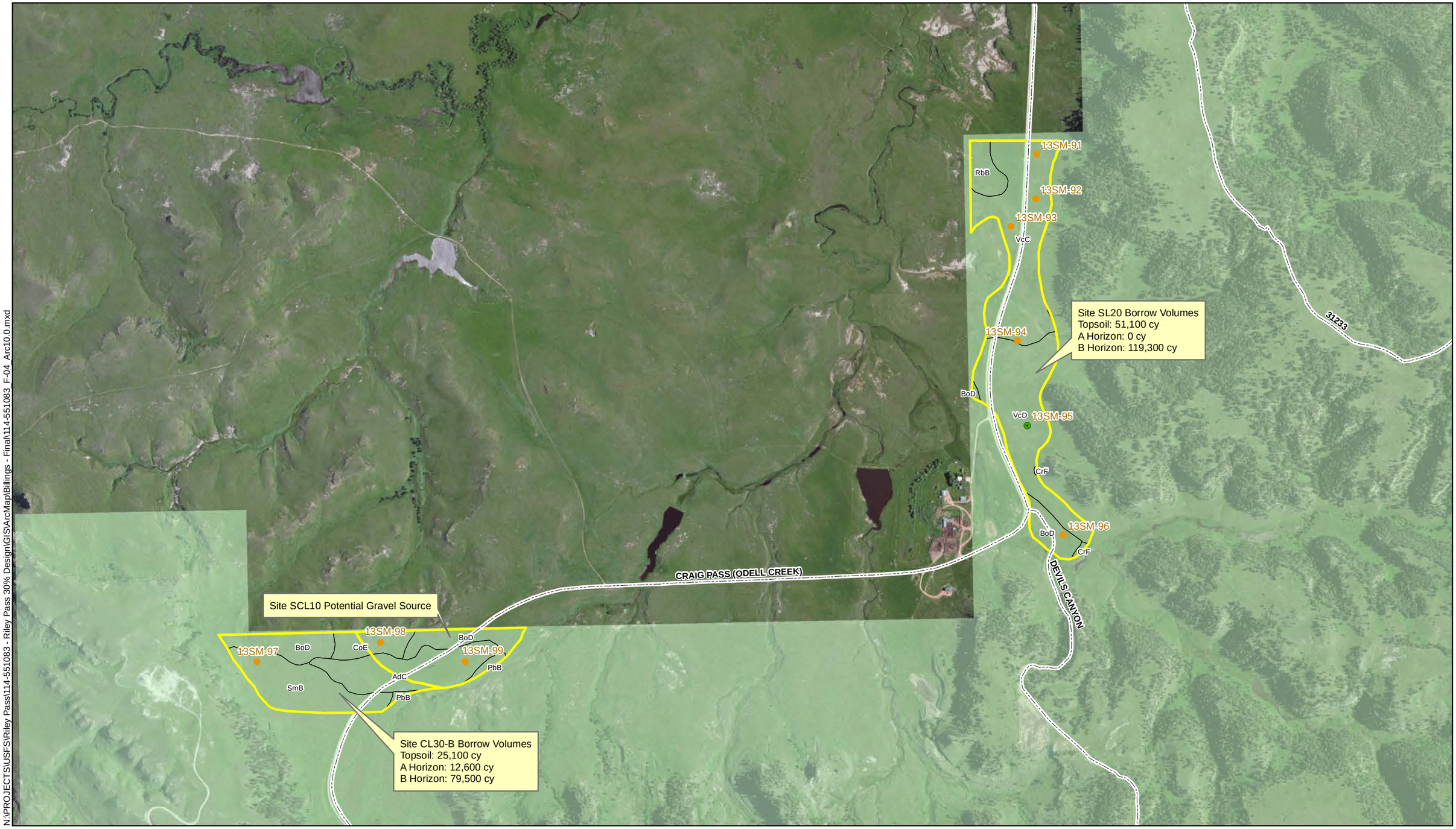
- Boring
- Soil Profile Location
- Soil Profile Location with Laboratory Analyses
- Custer NF Open Roads
- Public Borrow Area
- NRCS Soil Map Unit
  - SmB
- Custer National Forest

North USFS Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 3



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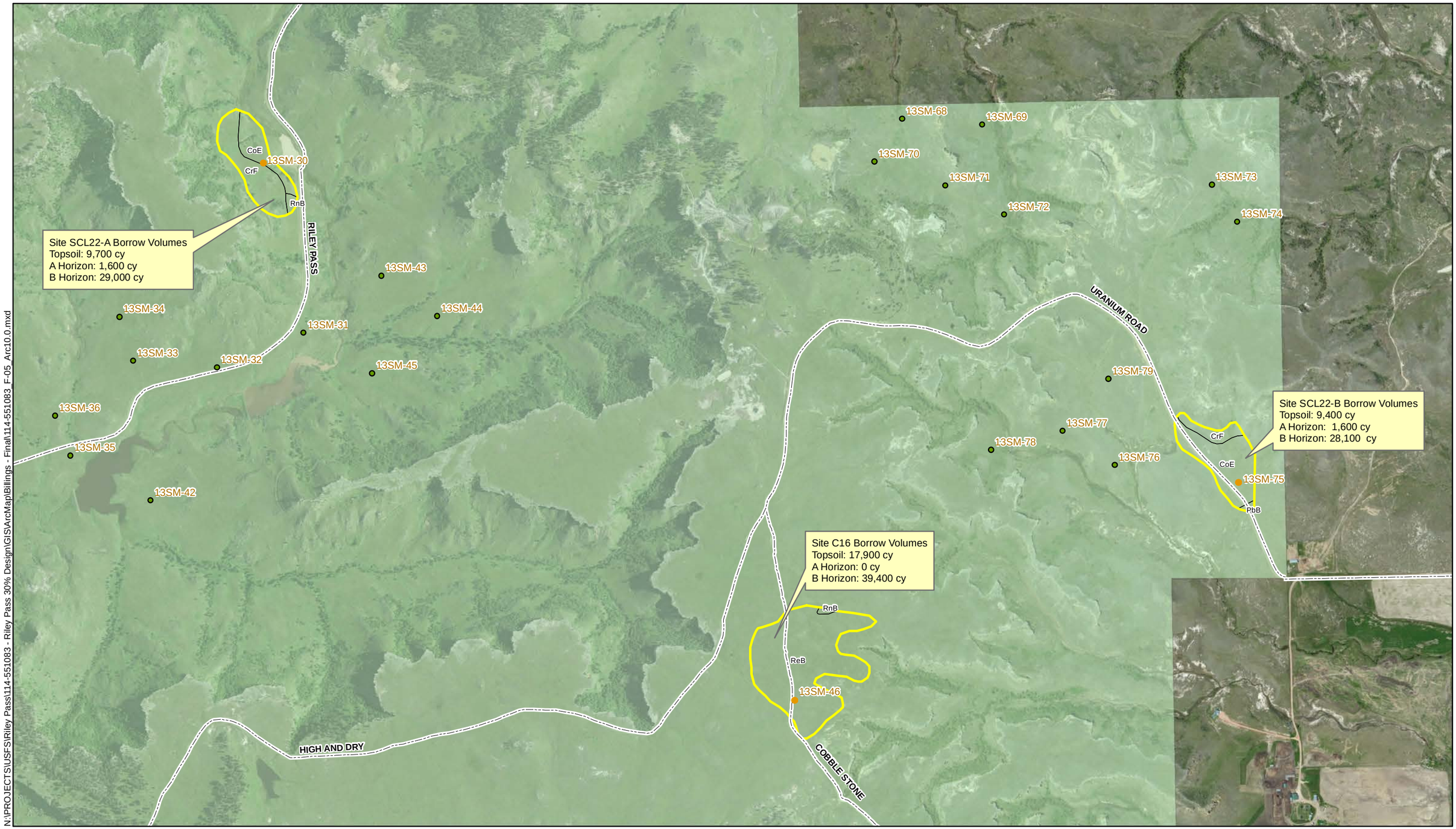
- Boring
- Soil Profile Location
- Soil Profile Location with Laboratory Analyses
- Custer NF Open Roads
- Public Borrow Area
- NRCS Soil Map Unit
- SmB
- Custer National Forest

Northwest USFS Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 4



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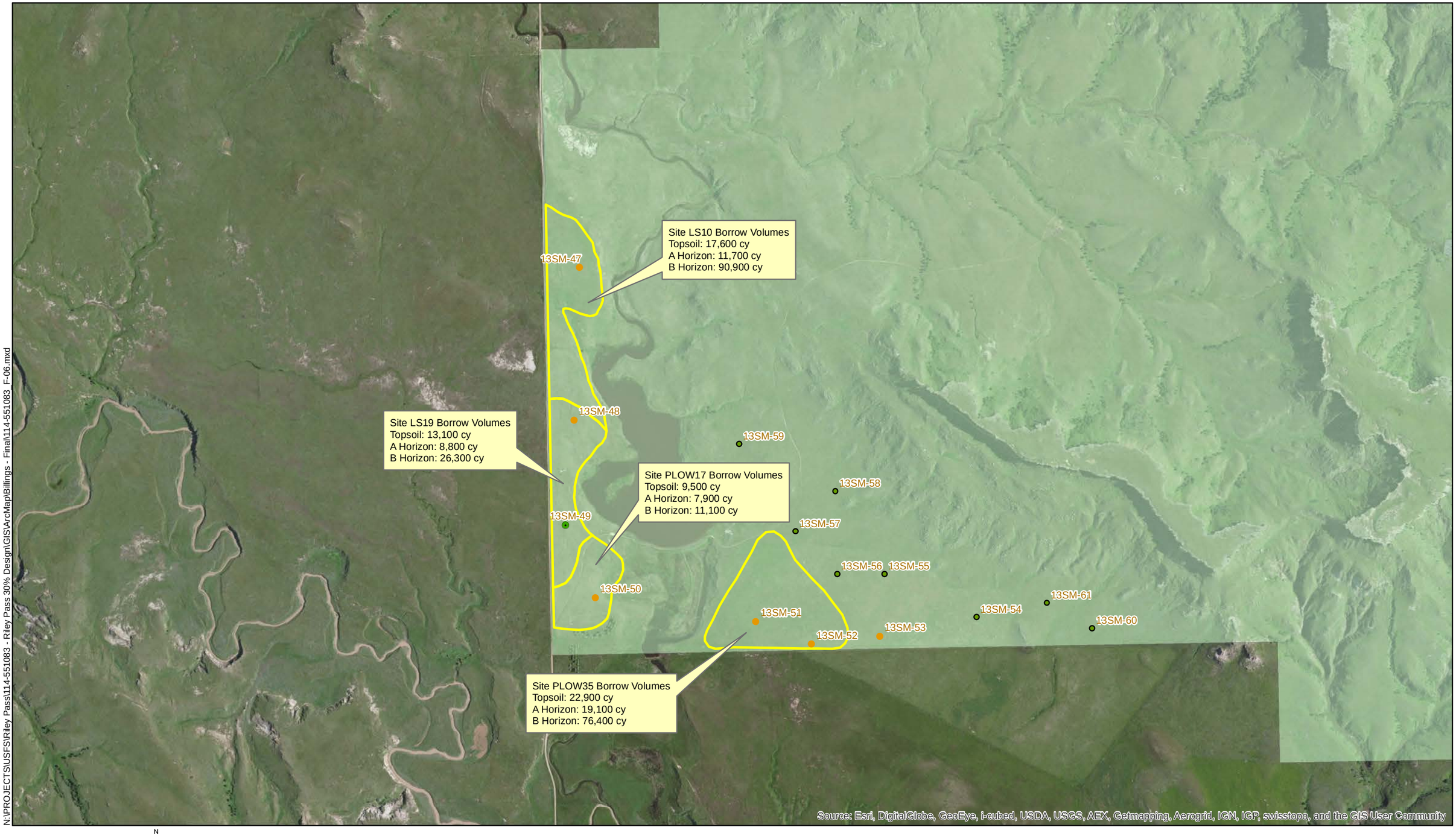
- Boring
- Soil Profile Location
- Soil Profile Location with Laboratory Analyses
- Custer NF Open Roads
- Public Borrow Area
- NRCS Soil Map Unit (ReB)
- Custer National Forest

Southeast USFS Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 5



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Datum: GCS North American 1983 UTM Zone 13T

- Boring
- Soil Profile Location
- Soil Profile Location with Laboratory Analyses
- Public Borrow Area
- Custer National Forest

Southwest USFS Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 6

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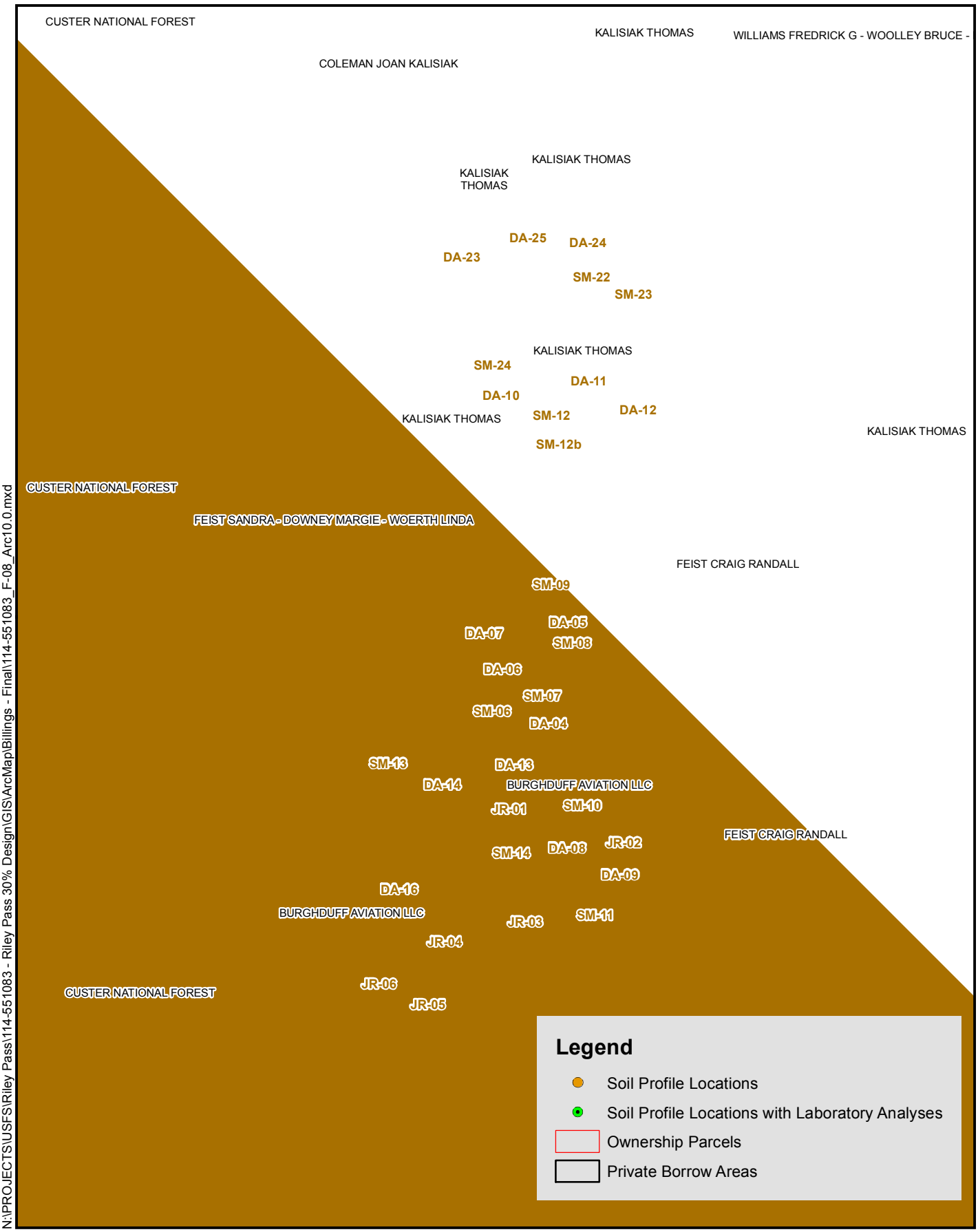
Datum: NAD83 State Plane South Dakota North

North Private Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 7



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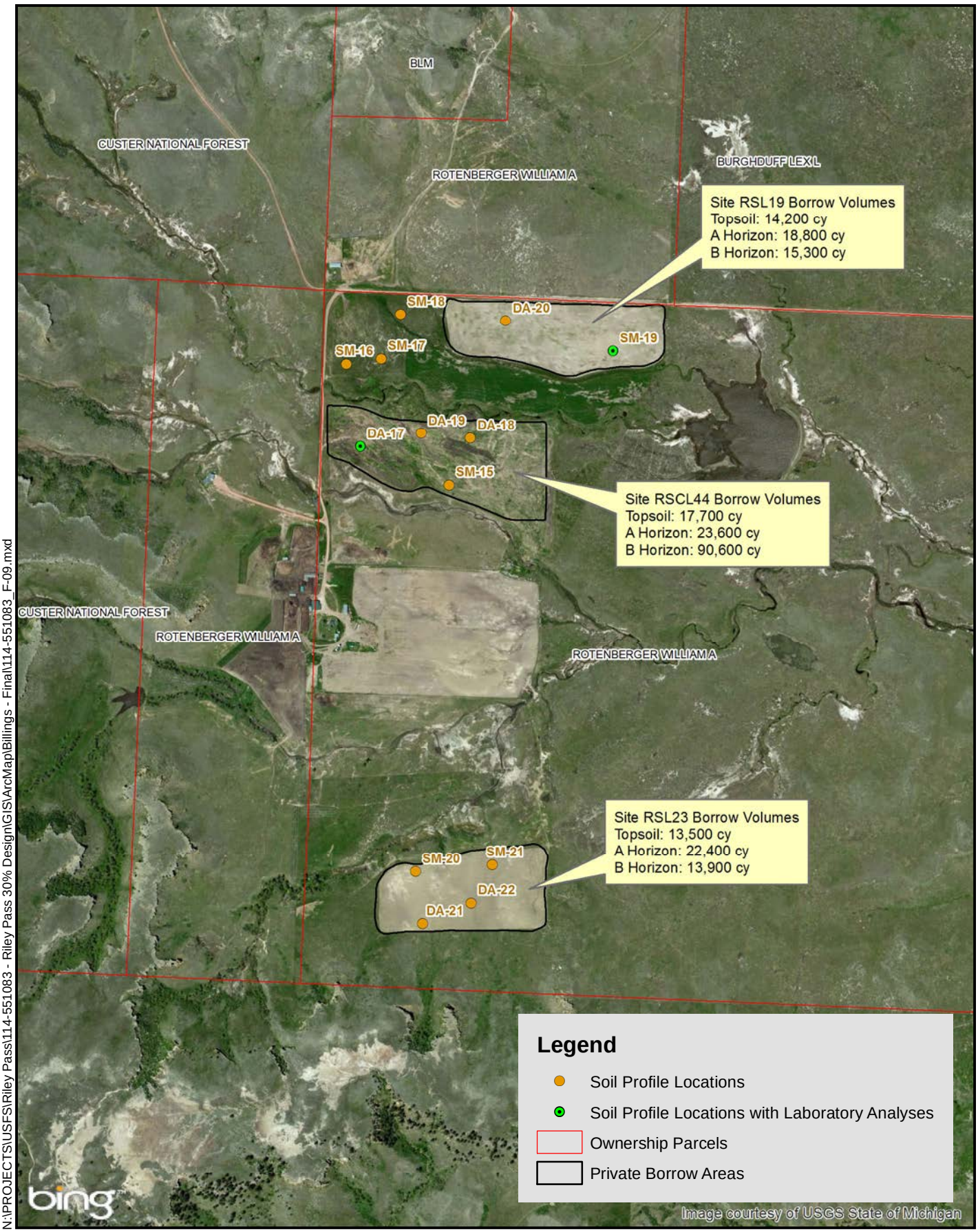
Datum: NAD83 State Plane South Dakota North

Central Private Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 8



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Datum: NAD83 State Plane South Dakota North

South Private Borrow Area
Riley Pass
Harding County, South Dakota
FIGURE 9

APPENDIX A

SOIL MAP UNIT AND SERIES DESCRIPTIONS

Harding County, South Dakota

AcC—Amor-Cabba loams, 6 to 9 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Amor and similar soils: 50 percent
Cabba and similar soils: 25 percent
Minor components: 25 percent

Description of Amor

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Typical profile

0 to 8 inches: Loam
8 to 20 inches: Loam
20 to 34 inches: Loam
34 to 60 inches: Weathered bedrock

Description of Cabba

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Linear, convex

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Shallow Loamy (R054XY030ND)
Other vegetative classification: Not suited (G054XY000ND), SHALLOW (054XY024SD_1)

Typical profile

0 to 2 inches: Loam
2 to 15 inches: Loam
15 to 60 inches: Unweathered bedrock

Minor Components

Arnegard

Percent of map unit: 5 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Loam (G054XY100ND)

Daglum

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Grail

Percent of map unit: 5 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Rhoades

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Vebar

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: Sandy (R054XY026ND)
Other vegetative classification: Very Droughty Loam (G054XY130ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

CaD—Cabba-Lantry-Amor loams, 9 to 25 percent slopes

Map Unit Setting

Landscape: Uplands, valleys
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Cabba and similar soils: 35 percent
Lantry and similar soils: 30 percent
Amor and similar soils: 20 percent
Minor components: 15 percent

Description of Cabba

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Linear, convex

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Shallow Loamy (R054XY030ND)
Other vegetative classification: Not suited (G054XY000ND), SHALLOW (054XY024SD_1)

Typical profile

0 to 2 inches: Loam
2 to 15 inches: Loam
15 to 60 inches: Weathered bedrock

Description of Lantry

Setting

Landform: Hillslopes, ridges
Landform position (two-dimensional): Backslope, shoulder
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Thin Loamy (R054XY038ND)
Other vegetative classification: Limy Upland (G054XY400ND)

Typical profile

0 to 4 inches: Loam
4 to 28 inches: Loam
28 to 30 inches: Weathered bedrock

Description of Amor

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)

Available water capacity: Low (about 5.4 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Typical profile

0 to 8 inches: Loam
8 to 20 inches: Loam
20 to 34 inches: Loam
34 to 60 inches: Weathered bedrock

Minor Components

Daglum

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Grail

Percent of map unit: 3 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Korchea

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Slickspots, dry

Percent of map unit: 2 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Non-site (R054XY999ND)
Other vegetative classification: Not suited (G054XY000ND)

Tanna

Percent of map unit: 2 percent
Landform: Hillslopes

Landform position (two-dimensional): Backslope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: Clayey (R054XY020ND)
Other vegetative classification: Clayey Subsoil (G054XY210ND)

Vebar

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Ecological site: Sandy (R054XY026ND)
Other vegetative classification: Very Droughty Loam (G054XY130ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

Km—Korchea-Archin complex

Map Unit Setting

Landscape: Uplands, valleys
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Korchea and similar soils: 50 percent
Archin and similar soils: 30 percent
Minor components: 20 percent

Description of Korchea

Setting

Landform: Flood plains, stream terraces
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.3 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 2c
Hydrologic Soil Group: B
Ecological site: Loamy Terrace (R054XY041ND)
Other vegetative classification: Loam (G054XY100ND)

Typical profile

0 to 7 inches: Loam
7 to 60 inches: Stratified fine sandy loam to silty clay loam

Description of Archin

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope

Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to moderately saline (2.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Moderate (about 7.7 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Typical profile

0 to 4 inches: Fine sandy loam
4 to 6 inches: Loam
6 to 17 inches: Loam
17 to 28 inches: Loam
28 to 60 inches: Loam

Minor Components

Bullock

Percent of map unit: 4 percent
Landform: Terraces
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Farnuf

Percent of map unit: 4 percent
Landform: Terraces
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Loam (G054XY100ND)

Grail

Percent of map unit: 4 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Rhoades

Percent of map unit: 3 percent
Landform: Fans, terraces
Landform position (two-dimensional): Footslope, toeslope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Shambo

Percent of map unit: 3 percent
Landform: Terraces
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Loam (G054XY100ND)

Slickspots, dry

Percent of map unit: 2 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Non-site (R054XY999ND)
Other vegetative classification: Not suited (G054XY000ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

PbB—Parchin-Bullock fine sandy loams, 2 to 9 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 2,300 to 4,020 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 120 to 130 days

Map Unit Composition

Parchin and similar soils: 50 percent
Bullock and similar soils: 30 percent
Minor components: 20 percent

Description of Parchin

Setting

Landform: Plains
Landform position (two-dimensional): Backslope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: Claypan (R058DY013SD)
Other vegetative classification: Claypan (G058DY800SD)

Typical profile

0 to 5 inches: Fine sandy loam
5 to 10 inches: Fine sandy loam
10 to 28 inches: Sandy clay loam
28 to 34 inches: Sandy clay loam
34 to 60 inches: Weathered bedrock

Description of Bullock

Setting

Landform: Terraces
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Very slightly saline to slightly saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: Thin Claypan (R058DY015SD)
Other vegetative classification: Not suited (G058DY000SD)

Typical profile

0 to 4 inches: Fine sandy loam
4 to 9 inches: Sandy clay loam
9 to 20 inches: Sandy clay loam
20 to 29 inches: Very fine sandy loam
29 to 60 inches: Weathered bedrock

Minor Components

Blackhall

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Shallow Sandy (R058DY028SD)
Other vegetative classification: Not suited (G058DY000SD)

Cabbart

Percent of map unit: 4 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder

Down-slope shape: Convex
Across-slope shape: Linear, convex
Ecological site: Shallow Loamy (R058DY024SD)
Other vegetative classification: Not suited (G058DY000SD)

Marmarth
Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: Loamy (R058DY010SD)
Other vegetative classification: Droughty Loam (G058DY120SD)

Delridge
Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Thin Loamy (R058DY012SD)
Other vegetative classification: Droughty Loam (G058DY120SD)

Twilight
Percent of map unit: 3 percent
Landform: Plains
Landform position (two-dimensional): Backslope, summit
Down-slope shape: Linear
Across-slope shape: Linear, convex
Ecological site: Sandy (R058DY009SD)
Other vegetative classification: Very Droughty Loam (G058DY130SD)

Slickspots, dry
Percent of map unit: 2 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Non-site (R058DY999SD)
Other vegetative classification: Not suited (G058DY000SD)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

PhA—Parshall fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Parshall and similar soils: 85 percent
Minor components: 15 percent

Description of Parshall

Setting

Landform: Terraces, fans
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: High (about 9.1 inches)

Interpretive groups

Farmland classification: Prime farmland if irrigated
Land capability (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Sandy (R054XY026ND)
Other vegetative classification: Loam (G054XY100ND)

Typical profile

0 to 8 inches: Fine sandy loam
8 to 42 inches: Fine sandy loam
42 to 60 inches: Fine sandy loam

Minor Components

Bullock

Percent of map unit: 5 percent
Landform: Terraces
Landform position (two-dimensional): Summit

Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Archin

Percent of map unit: 2 percent
Landform: Terraces
Landform position (two-dimensional): Footslope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Assinniboine

Percent of map unit: 2 percent
Landform: Fans
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy (R054XY026ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Chinook

Percent of map unit: 2 percent
Landform: Fans, terraces
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy (R054XY026ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Daglum

Percent of map unit: 2 percent
Landform: Terraces, fans
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Eapa

Percent of map unit: 2 percent
Landform: Terraces, fans
Landform position (two-dimensional): Footslope, summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Loam (G054XY100ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

RcC—Reeder-Cabba loams, 6 to 9 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Reeder and similar soils: 55 percent
Cabba and similar soils: 25 percent
Minor components: 20 percent

Description of Reeder

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Gypsum, maximum content: 1 percent
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Typical profile

0 to 6 inches: Loam
6 to 17 inches: Clay loam
17 to 30 inches: Clay loam
30 to 60 inches: Weathered bedrock

Description of Cabba

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Linear, convex

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Shallow Loamy (R054XY030ND)
Other vegetative classification: Not suited (G054XY000ND), SHALLOW (054XY024SD_1)

Typical profile

0 to 2 inches: Loam
2 to 15 inches: Loam
15 to 60 inches: Weathered bedrock

Minor Components

Arnegard

Percent of map unit: 5 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Loam (G054XY100ND)

Daglum

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Grail

Percent of map unit: 5 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Rhoades

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

Harding County, South Dakota

RnB—Rhoades-Daglum loams, 2 to 9 percent slopes

Map Unit Setting

Landscape: Uplands
Elevation: 1,660 to 3,610 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 41 to 46 degrees F
Frost-free period: 120 to 135 days

Map Unit Composition

Rhoades and similar soils: 55 percent
Daglum and similar soils: 30 percent
Minor components: 15 percent

Description of Rhoades

Setting

Landform: Fans, terraces
Landform position (two-dimensional): Footslope, toeslope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Parent material: Slope alluvium

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: Thin Claypan (R054XY033ND)
Other vegetative classification: Not suited (G054XY000ND)

Typical profile

0 to 2 inches: Loam
2 to 15 inches: Silty clay loam
15 to 32 inches: Silty clay
32 to 60 inches: Weathered bedrock

Description of Daglum

Setting

Landform: Terraces, fans
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 6 to 9 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 10 percent
Maximum salinity: Slightly saline to moderately saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 25.0
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Claypan (R054XY021ND)
Other vegetative classification: Claypan (G054XY800ND)

Typical profile

0 to 8 inches: Loam
8 to 19 inches: Clay loam
19 to 39 inches: Clay loam
39 to 60 inches: Weathered bedrock

Minor Components

Amor

Percent of map unit: 3 percent
Landform: Plains
Landform position (two-dimensional): Summit
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Cabba

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex

Across-slope shape: Linear, convex
Ecological site: Shallow Loamy (R054XY030ND)
Other vegetative classification: Not suited (G054XY000ND), SHALLOW (054XY024SD_1)

Grail

Percent of map unit: 3 percent
Landform: Swales
Landform position (two-dimensional): Footslope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: Loamy Overflow (R054XY023ND)
Other vegetative classification: Overflow (G054XY500ND)

Reeder

Percent of map unit: 3 percent
Landform: Plains
Landform position (two-dimensional): Backslope, summit, shoulder
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: Loamy (R054XY031ND)
Other vegetative classification: Droughty Loam (G054XY120ND)

Slickspots, dry

Percent of map unit: 3 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Non-site (R054XY999ND)
Other vegetative classification: Not suited (G054XY000ND)

Data Source Information

Soil Survey Area: Harding County, South Dakota
Survey Area Data: Version 14, Mar 24, 2011

APPENDIX B

SOIL PROFILE DESCRIPTIONS

MAP UNIT FSCL60

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-1 Date: 4-30-13
Parent Material: Time:
Slope: 5° Latitude/Northing
Aspect: South Longtitude/Easting:
Permeability: T-R-S: T22N R6E S1
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

NOTES: PH 6.0 7.9 SAR <0.85 1.9

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11		10YR 3/3	10YR 3/2	SCL SiL	17.5 10%	GR VF 1	NE	N	0
2	Bt	11	-	19		10YR 3/2	10YR 3/1	CL	30%	SBK M 2	NE	Y	0
3	Btk	19	-	31 78		11 11	10YR 3/2	CL	35 30%	SBK M 2	VE		0
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Sampled 0-11, 11-19, 19-31, 31-43

Potential Salvage = 0-31"
-6 = 25"

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-2
Date: 4-30-13
Parent Material:
Time:
Slope: 7°
Latitude/Northing
Aspect: S
Longtitude/Easting:
Permeability:
T-R-S: T22N - R6E - S1
Drainage:
Topographic Position: gentle slope just below low ridge crest
Epipedon:
Control Texture:
Vegetation: grass, beotalua (gramma)

NOTES: pH 7.6 SAR <0.85
8.0 4.3

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9	10YR 3/3	10YR 3/2	SiCL	27%	1 VF GR	NE	N	Ø
2	Bk	9	-	18	10YR 4/3	10YR 4/2	" CL "	" " 27.5	1 M SBK	VE	N	10% FG
3	Bk2	18	-	31	10YR 4/2	10YR 3/2	" SCL "	22.5 33%	2 M-CO SBK	VE	N	<5% FG
4	C	31	-	63	10YR 4/2	" "	" "	" "	3 M-CO SBK	VE	N	Ø
5	2C	63	-	70+	10YR 2/1	Black!	Si or SiL	7%	SGR*	NE except for ST on CO3 grains	N	Ø
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

* hard to observe, depp in pit or excavated pile

Sampled 0-9, (9-18), (18-31), 31-63

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-3 Date: 4-30-13

Parent Material: Time:

Slope: 2° Latitude/Northing

Aspect: E-SE Longtitude/Easting:

Permeability: T-R-S: T22N-R6E-S1

Drainage:

Topographic Position: Broad slope below ridge crest

Epipedon:

Control Texture:

Vegetation: Gramma, Sage, cactus (prickly pear?), short brush (willows?)

NOTES: Similar profile as SM-1

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	9	-	6	10YR 3/3	10YR 3/2	L	10%	1 VF GR	NE	N	Ø
2	Bt_1	6	-	22	10YR 2/1	10YR * 5/2	SiC	41%	2 M SBK	ST on CO_3 gleying only	Y	↓
3	Bt_2	22	-	68+	10YR 5/2	" "	SiC	45%	1 M SBK to massive	NE	Y	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

* Carbonates mix w/soil to "dilute" color

Reader

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 01
Parent Material: eolian sand, silt, clay
Slope: 3%
Aspect: 60% So W
Permeability:
Drainage:
Topographic Position: Shoulder
Epipedon:
Control Texture:
Vegetation: Crested wheat, Poa, Alfalfa

Date: 4-30-13
Time: 10:00
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N R5E Sec1

NOTES: Photos on phone, not good Burrow Soil

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	O1	0	-	2	—	—	—	—	—	—	—	—	
2	A	2	-	12	10YR 4/4	10YR 3/4	SIL	9%	1 VF GR	NE	N	<5%	
3	B	12	-	23	7.5YR 7/4	7.5YR 6/3	SI	<5%	1 VF GR	VE	N	<5%	
4	B	23	-	71	5YR 8/1	5YR 6/3	SI	<5%	1 VF GR	NE	N	<5%	
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA02
Parent Material: eolian
Slope: 4
Aspect: 120
Permeability: _____
Drainage: _____
Topographic Position: Mid-toe Slope
Epipedon: _____
Control Texture: Arg, Illic
Vegetation: Rangeland, Crested Wheat, Agspic

Date: 4/20/13
Time: 12:15
Latitude/Northing _____
Longtitude/Easting: _____
T-R-S: T22N R5E Sec 1

NOTES: Compare to SM 01, SM 03 Sampled

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	O1	0	-	2	—	—	—	—	—	—	—	—
2	A	2	-	10	10YR 4/2	10YR 2/1	SICL	15	1 VF GR	NE	N	<5%
3	Bt	10	-	22	10YR 4/1	10YR 2/2	CL	30	2 M ABK	NE	Y	<5%
4	Btk	22	-	71+	7.5YR 6/1	7.5YR 4/2	CL	35	3 M ABK	VE	Y	GR 30%
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT 1KL22

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 24
Parent Material: Alluvial / Sandstone
Slope: < 3 %
Aspect: NW
Permeability: mod slow
Drainage: Mod
Topographic Position:
Epipedon: Mollic
Control Texture:
Vegetation: Hay Pasture

Date: 5/3/24
Time: 09:00
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: In swale Knolls in field shallow stay at base
Knolls to shallow to salvage
Salvage 4"
12"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	10			10YR 3/3	CL	27+	2 m/co SBK	NE	N	<5
2	Bt	10	-	22			10YR 4/3	CL	35	2 m sbk	SE	N	<5
3	C	22	-	42			10YR 3/2	CL	33	2 m abk/sbk	VE	N	<5
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT 2KL22

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA-25
Date: 5/3/13
Parent Material: Alluvial/Colluvial
Time: 09:30
Slope: 3%
Latitude/Northing
Aspect: N / NW
Longtitude/Easting:
Permeability: Mod Slow
T-R-S:
Drainage: Mod
Topographic Position: Convex ridge in an undulating topography
Epipedon:
Control Texture:
Vegetation: Rangeland

NOTES: Photo on phone
20"to 32" Salvage depth
This pit is similar to DA23 and 24 but has more clay in the C horizon
Sample
Salvage A: 4"
B 12"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	10	—	10YR 3/3	CL	27+	2 M/W SBK	NE	N	<5
2	Bt	10	-	22	—	10YR 4/3	CL	35	2 M SBK	SE	N	<10
3	C	22	-	53	—	10YR 5/4	CL	38+	2 M/CO ~~SBK~~ ~~SBK~~	VE	N	<5
4	Lab	-		Sample								
5		17	-	26	pH 7.7	~~SAR~~ 1.7	Loam					
6		29	-	40	8.7	16.5	Silt Loam					
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

0-29
-6
23" Salvage

MAP UNIT KL21

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-22 Date: 5-3-13

Parent Material: Time:

Slope: 2° Latitude/Northing

Aspect: N Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: top of shallow rise in broad meadow

Epipedon:

Control Texture:

Vegetation: MISC grass

NOTES: Salvageable to 14" - below that soil is probably non-fertile

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7	10YR 3/3	10YR 3/2	SiL	25	1 MGR	NE	N	0
2	Bt	7	-	10		10YR 4/3	SiCL	35	2 M-CO SBK	SL	↓	0
3	Btk	10	-	14		2.5Y 4/3	SiCL	30	2 M-CO SBK	ST	↓	0
4	C	14	-	28+		2.5Y 5/2	" "	" "	1 FSBK to MA	ST	↓	10% (sandstone lenses)
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-23 Date: 5-3-13

Parent Material: Time:

Slope: 0-5° Latitude/Northing

Aspect: N Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: in shallow swale in broad meadow

Epipedon:

Control Texture:

Vegetation: misc grass

NOTES: Appears similar to DA-22

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8	10YR 3/3	10YR 2/2	L	25 20	2 MGR	NE	N	0
2	Bt	8	-	20		10YR 3/2	SiCL	35 5	2 CO PR CO ABK	NE	↓	↓
3	Bk	20	-	28+		10YR 2/2	11 11	11 11 27.5	1 M SBK	ST	↓	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Sampled 0-8, 8-20, 20-28

PH 5.9 8.0 5.9

SAR <0.85 5.0 <0.85

loader

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 21
Parent Material:
Slope: 2
Aspect: 40°
Permeability:
Drainage:
Topographic Position: fan
Epipedon: ochric
Control Texture:
Vegetation: alfalfa – cultivated field

Date: 5/2/13
Time: 1240
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Salvage depth 8"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8	—	10YR 2/2		L	20	1 M SBK	NE	N	<5% GR
2	B	8	-	24	—	10YR 5/4		LS	12	1 M SBK/GR	NE	N	<5% GR
3	C	24	-	40	✓	10YR 3/2		CL	32	2M SBK	VE	N	<5% GR
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT KSL30

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA-23
Date: 5/3/12
Parent Material:
Time: 820
Slope: 2%
Latitude/Northing
Aspect: 20°
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: Valley Rolling hills Concave toe slope
Epipedon: Mollic
Control Texture:
Vegetation: Farm field (cultivated)

NOTES: This pit is similar to the deep clay rich soils
salvage
Salvage depth 30" Soils @ 30" Hz 1 = 10"
Hz 2 = 20"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11	—	10YR 3/3		L	18	Plowed	NE	N	<5% GR
2	B	11	-	30	—	10YR 3/4		Cl	36	2 M SBK/PR	NE	N	<5% GR
3	C	30	-	56	—	10YR 3/4		Cl	30	2 M SBK	VE	N	<5% GR
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT BSCL41

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 04
Parent Material: Scoria,
Slope: 0
Aspect: 0
Permeability:
Drainage:
Topographic Position: Valley bottom
Epipedon: /
Control Texture:
Vegetation:

Date: 05-01-13
Time: 9:23
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Change DA 04 to this pit - photo on phone
Similar STE 6 and 9
Sample collected
pH 7.5, SAR <1.7

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)		Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	O	0	-	2	—	—	—	—	—	—	—	<5% GR
2	A	2	-	9	10YR 3/1	10YR 2/2	SL	18	2VC GR	SL	N	<5% GR
3	ABk	9	-	29	10YR 4/2	10YR 4/2	Sandy Clay Loam CL	42.5 40	2M PR,	SL	N	<5% GR
4	B	29	-	31	7.5YR 4/4	7.5 5/4	LVFS	10	2 M SBK	NE	N	<5% GR
5	BC	31	-	73+	7.5YR 4/6	7.5 5/4	LVFS	10	1 M SBK	NE	N	<5% GR
6			-									
7			-									
8			-									
9			-									

as soils

* Dry color only required as necessary to determine epipedon.

0-37" Borrow
-6" Top
31" Total Borrow.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 13
Parent Material:
Slope: 1%
Aspect: 65°
Permeability:
Drainage:
Topographic Position:
Epipedon: Mollic
Control Texture: Argillic
Vegetation: plowed field

Date: 5-1-13
Time: 1415
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Sampled entire profile Salvage depth 18"

pH 7.1 to 8.0 ↑ SAR increased w/depth

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9	—	10YR 3/2		L	18	Plowed	NE	N	<5% GR
2	B	9	-	18	—	10YR 3/2		SCL	27 32	3 M ABK	NE	some	<15% GR
3	BC	18	-	40	—	10YR 5/4		Sandy Loam FS	8 15	2 M + CO SAK	VE	N	<5% GR
4	C	40	-	68		10YR 3/2		C	60	3 PL	SL	N	<5% GR
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

40" Salvage
- 6
38" Salvage

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: PA 14
Parent Material:
Slope: 3°
Aspect: 65°
Permeability:
Drainage:
Topographic Position: Gully
Epipedon: Mollic
Control Texture:
Vegetation: plowed field

Date: 5/1/13
Time: 1436
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Similar to SM 13 – Salvage depth 27"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8		10YR 3/2	L	15	1Co GR	NE	N	<5 GR
2	B	8	-	19		10YR 3/2	L	15	2 Co-VC SBK		N	<5 GR
3	Bt	19	-	42		10 YR 3/3	SICL	35	2M-Co PR		Y	<5 GR
4	C	42	-	70+		10YR 4/3	si CL	30	1M SBK	SE	Y	5 GR
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-13 Date: 5-1-13

Parent Material: Time:

Slope: 2° Latitude/Northing

Aspect: S-SW Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: Cultivated, flat ~~Mod~~ area @ foot of "Bluff B"

Epipedon:

Control Texture:

Vegetation: NONE at time of visit recently tilled
maybe some Foxtail Barley or similar grass

NOTES: Salvageble to 27", Deeper if Salt & Clay % aren't too high

SAR increase with depth 0.85 to 6.0

pH 5.5 to 6.8

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8	10YR 3/3	10YR 3/2	SL	12.5 15%	1 CO GR	NE	N	X
2	B_1	8	-	19		10YR 3/2	L	15%	2 CO-VC SBK		N	
3	B_2	19	-	27		10YR 3/3	SiL	22.5 15%	M 1		N	
4	Bk	27	-	42		10YR 4/3	SiCL	35%	2 M-CO PR	↓	Y	
5	C	42	-	70+		10YR 4/3	SiCL	30%	1 M SBK	VS on CO3	Y	
6			-							Strings only		
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Sampled (0-8), 8-19, (19-27), 27-42

0-27"

-6

21" Salvage

n\typing\forms\Soil Pedon Description Form

MAP UNIT BCL50

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR02
Parent Material: Sed rock SS
Slope: 3-5
Aspect: W
Permeability: Slow
Drainage: Mod rapid
Topographic Position: Knob side hill
Epipedon: Mollic
Control Texture:
Vegetation: hay field near grass edge

Date: 5/1/13
Time: 10:30
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p	0	-	4		10YR 3/2	L+	25+	2 VFGR 2 SBK (D)	NE		<1
2	A	4	-	9		10YR 3/2	L+	25+	2 VFGR SBK/ABK	NE		<1
3	B	9	-	20		10YR 4/2	CL	35	3 CO ABK	1	Y Thn	4
4	B	20	-	34		10YR 3/1	SCL	30	2 M ABK	2		<1
5	C_1	34+	-		coal ?							
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Borrow to 30" if salts ok

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR03
Parent Material: SS
Slope: <3
Aspect: South Towards adjoining drainage
Permeability: Mod
Drainage: Mod
Topographic Position: low sideslope
Epipedon: Mollic
Control Texture:
Vegetation: hay Field

Date: 5/1/13
Time: 11:15
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p	0	-	~~4~~		10YR 3/2 Black!	L	25	2 co pl	NE	N	<1
2	A_2	4	-	12		10YR 2/1	SiL	25	2 co SBK	NE	N	<1
3	B_{tK}	12	-	20		10YR 3/1	SiL	20	2 co ABK	ST	FPF	<1
4	BC_K	20	-	30		10YR 4/1	L high s. ± vfs	20	2 m ABK	SL/ST	~~LP~~	<1 concretions (iron?) in horizon
5	C	30	-	60+		10YR 7/1	VFSL	8	M	NE	N.	
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

salvage to 30" - do not expect salt issues roots ≥ 30"

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR04 Date: 5/1/13
Parent Material: ss Time: 12:00
Slope: < 3 Latitude/Northing
Aspect: NE Longtitude/Easting:
Permeability: slow T-R-S:
Drainage: mod slow
Topographic Position: See below
Epipedon: Mollic
Control Texture:
Vegetation: hay field

NOTES: Site representative of Main/center of field although at Toe of Side Slope not Farmed (rock shallow)

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	Ap & A1		0	-	7		10YR 3/2	CL	28	1 co pl	NE	N	<1
2	AB	E	7	-	14		10YR 3/2	CL+	38	3 MAbk Co	~~NE~~ SL VS	~~N~~ Y	<1
3	B	tk	14	-	24		10 YR 3/1	CL	35 ~~38~~	3m Abk	ST	Y	<1
4	B	k1	24	-	40		10YR 4/2	CL	30 ~~38~~	2M Abk	ST	N.	<1
5	~~BC~~ C	B	40	-	60		10YR 4/3	~~SCL~~ SiCL	28	1 MSBK	SL	N	
6				-									
7				-									
8				-									
9				-									

* Dry color only required as necessary to determine epipedon.

Could go 40" if soils acceptable

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR-05
Parent Material: ss
Slope: < 3
Aspect: NE
Permeability: Mod slow
Drainage: slow
Topographic Position:
Epipedon:
Control Texture:
Vegetation: hay Field

Date: 5/1/13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Slight knoll to west will be shallower as will soils on gentle slope to west coming off rim to west - See pit JR-06

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p + A	0	-	7		10YR 3/2	L (SiL)	20	2 m sbk	NE	N	<1
2	AB_t	7	-	14		10YR 3/2	CL	35	2 m P/	NE	Y	<1
3	2 A	14	-	18		10YR 3/2	~~VFSL~~	18	2 m Abk	NE	~~Y~~ N	<1
4	2 B	18	-	32		10YR 3/3	VFSL	20	2 M Abk	NE	N	<1
5	2 B_K	32	-	52		10YR 4/3	L	22	2 co Abk	St	N	<1
6	2C	52	-	60+		10YR 5/3	~~L~~ FS	7	M	VSL	N	<1
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Borrow to 32" easy - actually whole profile available to 52" C horizon will be to errosive

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR-06 Date: 5/1/13
Parent Material: SS Time:
Slope: 3 % Latitude/Northing
Aspect: NE Longtitude/Easting:
Permeability: T-R-S:
Drainage: Mod Rapid
Topographic Position: side slope
Epipedon:
Control Texture:
Vegetation: hay Field

NOTES: This pit appears typical For the uplands along west side of field Shallower A no argillics - mostly blow sand derived -

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p	0	-	4		10YR 3/2	L VFS+S.	15	1 co pl	NE	N	<1
2	A	4	-	12		10YR 3/2	L VFS-FS	15	1 m SBK	NE	N	<1
3	B_w	12	-	20		10YR 4/3	L	20	1 m pr	VS	N	<1
4	CB	20	-	33		10YR 5/3	VFSL	15	1 m SBK	St	N	<1
5	CB_1	33	+			10YR 5/3	VFSL (S.)	15	1 co SBK	VE S. VST	N	<1
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Borrow to 20" - maybe 30" IP NSC. but erosive soils

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 08
Parent Material: Eolian Sand / Alluvium
Slope: 1%
Aspect: 0° to 10°
Permeability:
Drainage:
Topographic Position: Alluvial fan (toe)
Epipedon:
Control Texture:
Vegetation: Alfalfa (cultivated)

Date: 5/1/30
Time: 1030
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Very Good Borrow Soil Salvage depth 24"
CaCO3 percipitants @ 48"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	10	10YR 3/1	10YR 2/2	SCL	27	2VC GR	NE	N	<5% GR
2	B	10	-	22	10YR 3/1	10YR 2/2	CL	40	2CO SBK	NE	Y Some	<5% GR
3	BC	22	-	75	10YR 6/4	10YR 5/3	LVFS	8/10	1 VF GR	ST	N	<5% GR
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA09
Parent Material: Alluvial, eolian sand/clay (Limestone? $CaCO_3$)
Slope: 1°
Aspect: 50°
Permeability:
Drainage:
Topographic Position:
Epipedon: Mollic
Control Texture:
Vegetation: hayfield

Date: 5-1-13
Time: 11:00
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Very hard to texture B horizon. Salvage depth 29" depending on salts
B= 80% $CaCO_3$ visible percolates

Salvage:
A=3
B=16

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9	10YR 4/3	10YR 4/3	SCL	25	1 VF GR	NE	N	<5% GR
2	BAk	9	-	29	10YR 2/1	10YR 1/1	SCL	30	3 CO SBK	ST	N	<5% GR
3	BC	29	-	76	2.5Y 5/4	2.5Y 5/2	L	20	2 F ABK	NE	N	<5% GR
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Reader

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-14
Parent Material: Sandstone ?
Slope: 10
Aspect: N - NW
Permeability:
Drainage:
Topographic Position: broad rolling hills
Epipedon:
Control Texture:
Vegetation: smooth brome & Alfalfa

Date: 5-1-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Salvageable to 19" but fine sand below 19" will likely erode quickly until reclaimed

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9	10YR 3/3	10YR 3/2	SiL L	(22%)	1 M GR	NE	N	Ø
2	B	9	-	19		10YR 3/3	SiL SL	~~25%~~ 17	1 M-CO SBK	NE	↓	↓
3	C	19	-	60+		2.5Y 4/3	Fine LS	5%	SGR	VE	↓	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

sampled

0-9
9-19
19-60

PH
6.3
7.2

SAR
2.5
5

19"
-6
13" Salvage

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: Sm-11 Date: 5-1-13

Parent Material: Time:

Slope: Ø Latitude/Northing

Aspect: Ø Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: low terrace above gully

Epipedon:

Control Texture:

Vegetation: misc grass, dandelion

NOTES: Salvageable to 33" (if not salty, below 21")

pH 7.6 SAR 7.3

8.0 8.0

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	9	10 YR 3/2	10 YR 3/2	L	25	1 M GR to 1 F SBK	NE	N	Ø
2	B+	9	-	21		10 YR 3/3	CL	3/20	2 M SBK	NE	Y	
3	B+k	21	-	33		10 YR 4/3	SCL	25	MA	SL to ST	Y	
4	C	33	-	90+					MA			
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Sample 0-9, 9-21, 21-33

Salvage 0-33 - 6 = 27"

MAP UNIT RSL19

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-19
Parent Material:
Slope: 0-5°
Aspect: S
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: Alfalfa

Date: 5-2-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Salvagable to 22 if NOT too clayey or salty - I suspect too much clay below 7" though

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	0 - 7	10YR 4/3	10YR 3/2	CL	27	1 M GR	NE	N	0
2	7 - 22		10YR 5/3	SiCL sandy loam	35 36.3	2 CO SBK	SL	Y	
3	22 - 40+		" "	" "	" "	1 CO SBK to MA	ST	Y	
4	-								
5	-								
6	-								
7	-								
8	-								
9	-								

* Dry color only required as necessary to determine epipedon.

Sampled 0-7, 7-22, 22-40

6-22
- 6
15"

pH 8.4
SAR 5.2

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA20
Parent Material:
Slope: 2
Aspect: 100°
Permeability:
Drainage:
Topographic Position: Toe of a fan
Epipedon: Mollic
Control Texture:
Vegetation:

Date: 5/2/13
Time: 11:15
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Increase in Sand w/depth
Salvage depth 38+ depending on salts

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	9		10YR 3/2		SL	18	1 F GR	NE	N	< 5% GR
2	B	9	-	19		10YR 3/3		SCL	27	2 M SBK	NE	N	< 5% GR
3	C	19	-	38		10YR 3/3		SL	20	2 M SB/C	ST	N	< 5%, GR
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT RSCL44

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-15 Date: 5-2-13

Parent Material: Time:

Slope: 0 Latitude/Northing

Aspect: 0 Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: Field, Flat plain

Epipedon:

Control Texture:

Vegetation: Corn

NOTES: Salvage-able to 25" or deeper if not too clayey or salty below 25"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p	0	-	7	10YR 3/3	10YR 2/2	L	22	1 M GR	NE	N	0
2	B	7	-	25		10YR 3/3	L	25	2 M SBK	NE	N	0
3	~~BK~~	25	-	33+		10YR 4/3	CL	32	1 M SBK	SC	N	0
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: 22 1-7
Parent Material:
Slope: 2°
Aspect: 70°
Permeability:
Drainage:
Topographic Position:
Epipedon: Mollic
Control Texture:
Vegetation:

Date: 5/2/13
Time: 940
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Corn field chang on GPS
Sampled
plow pan @ 24"
24" Salvage or until Salts

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8	—	10YR 3/3	L	18	Plowed	NE	N	<5 GR
2	B1	8	-	28	—	10YR 3/2	SCL CL	30 25	to PR 2 CO ABK	NE	Y	<5 GL
3	B2t	28	-	40+	—	10YR 3/2	CL	30	2 M ABK	ST	Y	7 10 GR
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

0 - 28" Salvage
- 6
22" Salvage.

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Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 18
Parent Material:
Slope:
Aspect:
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

Date: 5/2/13
Time: 10:20
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Similar to DA 17 - with increase in CaCO3
Salvage depth 19"
Fe oxides

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8						ST		
2	Bk	8	-	19						ST		
3	BC	19	-	50						S/E		
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA19
Parent Material:
Slope:
Aspect:
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

Date: 5/2/13
Time: 10:50
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Similar to DA 17:18
20 inch solvage depth

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9						NE		<5 GR
2	Bt	9	-	20						NE		20% GR
3	BC	20	-	48						St		<5 GR
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT RSL23

Reader

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA22
Parent Material:
Slope: 3%
Aspect: 35°
Permeability:
Drainage:
Topographic Position: mid slope of fan
Epipedon: mollic
Control Texture:
Vegetation:

Date: 5-2-13
Time: 1360
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Salvage depth 13" – very similar to DA22 in color, texture with a deeper A horizon

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A1	0	-	6	—	—	L	15	1M SBK	NE	N	<5 GR
2	A2	6	-	13	—		L	18	1M SBK	NE	N	<5 GR
3	B/E	13	-	30			SL	9	1MC SBK/GR	SL	N	<5% GR 3% CO
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Reedley

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-20 Date: 5-2-13

Parent Material: Time:

Slope: 0-5° Latitude/Northing

Aspect: N-NW Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: toe of slope above drainage bottom

Epipedon:

Control Texture:

Vegetation: alfalfa

NOTES: If no salt, entire depth is salvageable if high sand content is desired

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6	10YR 3/3	10YR 3/2	L	20	1 M GR	NE	N	0
2	B	6	-	13		2.5Y 3/3	SL	15	1 M SBK	NE	↓	↓
3	C	13	-	33+		2.5Y 5/4	LS	7	MA	SE	↓	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Reeder

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-21
Parent Material:
Slope: 0-5
Aspect: N-NE
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: Alfalfa

Date: 5-2-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: See notes for SM-20

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	AP	0	-	6	10YR 3/2	10YR 3/2	SiL	20	1 M GR	NE	N	0
2	A	6	-	13		10YR 3/4	SiL	15	1 M SBK	NE		
3	B	13	-	22		2.5Y 4/4	LS	10	1 M-CO SBK	ST		
4	C	22	-	34+		" "	SC	15	" "	VE		
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

SOIL PROFILES NOT WITHIN SOIL BORROW MAP UNITS (Private)

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-10 Date: 5-1-13

Parent Material: Time:

Slope: Ø Latitude/Northing

Aspect: Ø Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: Flat field

Epipedon:

Control Texture:

Vegetation: Smooth brome, Alfalfa

NOTES: could salvage to 46" if not salty below 21". (Salvage A=3 B 10)

Profile similar to SM-6 & 7 but deeper to top of C-horizon & with more clayey B-horizon

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9	10 YR 3/3	10 YR 3/3	SL	12.5 10%	1 VF GR	NE	N	Ø
2	Bt	9	-	21		10 YR 3/2	SCL CL	22 32%	2 M-CO SBK	NE	Y	Ø
3	Btk	21	-	46		10 YR 2/2	CL	32%	2 M SBK	SL	Y	5% F GR
4	C	46	-	72+	—	—	—	—	—	—	—	—
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Sampled 0-9, 9-21, 21-46

PH 5.4 7.2

SAR 2.5 5.0

46 − 6 = 40" Salvage

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: JR - 01
Date: 5/1/13
Parent Material: lower slope
Time: 08:45
Slope: < 3 %
Latitude/Northing
Aspect: N - NE
Longtitude/Easting:
Permeability: Mod slow
T-R-S:
Drainage: Mod
Topographic Position: lower Alluvial slope
Epipedon: Mollic
Control Texture:
Vegetation: hayed field

NOTES: Borrow ~~Apt~~ Suitablity based on Bk horizon salts
third horizon looks to be slope wash

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A Ap+A	0	-	8 ranges 7-10		10YR 3/2	L high ≤ VFSL	18	2 m sbk below Ap	NE	N	<1
2	Btk	8	-	16	10YR 7/2	10YR 5/2	C -	45	2 m pl co-vco breaking ABK	VE	~~Yes~~ ~~Many~~ CD D	<1 Many ca mottle roots on ped face
3	~~B~~C	16	-	24		10YR 4/2	L high 4% VFSL	17	2 co sbk	SL	N	<1 few scat
4	2C1	24	-	40		10YR 3/3	CL +	27	1-2 m sbk	ST	N	<1
5	2C2	40	-	+		10YR 3/3	CL +	27	"	ST	N	"
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

May need to move in 100 ys from toe before borrow allowed

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Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-16, SM-17 Date: 5-2-13

Parent Material: _____ Time: _____

Slope: _____ Latitude/Northing _____

Aspect: _____ Longtitude/Easting: _____

Permeability: _____ T-R-S: _____

Drainage: _____

Topographic Position: _____

Epipedon: _____

Control Texture: _____

Vegetation: _____

NOTES: SM-16 - too shallow to salvage → 16" over rock / C-horizon } foot in photos
SM-17 - " 3" x 10" " } Point to lower limit of suitable soil

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
		Dry*	Moist						
1	-								
2	-								
3	-								
4	-								
5	-								
6	-								
7	-								
8	-								
9	-								

* Dry color only required as necessary to determine epipedon.

No Selvage

Farnuf

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA-16

Date: 5-1-13

Parent Material:

Time:

Slope: 0-5°

Latitude/Northing

Aspect: N-NW

Longtitude/Easting:

Permeability:

T-R-S:

Drainage:

Topographic Position: Broad flat hills below "Bluff B"

Epipedon:

Control Texture:

Vegetation: grass

NOTES: Similar to DA-14 but w/less clay in C-horizon

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9		10YR 3/2	L	15	1Co GR	NE	N	<5 GR
2	B	9	-	28		10YR 3/3	SiCl	35	2M-CoPR	NE	Y	<5 GR
3	C	28	-	60		10YR 4/3	V	35	1M SBK	SE	Y	< GR
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

No Salvage Farout

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 15
Parent Material:
Slope: 3°
Aspect: 20°
Permeability:
Drainage:
Topographic Position: Fan
Epipedon:
Control Texture:
Vegetation: Not Suitable Salvage Soil

Date: 5/1/13
Time: 1500
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Sampled Salvage depth 44"

Very Salty SAR 26. 25

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
SAR													
24	1	A	0	-	8	/	10YR 3/2	SICL	25	1 M SBK	NE	N	<5% GR
25	2	B	8	-	14	/	10YR 3/3	CL	35	2 M ABK	NE	N	<5% GR
27	3	B	14	-	44	/	10YR 5/3	VFSL	18	1 M SBK	SL	N	<5% GR <1% Co
	4	CB	44	-	75	/	10YR 5/3	SCL	22	1 M SBK	SL	N	<5% GR
	5			-									
	6			-									
	7			-									
	8			-									
	9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-18 Date: 5-2-13

Parent Material: Time:

Slope: 0-2° Latitude/Northing

Aspect: S Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: Just below knob in field

Epipedon:

Control Texture:

Vegetation: gramma, cactus (which I sat on!), misc range grasses

NOTES: Salvageable to 19" & potentially deeper if not too salty

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A		0	-	7	10YR 3/3	10YR 3/2	CL	27%	1 M GR	NE	N	Ø
2			7	-	19		10YR 4/3	L	22%	2 CO ABK	NE	↓	↓
3			19	-	30+		2.5Y 5/3	LS	12%	1 M SBK	ST	↓	↓
4				-									
5				-									
6				-									
7				-									
8				-									
9				-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 05
Parent Material: Alluvium / eolian
Slope: 2%
Aspect: 0°
Permeability:
Drainage:
Topographic Position:
Epipedon: Mollic
Control Texture: Argillic ?
Vegetation: native range

Date: 4/30/13
Time: 1350
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N 5E Sec 24 SE 1/4

NOTES: 51 to 56 - Fe oxids - sampled

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	O	0	-	2	—	—	—	—	—	—	—	<5%
2	A	2	-	9	10YR 3/4	10YR 2/2	SCL	5	1VF GR	NE	N	<5%
3	Bt	9	-	51	10YR 3/1	10YR 2/1	CL	40	2to3 CO PR	VS	Some	<5%
4	Bt	51	-	56+	10YR 3/1	10YR 2/1	SCl	25	1VF GR	SL	N	<5%
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA06
Parent Material: Residuum / Eolian
Slope: 2%
Aspect: 40°
Permeability:
Drainage:
Topographic Position: Valley Bottom
Epipedon: Ochric
Control Texture:
Vegetation: Rangeland

Date: 4/30/13
Time: 1700
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N R5E Section 24 SE 1/4

NOTES: Sampled

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	O_i	0	-	2	—	—	—	—	—	—	—	—	—
2	A	2	-	9	10YR 4/4	10YR 3/4	SCL	8	1 F GR	N	N	< 5% GR
3	Bk	9	-	17	10YR 4/4	10YR 3/4	L	25	2M SBK	SL	N	< 10% GR
4	Bk	17	-	49	10YR 4/4	10YR 3/4	L	18	1M SBK	SL	N	< 15% GR
5	Bk	49+	-		10YR 4/4	10YR 3/4	CL	38	2M SBK	N	N	< 5% GR
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-8
Date: 4-30-13
Parent Material:
Time:
Slope: 0
Latitude/Northing
Aspect:
Longtitude/Easting:
Permeability:
T-R-S: T22N-R6E-S24
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: willows, gramma, misc grass

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11	10YR 2/2	10 YR 2/1	SiL	20	1 M GR	N	N	
2	B	11	-	24		10YR 3/2	" "	25	2-3 MSBK	N	N	
3	B	24	-	35		10YR 4/3	SiCL	30	" "	N	Y	
4	C	35	-	70+		2.5YR 4/3	FSL	15	MA	VE	N	
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-6 & SM-7
Parent Material:
Slope: 0-2°
Aspect: NW
Permeability:
Drainage:
Topographic Position: Low rolling "Breaks" topography @ top of terrace
Epipedon:
Control Texture:
Vegetation: Grama, cactus, misc grasses

Date: 4-30-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N-R6E-S24

NOTES: Site SM-7 Samp as SM-6 but A=0-12", Bk=12-19, C=19-66+

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7	10YR 3/4	10YR 4/3	CL	30	3MSBK	NE	Y	Ø	
2	Bk	7	-	22	10YR 5/6 & 10YR 2/2	10YR 4/2	CL	30	2MSBK	ST	Y	Ø	
3	C	22	-	60+	*	10YR 4/3	SiCL	39	MA	NE	Y	100% Highly weathered alternating yellow & Maroon BR	
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

* alternating yellow & maroon layers of decomposed rock

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA-07
Parent Material: Scoria
Slope: 0
Aspect: 0
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

Date: 5/1/13
Time: 9:50
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Similar to DA 04, SM06 & 07

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
		Dry*	Moist						
1	-								
2	-								
3	-								
4	-								
5	-								
6	-								
7	-								
8	-								
9	-								

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-12

Date: 5-1-30

Parent Material:

Time:

Slope: 5°

Latitude/Northing

Aspect: S-SW

Longtitude/Easting:

Permeability:

T-R-S:

Drainage:

Topographic Position: bottom of broad swale

Epipedon:

Control Texture:

Vegetation: crested wheat grass

NOTES: GPSed as "SM-1222", Salvageable to 19" inches (31" if not salty or too clayey below 19").
7-19 6.7 <0.85
High pH 19-31 = 8.8 SAR 12.1

SOIL PROFILE DESCRIPTION (***Use NASIS Abbreviations***)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7	10YR 4/3	10YR 3/2	SiL	22	1 CO GR	NE	N	Ø
2	Bt	7	-	19		10YR 4/3	SiCL	35	2 MSBK	NE	N	↓
3	Btk	19	-	31		" "	SiCL	37	" "	ST	Y	↓
4	C	31	-	72+	→							
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

sampled 0-7, 7-19, 19-31

0-19 ~~Salvage~~
— 4 13"

n\typing\forms\Soil Pedon Description Form

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-12B
Date: 5-1-13
Parent Material:
Time:
Slope: W 5
Latitude/Northing
Aspect: ~120° E
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: Near top of ridge
Epipedon:
Control Texture:
Vegetation: gramma, misc grasses

NOTES: Profile not described - Probably would not use as horizon b/c of shallow depth to Bedrock. Scoria outcrops at points along ridge to South & this pit is shallow covering of soil above scoria.

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9								
2	B+	9	-	25								
3	R	25	-	60+								
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA12
Parent Material:
Slope: 1%
Aspect: 120°
Permeability: Mod
Drainage: Mod
Topographic Position: Concave toe Slope
Epipedon:
Control Texture:
Vegetation:

Date: 5-1-13
Time: 1310
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Similar to DA 10 and 11 what appears to be Weathered Coal @ 60" depth
Sampled
38" Salvage pH 7.5 SAR <1.7

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	14	10YR 4/4		SiCL	30	1M SBK	NE	N	<5
2	B	14	-	38	10YR 3/3		Clay Loam	32.5	1M SBK	ST	N?	<5
3	C	38	-	60	Peat				2M+ CO SBK	ST	N	>20%
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

ab easily

* Dry color only required as necessary to determine epipedon.

0-38" Salvage
- 6
32"

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 11
Parent Material:
Slope: 2°
Aspect: 70°
Permeability:
Drainage:
Topographic Position:
Epipedon: Mollic
Control Texture:
Vegetation:

Date: 5-1-13
Time: 1300
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Same as DA 10 - Salvage depth 24"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6								
2	Btk	6	-	20								
3	BCk	20	-	65								
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA-10
Parent Material:
Slope: 2°
Aspect: 70°
Permeability:
Drainage:
Topographic Position: mill
Epipedon: mollic
Control Texture:
Vegetation: Crested Wheat Rangeland

Date: 5-1-13
Time: 12:30
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: Salvage depth 20" Salt dependent A=0
Sarhyload. B=18

pH 7.8 SAR 0.93

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6	-	10YR 4/4		SiCl	30	1 M SAB	VE	N	<5%
2	B/C	6	-	20	-	10YR 3/3		SiCl	14% 35	1 M SBK	ST	N	<5%
3	BCk	20	-	65	-	10 YR 4/4		SiCl	30	2 M to CO SBK	ST	N	>20%
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

ab Rock

* Dry color only required as necessary to determine epipedon.

0 - 65" Borrow
- 6" Top.
59" Borrow.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-9 Date: 5-1-13

Parent Material: Time:

Slope: Ø Latitude/Northing

Aspect: Ø Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: top of knob

Epipedon:

Control Texture:

Vegetation:

NOTES: C-horizon a mix of SG (Possibly weathered coal) & massive weathered layers of yellow, red/orange, & dark rock

A=7"
B 16"

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11		10YR 2/1	10YR 2/1	L	15%	1 M GR	NE	N	Ø
2	B	11	-	27			10YR 2/1	L	20%	1 M-CO SBK	NE	N	10% cobbles
3	C	27	-	70+			10YR 2/1	SiL	10%	SG & MA	NE	N	Ø
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Sampled 0-11, 11-27, 27-40, 40-52

NO Salvage Potential

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-24
Date: 5-3-13
Parent Material:
Time:
Slope: 10°
Latitude/Northing
Aspect: W - NW
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: ~~Sto~~ shallow slope near top of hill
Epipedon:
Control Texture:
Vegetation: gramma & misl grasses

NOTES: Not Salvageable 8-10" A/B over C w/ silty coal ~~Parent Material at about~~ 4 ft

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
		Dry*	Moist						
1	-								
2	-								
3	-								
4	-								
5	-								
6	-								
7	-								
8	-								
9	-								

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-4
Parent Material:
Slope:
Aspect:
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

Date: 4-30-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N-R5E-S11

NOTES: No detailed profile description – too fine textural
Road side (N side of driveway to out-buildings

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon appx		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
					Dry*	Moist						
1	0		-	8			SiL	little to				ø
2	8		-	24			vfSL	no clay				↓
3	24		-	36+			↓	light	brown			↓
4			-					dry	color			↓
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: DA 03
Parent Material: eolian, Residuum
Slope: 3%
Aspect: 120°
Permeability:
Drainage:
Topographic Position: Toe slope
Epipedon:
Control Texture:
Vegetation: Cultivated field

Date: 4/30/13
Time: 1430
Latitude/Northing
Longtitude/Easting:
T-R-S: T22N. R5E Sec 11

NOTES: Similar to SM-05 CaCO3 deposition @ 29" depth

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	12	10YR 5/3	10YR 4/3	SCL	5%	1 M SAB	NE	N	<5% GR
2	B/E	12	-	23	5Y 7/2	7.5YR 4/3	SCL	5%	1 F GR	VE	N	<5% GR
3	B	23	-	29	10YR 3/3	10YR 2/2	SCL	30	2 M SAB	SL	N	<5% GR
4	B	29	-	45	10YR 3/3	10YR 2/2	SCL	35	2 M SAB	SL	N	<5% GR
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

TBO Sandy

Riley Pass Profile Description Data Sheet (page 1 of 2)

Site ID: SM-5
Date: 4-30-13
Parent Material:
Time:
Slope: 1°
Latitude/Northing
Aspect: S - SE
Longtitude/Easting:
Permeability:
T-R-S: T-22N-R5E-S11
Drainage:
Topographic Position: flat area near base of cave hills/cliff
Epipedon:
Control Texture:
Vegetation: crested wheat, ~~Noto~~ halogeton, spurge - hay field

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	14	2.5 YR 4/4	2.5 YR 4/3	LS	5	SGR	ST	N	~~0~~
2	Bt	14	-	22	10 YR 3/2	10 YR 2/2	SiCL	30	2M SBK	SL	N	↓
3	Btk	22	-	45+	10YR 3/2	" "	SiCL	35	2-3 M PR	ST on CO3 grains only	Y	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Sampled 0-14, 14-22, 22-45

MAP UNIT 1SL24-A

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M64 Date: 9-11-13

Parent Material: Time:

Slope: ~15° Latitude/Northing

Aspect: N Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: foot hill toward valley bottom & cliff

Epipedon:

Control Texture: echinacea, sage, chamomile/mint, & grass

Vegetation:

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	8			10YR 3/3	SL	19%	1 MGR	NE	N	0
2	B	8	-	24			10YR 3/3	SL	15%	1 MSBK	SL	N	0
3	C	24	-	~~41+~~ 36			10YR 5/6	LS	5%	SG	VE	N	5% MGR
4	Cr	36	-	41+									
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT 1SL24-B

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM 1
Date: 9-11-13
Parent Material: colluvium
Time:
Slope: 15-25°
Latitude/Northing
Aspect: N
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: slump/landslide on hill slope below cliff
Epipedon:
Control Texture:
Vegetation: thick grass (fescue, bromelia, clover or alfalfa), sage

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	2			10YR 3/3	L to SL	15%	1 f GR	NE	N	Ø
2	B	2	-	20			10YR 4/3	CL	30%	1 M SBK	NE	N	Ø
3	C	20	-	32+							ST	N	25% 95% to cobbles
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM2 Date: 9-11-13
Parent Material: Time:
Slope: 15-20° Latitude/Northing
Aspect: E - NE Longtitude/Easting:
Permeability: T-R-S:
Drainage:
Topographic Position: toe slope
Epipedon:
Control Texture:
Vegetation: Sage, lupine, needle grass & other grass

NOTES: Very similar to 13SM64

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6		10YR 3/2	SL to SCL	20%	1 FGR	NE	N	0
2	B	6	-	22		10YR 3/3	SL	18%	1 MSBK	↓	N	↓
3	C	22	-	38+			LS	4%		↓	N	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT CL30-A

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13 SM 3
Date: 9-11-13
Parent Material:
Time:
Slope: 5-10°
Latitude/Northing
Aspect: W - SW
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: valley bottom, stream terrace
Epipedon:
Control Texture:
Vegetation: cheatgrass, wheat, grama, sage

NOTES: Difficult to ID A to B margin good salvage in this area
Sampled A & B horizons

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	~11"		10YR 3/2	CL	30%	2 M GR	NE	N	~0
2	B	11	-	20		11 11	CL	34%	2 M SBK	NE		
3	C	20	-	56+			C	45%		ST		
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM4 Date: 9-11-13

Parent Material: Time:

Slope: 5° West Latitude/Northing

Aspect: Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: Floodplain near small stream

Epipedon:

Control Texture:

Vegetation: Sage, gramma, dense grasses

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7		10YR 2/2	SCL	25%	2 FGR	NE	N	Ø
2	B	7	-	28		10YR 3/3	SCL	30%	2 M SBK	↓	N	Ø
3	R	28	-	29								~50% cobbs
4			-									↓ can't auger
5			-									through, VNSR
6			-									of CF's
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM7
Date: 9-11-13
Parent Material:
Time:
Slope: 5-10°
Latitude/Northing
Aspect: W-NW
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: STream terrace
Epipedon:
Control Texture:
Vegetation: gramma, Sage, Needle grass

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	1	-	9		10YR 4/2	SiCL to CL	30%	2 FGR	NE	N	20% FG
2	B	9	-	21		10YR 4/2	" "	" "		SL	N	10% FG
3	C	21	-	22+			C	40%		NE	N	∅
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT 2SL24

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13 SM 6
Date: 9-11-13
Parent Material:
Time:
Slope: 0-10°
Latitude/Northing
Aspect: W - NW
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: toe slope berm drainage bottom & cliff
Epipedon:
Control Texture:
Vegetation: sage, gramma

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	10		10YR 3/3	SL	8%	1 M GR	N	N	<5% CGR
2	B	10	-	24		10YR 3/2	SL	15%	1 M SBK	↓	↓	" "
3	C	24	-	43+		10YR 4/2	SCL	25%		↓	↓	∅
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT SCL10

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M 98
Parent Material: colluvium
Slope: 0-5°
Aspect: N-NE
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: Crested wheat, sage, Echinacea

Date: 9-12-13
Time:
Latitude/Northing 0612803 UTM
Longtitude/Easting: 5079824
T-R-S:

NOTES: Dry to 8" depth 70% channers ✱, not suitable

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon	Depth (inches)	Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
		Dry*	Moist						
1	-								
2	-								
3	-								
4	-								
5	-								
6	-								
7	-								
8	-								
9	-								

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM99
Date: 9-12-11
Parent Material:
Time:
Slope:
Latitude/Northing 0612973 UTM
Aspect:
Longtitude/Easting: 5079726
Permeability:
T-R-S:
Drainage:
Topographic Position: valley floor / stream terrace
Epipedon:
Control Texture:
Vegetation: crested wheat, sage (mostly crested wheat)

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A/B	0	-	12		10YR 3/3	SCL	27%	1 F GR to 1 F SBK	NE	N	5% F gravel
2	C	12+	-		shovel	reversal				NE	N	750% FG to Channels
3			-									
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT CL30-B

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM 97
Parent Material:
Slope: 0-50
Aspect: N
Permeability:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: Lupine, Sage grass

Date: 9-12-11
Time:
Latitude/Northing 0612587 UTM
Longtitude/Easting: 5079783
T-R-S:

NOTES: Good salvage soil here but some parts of bench are very rocky

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1		0	-	10		10YR 3/3	SCL to CL	~25%	2-3 MGR	NE	N	NO
2		10	-	30		10YR 3/3	CL	30	2 MSBK	NE	Y	0
3	C	30	-	37+						ST	N	20% channers
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT SL20

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: ~~T3SM93~~ T3SM91 Date: 9-12-13

Parent Material: Time:

Slope: 0-10° Latitude/Northing 0614981 UTM

Aspect: W Longtitude/Easting: 5081513

Permeability: T-R-S:

Drainage:

Topographic Position: foothill in shallow swell

Epipedon:

Control Texture:

Vegetation: gramma, echinacea, silver sage, Asteracea

NOTES: Very similar to 94 & 95 Calmost the same

Thin lense of ~~sands~~ stone gravel At interface between A & B horizon

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6			10YR 3/2	SL	12%	2 MGR	NE	N	∅
2	B	6	-	21			10YR 3/3	CO SL	15%	1 MSBK	↓	↓	∅
3	C	21	-	22+							↓	↓	Auger refusal
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM93
Date: 9-12-13
Parent Material:
Time:
Slope: 5-10°
Latitude/Northing 0614894 UTM
Aspect: W
Longtitude/Easting: 5081334
Permeability:
T-R-S:
Drainage:
Topographic Position: Toe slope / terrace
Epipedon:
Control Texture:
Vegetation: Very Dense cresta wheat

NOTES: 13SM92 = same as 93 but steeper hill slope (10-15°) 0615017 5081339 UTM

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	6		10YR 2/2	SCL	25%	2 MGR	NE	N	Ø
2	B	6	-	24		10YR 3/2	SCL	33%	2 MSBK	NE	N	Ø
3	Cr	24	-	25+	Auger	refusal						
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM 94 — Date: 9-12-13

Parent Material: — Time:

Slope: 0-10 — Latitude/Northing 0614945 UTM

Aspect: ~~East~~ W-NW — Longtitude/Easting: 5080873

Permeability: — T-R-S:

Drainage:

Topographic Position: Toe Slope / alluvial fan

Epipedon:

Control Texture:

Vegetation: Silver Sage, gramma, chamomile-mint, Fringed Sage, Smooth brome

NOTES: Slumped area to North

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	~~A~~		-									
2	A/B	0	-	11		10YR 3/3	LS to SL	10%	1 F GR	NE	N	None
3	C	11	-	34+		10YR 4/4	CO Sand	5%		NE	N	None
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M 95
Date: 9-12-13
Parent Material:
Time:
Slope: 0-5°
Latitude/Northing 0614940 UTM
Aspect: W NW
Longtitude/Easting: 5080582
Permeability:
T-R-S:
Drainage:
Topographic Position: toeslope / Alluvial fan
Epipedon:
Control Texture:
Vegetation: crested wheatgrass, silver sage

NOTES: Sampled 0-8 & 8-24
very similar profile as 135M96

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	8		10YR 3/3		SL	15%	2 FGR	NE	N	0
2	B	8	-	24		10YR 3/3		LS	10%	1 F-M SBK	↓	↓	0
3	C	24	-	46+				CO SL	10%		↓	↓	0
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM96 Date: 9-12-13

Parent Material: Time:

Slope: Ø Latitude/Northing 0615053 UTM

Aspect: Longtitude/Easting: 5080197

Permeability: T-R-S:

Drainage:

Topographic Position: Mouth of 2 canyons

Epipedon:

Control Texture:

Vegetation: Crested wheat, sage, cheat

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	9		10YR 3/3	COSL	12%	2 F GR	NE	N	Ø
2	B	9	-	17		10YR 3/3	LS	10%	1 F SBK	NE	↓	Ø
3	C	17	-	36						ST	↓	5% CoGR channers
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT SCL22-A

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M30 Date: 9-10-13

Parent Material: Time:

Slope: 25° Latitude/Northing

Aspect: NE Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: hill slope below cliff

Epipedon:

Control Texture:

Vegetation: Fescue, ~~forbs~~ wheatgrass, sage

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7		10YR 3/3	SCL	25%	3 M GR	NE	N	0
2	~~B~~	7	-	25		~~10YR~~ 2.5YR 4/4	SCL	27%	↓	NE	↓	↓
3	C	25	-	51+					↓	ST	↓	↓
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT SCL22-B

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M 75
Date: 9-11-13
Parent Material:
Time:
Slope: 5-10°
Latitude/Northing
Aspect: S
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation: grama/sage/ blome

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
					Dry*	Moist						
1	A	0	-	8		10YR 3/2	SCL	22%	1 MGR	NE	N	2
2	B	8	-	20		10YR 4/2	coarse SCL	22%	1 MSBK	↓	↓	5%
3	C	20	-	31						↓	↓	
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

MAP UNIT C16

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM ~~76~~ 46
Date: 9-11-13
Parent Material:
Time:
Slope: 0°
Latitude/Northing
Aspect:
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position: Top of Butte
Epipedon:
Control Texture:
Vegetation: grass (biome?) and sage

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	5		10YR 3/3	CL to SiCL	30%	2 FGR	N	N	Q
2	B	5	-	16		10YR 4/4	CL	>50%	2 CO SBK	N	Y	↓
3	C	16	-	30+						VE		↓
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT PLOW17

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M 50 Date: 9-10-13

Parent Material: Time:

Slope: 0° Latitude/Northing

Aspect: Ø Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: flat broad valley bottom

Epipedon: mollic

Control Texture:

Vegetation: grass bluegrass, wet meadow

NOTES: very wet soil at time of visit to depth of 16"

difficult to texture A-hor bk its sooo wet

top of C difficult to determine, what I have as C on this form may

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*) hr Bk

	Horizon		Depth (inches)			Color Dry*	Color Moist*	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11		10YR 2/2	35	Si CL or Si C	SMGR	NE	N	0
2	B	11	-	17		10YR 3/2	45	Si C		SL	N	0
3	C	17	-	52+		10YR 4/2	40	Si C		ST	N	0
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT LS19

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM49 Date: 9-10-13

Parent Material: Time:

Slope: 0 Latitude/Northing

Aspect: 0 Longtitude/Easting:

Permeability: T-R-S:

Drainage:

Topographic Position: valley bottom

Epipedon:

Control Texture:

Vegetation: grass, Rye / Lolium Sage

NOTES: Sample/ 0-10 & 10-22

13SM48 is the same profile but shallower A

A: 0-6, B=6-16+ don't think I hit C but fizz was increasing w/ depth through B

loam 15% CL 40%

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A_p	0	-	10		10YR 3/2	L	17%	2 M GR	N	N	0
2	B	10	-	22		10YR 3/3	L	22%	1 C SBK ABK	N	N	0
3	C	22	-	34+						ST	N	0
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

n\typing\forms\Soil Pedon Description Form

13SM46 on flat immediately below small ridge

top of knoll was also looked at (See map) A = 0-6, B 6≈20, C≈20-34+

MAP UNIT LS10

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM47
Parent Material: Sandstone
Slope: 5-15° S
Aspect:
Permeability:
Drainage:
Topographic Position: hill top
Epipedon:
Control Texture:
Vegetation: smooth brome (very thick)

Date: 9-10-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: A horizon becomes thinner moving from 13SM50 north to this location as B/C becomes less clayey and more sandy

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	10		10YR 3/3	SL	15%	1 F GR	NE	N	0
2	B/C	10	-	41		2.5YR 4/3	LS	7%		ST	N	0
3			-										
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

MAP UNIT PLOW35

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 135M51
Parent Material:
Slope: 1-3° N-NW
Aspect:
Permeability:
Drainage:
Topographic Position: flow meadow, broad valley bottom
Epipedon:
Control Texture:
Vegetation: Crested wht, sage,

Date: 9-10-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES:

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color		Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
						Dry*	Moist						
1	A	0	-	11			10YR 3/3	SL	10%	M F GR	NE	N	0
2	B	11	-	19			10YR 3/2	SL	15%	M M SBK	NE		0
3	BC	19	-	40			10YR 4/4	LS	<5%	SG	ST		0
4	C	40	-	48				SCL	30%	M	NE	↓	0
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM52
Parent Material:
Slope: 2-5°
Aspect: W- NW
Permeability:
Drainage:
Topographic Position: valley bottom
Epipedon: Mollic
Control Texture:
Vegetation: Rye grass & Crested wheat

Date: 9-10-13
Time:
Latitude/Northing 13061 7848
Longtitude/Easting: 550721 83
VTM T-R-S:
13SM53 coords

NOTES: 13 SM 53 = 6-8" of good A/B over Sandy loam B/C w/ 5-8% clay. Not described further. Boundary between cultivated & non cultivated would be good salvage boundary

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11		10YR 3/2	SiCL	35	M MGR	NE	N	0
2	B	11	-	34		10YR 3/2	SiC	50	M CO SBK	NE	Y	1-2% fgr
3	C	34	-	40+		10YR 4/2	SCL	30		ST	N	0
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

* Dry color only required as necessary to determine epipedon.

SOIL PROFILES NOT WITHIN SOIL BORROW MAP UNITS (USFS)

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM37
Date: 9-10-13
Parent Material:
Time:
Slope: 0-5%
Latitude/Northing
Aspect: S
Longtitude/Easting:
Permeability:
T-R-S:
Drainage:
Topographic Position:
Epipedon:
Control Texture:
Vegetation:

NOTES: Snowberry, fescue, sparse sage 13SM37 has no distinct break between A, B, or C
site adjacent (20' away) in all grass has
~~no distinct break between B & C~~ distinct horizon w/ 10" A (loam)
Grassy pit sample/ 0-10" & 10-16+

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon	Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	4		10YR 3/3	L	25%	2 M GR	N	N	N
2	B	4	-	11		" "	C	50%	1 M SBK	ST	↓	N
3	C	11	-	48		10YR 4/3	SL	18%		ST	↓	
4			-									
5			-									
6			-									
7			-									
8			-									
9			-									

Snowberry site described in detail
grass site sampled
A-horiz is same except for depth
is greater under grass

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13Sm66
Parent Material: colluvium
Slope: 5-20° (stepped-terraced)
Aspect: East
Permeability:
Drainage:
Topographic Position: toe slope
Epipedon:
Control Texture:
Vegetation: gramma, sage, fescue, bluestem

Date: 9-11-13
Time:
Latitude/Northing
Longtitude/Easting:
T-R-S:

NOTES: big landslide, "Profile" is a jumbled mix of classes in heavy clay soil

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A/B	0	-	15+		10YR 4/3	C	≥40%	2 MC SBK	SL to ST	Y	10% CGR-cobbles	
2			-										
3			-										
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

off Limits Cultural Resources Found

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM 68
Parent Material:
Slope: 15°
Aspect: S - SW
Permeability:
Drainage:
Topographic Position: side slope
Epipedon:
Control Texture:
Vegetation: Blue stem grass

Date: 9-9-13
Time: 17:45
Latitude/Northing 0620027
Longtitude/Easting: 5076779
T-R-S:

NOTES: NO photo, bad light, sparse sage

13 SM 69 is similar soil x 20" to C-horizon

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	7			10YR 3/3	SL	15%	WFGR	NE	N	Q
2	B	7	-	18			10YR 3/4	LS	10%	\	NE	|	Q
3	C	18	-	26+						\	ST	↓	some rocks of weathered residium
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

Riley Pass - Full Profile Description Data Sheet (page 1 of 2)

Site ID: 13SM70 Date: 9-9-13
Parent Material: Time: 17:00
Slope: 10° Latitude/Northing 5076615.40 N UTM
Aspect: N Longtitude/Easting: 619913.82 E
Permeability: T-R-S:
Drainage:
Topographic Position: gentle slope near drainage
Epipedon:
Control Texture:
Vegetation: sage, grass

NOTES: it had rained several inches last night, soil is moist

SOIL PROFILE DESCRIPTION (*Use NASIS Abbreviations*)

	Horizon		Depth (inches)			Color Dry*	Color Moist	Texture	Clay %	Structure (grade, size, Class)	HCl (eff)	Clay Films (Y/N)	C.F. % by Vol (note size)
1	A	0	-	11		10YR 3/3	10YR 3/3	SC	42%	M F SBK M M GR	0	N	0
2	B	11	-	~50			10YR 3/4	LS	8%		↓	↓	↓
3	C	50	-	+							↓	↓	↓
4			-										
5			-										
6			-										
7			-										
8			-										
9			-										

* Dry color only required as necessary to determine epipedon.

APPENDIX C

LABORATORY ANALYTICAL REPORTS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

May 29, 2013

Jeffrey Rice
Tetra Tech, Inc.
PO Box 30615
Billings, MT 59107

RE: Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Dear Jeffrey Rice:
Enclosed are the analytical results for sample(s) received by the laboratory on May 07, 2013. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Samantha Rupe

samantha.rupe@pacelabs.com
Project Manager

Enclosures

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

CERTIFICATIONS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Hawaii Certification #Pace
Idaho Certification #: MN00064
Illinois Certification #: 200011
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nebraska Certification #: Pace
Nevada Certification #: MN_00064
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
North Dakota Certification #: R-036A
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Utah Certification #: MN00064
Virginia/DCLS Certification #: 002521
Virginia/VELAP Certification #: 460163
Washington Certification #: C754
West Virginia Certification #: 382
Wisconsin Certification #: 999407970

Montana Certification IDs

602 South 25th Street, Billings, MT 59101
EPA Region 8 Certification #: 8TMS-Q
Idaho Certification #: MT00012
Montana Certification #: MT CERT0040
NVLAP Certification #: 101292-0
Minnesota Dept of Health Certification #: 030-999-442
Washington Department of Ecology #: C993

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

SAMPLE SUMMARY

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10227774001	SM01 0-11"	Solid	04/30/13 00:00	05/07/13 12:45
10227774002	SM01 19-31"	Solid	04/30/13 00:00	05/07/13 12:45
10227774003	SM02 9-18"	Solid	04/30/13 00:00	05/07/13 12:45
10227774004	SM02 18-31"	Solid	04/30/13 00:00	05/07/13 12:45
10227774005	SM11 9-21"	Solid	05/01/13 00:00	05/07/13 12:45
10227774006	SM11 21-33"	Solid	05/01/13 00:00	05/07/13 12:45
10227774007	SM12 7-19"	Solid	05/01/13 00:00	05/07/13 12:45
10227774008	SM12 19-31"	Solid	05/01/13 00:00	05/07/13 12:45
10227774009	SM13 0-8"	Solid	05/01/13 00:00	05/07/13 12:45
10227774010	SM13 19-27"	Solid	05/01/13 00:00	05/07/13 12:45
10227774011	SM14 0-9"	Solid	05/01/13 00:00	05/07/13 12:45
10227774012	SM14 9-19"	Solid	05/01/13 00:00	05/07/13 12:45
10227774013	SM10 0-9"	Solid	05/01/13 00:00	05/07/13 12:45
10227774014	SM10 9-21"	Solid	05/01/13 00:00	05/07/13 12:45
10227774015	SM19 7-22"	Solid	05/01/13 00:00	05/07/13 12:45
10227774016	SM23 0-8"	Solid	05/02/13 00:00	05/07/13 12:45
10227774017	SM23 8-20"	Solid	05/02/13 00:00	05/07/13 12:45
10227774018	SM23 20-28"	Solid	05/02/13 00:00	05/07/13 12:45
10227774019	DA04 9-29"	Solid	04/30/13 00:00	05/07/13 12:45
10227774020	DA10 6-20"	Solid	05/01/13 00:00	05/07/13 12:45
10227774021	DA12 14-24"	Solid	05/01/13 00:00	05/07/13 12:45
10227774022	DA13 9-18"	Solid	05/01/13 00:00	05/07/13 12:45
10227774023	DA13 18-40"	Solid	05/01/13 00:00	05/07/13 12:45
10227774024	DA15 0-9"	Solid	05/01/13 00:00	05/07/13 12:45
10227774025	DA15 8-14"	Solid	05/01/13 00:00	05/07/13 12:45
10227774026	DA15 14-44"	Solid	05/01/13 00:00	05/07/13 12:45
10227774027	DA17 8-28"	Solid	05/01/13 00:00	05/07/13 12:45
10227774028	DA25 17-26"	Solid	05/01/13 00:00	05/07/13 12:45
10227774029	DA25 29-40"	Solid	05/01/13 00:00	05/07/13 12:45
10227774030	JR01 0-8"	Solid	05/01/13 00:00	05/07/13 12:45
10227774031	JR01 8-16"	Solid	05/01/13 00:00	05/07/13 12:45
10227774032	JR01 16-24"	Solid	05/01/13 00:00	05/07/13 12:45
10227774033	JR01 24-40"	Solid	05/01/13 00:00	05/07/13 12:45
10227774034	JR01 40-60"	Solid	05/01/13 00:00	05/07/13 12:45
10227774035	JR02 0-9"	Solid	05/01/13 00:00	05/07/13 12:45
10227774036	JR02 9-20"	Solid	05/01/13 00:00	05/07/13 12:45
10227774037	JR02 20-34"	Solid	05/01/13 00:00	05/07/13 12:45

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

SAMPLE SUMMARY

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10227774038	**JR03 4-12"**	Solid	05/01/13 00:00	05/07/13 12:45
10227774039	**JR03 12-20"**	Solid	05/01/13 00:00	05/07/13 12:45
10227774040	**JR03 20-30"**	Solid	05/01/13 00:00	05/07/13 12:45
10227774041	**JR03 30-40"**	Solid	05/01/13 00:00	05/07/13 12:45
10227774042	**JR04 14-24"**	Solid	05/01/13 00:00	05/07/13 12:45
10227774043	**JR04 24-40"**	Solid	05/01/13 00:00	05/07/13 12:45

Pace Analytical Services, Inc.
602 S 25th Street
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(406)254-7226

SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10227774001	**SM01 0-11"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774002	**SM01 19-31"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774003	**SM02 9-18"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774004	**SM02 18-31"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774005	**SM11 9-21"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774006	**SM11 21-33"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774007	**SM12 7-19"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774008	**SM12 19-31"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M

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SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774009	**SM13 0-8"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774010	**SM13 19-27"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774011	**SM14 0-9"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774012	**SM14 9-19"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774013	**SM10 0-9"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774014	**SM10 9-21"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774015	**SM19 7-22"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT

Pace Analytical Services, Inc.
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(406)254-7226

SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		ASA 10-3.3	CS1	1	PASI-MT
10227774016	**SM23 0-8"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774017	**SM23 8-20"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774018	**SM23 20-28"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774019	**DA04 9-29"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774020	**DA10 6-20"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774021	**DA12 14-24"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774022	**DA13 9-18"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774023	**DA13 18-40"**	EPA 6010	IP	5	PASI-M

Pace Analytical Services, Inc.
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SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774024	**DA15 0-9"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774025	**DA15 8-14"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774026	**DA15 14-44"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774027	**DA17 8-28"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774028	**DA25 17-26"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774029	**DA25 29-40"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774030	**JR01 0-8"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT

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SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774031	**JR01 8-16"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774032	**JR01 16-24"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774033	**JR01 24-40"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774034	**JR01 40-60"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774035	**JR02 0-9"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774036	**JR02 9-20"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774037	**JR02 20-34"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT

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SAMPLE ANALYTE COUNT

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10227774038	**JR03 4-12"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774039	**JR03 12-20"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774040	**JR03 20-30"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774041	**JR03 30-40"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	CS1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774042	**JR04 14-24"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	CS1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT
10227774043	**JR04 24-40"**	EPA 6010	IP	5	PASI-M
		EPA 6010	IP	4	PASI-M
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	CS1	4	PASI-MT
		ASA 10-3.3	CS1	1	PASI-MT

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PROJECT NARRATIVE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Method: **EPA 6010**
Description: 6010 MET ICP
Client: Tetra Tech, Inc. - MT
Date: May 29, 2013

General Information:
43 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Method: **EPA 6010**
Description: Sodium Adsorption Ratio, ICP
Client: Tetra Tech, Inc. - MT
Date: May 29, 2013

General Information:
43 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Method: **USDA 21A**
Description: USDA 21A pH
Client: Tetra Tech, Inc. - MT
Date: May 29, 2013

General Information:
43 samples were analyzed for USDA 21A. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Method: **ASA 15-5 mod**
Description: PSA Percent Sand,Silt,Clay
Client: Tetra Tech, Inc. - MT
Date: May 29, 2013

General Information:
43 samples were analyzed for ASA 15-5 mod. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Method: **ASA 10-3.3**
Description: ASA10-3.3 Specific Conductance
Client: Tetra Tech, Inc. - MT
Date: May 29, 2013

General Information:
43 samples were analyzed for ASA 10-3.3. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM01 0-11" **Lab ID: 10227774001** Collected: 04/30/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**11.0**	mg/kg	3.8	0.63	5	05/24/13 16:44	05/26/13 16:08	7440-38-2	
Cadmium	**<0.28**	mg/kg	0.57	0.28	5	05/24/13 16:44	05/26/13 16:08	7440-43-9	
Copper	**9.2**	mg/kg	1.9	0.21	5	05/24/13 16:44	05/26/13 16:08	7440-50-8	
Lead	**12.9**	mg/kg	3.8	0.27	5	05/24/13 16:44	05/26/13 16:08	7439-92-1	
Zinc	**38.4**	mg/kg	3.8	1.2	5	05/24/13 16:44	05/26/13 16:08	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.3**	meq/L	0.50	0.25	10		05/27/13 12:14	7440-70-2	
Magnesium saturated paste	**0.83**	meq/L	0.80	0.40	10		05/27/13 12:14	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 12:14		
Sodium saturated paste	**0.53**	meq/L	0.40	0.20	10		05/27/13 12:14	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**6.0**	Std. Units	0.10	0.050	1		05/14/13 08:44		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**17.5**	% (w/w)	0.10		1		05/14/13 17:12		
Percent Sand	**57.5**	% (w/w)	0.10		1		05/14/13 17:12		
Percent Silt	**25.0**	% (w/w)	0.10		1		05/14/13 17:12		
Texture	**sandy loam**				1		05/14/13 17:12		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.29**	mmhos/cm	0.010	0.0050	1		05/20/13 09:33		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM01 19-31" **Lab ID: 10227774002** Collected: 04/30/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**14.2**	mg/kg	4.1	0.69	5	05/24/13 16:44	05/26/13 16:28	7440-38-2	
Cadmium	**0.33J**	mg/kg	0.62	0.31	5	05/24/13 16:44	05/26/13 16:28	7440-43-9	
Copper	**13.6**	mg/kg	2.1	0.23	5	05/24/13 16:44	05/26/13 16:28	7440-50-8	
Lead	**15.7**	mg/kg	4.1	0.30	5	05/24/13 16:44	05/26/13 16:28	7439-92-1	
Zinc	**44.1**	mg/kg	4.1	1.3	5	05/24/13 16:44	05/26/13 16:28	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.4**	meq/L	0.50	0.25	10		05/27/13 12:19	7440-70-2	
Magnesium saturated paste	**1.7**	meq/L	0.80	0.40	10		05/27/13 12:19	7439-95-4	
Sodium Adsorption Ratio	**1.9**		1.7	0.85	10		05/27/13 12:19		
Sodium saturated paste	**2.4**	meq/L	0.40	0.20	10		05/27/13 12:19	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.9**	Std. Units	0.10	0.050	1		05/14/13 08:47		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**35.0**	% (w/w)	0.10		1		05/14/13 17:23		
Percent Sand	**37.5**	% (w/w)	0.10		1		05/14/13 17:23		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 17:23		
Texture	**clay loam**				1		05/14/13 17:23		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.61**	mmhos/cm	0.010	0.0050	1		05/20/13 09:36		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM02 9-18" **Lab ID: 10227774003** Collected: 04/30/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**16.9**	mg/kg	3.7	0.62	5	05/24/13 16:44	05/26/13 16:35	7440-38-2	
Cadmium	**<0.28**	mg/kg	0.56	0.28	5	05/24/13 16:44	05/26/13 16:35	7440-43-9	
Copper	**9.9**	mg/kg	1.9	0.21	5	05/24/13 16:44	05/26/13 16:35	7440-50-8	
Lead	**12.1**	mg/kg	3.7	0.27	5	05/24/13 16:44	05/26/13 16:35	7439-92-1	
Zinc	**34.8**	mg/kg	3.7	1.2	5	05/24/13 16:44	05/26/13 16:35	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.2**	meq/L	0.50	0.25	10		05/27/13 12:28	7440-70-2	
Magnesium saturated paste	**0.88**	meq/L	0.80	0.40	10		05/27/13 12:28	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 12:28		
Sodium saturated paste	**0.44**	meq/L	0.40	0.20	10		05/27/13 12:28	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.6**	Std. Units	0.10	0.050	1		05/14/13 12:11		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/14/13 17:33		
Percent Sand	**45.0**	% (w/w)	0.10		1		05/14/13 17:33		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 17:33		
Texture	**clay loam**				1		05/14/13 17:33		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.38**	mmhos/cm	0.010	0.0050	1		05/20/13 09:42		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM02 18-31" **Lab ID: 10227774004** Collected: 04/30/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**12.2**	mg/kg	4.2	0.70	5	05/24/13 16:44	05/26/13 16:42	7440-38-2	
Cadmium	**<0.31**	mg/kg	0.63	0.31	5	05/24/13 16:44	05/26/13 16:42	7440-43-9	
Copper	**8.5**	mg/kg	2.1	0.23	5	05/24/13 16:44	05/26/13 16:42	7440-50-8	
Lead	**10.5**	mg/kg	4.2	0.30	5	05/24/13 16:44	05/26/13 16:42	7439-92-1	
Zinc	**35.3**	mg/kg	4.2	1.3	5	05/24/13 16:44	05/26/13 16:42	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.7**	meq/L	0.50	0.25	10		05/27/13 12:33	7440-70-2	
Magnesium saturated paste	**1.9**	meq/L	0.80	0.40	10		05/27/13 12:33	7439-95-4	
Sodium Adsorption Ratio	**4.3**		1.7	0.85	10		05/27/13 12:33		
Sodium saturated paste	**5.8**	meq/L	0.40	0.20	10		05/27/13 12:33	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		05/14/13 12:13		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/14/13 17:37		
Percent Sand	**50.0**	% (w/w)	0.10		1		05/14/13 17:37		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 17:37		
Texture	**sandy clay loam**				1		05/14/13 17:37		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.0**	mmhos/cm	0.010	0.0050	1		05/20/13 09:44		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM11 9-21" **Lab ID: 10227774005** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**20.5**	mg/kg	3.4	0.57	5	05/24/13 16:44	05/26/13 16:49	7440-38-2	
Cadmium	**0.33J**	mg/kg	0.51	0.26	5	05/24/13 16:44	05/26/13 16:49	7440-43-9	
Copper	**8.1**	mg/kg	1.7	0.19	5	05/24/13 16:44	05/26/13 16:49	7440-50-8	
Lead	**11.3**	mg/kg	3.4	0.25	5	05/24/13 16:44	05/26/13 16:49	7439-92-1	
Zinc	**45.6**	mg/kg	3.4	1.1	5	05/24/13 16:44	05/26/13 16:49	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.2**	meq/L	0.50	0.25	10		05/27/13 12:38	7440-70-2	
Magnesium saturated paste	**1.6**	meq/L	0.80	0.40	10		05/27/13 12:38	7439-95-4	
Sodium Adsorption Ratio	**7.3**		1.7	0.85	10		05/27/13 12:38		
Sodium saturated paste	**10.1**	meq/L	0.40	0.20	10		05/27/13 12:38	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.6**	Std. Units	0.10	0.050	1		05/14/13 12:15		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**25.0**	% (w/w)	0.10		1		05/14/13 17:41		
Percent Sand	**52.5**	% (w/w)	0.10		1		05/14/13 17:41		
Percent Silt	**22.5**	% (w/w)	0.10		1		05/14/13 17:41		
Texture	**sandy clay loam**				1		05/14/13 17:41		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.0**	mmhos/cm	0.010	0.0050	1		05/22/13 13:18		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM11 21-33" **Lab ID: 10227774006** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**30.5**	mg/kg	4.1	0.69	5	05/24/13 16:44	05/26/13 17:03	7440-38-2	
Cadmium	**0.45J**	mg/kg	0.62	0.31	5	05/24/13 16:44	05/26/13 17:03	7440-43-9	
Copper	**7.6**	mg/kg	2.1	0.23	5	05/24/13 16:44	05/26/13 17:03	7440-50-8	
Lead	**9.7**	mg/kg	4.1	0.30	5	05/24/13 16:44	05/26/13 17:03	7439-92-1	
Zinc	**38.3**	mg/kg	4.1	1.3	5	05/24/13 16:44	05/26/13 17:03	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.6**	meq/L	0.50	0.25	10		05/27/13 12:42	7440-70-2	
Magnesium saturated paste	**0.95**	meq/L	0.80	0.40	10		05/27/13 12:42	7439-95-4	
Sodium Adsorption Ratio	**8.0**		1.7	0.85	10		05/27/13 12:42		
Sodium saturated paste	**9.1**	meq/L	0.40	0.20	10		05/27/13 12:42	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.2**	Std. Units	0.10	0.050	1		05/14/13 12:19		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**20.0**	% (w/w)	0.10		1		05/14/13 17:45		
Percent Sand	**62.5**	% (w/w)	0.10		1		05/14/13 17:45		
Percent Silt	**17.5**	% (w/w)	0.10		1		05/14/13 17:45		
Texture	**sandy clay loam**				1		05/14/13 17:45		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.95**	mmhos/cm	0.010	0.0050	1		05/22/13 13:19		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM12 7-19" **Lab ID: 10227774007** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**8.1**	mg/kg	3.4	0.56	5	05/24/13 16:44	05/26/13 17:10	7440-38-2	
Cadmium	**0.27J**	mg/kg	0.51	0.25	5	05/24/13 16:44	05/26/13 17:10	7440-43-9	
Copper	**13.0**	mg/kg	1.7	0.19	5	05/24/13 16:44	05/26/13 17:10	7440-50-8	
Lead	**15.2**	mg/kg	3.4	0.24	5	05/24/13 16:44	05/26/13 17:10	7439-92-1	
Zinc	**54.2**	mg/kg	3.4	1.0	5	05/24/13 16:44	05/26/13 17:10	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.3**	meq/L	0.50	0.25	10		05/27/13 13:00	7440-70-2	
Magnesium saturated paste	**1.8**	meq/L	0.80	0.40	10		05/27/13 13:00	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 13:00		
Sodium saturated paste	**0.86**	meq/L	0.40	0.20	10		05/27/13 13:00	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**6.7**	Std. Units	0.10	0.050	1		05/14/13 12:21		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**12.5**	% (w/w)	0.10		1		05/14/13 17:49		
Percent Sand	**27.5**	% (w/w)	0.10		1		05/14/13 17:49		
Percent Silt	**60.0**	% (w/w)	0.10		1		05/14/13 17:49		
Texture	**silt loam**				1		05/14/13 17:49		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.54**	mmhos/cm	0.010	0.0050	1		05/20/13 09:47		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM12 19-31" **Lab ID: 10227774008** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**7.7**	mg/kg	3.7	0.62	5	05/24/13 16:44	05/26/13 17:17	7440-38-2	
Cadmium	**<0.28**	mg/kg	0.56	0.28	5	05/24/13 16:44	05/26/13 17:17	7440-43-9	
Copper	**19.0**	mg/kg	1.9	0.21	5	05/24/13 16:44	05/26/13 17:17	7440-50-8	
Lead	**19.0**	mg/kg	3.7	0.27	5	05/24/13 16:44	05/26/13 17:17	7439-92-1	
Zinc	**60.3**	mg/kg	3.7	1.2	5	05/24/13 16:44	05/26/13 17:17	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.4**	meq/L	0.50	0.25	10		05/27/13 13:05	7440-70-2	
Magnesium saturated paste	**1.3**	meq/L	0.80	0.40	10		05/27/13 13:05	7439-95-4	
Sodium Adsorption Ratio	**12.1**		1.7	0.85	10		05/27/13 13:05		
Sodium saturated paste	**14.0**	meq/L	0.40	0.20	10		05/27/13 13:05	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.8**	Std. Units	0.10	0.050	1		05/14/13 12:23		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**32.5**	% (w/w)	0.10		1		05/14/13 17:55		
Percent Sand	**40.0**	% (w/w)	0.10		1		05/14/13 17:55		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 17:55		
Texture	**clay loam**				1		05/14/13 17:55		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.3**	mmhos/cm	0.010	0.0050	1		05/22/13 13:23		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM13 0-8" **Lab ID: 10227774009** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**9.6**	mg/kg	4.4	0.73	5	05/24/13 16:44	05/26/13 17:24	7440-38-2	
Cadmium	**<0.33**	mg/kg	0.66	0.33	5	05/24/13 16:44	05/26/13 17:24	7440-43-9	
Copper	**6.5**	mg/kg	2.2	0.25	5	05/24/13 16:44	05/26/13 17:24	7440-50-8	
Lead	**9.7**	mg/kg	4.4	0.32	5	05/24/13 16:44	05/26/13 17:24	7439-92-1	
Zinc	**39.3**	mg/kg	4.4	1.4	5	05/24/13 16:44	05/26/13 17:24	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.0**	meq/L	0.50	0.25	10		05/27/13 13:10	7440-70-2	
Magnesium saturated paste	**1.3**	meq/L	0.80	0.40	10		05/27/13 13:10	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 13:10		
Sodium saturated paste	**0.45**	meq/L	0.40	0.20	10		05/27/13 13:10	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.5**	Std. Units	0.10	0.050	1		05/14/13 12:25		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**12.5**	% (w/w)	0.10		1		05/14/13 18:01		
Percent Sand	**57.5**	% (w/w)	0.10		1		05/14/13 18:01		
Percent Silt	**30.0**	% (w/w)	0.10		1		05/14/13 18:01		
Texture	**sandy loam**				1		05/14/13 18:01		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.56**	mmhos/cm	0.010	0.0050	1		05/20/13 09:53		

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM13 19-27" **Lab ID: 10227774010** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**9.6**	mg/kg	4.3	0.71	5	05/24/13 16:44	05/26/13 17:31	7440-38-2	
Cadmium	**<0.32**	mg/kg	0.64	0.32	5	05/24/13 16:44	05/26/13 17:31	7440-43-9	
Copper	**6.8**	mg/kg	2.1	0.24	5	05/24/13 16:44	05/26/13 17:31	7440-50-8	
Lead	**10.9**	mg/kg	4.3	0.31	5	05/24/13 16:44	05/26/13 17:31	7439-92-1	
Zinc	**38.5**	mg/kg	4.3	1.3	5	05/24/13 16:44	05/26/13 17:31	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.74**	meq/L	0.50	0.25	10		05/27/13 13:14	7440-70-2	
Magnesium saturated paste	**0.52J**	meq/L	0.80	0.40	10		05/27/13 13:14	7439-95-4	
Sodium Adsorption Ratio	**6.1**		1.7	0.85	10		05/27/13 13:14		
Sodium saturated paste	**4.8**	meq/L	0.40	0.20	10		05/27/13 13:14	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**6.8**	Std. Units	0.10	0.050	1		05/14/13 12:27		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**15.0**	% (w/w)	0.10		1		05/14/13 18:06		
Percent Sand	**50.0**	% (w/w)	0.10		1		05/14/13 18:06		
Percent Silt	**35.0**	% (w/w)	0.10		1		05/14/13 18:06		
Texture	**loam**				1		05/14/13 18:06		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.83**	mmhos/cm	0.010	0.0050	1		05/22/13 13:24		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM14 0-9" **Lab ID: 10227774011** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**26.4**	mg/kg	4.2	0.71	5	05/24/13 16:44	05/26/13 17:38	7440-38-2	
Cadmium	**0.40J**	mg/kg	0.64	0.32	5	05/24/13 16:44	05/26/13 17:38	7440-43-9	
Copper	**8.3**	mg/kg	2.1	0.24	5	05/24/13 16:44	05/26/13 17:38	7440-50-8	
Lead	**12.8**	mg/kg	4.2	0.31	5	05/24/13 16:44	05/26/13 17:38	7439-92-1	
Zinc	**45.7**	mg/kg	4.2	1.3	5	05/24/13 16:44	05/26/13 17:38	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.6**	meq/L	0.50	0.25	10		05/27/13 13:19	7440-70-2	
Magnesium saturated paste	**1.1**	meq/L	0.80	0.40	10		05/27/13 13:19	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 13:19		
Sodium saturated paste	**0.76**	meq/L	0.40	0.20	10		05/27/13 13:19	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**6.3**	Std. Units	0.10	0.050	1		05/14/13 12:28		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/14/13 18:11		
Percent Sand	**42.5**	% (w/w)	0.10		1		05/14/13 18:11		
Percent Silt	**35.0**	% (w/w)	0.10		1		05/14/13 18:11		
Texture	**loam**				1		05/14/13 18:11		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.36**	mmhos/cm	0.010	0.0050	1		05/20/13 09:55		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM14 9-19" **Lab ID: 10227774012** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**24.7**	mg/kg	3.9	0.65	5	05/24/13 16:44	05/26/13 17:44	7440-38-2	
Cadmium	**0.41J**	mg/kg	0.59	0.29	5	05/24/13 16:44	05/26/13 17:44	7440-43-9	
Copper	**8.7**	mg/kg	2.0	0.22	5	05/24/13 16:44	05/26/13 17:44	7440-50-8	
Lead	**11.2**	mg/kg	3.9	0.28	5	05/24/13 16:44	05/26/13 17:44	7439-92-1	
Zinc	**42.6**	mg/kg	3.9	1.2	5	05/24/13 16:44	05/26/13 17:44	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.7**	meq/L	0.50	0.25	10		05/27/13 13:24	7440-70-2	
Magnesium saturated paste	**2.2**	meq/L	0.80	0.40	10		05/27/13 13:24	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 13:24		
Sodium saturated paste	**1.0**	meq/L	0.40	0.20	10		05/27/13 13:24	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**6.7**	Std. Units	0.10	0.050	1		05/14/13 12:31		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**17.5**	% (w/w)	0.10		1		05/14/13 18:15		
Percent Sand	**55.0**	% (w/w)	0.10		1		05/14/13 18:15		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 18:15		
Texture	**sandy loam**				1		05/14/13 18:15		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.65**	mmhos/cm	0.010	0.0050	1		05/20/13 09:58		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM10 0-9" **Lab ID: 10227774013** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**15.3**	mg/kg	3.7	0.62	5	05/24/13 16:44	05/26/13 17:51	7440-38-2	
Cadmium	**<0.28**	mg/kg	0.56	0.28	5	05/24/13 16:44	05/26/13 17:51	7440-43-9	
Copper	**5.6**	mg/kg	1.9	0.21	5	05/24/13 16:44	05/26/13 17:51	7440-50-8	
Lead	**9.0**	mg/kg	3.7	0.27	5	05/24/13 16:44	05/26/13 17:51	7439-92-1	
Zinc	**32.0**	mg/kg	3.7	1.2	5	05/24/13 16:44	05/26/13 17:51	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.1**	meq/L	0.50	0.25	10		05/27/13 13:33	7440-70-2	
Magnesium saturated paste	**0.79J**	meq/L	0.80	0.40	10		05/27/13 13:33	7439-95-4	
Sodium Adsorption Ratio	**2.5**		1.7	0.85	10		05/27/13 13:33		
Sodium saturated paste	**2.4**	meq/L	0.40	0.20	10		05/27/13 13:33	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.4**	Std. Units	0.10	0.050	1		05/14/13 12:46		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**12.5**	% (w/w)	0.10		1		05/14/13 18:23		
Percent Sand	**60.0**	% (w/w)	0.10		1		05/14/13 18:23		
Percent Silt	**27.5**	% (w/w)	0.10		1		05/14/13 18:23		
Texture	**sandy loam**				1		05/14/13 18:23		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.52**	mmhos/cm	0.010	0.0050	1		05/20/13 10:03		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM10 9-21" **Lab ID: 10227774014** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**26.2**	mg/kg	4.3	0.72	5	05/24/13 16:44	05/26/13 17:58	7440-38-2	
Cadmium	**0.41J**	mg/kg	0.65	0.32	5	05/24/13 16:44	05/26/13 17:58	7440-43-9	
Copper	**9.3**	mg/kg	2.2	0.24	5	05/24/13 16:44	05/26/13 17:58	7440-50-8	
Lead	**13.5**	mg/kg	4.3	0.31	5	05/24/13 16:44	05/26/13 17:58	7439-92-1	
Zinc	**55.3**	mg/kg	4.3	1.3	5	05/24/13 16:44	05/26/13 17:58	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.86**	meq/L	0.50	0.25	10		05/27/13 13:47	7440-70-2	
Magnesium saturated paste	**0.48J**	meq/L	0.80	0.40	10		05/27/13 13:47	7439-95-4	
Sodium Adsorption Ratio	**5.0**		1.7	0.85	10		05/27/13 13:47		
Sodium saturated paste	**4.1**	meq/L	0.40	0.20	10		05/27/13 13:47	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.2**	Std. Units	0.10	0.050	1		05/14/13 12:48		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/14/13 18:28		
Percent Sand	**65.0**	% (w/w)	0.10		1		05/14/13 18:28		
Percent Silt	**12.5**	% (w/w)	0.10		1		05/14/13 18:28		
Texture	**sandy clay loam**				1		05/14/13 18:28		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.44**	mmhos/cm	0.010	0.0050	1		05/22/13 13:25		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM19 7-22" **Lab ID: 10227774015** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**26.3**	mg/kg	3.9	0.65	5	05/24/13 16:44	05/26/13 18:13	7440-38-2	
Cadmium	**<0.29**	mg/kg	0.59	0.29	5	05/24/13 16:44	05/26/13 18:13	7440-43-9	
Copper	**11.3**	mg/kg	2.0	0.22	5	05/24/13 16:44	05/26/13 18:13	7440-50-8	
Lead	**10.1**	mg/kg	3.9	0.28	5	05/24/13 16:44	05/26/13 18:13	7439-92-1	
Zinc	**47.1**	mg/kg	3.9	1.2	5	05/24/13 16:44	05/26/13 18:13	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.3**	meq/L	0.50	0.25	10		05/27/13 13:52	7440-70-2	
Magnesium saturated paste	**0.75J**	meq/L	0.80	0.40	10		05/27/13 13:52	7439-95-4	
Sodium Adsorption Ratio	**5.2**		1.7	0.85	10		05/27/13 13:52		
Sodium saturated paste	**5.4**	meq/L	0.40	0.20	10		05/27/13 13:52	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.4**	Std. Units	0.10	0.050	1		05/14/13 12:51		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**7.5**	% (w/w)	0.10		1		05/14/13 18:33		
Percent Sand	**75.0**	% (w/w)	0.10		1		05/14/13 18:33		
Percent Silt	**17.5**	% (w/w)	0.10		1		05/14/13 18:33		
Texture	**sandy loam**				1		05/14/13 18:33		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.65**	mmhos/cm	0.010	0.0050	1		05/22/13 13:29		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM23 0-8" **Lab ID: 10227774016** Collected: 05/02/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**10.8**	mg/kg	4.6	0.77	5	05/24/13 16:44	05/26/13 18:19	7440-38-2	
Cadmium	**<0.35**	mg/kg	0.69	0.35	5	05/24/13 16:44	05/26/13 18:19	7440-43-9	
Copper	**12.1**	mg/kg	2.3	0.26	5	05/24/13 16:44	05/26/13 18:19	7440-50-8	
Lead	**15.7**	mg/kg	4.6	0.33	5	05/24/13 16:44	05/26/13 18:19	7439-92-1	
Zinc	**52.7**	mg/kg	4.6	1.4	5	05/24/13 16:44	05/26/13 18:19	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.3**	meq/L	0.50	0.25	10		05/27/13 13:56	7440-70-2	
Magnesium saturated paste	**0.79J**	meq/L	0.80	0.40	10		05/27/13 13:56	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 13:56		
Sodium saturated paste	**0.61**	meq/L	0.40	0.20	10		05/27/13 13:56	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.9**	Std. Units	0.10	0.050	1		05/14/13 12:53		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/14/13 18:38		
Percent Sand	**35.0**	% (w/w)	0.10		1		05/14/13 18:38		
Percent Silt	**42.5**	% (w/w)	0.10		1		05/14/13 18:38		
Texture	**loam**				1		05/14/13 18:38		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.30**	mmhos/cm	0.010	0.0050	1		05/20/13 10:05		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM23 8-20" **Lab ID: 10227774017** Collected: 05/02/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**10.3**	mg/kg	3.6	0.61	5	05/24/13 16:44	05/26/13 18:26	7440-38-2	
Cadmium	**0.28J**	mg/kg	0.55	0.27	5	05/24/13 16:44	05/26/13 18:26	7440-43-9	
Copper	**13.8**	mg/kg	1.8	0.20	5	05/24/13 16:44	05/26/13 18:26	7440-50-8	
Lead	**13.2**	mg/kg	3.6	0.26	5	05/24/13 16:44	05/26/13 18:26	7439-92-1	
Zinc	**43.1**	mg/kg	3.6	1.1	5	05/24/13 16:44	05/26/13 18:26	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.5**	meq/L	1.0	0.50	20		05/27/13 14:01	7440-70-2	
Magnesium saturated paste	**2.3**	meq/L	1.6	0.80	20		05/27/13 14:01	7439-95-4	
Sodium Adsorption Ratio	**5.0**		3.4	1.7	20		05/27/13 14:01		
Sodium saturated paste	**6.9**	meq/L	0.80	0.40	20		05/27/13 14:01	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		05/14/13 12:54		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**5.0**	% (w/w)	0.10		1		05/14/13 18:43		
Percent Sand	**27.5**	% (w/w)	0.10		1		05/14/13 18:43		
Percent Silt	**67.5**	% (w/w)	0.10		1		05/14/13 18:43		
Texture	**silt loam**				1		05/14/13 18:43		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.0**	mmhos/cm	0.010	0.0050	1		05/20/13 10:07		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: SM23 20-28" **Lab ID: 10227774018** Collected: 05/02/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**9.0**	mg/kg	3.9	0.66	5	05/24/13 16:44	05/26/13 18:33	7440-38-2	
Cadmium	**<0.30**	mg/kg	0.59	0.30	5	05/24/13 16:44	05/26/13 18:33	7440-43-9	
Copper	**13.9**	mg/kg	2.0	0.22	5	05/24/13 16:44	05/26/13 18:33	7440-50-8	
Lead	**16.6**	mg/kg	3.9	0.28	5	05/24/13 16:44	05/26/13 18:33	7439-92-1	
Zinc	**52.1**	mg/kg	3.9	1.2	5	05/24/13 16:44	05/26/13 18:33	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.2**	meq/L	0.50	0.25	10		05/27/13 14:06	7440-70-2	
Magnesium saturated paste	**0.78J**	meq/L	0.80	0.40	10		05/27/13 14:06	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 14:06		
Sodium saturated paste	**0.73**	meq/L	0.40	0.20	10		05/27/13 14:06	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.9**	Std. Units	0.10	0.050	1		05/14/13 12:56		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/14/13 18:48		
Percent Sand	**30.0**	% (w/w)	0.10		1		05/14/13 18:48		
Percent Silt	**42.5**	% (w/w)	0.10		1		05/14/13 18:48		
Texture	**clay loam**				1		05/14/13 18:48		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.31**	mmhos/cm	0.010	0.0050	1		05/20/13 10:10		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA04 9-29" **Lab ID: 10227774019** Collected: 04/30/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**17.5**	mg/kg	4.0	0.67	5	05/24/13 16:44	05/26/13 18:40	7440-38-2	
Cadmium	**0.48J**	mg/kg	0.60	0.30	5	05/24/13 16:44	05/26/13 18:40	7440-43-9	
Copper	**7.5**	mg/kg	2.0	0.23	5	05/24/13 16:44	05/26/13 18:40	7440-50-8	
Lead	**13.5**	mg/kg	4.0	0.29	5	05/24/13 16:44	05/26/13 18:40	7439-92-1	
Zinc	**72.4**	mg/kg	4.0	1.2	5	05/24/13 16:44	05/26/13 18:40	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.7**	meq/L	1.0	0.50	20		05/27/13 14:11	7440-70-2	
Magnesium saturated paste	**1.2J**	meq/L	1.6	0.80	20		05/27/13 14:11	7439-95-4	
Sodium Adsorption Ratio	**<1.7**		3.4	1.7	20		05/27/13 14:11		
Sodium saturated paste	**1.5**	meq/L	0.80	0.40	20		05/27/13 14:11	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.5**	Std. Units	0.10	0.050	1		05/14/13 12:57		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**25.0**	% (w/w)	0.10		1		05/14/13 18:52		
Percent Sand	**55.0**	% (w/w)	0.10		1		05/14/13 18:52		
Percent Silt	**20.0**	% (w/w)	0.10		1		05/14/13 18:52		
Texture	**sandy clay loam**				1		05/14/13 18:52		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.57**	mmhos/cm	0.010	0.0050	1		05/20/13 10:12		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA10 6-20" **Lab ID: 10227774020** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**12.7**	mg/kg	0.75	0.12	1	05/24/13 16:44	05/26/13 18:47	7440-38-2	
Cadmium	**0.39**	mg/kg	0.11	0.056	1	05/24/13 16:44	05/26/13 18:47	7440-43-9	
Copper	**11.8**	mg/kg	0.37	0.042	1	05/24/13 16:44	05/26/13 18:47	7440-50-8	
Lead	**11.8**	mg/kg	0.75	0.054	1	05/24/13 16:44	05/26/13 18:47	7439-92-1	
Zinc	**56.0**	mg/kg	0.75	0.23	1	05/24/13 16:44	05/26/13 18:47	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.4**	meq/L	0.50	0.25	10		05/27/13 14:16	7440-70-2	
Magnesium saturated paste	**1.0**	meq/L	0.80	0.40	10		05/27/13 14:16	7439-95-4	
Sodium Adsorption Ratio	**0.93J**		1.7	0.85	10		05/27/13 14:16		
Sodium saturated paste	**1.0**	meq/L	0.40	0.20	10		05/27/13 14:16	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.8**	Std. Units	0.10	0.050	1		05/14/13 12:58		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**32.5**	% (w/w)	0.10		1		05/14/13 18:57		
Percent Sand	**17.5**	% (w/w)	0.10		1		05/14/13 18:57		
Percent Silt	**50.0**	% (w/w)	0.10		1		05/14/13 18:57		
Texture	**silty clay loam**				1		05/14/13 18:57		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.40**	mmhos/cm	0.010	0.0050	1		05/20/13 10:14		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA12 14-24" **Lab ID: 10227774021** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**10.5**	mg/kg	4.4	0.74	5	05/24/13 16:19	05/26/13 19:23	7440-38-2	
Cadmium	**<0.33**	mg/kg	0.66	0.33	5	05/24/13 16:19	05/26/13 19:23	7440-43-9	
Copper	**13.2**	mg/kg	2.2	0.25	5	05/24/13 16:19	05/26/13 19:23	7440-50-8	
Lead	**14.1**	mg/kg	4.4	0.32	5	05/24/13 16:19	05/26/13 19:23	7439-92-1	
Zinc	**55.2**	mg/kg	4.4	1.4	5	05/24/13 16:19	05/26/13 19:23	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.3**	meq/L	1.0	0.50	20		05/27/13 16:18	7440-70-2	
Magnesium saturated paste	**1.6J**	meq/L	1.6	0.80	20		05/27/13 16:18	7439-95-4	
Sodium Adsorption Ratio	**<1.7**		3.4	1.7	20		05/27/13 16:18		
Sodium saturated paste	**0.78J**	meq/L	0.80	0.40	20		05/27/13 16:18	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.5**	Std. Units	0.10	0.050	1		05/15/13 09:19		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**32.5**	% (w/w)	0.10		1		05/16/13 17:16		
Percent Sand	**32.5**	% (w/w)	0.10		1		05/16/13 17:16		
Percent Silt	**35.0**	% (w/w)	0.10		1		05/16/13 17:16		
Texture	**clay loam**				1		05/16/13 17:16		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.44**	mmhos/cm	0.010	0.0050	1		05/20/13 10:21		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA13 9-18" **Lab ID: 10227774022** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**23.5**	mg/kg	3.5	0.58	5	05/24/13 16:19	05/26/13 19:43	7440-38-2	
Cadmium	**0.32J**	mg/kg	0.52	0.26	5	05/24/13 16:19	05/26/13 19:43	7440-43-9	
Copper	**7.7**	mg/kg	1.7	0.19	5	05/24/13 16:19	05/26/13 19:43	7440-50-8	
Lead	**11.2**	mg/kg	3.5	0.25	5	05/24/13 16:19	05/26/13 19:43	7439-92-1	
Zinc	**40.7**	mg/kg	3.5	1.1	5	05/24/13 16:19	05/26/13 19:43	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.6**	meq/L	1.0	0.50	20		05/27/13 16:27	7440-70-2	
Magnesium saturated paste	**2.1**	meq/L	1.6	0.80	20		05/27/13 16:27	7439-95-4	
Sodium Adsorption Ratio	**<1.7**		3.4	1.7	20		05/27/13 16:27		
Sodium saturated paste	**2.6**	meq/L	0.80	0.40	20		05/27/13 16:27	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.1**	Std. Units	0.10	0.050	1		05/15/13 09:21		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/16/13 17:21		
Percent Sand	**57.5**	% (w/w)	0.10		1		05/16/13 17:21		
Percent Silt	**15.0**	% (w/w)	0.10		1		05/16/13 17:21		
Texture	**sandy clay loam**				1		05/16/13 17:21		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.76**	mmhos/cm	0.010	0.0050	1		05/20/13 10:26		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA13 18-40" **Lab ID: 10227774023** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**22.4**	mg/kg	4.2	0.70	5	05/24/13 16:19	05/26/13 19:50	7440-38-2	
Cadmium	**<0.31**	mg/kg	0.63	0.31	5	05/24/13 16:19	05/26/13 19:50	7440-43-9	
Copper	**4.6**	mg/kg	2.1	0.23	5	05/24/13 16:19	05/26/13 19:50	7440-50-8	
Lead	**7.3**	mg/kg	4.2	0.30	5	05/24/13 16:19	05/26/13 19:50	7439-92-1	
Zinc	**29.8**	mg/kg	4.2	1.3	5	05/24/13 16:19	05/26/13 19:50	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.97**	meq/L	0.50	0.25	10		05/27/13 16:31	7440-70-2	
Magnesium saturated paste	**0.79J**	meq/L	0.80	0.40	10		05/27/13 16:31	7439-95-4	
Sodium Adsorption Ratio	**3.2**		1.7	0.85	10		05/27/13 16:31		
Sodium saturated paste	**3.0**	meq/L	0.40	0.20	10		05/27/13 16:31	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		05/15/13 09:23		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**15.0**	% (w/w)	0.10		1		05/16/13 17:26		
Percent Sand	**75.0**	% (w/w)	0.10		1		05/16/13 17:26		
Percent Silt	**10.0**	% (w/w)	0.10		1		05/16/13 17:26		
Texture	**sandy loam**				1		05/16/13 17:26		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.51**	mmhos/cm	0.010	0.0050	1		05/20/13 11:44		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA15 0-9" **Lab ID: 10227774024** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**19.1**	mg/kg	4.1	0.68	5	05/24/13 16:19	05/26/13 19:56	7440-38-2	
Cadmium	**0.31J**	mg/kg	0.61	0.31	5	05/24/13 16:19	05/26/13 19:56	7440-43-9	
Copper	**7.0**	mg/kg	2.0	0.23	5	05/24/13 16:19	05/26/13 19:56	7440-50-8	
Lead	**10.6**	mg/kg	4.1	0.30	5	05/24/13 16:19	05/26/13 19:56	7439-92-1	
Zinc	**38.8**	mg/kg	4.1	1.3	5	05/24/13 16:19	05/26/13 19:56	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**4.4**	meq/L	0.50	0.25	10		05/27/13 16:41	7440-70-2	
Magnesium saturated paste	**7.7**	meq/L	0.80	0.40	10		05/27/13 16:41	7439-95-4	
Sodium Adsorption Ratio	**26.1**		1.7	0.85	10		05/27/13 16:41		
Sodium saturated paste	**64.3**	meq/L	0.40	0.20	10		05/27/13 16:41	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.9**	Std. Units	0.10	0.050	1		05/15/13 09:26		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/16/13 17:37		
Percent Sand	**57.5**	% (w/w)	0.10		1		05/16/13 17:37		
Percent Silt	**20.0**	% (w/w)	0.10		1		05/16/13 17:37		
Texture	**sandy clay loam**				1		05/16/13 17:37		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**8.0**	mmhos/cm	0.010	0.0050	1		05/20/13 10:28		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA15 8-14" **Lab ID: 10227774025** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**28.3**	mg/kg	3.4	0.57	5	05/24/13 16:19	05/26/13 20:03	7440-38-2	
Cadmium	**0.43J**	mg/kg	0.51	0.26	5	05/24/13 16:19	05/26/13 20:03	7440-43-9	
Copper	**10.3**	mg/kg	1.7	0.19	5	05/24/13 16:19	05/26/13 20:03	7440-50-8	
Lead	**13.1**	mg/kg	3.4	0.24	5	05/24/13 16:19	05/26/13 20:03	7439-92-1	
Zinc	**48.1**	mg/kg	3.4	1.1	5	05/24/13 16:19	05/26/13 20:03	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**21.1**	meq/L	0.50	0.25	10		05/27/13 16:56	7440-70-2	
Magnesium saturated paste	**97.6**	meq/L	0.80	0.40	10		05/27/13 16:56	7439-95-4	
Sodium Adsorption Ratio	**25.0**		8.5	4.2	50		05/28/13 11:12		
Sodium saturated paste	**192**	meq/L	2.0	1.0	50		05/28/13 11:12	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		05/15/13 09:31		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**30.0**	% (w/w)	0.10		1		05/16/13 17:41		
Percent Sand	**47.5**	% (w/w)	0.10		1		05/16/13 17:41		
Percent Silt	**22.5**	% (w/w)	0.10		1		05/16/13 17:41		
Texture	**sandy clay loam**				1		05/16/13 17:41		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**20.4**	mmhos/cm	0.010	0.0050	1		05/20/13 10:31		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA15 14-44" **Lab ID: 10227774026** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**28.6**	mg/kg	4.0	0.67	5	05/24/13 16:19	05/26/13 20:18	7440-38-2	
Cadmium	**0.45J**	mg/kg	0.60	0.30	5	05/24/13 16:19	05/26/13 20:18	7440-43-9	
Copper	**6.0**	mg/kg	2.0	0.22	5	05/24/13 16:19	05/26/13 20:18	7440-50-8	
Lead	**8.4**	mg/kg	4.0	0.29	5	05/24/13 16:19	05/26/13 20:18	7439-92-1	
Zinc	**34.1**	mg/kg	4.0	1.2	5	05/24/13 16:19	05/26/13 20:18	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**19.9**	meq/L	0.50	0.25	10		05/27/13 17:02	7440-70-2	
Magnesium saturated paste	**79.7**	meq/L	0.80	0.40	10		05/27/13 17:02	7439-95-4	
Sodium Adsorption Ratio	**27.3**		8.5	4.2	50		05/28/13 11:16		
Sodium saturated paste	**193**	meq/L	2.0	1.0	50		05/28/13 11:16	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.5**	Std. Units	0.10	0.050	1		05/15/13 09:33		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**30.0**	% (w/w)	0.10		1		05/16/13 17:46		
Percent Sand	**67.5**	% (w/w)	0.10		1		05/16/13 17:46		
Percent Silt	**2.5**	% (w/w)	0.10		1		05/16/13 17:46		
Texture	**sandy clay loam**				1		05/16/13 17:46		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**19.3**	mmhos/cm	0.010	0.0050	1		05/20/13 11:47		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA17 8-28" **Lab ID: 10227774027** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**15.4**	mg/kg	3.6	0.61	5	05/24/13 16:19	05/26/13 20:25	7440-38-2	
Cadmium	**0.28J**	mg/kg	0.54	0.27	5	05/24/13 16:19	05/26/13 20:25	7440-43-9	
Copper	**7.8**	mg/kg	1.8	0.20	5	05/24/13 16:19	05/26/13 20:25	7440-50-8	
Lead	**11.0**	mg/kg	3.6	0.26	5	05/24/13 16:19	05/26/13 20:25	7439-92-1	
Zinc	**39.8**	mg/kg	3.6	1.1	5	05/24/13 16:19	05/26/13 20:25	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.0**	meq/L	0.50	0.25	10		05/27/13 17:16	7440-70-2	
Magnesium saturated paste	**2.2**	meq/L	0.80	0.40	10		05/27/13 17:16	7439-95-4	
Sodium Adsorption Ratio	**1.4J**		1.7	0.85	10		05/27/13 17:16		
Sodium saturated paste	**2.1**	meq/L	0.40	0.20	10		05/27/13 17:16	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.4**	Std. Units	0.10	0.050	1		05/15/13 09:37		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**25.0**	% (w/w)	0.10		1		05/16/13 17:57		
Percent Sand	**50.0**	% (w/w)	0.10		1		05/16/13 17:57		
Percent Silt	**25.0**	% (w/w)	0.10		1		05/16/13 17:57		
Texture	**sandy clay loam**				1		05/16/13 17:57		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.73**	mmhos/cm	0.010	0.0050	1		05/20/13 10:34		

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA25 17-26" **Lab ID: 10227774028** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**10.7**	mg/kg	4.5	0.75	5	05/24/13 16:19	05/26/13 20:32	7440-38-2	
Cadmium	**<0.34**	mg/kg	0.68	0.34	5	05/24/13 16:19	05/26/13 20:32	7440-43-9	
Copper	**12.3**	mg/kg	2.3	0.25	5	05/24/13 16:19	05/26/13 20:32	7440-50-8	
Lead	**12.7**	mg/kg	4.5	0.32	5	05/24/13 16:19	05/26/13 20:32	7439-92-1	
Zinc	**43.8**	mg/kg	4.5	1.4	5	05/24/13 16:19	05/26/13 20:32	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.0**	meq/L	0.50	0.25	10		05/27/13 17:21	7440-70-2	
Magnesium saturated paste	**1.4**	meq/L	0.80	0.40	10		05/27/13 17:21	7439-95-4	
Sodium Adsorption Ratio	**1.3J**		1.7	0.85	10		05/27/13 17:21		
Sodium saturated paste	**1.7**	meq/L	0.40	0.20	10		05/27/13 17:21	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.7**	Std. Units	0.10	0.050	1		05/15/13 09:42		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**25.0**	% (w/w)	0.10		1		05/16/13 18:02		
Percent Sand	**27.5**	% (w/w)	0.10		1		05/16/13 18:02		
Percent Silt	**47.5**	% (w/w)	0.10		1		05/16/13 18:02		
Texture	**loam**				1		05/16/13 18:02		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.61**	mmhos/cm	0.010	0.0050	1		05/20/13 10:35		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: DA25 29-40" **Lab ID: 10227774029** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**8.7**	mg/kg	4.7	0.78	5	05/24/13 16:19	05/26/13 20:38	7440-38-2	
Cadmium	**<0.35**	mg/kg	0.70	0.35	5	05/24/13 16:19	05/26/13 20:38	7440-43-9	
Copper	**11.5**	mg/kg	2.3	0.26	5	05/24/13 16:19	05/26/13 20:38	7440-50-8	
Lead	**10.8**	mg/kg	4.7	0.34	5	05/24/13 16:19	05/26/13 20:38	7439-92-1	
Zinc	**47.3**	mg/kg	4.7	1.4	5	05/24/13 16:19	05/26/13 20:38	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.96**	meq/L	0.50	0.25	10		05/27/13 17:25	7440-70-2	
Magnesium saturated paste	**2.2**	meq/L	0.80	0.40	10		05/27/13 17:25	7439-95-4	
Sodium Adsorption Ratio	**16.5**		1.7	0.85	10		05/27/13 17:25		
Sodium saturated paste	**20.8**	meq/L	0.40	0.20	10		05/27/13 17:25	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.7**	Std. Units	0.10	0.050	1		05/15/13 09:44		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**20.0**	% (w/w)	0.10		1		05/16/13 18:06		
Percent Sand	**30.0**	% (w/w)	0.10		1		05/16/13 18:06		
Percent Silt	**50.0**	% (w/w)	0.10		1		05/16/13 18:06		
Texture	**silt loam**				1		05/16/13 18:06		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**2.7**	mmhos/cm	0.010	0.0050	1		05/20/13 11:50		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR01 0-8" **Lab ID: 10227774030** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**26.2**	mg/kg	3.5	0.59	5	05/24/13 16:19	05/26/13 20:45	7440-38-2	
Cadmium	**0.40J**	mg/kg	0.53	0.27	5	05/24/13 16:19	05/26/13 20:45	7440-43-9	
Copper	**5.2**	mg/kg	1.8	0.20	5	05/24/13 16:19	05/26/13 20:45	7440-50-8	
Lead	**9.6**	mg/kg	3.5	0.26	5	05/24/13 16:19	05/26/13 20:45	7439-92-1	
Zinc	**35.1**	mg/kg	3.5	1.1	5	05/24/13 16:19	05/26/13 20:45	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.6**	meq/L	0.50	0.25	10		05/27/13 17:30	7440-70-2	
Magnesium saturated paste	**0.97**	meq/L	0.80	0.40	10		05/27/13 17:30	7439-95-4	
Sodium Adsorption Ratio	**2.3**		1.7	0.85	10		05/27/13 17:30		
Sodium saturated paste	**2.6**	meq/L	0.40	0.20	10		05/27/13 17:30	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.9**	Std. Units	0.10	0.050	1		05/15/13 09:46		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**15.0**	% (w/w)	0.10		1		05/16/13 18:10		
Percent Sand	**67.5**	% (w/w)	0.10		1		05/16/13 18:10		
Percent Silt	**17.5**	% (w/w)	0.10		1		05/16/13 18:10		
Texture	**sandy loam**				1		05/16/13 18:10		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.61**	mmhos/cm	0.010	0.0050	1		05/20/13 11:59		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR01 8-16" **Lab ID: 10227774031** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**34.8**	mg/kg	4.6	0.77	5	05/24/13 16:19	05/26/13 20:52	7440-38-2	
Cadmium	**0.47J**	mg/kg	0.69	0.35	5	05/24/13 16:19	05/26/13 20:52	7440-43-9	
Copper	**6.8**	mg/kg	2.3	0.26	5	05/24/13 16:19	05/26/13 20:52	7440-50-8	
Lead	**7.9**	mg/kg	4.6	0.33	5	05/24/13 16:19	05/26/13 20:52	7439-92-1	
Zinc	**36.2**	mg/kg	4.6	1.4	5	05/24/13 16:19	05/26/13 20:52	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.5**	meq/L	0.50	0.25	10		05/27/13 17:35	7440-70-2	
Magnesium saturated paste	**1.3**	meq/L	0.80	0.40	10		05/27/13 17:35	7439-95-4	
Sodium Adsorption Ratio	**9.8**		1.7	0.85	10		05/27/13 17:35		
Sodium saturated paste	**13.5**	meq/L	0.40	0.20	10		05/27/13 17:35	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.8**	Std. Units	0.10	0.050	1		05/15/13 09:48		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**22.5**	% (w/w)	0.10		1		05/16/13 18:14		
Percent Sand	**52.5**	% (w/w)	0.10		1		05/16/13 18:14		
Percent Silt	**25.0**	% (w/w)	0.10		1		05/16/13 18:14		
Texture	**sandy clay loam**				1		05/16/13 18:14		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.5**	mmhos/cm	0.010	0.0050	1		05/22/13 13:30		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR01 16-24" **Lab ID: 10227774032** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**22.7**	mg/kg	4.2	0.71	5	05/24/13 16:19	05/26/13 20:59	7440-38-2	
Cadmium	**0.37J**	mg/kg	0.64	0.32	5	05/24/13 16:19	05/26/13 20:59	7440-43-9	
Copper	**5.6**	mg/kg	2.1	0.24	5	05/24/13 16:19	05/26/13 20:59	7440-50-8	
Lead	**8.4**	mg/kg	4.2	0.31	5	05/24/13 16:19	05/26/13 20:59	7439-92-1	
Zinc	**32.6**	mg/kg	4.2	1.3	5	05/24/13 16:19	05/26/13 20:59	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.3**	meq/L	1.0	0.50	20		05/27/13 17:39	7440-70-2	
Magnesium saturated paste	**7.4**	meq/L	1.6	0.80	20		05/27/13 17:39	7439-95-4	
Sodium Adsorption Ratio	**45.9**		3.4	1.7	20		05/27/13 17:39		
Sodium saturated paste	**95.7**	meq/L	0.80	0.40	20		05/27/13 17:39	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**9.0**	Std. Units	0.10	0.050	1		05/15/13 09:53		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**10.0**	% (w/w)	0.10		1		05/16/13 18:18		
Percent Sand	**77.5**	% (w/w)	0.10		1		05/16/13 18:18		
Percent Silt	**12.5**	% (w/w)	0.10		1		05/16/13 18:18		
Texture	**sandy loam**				1		05/16/13 18:18		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**9.9**	mmhos/cm	0.010	0.0050	1		05/20/13 12:04		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR01 24-40" **Lab ID: 10227774033** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**29.7**	mg/kg	4.1	0.68	5	05/24/13 16:19	05/26/13 21:06	7440-38-2	
Cadmium	**0.44J**	mg/kg	0.61	0.30	5	05/24/13 16:19	05/26/13 21:06	7440-43-9	
Copper	**10.9**	mg/kg	2.0	0.23	5	05/24/13 16:19	05/26/13 21:06	7440-50-8	
Lead	**14.3**	mg/kg	4.1	0.29	5	05/24/13 16:19	05/26/13 21:06	7439-92-1	
Zinc	**53.9**	mg/kg	4.1	1.3	5	05/24/13 16:19	05/26/13 21:06	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**3.3**	meq/L	0.50	0.25	10		05/27/13 17:54	7440-70-2	
Magnesium saturated paste	**20.8**	meq/L	0.80	0.40	10		05/27/13 17:54	7439-95-4	
Sodium Adsorption Ratio	**41.5**		3.4	1.7	20		05/28/13 11:26		
Sodium saturated paste	**144**	meq/L	0.80	0.40	20		05/28/13 11:26	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.8**	Std. Units	0.10	0.050	1		05/15/13 09:56		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**32.5**	% (w/w)	0.10		1		05/16/13 18:23		
Percent Sand	**45.0**	% (w/w)	0.10		1		05/16/13 18:23		
Percent Silt	**22.5**	% (w/w)	0.10		1		05/16/13 18:23		
Texture	**clay loam**				1		05/16/13 18:23		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**14.3**	mmhos/cm	0.010	0.0050	1		05/20/13 12:07		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR01 40-60" **Lab ID: 10227774034** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**18.0**	mg/kg	3.8	0.64	5	05/24/13 16:19	05/26/13 21:13	7440-38-2	
Cadmium	**<0.29**	mg/kg	0.58	0.29	5	05/24/13 16:19	05/26/13 21:13	7440-43-9	
Copper	**9.0**	mg/kg	1.9	0.22	5	05/24/13 16:19	05/26/13 21:13	7440-50-8	
Lead	**13.0**	mg/kg	3.8	0.28	5	05/24/13 16:19	05/26/13 21:13	7439-92-1	
Zinc	**49.4**	mg/kg	3.8	1.2	5	05/24/13 16:19	05/26/13 21:13	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**20.0**	meq/L	0.50	0.25	10		05/27/13 18:01	7440-70-2	
Magnesium saturated paste	**59.2**	meq/L	0.80	0.40	10		05/27/13 18:01	7439-95-4	
Sodium Adsorption Ratio	**39.8**		8.5	4.2	50		05/28/13 11:33		
Sodium saturated paste	**250**	meq/L	2.0	1.0	50		05/28/13 11:33	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.4**	Std. Units	0.10	0.050	1		05/15/13 09:59		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/16/13 18:28		
Percent Sand	**52.5**	% (w/w)	0.10		1		05/16/13 18:28		
Percent Silt	**20.0**	% (w/w)	0.10		1		05/16/13 18:28		
Texture	**sandy clay loam**				1		05/16/13 18:28		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**22.6**	mmhos/cm	0.010	0.0050	1		05/20/13 12:08		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR02 0-9" **Lab ID: 10227774035** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**14.1**	mg/kg	4.5	0.76	5	05/24/13 16:19	05/26/13 21:28	7440-38-2	
Cadmium	**<0.34**	mg/kg	0.68	0.34	5	05/24/13 16:19	05/26/13 21:28	7440-43-9	
Copper	**7.1**	mg/kg	2.3	0.25	5	05/24/13 16:19	05/26/13 21:28	7440-50-8	
Lead	**12.3**	mg/kg	4.5	0.33	5	05/24/13 16:19	05/26/13 21:28	7439-92-1	
Zinc	**41.5**	mg/kg	4.5	1.4	5	05/24/13 16:19	05/26/13 21:28	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.91**	meq/L	0.50	0.25	10		05/27/13 18:08	7440-70-2	
Magnesium saturated paste	**0.59J**	meq/L	0.80	0.40	10		05/27/13 18:08	7439-95-4	
Sodium Adsorption Ratio	**4.1**		1.7	0.85	10		05/27/13 18:08		
Sodium saturated paste	**3.6**	meq/L	0.40	0.20	10		05/27/13 18:08	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**5.9**	Std. Units	0.10	0.050	1		05/15/13 10:04		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**17.5**	% (w/w)	0.10		1		05/16/13 18:35		
Percent Sand	**60.0**	% (w/w)	0.10		1		05/16/13 18:35		
Percent Silt	**22.5**	% (w/w)	0.10		1		05/16/13 18:35		
Texture	**sandy loam**				1		05/16/13 18:35		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.91**	mmhos/cm	0.010	0.0050	1		05/22/13 13:32		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR02 9-20" **Lab ID: 10227774036** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**13.7**	mg/kg	4.2	0.70	5	05/24/13 16:19	05/26/13 21:35	7440-38-2	
Cadmium	**<0.31**	mg/kg	0.63	0.31	5	05/24/13 16:19	05/26/13 21:35	7440-43-9	
Copper	**11.8**	mg/kg	2.1	0.23	5	05/24/13 16:19	05/26/13 21:35	7440-50-8	
Lead	**16.0**	mg/kg	4.2	0.30	5	05/24/13 16:19	05/26/13 21:35	7439-92-1	
Zinc	**50.5**	mg/kg	4.2	1.3	5	05/24/13 16:19	05/26/13 21:35	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.3**	meq/L	0.50	0.25	10		05/27/13 18:12	7440-70-2	
Magnesium saturated paste	**0.96**	meq/L	0.80	0.40	10		05/27/13 18:12	7439-95-4	
Sodium Adsorption Ratio	**8.3**		1.7	0.85	10		05/27/13 18:12		
Sodium saturated paste	**8.8**	meq/L	0.40	0.20	10		05/27/13 18:12	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		05/15/13 10:06		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/16/13 18:40		
Percent Sand	**42.5**	% (w/w)	0.10		1		05/16/13 18:40		
Percent Silt	**30.0**	% (w/w)	0.10		1		05/16/13 18:40		
Texture	**clay loam**				1		05/16/13 18:40		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**1.3**	mmhos/cm	0.010	0.0050	1		05/20/13 12:10		

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR02 20-34" **Lab ID: 10227774037** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**12.6**	mg/kg	3.9	0.66	5	05/24/13 16:19	05/26/13 21:42	7440-38-2	
Cadmium	**0.39J**	mg/kg	0.59	0.30	5	05/24/13 16:19	05/26/13 21:42	7440-43-9	
Copper	**10.6**	mg/kg	2.0	0.22	5	05/24/13 16:19	05/26/13 21:42	7440-50-8	
Lead	**14.1**	mg/kg	3.9	0.28	5	05/24/13 16:19	05/26/13 21:42	7439-92-1	
Zinc	**95.3**	mg/kg	3.9	1.2	5	05/24/13 16:19	05/26/13 21:42	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**10.6**	meq/L	0.50	0.25	10		05/27/13 18:17	7440-70-2	
Magnesium saturated paste	**15.5**	meq/L	0.80	0.40	10		05/27/13 18:17	7439-95-4	
Sodium Adsorption Ratio	**10.5**		1.7	0.85	10		05/27/13 18:17		
Sodium saturated paste	**37.9**	meq/L	0.40	0.20	10		05/27/13 18:17	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.9**	Std. Units	0.10	0.050	1		05/15/13 10:12		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**30.0**	% (w/w)	0.10		1		05/16/13 18:47		
Percent Sand	**40.0**	% (w/w)	0.10		1		05/16/13 18:47		
Percent Silt	**30.0**	% (w/w)	0.10		1		05/16/13 18:47		
Texture	**clay loam**				1		05/16/13 18:47		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**6.2**	mmhos/cm	0.010	0.0050	1		05/20/13 12:13		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR03 4-12" **Lab ID: 10227774038** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**21.9**	mg/kg	4.9	0.82	5	05/24/13 16:19	05/26/13 21:49	7440-38-2	
Cadmium	**<0.37**	mg/kg	0.74	0.37	5	05/24/13 16:19	05/26/13 21:49	7440-43-9	
Copper	**12.0**	mg/kg	2.5	0.27	5	05/24/13 16:19	05/26/13 21:49	7440-50-8	
Lead	**14.5**	mg/kg	4.9	0.35	5	05/24/13 16:19	05/26/13 21:49	7439-92-1	
Zinc	**31.6**	mg/kg	4.9	1.5	5	05/24/13 16:19	05/26/13 21:49	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**2.9**	meq/L	0.50	0.25	10		05/27/13 18:22	7440-70-2	
Magnesium saturated paste	**2.1**	meq/L	0.80	0.40	10		05/27/13 18:22	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 18:22		
Sodium saturated paste	**0.69**	meq/L	0.40	0.20	10		05/27/13 18:22	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.4**	Std. Units	0.10	0.050	1		05/15/13 10:17		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**30.0**	% (w/w)	0.10		1		05/16/13 18:52		
Percent Sand	**37.5**	% (w/w)	0.10		1		05/16/13 18:52		
Percent Silt	**32.5**	% (w/w)	0.10		1		05/16/13 18:52		
Texture	**clay loam**				1		05/16/13 18:52		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.61**	mmhos/cm	0.010	0.0050	1		05/20/13 12:16		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR03 12-20" **Lab ID: 10227774039** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**19.5**	mg/kg	4.5	0.75	5	05/24/13 16:19	05/26/13 21:55	7440-38-2	
Cadmium	**<0.33**	mg/kg	0.67	0.33	5	05/24/13 16:19	05/26/13 21:55	7440-43-9	
Copper	**9.8**	mg/kg	2.2	0.25	5	05/24/13 16:19	05/26/13 21:55	7440-50-8	
Lead	**12.1**	mg/kg	4.5	0.32	5	05/24/13 16:19	05/26/13 21:55	7439-92-1	
Zinc	**31.2**	mg/kg	4.5	1.4	5	05/24/13 16:19	05/26/13 21:55	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.7**	meq/L	0.50	0.25	10		05/27/13 18:26	7440-70-2	
Magnesium saturated paste	**1.4**	meq/L	0.80	0.40	10		05/27/13 18:26	7439-95-4	
Sodium Adsorption Ratio	**<0.85**		1.7	0.85	10		05/27/13 18:26		
Sodium saturated paste	**0.69**	meq/L	0.40	0.20	10		05/27/13 18:26	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.8**	Std. Units	0.10	0.050	1		05/15/13 10:21		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.5**	% (w/w)	0.10		1		05/16/13 18:56		
Percent Sand	**37.5**	% (w/w)	0.10		1		05/16/13 18:56		
Percent Silt	**35.0**	% (w/w)	0.10		1		05/16/13 18:56		
Texture	**clay loam**				1		05/16/13 18:56		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.38**	mmhos/cm	0.010	0.0050	1		05/20/13 12:17		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR03 20-30" **Lab ID: 10227774040** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**7.4**	mg/kg	3.9	0.65	5	05/24/13 16:19	05/26/13 22:07	7440-38-2	
Cadmium	**<0.29**	mg/kg	0.58	0.29	5	05/24/13 16:19	05/26/13 22:07	7440-43-9	
Copper	**9.3**	mg/kg	1.9	0.22	5	05/24/13 16:19	05/26/13 22:07	7440-50-8	
Lead	**9.1**	mg/kg	3.9	0.28	5	05/24/13 16:19	05/26/13 22:07	7439-92-1	
Zinc	**37.4**	mg/kg	3.9	1.2	5	05/24/13 16:19	05/26/13 22:07	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.61**	meq/L	0.50	0.25	10		05/27/13 18:31	7440-70-2	
Magnesium saturated paste	**1.8**	meq/L	0.80	0.40	10		05/27/13 18:31	7439-95-4	
Sodium Adsorption Ratio	**1.0J**		1.7	0.85	10		05/27/13 18:31		
Sodium saturated paste	**1.1**	meq/L	0.40	0.20	10		05/27/13 18:31	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.2**	Std. Units	0.10	0.050	1		05/15/13 10:26		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**20.0**	% (w/w)	0.10		1		05/16/13 19:00		
Percent Sand	**37.5**	% (w/w)	0.10		1		05/16/13 19:00		
Percent Silt	**42.5**	% (w/w)	0.10		1		05/16/13 19:00		
Texture	**loam**				1		05/16/13 19:00		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.40**	mmhos/cm	0.010	0.0050	1		05/20/13 12:19		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR03 30-40" **Lab ID: 10227774041** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**8.0**	mg/kg	0.82	0.14	1	05/20/13 13:02	05/23/13 14:32	7440-38-2	
Cadmium	**0.18**	mg/kg	0.12	0.061	1	05/20/13 13:02	05/23/13 14:32	7440-43-9	
Copper	**8.2**	mg/kg	0.41	0.046	1	05/20/13 13:02	05/23/13 14:32	7440-50-8	
Lead	**7.5**	mg/kg	0.82	0.059	1	05/20/13 13:02	05/23/13 14:32	7439-92-1	
Zinc	**29.7**	mg/kg	0.82	0.25	1	05/20/13 13:02	05/23/13 14:32	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**0.53J**	meq/L	1.0	0.50	20		05/27/13 15:14	7440-70-2	
Magnesium saturated paste	**1.3J**	meq/L	1.6	0.80	20		05/27/13 15:14	7439-95-4	
Sodium Adsorption Ratio	**3.2J**		3.4	1.7	20		05/27/13 15:14		
Sodium saturated paste	**3.0**	meq/L	0.80	0.40	20		05/27/13 15:14	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.4**	Std. Units	0.10	0.050	1		05/15/13 11:32		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**10.0%**	% (w/w)	0.10		1		05/22/13 16:44		
Percent Sand	**65.0%**	% (w/w)	0.10		1		05/22/13 16:44		
Percent Silt	**25.0%**	% (w/w)	0.10		1		05/22/13 16:44		
Texture	**sandy loam**				1		05/22/13 16:44		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.50**	mmhos/cm	0.010	0.0050	1		05/20/13 12:29		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR04 14-24" **Lab ID: 10227774042** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**30.2**	mg/kg	0.91	0.15	1	05/20/13 13:02	05/23/13 14:37	7440-38-2	
Cadmium	**0.55**	mg/kg	0.14	0.068	1	05/20/13 13:02	05/23/13 14:37	7440-43-9	
Copper	**13.2**	mg/kg	0.45	0.051	1	05/20/13 13:02	05/23/13 14:37	7440-50-8	
Lead	**14.2**	mg/kg	0.91	0.065	1	05/20/13 13:02	05/23/13 14:37	7439-92-1	
Zinc	**47.0**	mg/kg	0.91	0.28	1	05/20/13 13:02	05/23/13 14:37	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.2**	meq/L	1.0	0.50	20		05/27/13 15:18	7440-70-2	
Magnesium saturated paste	**1.3J**	meq/L	1.6	0.80	20		05/27/13 15:18	7439-95-4	
Sodium Adsorption Ratio	**2.7J**		3.4	1.7	20		05/27/13 15:18		
Sodium saturated paste	**3.0**	meq/L	0.80	0.40	20		05/27/13 15:18	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.9**	Std. Units	0.10	0.050	1		05/15/13 11:39		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**32.5%**	% (w/w)	0.10		1		05/22/13 16:49		
Percent Sand	**40.0%**	% (w/w)	0.10		1		05/22/13 16:49		
Percent Silt	**27.5%**	% (w/w)	0.10		1		05/22/13 16:49		
Texture	**clay loam**				1		05/22/13 16:49		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.56**	mmhos/cm	0.010	0.0050	1		05/20/13 12:32		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Sample: JR04 24-40" **Lab ID: 10227774043** Collected: 05/01/13 00:00 Received: 05/07/13 12:45 Matrix: Solid

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**31.8**	mg/kg	0.67	0.11	1	05/20/13 13:02	05/23/13 14:43	7440-38-2	
Cadmium	**0.54**	mg/kg	0.10	0.050	1	05/20/13 13:02	05/23/13 14:43	7440-43-9	
Copper	**12.8**	mg/kg	0.33	0.037	1	05/20/13 13:02	05/23/13 14:43	7440-50-8	
Lead	**13.9**	mg/kg	0.67	0.048	1	05/20/13 13:02	05/23/13 14:43	7439-92-1	
Zinc	**47.1**	mg/kg	0.67	0.21	1	05/20/13 13:02	05/23/13 14:43	7440-66-6	
Sodium Adsorption Ratio, ICP	Analytical Method: EPA 6010								
Calcium saturated paste	**1.0**	meq/L	1.0	0.50	20		05/27/13 15:23	7440-70-2	
Magnesium saturated paste	**1.1J**	meq/L	1.6	0.80	20		05/27/13 15:23	7439-95-4	
Sodium Adsorption Ratio	**4.3**		3.4	1.7	20		05/27/13 15:23		
Sodium saturated paste	**4.4**	meq/L	0.80	0.40	20		05/27/13 15:23	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.1**	Std. Units	0.10	0.050	1		05/15/13 11:40		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**25.0%**	% (w/w)	0.10		1		05/22/13 16:49		
Percent Sand	**47.5%**	% (w/w)	0.10		1		05/22/13 16:49		
Percent Silt	**27.5%**	% (w/w)	0.10		1		05/22/13 16:49		
Texture	**sandy clay loam**				1		05/22/13 16:49		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.71**	mmhos/cm	0.010	0.0050	1		05/20/13 12:35		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MPRP/39101 Analysis Method: EPA 6010
QC Batch Method: EPA 3050 Analysis Description: 6010 MET
Associated Lab Samples: 10227774001, 10227774002, 10227774003, 10227774004, 10227774005, 10227774006, 10227774007, 10227774008, 10227774009, 10227774010, 10227774011, 10227774012, 10227774013, 10227774014, 10227774015, 10227774016, 10227774017, 10227774018, 10227774019, 10227774020

METHOD BLANK: 1429665 Matrix: Solid
Associated Lab Samples: 10227774001, 10227774002, 10227774003, 10227774004, 10227774005, 10227774006, 10227774007, 10227774008, 10227774009, 10227774010, 10227774011, 10227774012, 10227774013, 10227774014, 10227774015, 10227774016, 10227774017, 10227774018, 10227774019, 10227774020

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	<0.12	0.70	05/26/13 15:59	
Cadmium	mg/kg	<0.052	0.10	05/26/13 15:59	
Copper	mg/kg	<0.039	0.35	05/26/13 15:59	
Lead	mg/kg	<0.050	0.70	05/26/13 15:59	
Zinc	mg/kg	<0.22	0.70	05/26/13 15:59	

LABORATORY CONTROL SAMPLE: 1429666

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	49.5	43.9	89	80-120	
Cadmium	mg/kg	49.5	44.2	89	80-120	
Copper	mg/kg	49.5	47.1	95	80-120	
Lead	mg/kg	49.5	44.6	90	80-120	
Zinc	mg/kg	49.5	43.4	88	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1429667 1429668

Parameter	Units	10227774001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	11.0	46.3	39.4	55.2	47.2	95	92	75-125	16	30	
Cadmium	mg/kg	<0.28	46.3	39.4	44.5	37.2	96	94	75-125	18	30	
Copper	mg/kg	9.2	46.3	39.4	56.1	48.6	101	100	75-125	14	30	
Lead	mg/kg	12.9	46.3	39.4	58.7	51.3	99	98	75-125	13	30	
Zinc	mg/kg	38.4	46.3	39.4	89.8	79.8	111	105	75-125	12	30	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
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(406)254-7226

QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MPRP/39102 Analysis Method: EPA 6010
QC Batch Method: EPA 3050 Analysis Description: 6010 MET
Associated Lab Samples: 10227774021, 10227774022, 10227774023, 10227774024, 10227774025, 10227774026, 10227774027, 10227774028, 10227774029, 10227774030, 10227774031, 10227774032, 10227774033, 10227774034, 10227774035, 10227774036, 10227774037, 10227774038, 10227774039, 10227774040

METHOD BLANK: 1429669 Matrix: Solid
Associated Lab Samples: 10227774021, 10227774022, 10227774023, 10227774024, 10227774025, 10227774026, 10227774027, 10227774028, 10227774029, 10227774030, 10227774031, 10227774032, 10227774033, 10227774034, 10227774035, 10227774036, 10227774037, 10227774038, 10227774039, 10227774040

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	<0.14	0.86	05/26/13 19:14	
Cadmium	mg/kg	<0.065	0.13	05/26/13 19:14	
Copper	mg/kg	<0.048	0.43	05/26/13 19:14	
Lead	mg/kg	<0.062	0.86	05/26/13 19:14	
Zinc	mg/kg	<0.27	0.86	05/26/13 19:14	

LABORATORY CONTROL SAMPLE: 1429670

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	46.3	42.3	91	80-120	
Cadmium	mg/kg	46.3	42.6	92	80-120	
Copper	mg/kg	46.3	44.9	97	80-120	
Lead	mg/kg	46.3	42.9	93	80-120	
Zinc	mg/kg	46.3	41.7	90	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1429671 1429672

Parameter	Units	10227774021 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	10.5	36.2	35.5	41.5	42.2	86	89	75-125	2	30	
Cadmium	mg/kg	<0.33	36.2	35.5	33.3	33.2	91	93	75-125	.3	30	
Copper	mg/kg	13.2	36.2	35.5	47.4	47.4	94	97	75-125	.1	30	
Lead	mg/kg	14.1	36.2	35.5	46.4	46.5	89	91	75-125	.04	30	
Zinc	mg/kg	55.2	36.2	35.5	89.1	89.2	94	96	75-125	.1	30	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MPRP/39103 Analysis Method: EPA 6010
QC Batch Method: EPA 3050 Analysis Description: 6010 MET
Associated Lab Samples: 10227774041, 10227774042, 10227774043

METHOD BLANK: 1429673 Matrix: Solid
Associated Lab Samples: 10227774041, 10227774042, 10227774043

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	<0.12	0.74	05/23/13 13:29	
Cadmium	mg/kg	<0.056	0.11	05/23/13 13:29	
Copper	mg/kg	0.059J	0.37	05/23/13 13:29	
Lead	mg/kg	<0.053	0.74	05/23/13 13:29	
Zinc	mg/kg	<0.23	0.74	05/23/13 13:29	

LABORATORY CONTROL SAMPLE: 1429674

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	37	31.8	86	80-120	
Cadmium	mg/kg	37	32.7	88	80-120	
Copper	mg/kg	37	33.5	91	80-120	
Lead	mg/kg	37	32.5	88	80-120	
Zinc	mg/kg	37	32.5	88	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1429675 1429676

Parameter	Units	10227935001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	3.1	45	47.2	43.7	41.3	90	81	75-125	6	30	
Cadmium	mg/kg	ND	45	47.2	41.2	38.3	91	81	75-125	7	30	
Copper	mg/kg	2.7	45	47.2	46.4	43.4	97	86	75-125	7	30	
Lead	mg/kg	8.3	45	47.2	48.0	44.8	88	77	75-125	7	30	
Zinc	mg/kg	11.7	45	47.2	51.7	50.0	89	81	75-125	3	30	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11947 Analysis Method: USDA 21A
QC Batch Method: USDA 21A Analysis Description: USDA 21A pH saturated paste
Associated Lab Samples: 10227774001, 10227774002, 10227774003, 10227774004, 10227774005, 10227774006, 10227774007, 10227774008, 10227774009, 10227774010, 10227774011, 10227774012, 10227774013, 10227774014, 10227774015, 10227774016, 10227774017, 10227774018, 10227774019, 10227774020

LABORATORY CONTROL SAMPLE: 1430201

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
pH, Saturated Paste	Std. Units	7.4	7.2	97	94-105	

SAMPLE DUPLICATE: 1430202

Parameter	Units	10227774002 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	7.9	7.9	.3	20	

SAMPLE DUPLICATE: 1430203

Parameter	Units	10227774012 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	6.7	6.6	2	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11970 Analysis Method: USDA 21A
QC Batch Method: USDA 21A Analysis Description: USDA 21A pH saturated paste
Associated Lab Samples: 10227774021, 10227774022, 10227774023, 10227774024, 10227774025, 10227774026, 10227774027, 10227774028, 10227774029, 10227774030, 10227774031, 10227774032, 10227774033, 10227774034, 10227774035, 10227774036, 10227774037, 10227774038, 10227774039, 10227774040

LABORATORY CONTROL SAMPLE: 1431946

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
pH, Saturated Paste	Std. Units	7.4	7.2	97	94-105	

SAMPLE DUPLICATE: 1431948

Parameter	Units	10227774023 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	8.0	8.0	.1	20	

SAMPLE DUPLICATE: 1431949

Parameter	Units	10227774026 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	8.5	8.4	.1	20	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11971 Analysis Method: USDA 21A
QC Batch Method: USDA 21A Analysis Description: USDA 21A pH saturated paste
Associated Lab Samples: 10227774041, 10227774042, 10227774043

LABORATORY CONTROL SAMPLE: 1431950

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
pH, Saturated Paste	Std. Units	7.4	7.1	96	94-105	

SAMPLE DUPLICATE: 1431951

Parameter	Units	10227774043 Result	Dup Result	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	8.1	8.1	.2	20	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/12000 Analysis Method: ASA 15-5 mod
QC Batch Method: ASA 15-5 mod Analysis Description: PSA Percent Soil,Silt,Clay
Associated Lab Samples: 10227774041, 10227774042, 10227774043

SAMPLE DUPLICATE: 1433077

Parameter	Units	10227774043 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Clay	% (w/w)	25.0%	25.0%		20	
Percent Sand	% (w/w)	47.5%	47.5%		20	
Percent Silt	% (w/w)	27.5%	27.5%		20	
Texture		sandy clay loam	sandy clay			

REPORT OF LABORATORY ANALYSIS

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(406)254-7226

QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11983 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10227774001, 10227774002, 10227774003, 10227774004, 10227774007, 10227774009, 10227774011, 10227774012, 10227774013, 10227774016, 10227774017, 10227774018, 10227774019, 10227774020, 10227774021, 10227774022, 10227774024, 10227774025, 10227774027, 10227774028

METHOD BLANK: 1432684 Matrix: Water
Associated Lab Samples: 10227774001, 10227774002, 10227774003, 10227774004, 10227774007, 10227774009, 10227774011, 10227774012, 10227774013, 10227774016, 10227774017, 10227774018, 10227774019, 10227774020, 10227774021, 10227774022, 10227774024, 10227774025, 10227774027, 10227774028

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	05/20/13 09:28	

LABORATORY CONTROL SAMPLE: 1432685

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	.78	0.80	103	69-131	

SAMPLE DUPLICATE: 1432686

Parameter	Units	10227774002 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	0.61	0.60	.7	20	

SAMPLE DUPLICATE: 1432687

Parameter	Units	10227774012 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	0.65	0.67	4	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11984 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10227774023, 10227774026, 10227774029, 10227774030, 10227774032, 10227774033, 10227774034, 10227774036, 10227774037, 10227774038, 10227774039, 10227774040

METHOD BLANK: 1432688 Matrix: Water
Associated Lab Samples: 10227774023, 10227774026, 10227774029, 10227774030, 10227774032, 10227774033, 10227774034, 10227774036, 10227774037, 10227774038, 10227774039, 10227774040

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	05/20/13 11:35	

LABORATORY CONTROL SAMPLE: 1432689

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	.78	0.96	123	69-131	

SAMPLE DUPLICATE: 1432690

Parameter	Units	10227774023 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	0.51	0.51	2	20	

SAMPLE DUPLICATE: 1432691

Parameter	Units	10227774026 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	19.3	20.0	4	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/11985 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10227774041, 10227774042, 10227774043

METHOD BLANK: 1432692 Matrix: Water
Associated Lab Samples: 10227774041, 10227774042, 10227774043

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	05/20/13 12:25	

LABORATORY CONTROL SAMPLE: 1432693

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	.78	0.77	98	69-131	

SAMPLE DUPLICATE: 1432694

Parameter	Units	10227774043 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	0.71	0.72	2	20	

REPORT OF LABORATORY ANALYSIS

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(406)254-7226

QUALITY CONTROL DATA

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

QC Batch: MT/12068 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10227774005, 10227774006, 10227774008, 10227774010, 10227774014, 10227774015, 10227774031, 10227774035

METHOD BLANK: 1438662 Matrix: Water
Associated Lab Samples: 10227774005, 10227774006, 10227774008, 10227774010, 10227774014, 10227774015, 10227774031, 10227774035

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	05/22/13 13:13	

LABORATORY CONTROL SAMPLE: 1438663

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	.78	0.92	118	69-131	

SAMPLE DUPLICATE: 1438664

Parameter	Units	10227774006 Result	Dup Result	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	0.95	1.2	20	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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(406)254-7226

QUALIFIERS

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-MT	Pace Analytical Services - Montana

Pace Analytical Services, Inc.
602 S 25th Street
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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10227774001	**SM01 0-11"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774002	**SM01 19-31"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774003	**SM02 9-18"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774004	**SM02 18-31"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774005	**SM11 9-21"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774006	**SM11 21-33"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774007	**SM12 7-19"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774008	**SM12 19-31"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774009	**SM13 0-8"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774010	**SM13 19-27"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774011	**SM14 0-9"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774012	**SM14 9-19"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774013	**SM10 0-9"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774014	**SM10 9-21"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774015	**SM19 7-22"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774016	**SM23 0-8"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774017	**SM23 8-20"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774018	**SM23 20-28"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774019	**DA04 9-29"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774020	**DA10 6-20"**	EPA 3050	MPRP/39101	EPA 6010	ICP/16507
10227774021	**DA12 14-24"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774022	**DA13 9-18"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774023	**DA13 18-40"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774024	**DA15 0-9"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774025	**DA15 8-14"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774026	**DA15 14-44"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774027	**DA17 8-28"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774028	**DA25 17-26"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774029	**DA25 29-40"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774030	**JR01 0-8"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774031	**JR01 8-16"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774032	**JR01 16-24"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774033	**JR01 24-40"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774034	**JR01 40-60"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774035	**JR02 0-9"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774036	**JR02 9-20"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774037	**JR02 20-34"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774038	**JR03 4-12"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774039	**JR03 12-20"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774040	**JR03 20-30"**	EPA 3050	MPRP/39102	EPA 6010	ICP/16503
10227774041	**JR03 30-40"**	EPA 3050	MPRP/39103	EPA 6010	ICP/16445
10227774042	**JR04 14-24"**	EPA 3050	MPRP/39103	EPA 6010	ICP/16445
10227774043	**JR04 24-40"**	EPA 3050	MPRP/39103	EPA 6010	ICP/16445
10227774001	**SM01 0-11"**	EPA 6010	ICP/16403		
10227774002	**SM01 19-31"**	EPA 6010	ICP/16403		
10227774003	**SM02 9-18"**	EPA 6010	ICP/16403		
10227774004	**SM02 18-31"**	EPA 6010	ICP/16403		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10227774005	SM11 9-21"	EPA 6010	ICP/16403		
10227774006	SM11 21-33"	EPA 6010	ICP/16403		
10227774007	SM12 7-19"	EPA 6010	ICP/16403		
10227774008	SM12 19-31"	EPA 6010	ICP/16403		
10227774009	SM13 0-8"	EPA 6010	ICP/16403		
10227774010	SM13 19-27"	EPA 6010	ICP/16403		
10227774011	SM14 0-9"	EPA 6010	ICP/16403		
10227774012	SM14 9-19"	EPA 6010	ICP/16403		
10227774013	SM10 0-9"	EPA 6010	ICP/16403		
10227774014	SM10 9-21"	EPA 6010	ICP/16403		
10227774015	SM19 7-22"	EPA 6010	ICP/16403		
10227774016	SM23 0-8"	EPA 6010	ICP/16403		
10227774017	SM23 8-20"	EPA 6010	ICP/16403		
10227774018	SM23 20-28"	EPA 6010	ICP/16403		
10227774019	DA04 9-29"	EPA 6010	ICP/16403		
10227774020	DA10 6-20"	EPA 6010	ICP/16403		
10227774021	DA12 14-24"	EPA 6010	ICP/16405		
10227774022	DA13 9-18"	EPA 6010	ICP/16405		
10227774023	DA13 18-40"	EPA 6010	ICP/16405		
10227774024	DA15 0-9"	EPA 6010	ICP/16405		
10227774025	DA15 8-14"	EPA 6010	ICP/16405		
10227774026	DA15 14-44"	EPA 6010	ICP/16405		
10227774027	DA17 8-28"	EPA 6010	ICP/16405		
10227774028	DA25 17-26"	EPA 6010	ICP/16405		
10227774029	DA25 29-40"	EPA 6010	ICP/16405		
10227774030	JR01 0-8"	EPA 6010	ICP/16405		
10227774031	JR01 8-16"	EPA 6010	ICP/16405		
10227774032	JR01 16-24"	EPA 6010	ICP/16405		
10227774033	JR01 24-40"	EPA 6010	ICP/16405		
10227774034	JR01 40-60"	EPA 6010	ICP/16405		
10227774035	JR02 0-9"	EPA 6010	ICP/16405		
10227774036	JR02 9-20"	EPA 6010	ICP/16405		
10227774037	JR02 20-34"	EPA 6010	ICP/16405		
10227774038	JR03 4-12"	EPA 6010	ICP/16405		
10227774039	JR03 12-20"	EPA 6010	ICP/16405		
10227774040	JR03 20-30"	EPA 6010	ICP/16405		
10227774041	JR03 30-40"	EPA 6010	ICP/16406		
10227774042	JR04 14-24"	EPA 6010	ICP/16406		
10227774043	JR04 24-40"	EPA 6010	ICP/16406		
10227774001	SM01 0-11"	USDA 21A	MT/11947		
10227774002	SM01 19-31"	USDA 21A	MT/11947		
10227774003	SM02 9-18"	USDA 21A	MT/11947		
10227774004	SM02 18-31"	USDA 21A	MT/11947		
10227774005	SM11 9-21"	USDA 21A	MT/11947		
10227774006	SM11 21-33"	USDA 21A	MT/11947		
10227774007	SM12 7-19"	USDA 21A	MT/11947		
10227774008	SM12 19-31"	USDA 21A	MT/11947		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10227774009	SM13 0-8"	USDA 21A	MT/11947		
10227774010	SM13 19-27"	USDA 21A	MT/11947		
10227774011	SM14 0-9"	USDA 21A	MT/11947		
10227774012	SM14 9-19"	USDA 21A	MT/11947		
10227774013	SM10 0-9"	USDA 21A	MT/11947		
10227774014	SM10 9-21"	USDA 21A	MT/11947		
10227774015	SM19 7-22"	USDA 21A	MT/11947		
10227774016	SM23 0-8"	USDA 21A	MT/11947		
10227774017	SM23 8-20"	USDA 21A	MT/11947		
10227774018	SM23 20-28"	USDA 21A	MT/11947		
10227774019	DA04 9-29"	USDA 21A	MT/11947		
10227774020	DA10 6-20"	USDA 21A	MT/11947		
10227774021	DA12 14-24"	USDA 21A	MT/11970		
10227774022	DA13 9-18"	USDA 21A	MT/11970		
10227774023	DA13 18-40"	USDA 21A	MT/11970		
10227774024	DA15 0-9"	USDA 21A	MT/11970		
10227774025	DA15 8-14"	USDA 21A	MT/11970		
10227774026	DA15 14-44"	USDA 21A	MT/11970		
10227774027	DA17 8-28"	USDA 21A	MT/11970		
10227774028	DA25 17-26"	USDA 21A	MT/11970		
10227774029	DA25 29-40"	USDA 21A	MT/11970		
10227774030	JR01 0-8"	USDA 21A	MT/11970		
10227774031	JR01 8-16"	USDA 21A	MT/11970		
10227774032	JR01 16-24"	USDA 21A	MT/11970		
10227774033	JR01 24-40"	USDA 21A	MT/11970		
10227774034	JR01 40-60"	USDA 21A	MT/11970		
10227774035	JR02 0-9"	USDA 21A	MT/11970		
10227774036	JR02 9-20"	USDA 21A	MT/11970		
10227774037	JR02 20-34"	USDA 21A	MT/11970		
10227774038	JR03 4-12"	USDA 21A	MT/11970		
10227774039	JR03 12-20"	USDA 21A	MT/11970		
10227774040	JR03 20-30"	USDA 21A	MT/11970		
10227774041	JR03 30-40"	USDA 21A	MT/11971		
10227774042	JR04 14-24"	USDA 21A	MT/11971		
10227774043	JR04 24-40"	USDA 21A	MT/11971		
10227774001	SM01 0-11"	ASA 15-5 mod	MT/11915		
10227774002	SM01 19-31"	ASA 15-5 mod	MT/11915		
10227774003	SM02 9-18"	ASA 15-5 mod	MT/11915		
10227774004	SM02 18-31"	ASA 15-5 mod	MT/11915		
10227774005	SM11 9-21"	ASA 15-5 mod	MT/11915		
10227774006	SM11 21-33"	ASA 15-5 mod	MT/11915		
10227774007	SM12 7-19"	ASA 15-5 mod	MT/11915		
10227774008	SM12 19-31"	ASA 15-5 mod	MT/11915		
10227774009	SM13 0-8"	ASA 15-5 mod	MT/11915		
10227774010	SM13 19-27"	ASA 15-5 mod	MT/11915		
10227774011	SM14 0-9"	ASA 15-5 mod	MT/11915		
10227774012	SM14 9-19"	ASA 15-5 mod	MT/11915		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10227774013	SM10 0-9"	ASA 15-5 mod	MT/11915		
10227774014	SM10 9-21"	ASA 15-5 mod	MT/11915		
10227774015	SM19 7-22"	ASA 15-5 mod	MT/11915		
10227774016	SM23 0-8"	ASA 15-5 mod	MT/11915		
10227774017	SM23 8-20"	ASA 15-5 mod	MT/11915		
10227774018	SM23 20-28"	ASA 15-5 mod	MT/11915		
10227774019	DA04 9-29"	ASA 15-5 mod	MT/11915		
10227774020	DA10 6-20"	ASA 15-5 mod	MT/11915		
10227774021	DA12 14-24"	ASA 15-5 mod	MT/11999		
10227774022	DA13 9-18"	ASA 15-5 mod	MT/11999		
10227774023	DA13 18-40"	ASA 15-5 mod	MT/11999		
10227774024	DA15 0-9"	ASA 15-5 mod	MT/11999		
10227774025	DA15 8-14"	ASA 15-5 mod	MT/11999		
10227774026	DA15 14-44"	ASA 15-5 mod	MT/11999		
10227774027	DA17 8-28"	ASA 15-5 mod	MT/11999		
10227774028	DA25 17-26"	ASA 15-5 mod	MT/11999		
10227774029	DA25 29-40"	ASA 15-5 mod	MT/11999		
10227774030	JR01 0-8"	ASA 15-5 mod	MT/11999		
10227774031	JR01 8-16"	ASA 15-5 mod	MT/11999		
10227774032	JR01 16-24"	ASA 15-5 mod	MT/11999		
10227774033	JR01 24-40"	ASA 15-5 mod	MT/11999		
10227774034	JR01 40-60"	ASA 15-5 mod	MT/11999		
10227774035	JR02 0-9"	ASA 15-5 mod	MT/11999		
10227774036	JR02 9-20"	ASA 15-5 mod	MT/11999		
10227774037	JR02 20-34"	ASA 15-5 mod	MT/11999		
10227774038	JR03 4-12"	ASA 15-5 mod	MT/11999		
10227774039	JR03 12-20"	ASA 15-5 mod	MT/11999		
10227774040	JR03 20-30"	ASA 15-5 mod	MT/11999		
10227774041	JR03 30-40"	ASA 15-5 mod	MT/12000		
10227774042	JR04 14-24"	ASA 15-5 mod	MT/12000		
10227774043	JR04 24-40"	ASA 15-5 mod	MT/12000		
10227774001	SM01 0-11"	ASA 10-3.3	MT/11983		
10227774002	SM01 19-31"	ASA 10-3.3	MT/11983		
10227774003	SM02 9-18"	ASA 10-3.3	MT/11983		
10227774004	SM02 18-31"	ASA 10-3.3	MT/11983		
10227774005	SM11 9-21"	ASA 10-3.3	MT/12068		
10227774006	SM11 21-33"	ASA 10-3.3	MT/12068		
10227774007	SM12 7-19"	ASA 10-3.3	MT/11983		
10227774008	SM12 19-31"	ASA 10-3.3	MT/12068		
10227774009	SM13 0-8"	ASA 10-3.3	MT/11983		
10227774010	SM13 19-27"	ASA 10-3.3	MT/12068		
10227774011	SM14 0-9"	ASA 10-3.3	MT/11983		
10227774012	SM14 9-19"	ASA 10-3.3	MT/11983		
10227774013	SM10 0-9"	ASA 10-3.3	MT/11983		

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-551083 Riley Pass
Pace Project No.: 10227774

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10227774014	**SM10 9-21"**	ASA 10-3.3	MT/12068		
10227774015	**SM19 7-22"**	ASA 10-3.3	MT/12068		
10227774016	**SM23 0-8"**	ASA 10-3.3	MT/11983		
10227774017	**SM23 8-20"**	ASA 10-3.3	MT/11983		
10227774018	**SM23 20-28"**	ASA 10-3.3	MT/11983		
10227774019	**DA04 9-29"**	ASA 10-3.3	MT/11983		
10227774020	**DA10 6-20"**	ASA 10-3.3	MT/11983		
10227774021	**DA12 14-24"**	ASA 10-3.3	MT/11983		
10227774022	**DA13 9-18"**	ASA 10-3.3	MT/11983		
10227774023	**DA13 18-40"**	ASA 10-3.3	MT/11984		
10227774024	**DA15 0-9"**	ASA 10-3.3	MT/11983		
10227774025	**DA15 8-14"**	ASA 10-3.3	MT/11983		
10227774026	**DA15 14-44"**	ASA 10-3.3	MT/11984		
10227774027	**DA17 8-28"**	ASA 10-3.3	MT/11983		
10227774028	**DA25 17-26"**	ASA 10-3.3	MT/11983		
10227774029	**DA25 29-40"**	ASA 10-3.3	MT/11984		
10227774030	**JR01 0-8"**	ASA 10-3.3	MT/11984		
10227774031	**JR01 8-16"**	ASA 10-3.3	MT/12068		
10227774032	**JR01 16-24"**	ASA 10-3.3	MT/11984		
10227774033	**JR01 24-40"**	ASA 10-3.3	MT/11984		
10227774034	**JR01 40-60"**	ASA 10-3.3	MT/11984		
10227774035	**JR02 0-9"**	ASA 10-3.3	MT/12068		
10227774036	**JR02 9-20"**	ASA 10-3.3	MT/11984		
10227774037	**JR02 20-34"**	ASA 10-3.3	MT/11984		
10227774038	**JR03 4-12"**	ASA 10-3.3	MT/11984		
10227774039	**JR03 12-20"**	ASA 10-3.3	MT/11984		
10227774040	**JR03 20-30"**	ASA 10-3.3	MT/11984		
10227774041	**JR03 30-40"**	ASA 10-3.3	MT/11985		
10227774042	**JR04 14-24"**	ASA 10-3.3	MT/11985		
10227774043	**JR04 24-40"**	ASA 10-3.3	MT/11985		

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 6

1527030

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: Tetra Tech	Report To: Jeff Rice	Attention:
Address:	Copy To:	Company Name:
Billings		Address:
Email To: Jeffrey.rice@tetratech.com	Purchase Order No.: 114-551083	Pace Quote Reference:
Phone: 406.249.9161 Fax: 9262	Project Name: Riley Pass	Pace Project Manager:
Requested Due Date/TAT:	Project Number: 114-551083	Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: _____

Requested Analysis Filtered (Y/N)

ITEM #	Section D Required Client Information: SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	Matrix Codes MATRIX / CODE: Drinking Water DW, Water WT, Waste Water WW, Product P, Soil/Solid SL, Oil OL, Wipe WP, Air AR, Tissue TS, Other OT	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	USDA Texture	pH	EC	SAR	Arsenic	Cadmium	Copper	Lead	Zinc	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	SM01 0-11"		S	G	4/30/13					1	✓																				10227774 001
2	" 19-31"																														002
3	SM02 9-18"																														003
4	" 18-31"																														004
5	SM 11 9-21"				5/1/13																										005
6	" 21-33"																														006
7	SM12 7-19"																														007
8	" 19-31"																														008
9	SM 13 0-8"																														009
10	" 19-27"																														010
11	SM14 0-9"																														011
12	" 9-19"		↓	↓	↓					↓	↓										↓	↓	↓	↓	↓	↓	↓	↓	↓		012

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
[redacted]	[redacted]	5/7/13	12:45	Norma C Franklin/Tes	5/7/13	1245				
							NA	N	N	Y

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE: [redacted]

PRINT Name of SAMPLER: Debbie Anderson

SIGNATURE of SAMPLER: [redacted] DATE Signed (MM/DD/YY): 5/7/13

ORIGINAL

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

1527031

Section A Required Client Information:

Company: Tetra Tech
Address: Billings
Email To: Jeffery.rice@tetratech.com
Phone: 406.248.9161 Fax: 9762
Requested Due Date/TAT:

Section B Required Project Information:

Report To: Jeff Rice
Copy To:
Purchase Order No.: 114-551083
Project Name: Riley Pass
Project Number: 114-551083

Section C Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager:
Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER

Site Location STATE:

Section D Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes MATRIX / CODE

Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID		MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	USDA Texture	pH	SC	SAR	Arsenic	Cadmium	Copper	Lead	Zinc	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	SM10	0-9"	SL	G	5/1/13																									013
2	"	9-21"																												014
3	SM19	7-22"																												015
4	SM23	0-8"			5/2/13																									016
5	"	8-20"																												017
6	"	20-28"																												018
7	DA04	9-29			4/30/13																									019
8	DA10	6-20			5/1/13																									020
9	DA12	14-24																												021
10	~~[illegible]~~	0-14																												
11	DA13	9-18																												022
12	"	18-40																												023

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
	[signature]	5/7/13	1245	Norma Chandler/Pace	5/7/13	1245	

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
NA	N	N	Y

ORIGINAL

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Destin Anderson
SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 5/7/13

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 3 of 6

1527032

Section A Required Client Information:

Company:	Tetra tech
Address:	Same As
Email To:	Page 1
Phone:	Fax:
Requested Due Date/TAT:	

Section B Required Project Information:

Report To:	
Copy To:	SEE page 1
Purchase Order No.:	
Project Name:	
Project Number:	

Section C Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	
Pace Profile #:	

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER ______

Site Location STATE: ______

Section D Required Client Information

Matrix Codes MATRIX / CODE: Drinking Water DW, Water WT, Waste Water WW, Product P, Soil/Solid SL, Oil OL, Wipe WP, Air AR, Tissue TS, Other OT

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

Analysis Test: USDA Texture, PH, EC, SAR, Arsenic, Cadmium, Copper, Lead, Zinc

Pace Project No./ Lab I.D.: 10227774

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	COMPOSITE START DATE	TIME	COMPOSITE END/GRAB DATE	TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	DA15 0-9"	SL	G	5/1/13					1	✓									024
2	" 8-14"																		025
3	" 14-44"																		026
4	DA17 8-28"																		027
5	DA25 17-26"																		028
6	" 29-40"																		029
7	JR01 0-8"																		030
8	" 8-16"																		031
9	" 16-24"																		032
10	" 24-40"																		033
11	" 40-60"																		034
12	JR 02 0-9"																		035

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
	[signature]	5/7/13	12:45	Norma C Franklin/Pace	5/7/13	1245	

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dustin Anderson

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 5/7/13

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
NA	N	N	Y

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

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1527033

Section A
Required Client Information:

Company:	
Address:	SEE Page #1
Email To:	
Phone:	Fax:
Requested Due Date/TAT:	

Section B
Required Project Information:

Report To:	
Copy To:	SEE Page #1
Purchase Order No.:	
Project Name:	
Project Number:	

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	
Pace Profile #:	

REGULATORY AGENCY

NPDES / GROUND WATER / DRINKING WATER / UST / RCRA / OTHER

Site Location STATE:

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes MATRIX	CODE
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Requested Analysis Filtered (Y/N)

Pace Project No./ Lab I.D.: 10227774

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	TIME	COMPOSITE END/GRAB DATE	TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test: USDA Texture, pH, ISC, SAR, Arsenic, Cadmium, Copper, Lead, Zinc	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	JR 02 9-20"	SL	G	5/7/13					1	✓										036
2	" " 20-34"																			037
3	JR 03 4-12"																			038
4	~~JR 03~~ 12-20" ~~20-30"~~																			~~039~~ 040
5	" " 30-40"																			041
6	JR 04 14-24"																			042
7	" " 24-40"																			043
8	~~BA-3 0-1'~~			5/7/13																
9	~~" " 1-5'~~																			
10	~~BA-5 0-1'~~																			
11	~~1-6'~~																			
12	~~BA-11 0-1'~~																			

DA Cocked

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	[signature]	5/7/13	12:45	Norma C Trenkel/Pace	5/7/13	1245				
	Norma C Trenkel/Pace	5/7/13	1500	[signature]	5/7/13	3:00				
							NA	N	N	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dustin Anderson

SIGNATURE of SAMPLER: [signature]   DATE Signed (MM/DD/YY): 5/7/13

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 14Nov2012 Page 1 of 1
	Document No.: **F-MT-C-184-rev.02**	Issuing Authority: Pace Montana Quality Office

Sample Condition Upon Receipt

Client Name: T+-BILLINGS **Project #:** WO#: 10227774 (10227774)

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☒ Client ☐ Commercial ☐ Pace ☐ Other: _____

Tracking Number: NONE

Custody Seal on Cooler/Box Present? ☐ Yes ☒ No **Seals Intact?** ☐ Yes ☒ No **Optional:** Proj. Due Date: Proj. Name:

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other: _____ **Temp Blank?** ☐ Yes ☒ No

Thermometer Used: ☐ 1383045 ☐ 135 ☒ NA **Type of Ice:** ☐ Wet ☐ Blue ☒ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read: _____ **Date and Initials of Person Examining Contents:** nc 5/7/13

Cooler Temp Corrected: NA **Biological Tissue Frozen?** ☐ Yes ☐ No

Temp should be above freezing to 6°C

Comments:

Chain of Custody Present?	☒ Yes	☐ No	☐ N/A	1. client dropped off all soils listed on
Chain of Custody Filled Out?	☒ Yes	☐ No	☐ N/A	2. 6 COCs initially, but returned later in
Chain of Custody Relinquished?	☒ Yes	☐ No	☐ N/A	3. day to retrieve some samples & those were
Sampler Name and Signature on COC?	☒ Yes	☐ No	☐ N/A	4. signed back over to client. nc 5/7/13
Samples Arrived within Hold Time?	☒ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☒ Yes	☐ No	☐ N/A	6. pH
Rush Turn Around Time Requested?	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume?	☒ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☐ Yes	☒ No	☐ N/A	bag for -037 received w/ below bag, sample
Containers Intact?	☒ Yes	☐ No	☐ N/A	10. noted & placed into secondary bag.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	11. JR01 40-60 on COC, ID on containers JR01 40-50
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SOIL	☐ Yes	☒ No	☐ N/A	12. Lab received JR03 20-30, but sample not listed on COC, added during log-in nc 5/7/13
All containers needing acid/base preservation have been checked? Noncompliances are noted in 13.	☐ Yes	☐ No	☒ N/A	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH>12)	☐ Yes	☐ No	☒ N/A	Sample #
Exceptions: VOA, Coliform, TOC, Oil and Grease, WI-DRO (water)	☐ Yes	☒ No		Initial when completed: Lot # of added preservative:
Samples checked for dechlorination?	☐ Yes	☐ No	☒ N/A	14.
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	16.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted: _____ Date/Time: _____

Comments/Resolution: _____

Project Manager Review: _____ **Date:** 5-8-13

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

October 15, 2013

Jeffrey Rice
Tetra Tech, Inc.
PO Box 30615
Billings, MT 59107

RE: Project: 551083 Riley Pass
Pace Project No.: 10243013

Dear Jeffrey Rice:
Enclosed are the analytical results for sample(s) received by the laboratory on September 23, 2013. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Samantha Rupe

samantha.rupe@pacelabs.com
Project Manager

Enclosures

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

CERTIFICATIONS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Hawaii Certification #Pace
Idaho Certification #: MN00064
Illinois Certification #: 200011
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nebraska Certification #: Pace
Nevada Certification #: MN_00064
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Utah Certification #: MN00064
Virginia/DCLS Certification #: 002521
Virginia/VELAP Certification #: 460163
Washington Certification #: C754
West Virginia Certification #: 382
Wisconsin Certification #: 999407970

Montana Certification IDs

602 South 25th Street, Billings, MT 59101
EPA Region 8 Certification #: 8TMS-Q
Idaho Certification #: MT00012
Montana Certification #: MT CERT0040
NVLAP Certification #: 101292-0
Minnesota Dept of Health Certification #: 030-999-442
Washington Department of Ecology #: C993

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

SAMPLE SUMMARY

Project: 551083 Riley Pass
Pace Project No.: 10243013

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10243013001	**135 SM3 0-11**	Solid	09/11/13 09:45	09/23/13 15:30
10243013002	**135 SM3 11-20**	Solid	09/11/13 09:45	09/23/13 15:30
10243013003	**135 SM49 0-10**	Solid	09/10/13 12:50	09/23/13 15:30
10243013004	**135 SM49 10-22**	Solid	09/10/13 12:50	09/23/13 15:30
10243013005	**135 SM95 0-8**	Solid	09/12/13 13:15	09/23/13 15:30
10243013006	**135 SM95 8-24**	Solid	09/12/13 13:15	09/23/13 15:30

Pace Analytical Services, Inc.
602 S 25th Street
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(406)254-7226

SAMPLE ANALYTE COUNT

Project: 551083 Riley Pass
Pace Project No.: 10243013

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10243013001	**135 SM3 0-11**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT
10243013002	**135 SM3 11-20**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT
10243013003	**135 SM49 0-10**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT
10243013004	**135 SM49 10-22**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT
10243013005	**135 SM95 0-8**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT
10243013006	**135 SM95 8-24**	EPA 6010	IP	5	PASI-M
		ASTM D2974	GB1	1	PASI-M
		EPA 6010	WT1	4	PASI-MT
		USDA 21A	CS1	1	PASI-MT
		ASA 15-5 mod	WT1	5	PASI-MT
		ASA 10-3.3	WT1	1	PASI-MT

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

PROJECT NARRATIVE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Method: **EPA 6010**
Description: 6010 MET ICP
Client: Tetra Tech, Inc. - MT
Date: October 15, 2013

General Information:
6 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

PROJECT NARRATIVE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Method: **EPA 6010**
Description: Sodium Adsorption Ratio, MT
Client: Tetra Tech, Inc. - MT
Date: October 15, 2013

General Information:
6 samples were analyzed for EPA 6010. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

PROJECT NARRATIVE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Method: **USDA 21A**
Description: USDA 21A pH
Client: Tetra Tech, Inc. - MT
Date: October 15, 2013

General Information:
6 samples were analyzed for USDA 21A. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

PROJECT NARRATIVE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Method: **ASA 15-5 mod**
Description: PSA Percent Sand,Silt,Clay
Client: Tetra Tech, Inc. - MT
Date: October 15, 2013

General Information:
6 samples were analyzed for ASA 15-5 mod. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

PROJECT NARRATIVE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Method: **ASA 10-3.3**
Description: ASA10-3.3 Specific Conductance
Client: Tetra Tech, Inc. - MT
Date: October 15, 2013

General Information:
6 samples were analyzed for ASA 10-3.3. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM3 0-11 **Lab ID: 10243013001** Collected: 09/11/13 09:45 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**15.2**	mg/kg	0.64	0.11	1	09/27/13 06:56	09/30/13 18:09	7440-38-2	
Cadmium	**0.20**	mg/kg	0.096	0.048	1	09/27/13 06:56	09/30/13 18:09	7440-43-9	
Copper	**10.0**	mg/kg	0.32	0.036	1	09/27/13 06:56	09/30/13 18:09	7440-50-8	
Lead	**18.6**	mg/kg	0.64	0.046	1	09/27/13 06:56	09/30/13 18:09	7439-92-1	
Selenium	**<0.16**	mg/kg	0.48	0.16	1	09/27/13 06:56	09/30/13 18:09	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**2.8**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**1.5**	meq/L	0.50	0.25	10	09/30/13 13:05	09/30/13 15:07	7440-70-2	
Magnesium saturated paste	**1.1**	meq/L	0.82	0.41	10	09/30/13 13:05	09/30/13 15:07	7439-95-4	
Sodium Adsorption Ratio	**0.29**		0.10	0.10	10	09/30/13 13:05	09/30/13 15:07		
Sodium saturated paste	**0.33J**	meq/L	0.43	0.22	10	09/30/13 13:05	09/30/13 15:07	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.3**	Std. Units	0.10	0.050	1		09/27/13 11:40		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**27.50**	% (w/w)	0.10		1		09/27/13 15:46		
Percent Sand	**30.00**	% (w/w)	0.10		1		09/27/13 15:46		
Percent Silt	**42.50**	% (w/w)	0.10		1		09/27/13 15:46		
Texture	**clay loam**				1		09/27/13 15:46		
Very Fine Sand	**23.3**	% (w/w)	0.10		1		09/27/13 15:46		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.19**	mmhos/cm	0.010	0.0050	1		10/01/13 15:20		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM3 11-20 **Lab ID: 10243013002** Collected: 09/11/13 09:45 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**19.6**	mg/kg	0.73	0.12	1	09/27/13 06:56	09/30/13 18:15	7440-38-2	
Cadmium	**0.29**	mg/kg	0.11	0.055	1	09/27/13 06:56	09/30/13 18:15	7440-43-9	
Copper	**12.1**	mg/kg	0.36	0.041	1	09/27/13 06:56	09/30/13 18:15	7440-50-8	
Lead	**18.2**	mg/kg	0.73	0.053	1	09/27/13 06:56	09/30/13 18:15	7439-92-1	
Selenium	**<0.18**	mg/kg	0.55	0.18	1	09/27/13 06:56	09/30/13 18:15	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**2.1**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**0.79**	meq/L	0.50	0.25	10	09/30/13 13:05	09/30/13 15:11	7440-70-2	
Magnesium saturated paste	**0.72J**	meq/L	0.82	0.41	10	09/30/13 13:05	09/30/13 15:11	7439-95-4	
Sodium Adsorption Ratio	**0.85**		0.10	0.10	10	09/30/13 13:05	09/30/13 15:11		
Sodium saturated paste	**0.74**	meq/L	0.43	0.22	10	09/30/13 13:05	09/30/13 15:11	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.0**	Std. Units	0.10	0.050	1		09/27/13 11:42		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**26.25**	% (w/w)	0.10		1		09/27/13 15:55		
Percent Sand	**37.50**	% (w/w)	0.10		1		09/27/13 15:55		
Percent Silt	**36.25**	% (w/w)	0.10		1		09/27/13 15:55		
Texture	**loam**				1		09/27/13 15:55		
Very Fine Sand	**32.8**	% (w/w)	0.10		1		09/27/13 15:55		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.25**	mmhos/cm	0.010	0.0050	1		10/02/13 13:13		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM49 0-10 **Lab ID: 10243013003** Collected: 09/10/13 12:50 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**8.2**	mg/kg	0.71	0.12	1	09/27/13 06:56	09/30/13 18:21	7440-38-2	
Cadmium	**0.20**	mg/kg	0.11	0.054	1	09/27/13 06:56	09/30/13 18:21	7440-43-9	
Copper	**6.0**	mg/kg	0.36	0.040	1	09/27/13 06:56	09/30/13 18:21	7440-50-8	
Lead	**11.0**	mg/kg	0.71	0.051	1	09/27/13 06:56	09/30/13 18:21	7439-92-1	
Selenium	**<0.18**	mg/kg	0.54	0.18	1	09/27/13 06:56	09/30/13 18:21	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**4.1**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**0.58**	meq/L	0.50	0.25	10	09/30/13 13:05	09/30/13 15:15	7440-70-2	
Magnesium saturated paste	**0.65J**	meq/L	0.82	0.41	10	09/30/13 13:05	09/30/13 15:15	7439-95-4	
Sodium Adsorption Ratio	**1.9**		0.10	0.10	10	09/30/13 13:05	09/30/13 15:15		
Sodium saturated paste	**1.5**	meq/L	0.43	0.22	10	09/30/13 13:05	09/30/13 15:15	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.6**	Std. Units	0.10	0.050	1		09/27/13 11:44		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**15**	% (w/w)	0.10		1		09/27/13 16:08		
Percent Sand	**43.75**	% (w/w)	0.10		1		09/27/13 16:08		
Percent Silt	**41.25**	% (w/w)	0.10		1		09/27/13 16:08		
Texture	**loam**				1		09/27/13 16:08		
Very Fine Sand	**42.3**	% (w/w)	0.10		1		09/27/13 16:08		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.41**	mmhos/cm	0.010	0.0050	1		10/01/13 15:25		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM49 10-22 **Lab ID: 10243013004** Collected: 09/10/13 12:50 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**12.6**	mg/kg	0.89	0.15	1	09/27/13 06:56	09/30/13 18:27	7440-38-2	
Cadmium	**0.20**	mg/kg	0.13	0.067	1	09/27/13 06:56	09/30/13 18:27	7440-43-9	
Copper	**7.0**	mg/kg	0.45	0.050	1	09/27/13 06:56	09/30/13 18:27	7440-50-8	
Lead	**12.6**	mg/kg	0.89	0.064	1	09/27/13 06:56	09/30/13 18:27	7439-92-1	
Selenium	**0.49J**	mg/kg	0.67	0.22	1	09/27/13 06:56	09/30/13 18:27	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**1.5**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**10.4**	meq/L	5.0	2.5	100	09/30/13 13:05	09/30/13 15:43	7440-70-2	
Magnesium saturated paste	**24.1**	meq/L	8.2	4.1	100	09/30/13 13:05	09/30/13 15:43	7439-95-4	
Sodium Adsorption Ratio	**12.0**		1.0	1.0	100	09/30/13 13:05	09/30/13 15:43		
Sodium saturated paste	**50.0**	meq/L	4.3	2.2	100	09/30/13 13:05	09/30/13 15:43	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.2**	Std. Units	0.10	0.050	1		09/27/13 11:45		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**20**	% (w/w)	0.10		1		09/27/13 16:15		
Percent Sand	**57.5**	% (w/w)	0.10		1		09/27/13 16:15		
Percent Silt	**22.5**	% (w/w)	0.10		1		09/27/13 16:15		
Texture	**sandy clay loam**				1		09/27/13 16:15		
Very Fine Sand	**45.3**	% (w/w)	0.10		1		09/27/13 16:15		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.63**	mmhos/cm	0.010	0.0050	1		10/01/13 15:26		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
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(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM95 0-8 **Lab ID: 10243013005** Collected: 09/12/13 13:15 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**10.4**	mg/kg	0.77	0.13	1	09/27/13 06:56	09/30/13 18:33	7440-38-2	
Cadmium	**0.14**	mg/kg	0.12	0.058	1	09/27/13 06:56	09/30/13 18:33	7440-43-9	
Copper	**4.6**	mg/kg	0.39	0.043	1	09/27/13 06:56	09/30/13 18:33	7440-50-8	
Lead	**10.3**	mg/kg	0.77	0.056	1	09/27/13 06:56	09/30/13 18:33	7439-92-1	
Selenium	**<0.19**	mg/kg	0.58	0.19	1	09/27/13 06:56	09/30/13 18:33	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**2.0**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**0.82**	meq/L	0.50	0.25	10	09/30/13 13:05	09/30/13 15:35	7440-70-2	
Magnesium saturated paste	**0.49J**	meq/L	0.82	0.41	10	09/30/13 13:05	09/30/13 15:35	7439-95-4	
Sodium Adsorption Ratio	**0.34**		0.10	0.10	10	09/30/13 13:05	09/30/13 15:35		
Sodium saturated paste	**0.27J**	meq/L	0.43	0.22	10	09/30/13 13:05	09/30/13 15:35	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**7.3**	Std. Units	0.10	0.050	1		09/27/13 11:47		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**12.5**	% (w/w)	0.10		1		09/27/13 16:13		
Percent Sand	**65**	% (w/w)	0.10		1		09/27/13 16:13		
Percent Silt	**22.5**	% (w/w)	0.10		1		09/27/13 16:13		
Texture	**sandy loam**				1		09/27/13 16:13		
Very Fine Sand	**45.5**	% (w/w)	0.10		1		09/27/13 16:13		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.18**	mmhos/cm	0.010	0.0050	1		10/01/13 15:29		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

ANALYTICAL RESULTS

Project: 551083 Riley Pass
Pace Project No.: 10243013

Sample: 135 SM95 8-24 **Lab ID: 10243013006** Collected: 09/12/13 13:15 Received: 09/23/13 15:30 Matrix: Solid

Results reported on a "dry-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010 Preparation Method: EPA 3050								
Arsenic	**11.2**	mg/kg	0.73	0.12	1	09/27/13 06:56	09/30/13 18:39	7440-38-2	
Cadmium	**0.13**	mg/kg	0.11	0.055	1	09/27/13 06:56	09/30/13 18:39	7440-43-9	
Copper	**4.6**	mg/kg	0.37	0.041	1	09/27/13 06:56	09/30/13 18:39	7440-50-8	
Lead	**10.7**	mg/kg	0.73	0.053	1	09/27/13 06:56	09/30/13 18:39	7439-92-1	
Selenium	**<0.18**	mg/kg	0.55	0.18	1	09/27/13 06:56	09/30/13 18:39	7782-49-2	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**1.2**	%	0.10	0.10	1		09/27/13 10:01		
Sodium Adsorption Ratio, MT	Analytical Method: EPA 6010								
Calcium saturated paste	**1.0**	meq/L	0.50	0.25	10	09/30/13 13:05	09/30/13 15:39	7440-70-2	
Magnesium saturated paste	**0.67J**	meq/L	0.82	0.41	10	09/30/13 13:05	09/30/13 15:39	7439-95-4	
Sodium Adsorption Ratio	**0.68**		0.10	0.10	10	09/30/13 13:05	09/30/13 15:39		
Sodium saturated paste	**0.63**	meq/L	0.43	0.22	10	09/30/13 13:05	09/30/13 15:39	7440-23-5	
USDA 21A pH	Analytical Method: USDA 21A								
pH, Saturated Paste	**8.1**	Std. Units	0.10	0.050	1		09/27/13 11:49		
PSA Percent Sand,Silt,Clay	Analytical Method: ASA 15-5 mod								
Percent Clay	**12.5**	% (w/w)	0.10		1		09/27/13 16:19		
Percent Sand	**70**	% (w/w)	0.10		1		09/27/13 16:19		
Percent Silt	**17.5**	% (w/w)	0.10		1		09/27/13 16:19		
Texture	**sandy loam**				1		09/27/13 16:19		
Very Fine Sand	**45.8**	% (w/w)	0.10		1		09/27/13 16:19		
ASA10-3.3 Specific Conductance	Analytical Method: ASA 10-3.3								
Sp.Conductance Saturated Paste	**0.27**	mmhos/cm	0.010	0.0050	1		10/02/13 13:16		

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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(406)254-7226

QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MPRP/42105 Analysis Method: EPA 6010
QC Batch Method: EPA 3050 Analysis Description: 6010 MET
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

METHOD BLANK: 1533759 Matrix: Solid
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	<0.13	0.81	09/30/13 15:40	
Cadmium	mg/kg	<0.060	0.12	09/30/13 15:40	
Copper	mg/kg	<0.045	0.40	09/30/13 15:40	
Lead	mg/kg	<0.058	0.81	09/30/13 15:40	
Selenium	mg/kg	<0.20	0.60	09/30/13 18:00	

LABORATORY CONTROL SAMPLE: 1533760

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	41.3	33.8	82	80-120	
Cadmium	mg/kg	41.3	36.1	87	80-120	
Copper	mg/kg	41.3	39.2	95	80-120	
Lead	mg/kg	41.3	35.6	86	80-120	
Selenium	mg/kg	41.3	38.0	92	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1533761 1533762

Parameter	Units	10242979004 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	3.5	46.7	53.1	50.2	56.0	100	99	75-125	11	30	
Cadmium	mg/kg	ND	46.7	53.1	46.0	52.9	99	100	75-125	14	30	
Copper	mg/kg	5.3	46.7	53.1	54.7	61.2	106	105	75-125	11	30	
Lead	mg/kg	5.4	46.7	53.1	50.8	57.0	97	97	75-125	11	30	
Selenium	mg/kg	ND	46.7	53.1	44.6	48.9	96	92	75-125	9	30	

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QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MPRP/42121 Analysis Method: ASTM D2974
QC Batch Method: ASTM D2974 Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

SAMPLE DUPLICATE: 1534412

Parameter	Units	10243013001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	2.8	2.8	.3	30	

SAMPLE DUPLICATE: 1534413

Parameter	Units	10243063001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	2.2	2.2	.5	30	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MT/13811 Analysis Method: USDA 21A
QC Batch Method: USDA 21A Analysis Description: USDA 21A pH saturated paste
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

LABORATORY CONTROL SAMPLE & LCSD: 1536824 1536825

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
pH, Saturated Paste	Std. Units	7.7	8.0	8.0	105	105	95-105	.2	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MT/13794 Analysis Method: ASA 15-5 mod
QC Batch Method: ASA 15-5 mod Analysis Description: PSA Percent Soil,Silt,Clay
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

SAMPLE DUPLICATE: 1535984

Parameter	Units	10243013002 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Clay	% (w/w)	26.25	26.25		20	
Percent Sand	% (w/w)	37.50	37.5		20	
Percent Silt	% (w/w)	36.25	36.25		20	
Texture		loam	loam			
Very Fine Sand	% (w/w)	32.8	28.5			

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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(406)254-7226

QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MT/13788 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10243013001, 10243013003, 10243013004, 10243013005

METHOD BLANK: 1535604 Matrix: Water
Associated Lab Samples: 10243013001, 10243013003, 10243013004, 10243013005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	10/01/13 15:17	

LABORATORY CONTROL SAMPLE & LCSD: 1535605 1535606

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	1.4	1.6	1.6	114	114	68-132	.2	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
602 S 25th Street
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(406)254-7226

QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MT/13902 Analysis Method: ASA 10-3.3
QC Batch Method: ASA 10-3.3 Analysis Description: ASA 10-3.3 Specific Conductance
Associated Lab Samples: 10243013002, 10243013006

METHOD BLANK: 1541786 Matrix: Water
Associated Lab Samples: 10243013002, 10243013006

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	<0.0050	0.010	10/02/13 13:07	

LABORATORY CONTROL SAMPLE & LCSD: 1541787 1541798

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Sp.Conductance Saturated Paste	mmhos/cm	1.4	1.5	1.6	110	116	68-132	5	20	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: 551083 Riley Pass
Pace Project No.: 10243013

QC Batch: MTPR/2749 Analysis Method: EPA 6010
QC Batch Method: EPA 6010 Analysis Description: Sodium Adsorption Ratio, SAR
Associated Lab Samples: 10243013001, 10243013002, 10243013003, 10243013004, 10243013005, 10243013006

LABORATORY CONTROL SAMPLE: 1539145

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Calcium saturated paste	meq/L	8.3	6.8	82	64-136	
Magnesium saturated paste	meq/L	1.9	1.6	88	57-143	
Sodium Adsorption Ratio		1.6	1.3	79	75-125	
Sodium saturated paste	meq/L	3.8	2.6	68	61-139	

SAMPLE DUPLICATE: 1539153

Parameter	Units	10243013004 Result	Dup Result	RPD	Max RPD	Qualifiers
Calcium saturated paste	meq/L	10.4	10.5	.7	30	
Magnesium saturated paste	meq/L	24.1	24.2	.1	30	
Sodium Adsorption Ratio		12.0	12.0	.1	30	
Sodium saturated paste	meq/L	50.0	50.0	0	30	

Pace Analytical Services, Inc.
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QUALIFIERS

Project: 551083 Riley Pass
Pace Project No.: 10243013

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-MT	Pace Analytical Services - Montana

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 551083 Riley Pass
Pace Project No.: 10243013

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10243013001	**135 SM3 0-11**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013002	**135 SM3 11-20**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013003	**135 SM49 0-10**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013004	**135 SM49 10-22**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013005	**135 SM95 0-8**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013006	**135 SM95 8-24**	EPA 3050	MPRP/42105	EPA 6010	ICP/17683
10243013001	**135 SM3 0-11**	ASTM D2974	MPRP/42121		
10243013002	**135 SM3 11-20**	ASTM D2974	MPRP/42121		
10243013003	**135 SM49 0-10**	ASTM D2974	MPRP/42121		
10243013004	**135 SM49 10-22**	ASTM D2974	MPRP/42121		
10243013005	**135 SM95 0-8**	ASTM D2974	MPRP/42121		
10243013006	**135 SM95 8-24**	ASTM D2974	MPRP/42121		
10243013001	**135 SM3 0-11**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013002	**135 SM3 11-20**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013003	**135 SM49 0-10**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013004	**135 SM49 10-22**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013005	**135 SM95 0-8**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013006	**135 SM95 8-24**	EPA 6010	MTPR/2749	EPA 6010	MT/13848
10243013001	**135 SM3 0-11**	USDA 21A	MT/13811		
10243013002	**135 SM3 11-20**	USDA 21A	MT/13811		
10243013003	**135 SM49 0-10**	USDA 21A	MT/13811		
10243013004	**135 SM49 10-22**	USDA 21A	MT/13811		
10243013005	**135 SM95 0-8**	USDA 21A	MT/13811		
10243013006	**135 SM95 8-24**	USDA 21A	MT/13811		
10243013001	**135 SM3 0-11**	ASA 15-5 mod	MT/13794		
10243013002	**135 SM3 11-20**	ASA 15-5 mod	MT/13794		
10243013003	**135 SM49 0-10**	ASA 15-5 mod	MT/13794		
10243013004	**135 SM49 10-22**	ASA 15-5 mod	MT/13794		
10243013005	**135 SM95 0-8**	ASA 15-5 mod	MT/13794		
10243013006	**135 SM95 8-24**	ASA 15-5 mod	MT/13794		
10243013001	**135 SM3 0-11**	ASA 10-3.3	MT/13788		
10243013002	**135 SM3 11-20**	ASA 10-3.3	MT/13902		
10243013003	**135 SM49 0-10**	ASA 10-3.3	MT/13788		
10243013004	**135 SM49 10-22**	ASA 10-3.3	MT/13788		
10243013005	**135 SM95 0-8**	ASA 10-3.3	MT/13788		
10243013006	**135 SM95 8-24**	ASA 10-3.3	MT/13902		

REPORT OF LABORATORY ANALYSIS

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

1628850

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: Tetra Tech	Report To: Jeff Rice	Attention: Jeff Rice
Address: Billings, MT	Copy To: Dustin Anderson	Company Name: Tetra Tech
Email To: Jeff.Rice@tetratech.com	Purchase Order No.: 114-551083	Address:
Phone: 248-9161 Fax:	Project Name: Riley Pass	Pace Quote Reference:
Requested Due Date/TAT:	Project Number: 551083	Pace Project Manager:
		Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: SD

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Matrix Codes — MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	pH	EC	SAR	Arsenic	Cadmium	Lead	Copper	USDA Texture	% fine Sand/Silt/Clay	% fine Sand	Selenium	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	1355M3 0-11	SL	G			9/11/13	0945		1	X									✓	✓	✓	✓	✓	✓	✓				001
2	1355M3 11-20					9/11/13	0945																						002
3	135 SM49 0-10					9/10/13	1250																						003
4	135 SM49 10-22					9/10/13	1250																						004
5	135 SM95 0-8					9/12/13	1315																						005
6	135 SM95 8-24	↓	↓			9/12/13	1315		✓	✓									✓	✓	✓	✓	✓	✓	✓	✓			006
7																													
8																													
9																													
10																													
11																													
12																													

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
Please include very fine Sand percent in the USDA texture analysis		9/23/13	1530	VMT-Pace	9/23/13	1530	23.9	N	N	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dustin Anderson

SIGNATURE of SAMPLER: _____ DATE Signed (MM/DD/YY): 9/23/13

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

ORIGINAL

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Pace Analytical	Document Name: Sample Condition Upon Receipt Form	Document Revised: 14Nov2012 Page 1 of 1
	Document No.: F-MT-C-184-rev.02	Issuing Authority: Pace Montana Quality Office

Sample Condition Upon Receipt

Client Name: PetraTech

Project #: WO# : 10243013

10243013

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☒ Client ☐ Commercial ☐ Pace ☐ Other:

Tracking Number: N/A

Custody Seal on Cooler/Box Present? ☐ Yes ☒ No **Seals Intact?** ☐ Yes ☒ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other: **Temp Blank?** ☐ Yes ☒ No

Thermometer Used: ☒ 1383045 ☐ 135 ☐ NA **Type of Ice:** ☐ Wet ☐ Blue ☒ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read: 23.4

Cooler Temp Corrected: 23.4

Temp should be above freezing to 6°C

Date and Initials of Person Examining Contents: [initials]

Biological Tissue Frozen? ☐ Yes ☒ No

	Yes	No	N/A	Comments:
Chain of Custody Present?	☒	☐	☐	1.
Chain of Custody Filled Out?	☒	☐	☐	2.
Chain of Custody Relinquished?	☒	☐	☐	3.
Sampler Name and Signature on COC?	☒	☐	☐	4.
Samples Arrived within Hold Time?	☒	☐	☐	5.
Short Hold Time Analysis (<72 hr)?	☐	☒	☐	6.
Rush Turn Around Time Requested?	☐	☒	☐	7.
Sufficient Volume?	☒	☐	☐	8.
Correct Containers Used?	☒	☐	☐	9.
-Pace Containers Used?	☐	☒	☐	
Containers Intact?	☒	☐	☐	10.
Filtered Volume Received for Dissolved Tests?	☐	☐	☒	11.
Sample Labels Match COC?	☒	☐	☐	12.
-Includes Date/Time/ID/Analysis Matrix: Soil				
All containers needing acid/base preservation have been checked? Noncompliances are noted in 13.	☐	☐	☒	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH>12)	☐	☐	☒	Sample #
Exceptions: VOA, Coliform, TOC, Oil and Grease, WI-DRO (water)	☐	☒		Initial when completed: ____ Lot # of added preservative: ____
Samples checked for dechlorination?	☐	☐	☒	14.
Headspace in VOA Vials (>6mm)?	☐	☐	☒	15.
Trip Blank Present?	☐	☐	☒	16.
Trip Blank Custody Seals Present?	☐	☐	☒	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution: Please include very fine sand precent in the USDA texture Analysis.

Project Manager Review: [signature] **Date:** 9-24-13

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical	Document Name: MN Sample Transfer Form Document Number: F-MT-C-179-rev.04	Revised Date: 19Apr2013 Page: 1 of 1 Issuing Authority: Pace Minnesota Quality Office

Shipping (circle):	UPS (Fed Ex)
Tracking #:	5695 6557 5920
Client:	Tetra Tech
Due Date:	30-Sep-2013
Pace WO:	10243013
Project Manager:	Samantha Rupe

MT to MN Sample Transfer Condition Upon Receipt Form

ANALYSIS REQUESTED

Method Number & Description	Container Type	# of Bottles	Number of Samples	Preservative Yes or No	Verify Arrival Date & Initials
Tests					
6010 metals	PB	6	6	No	JH 9/25/13

REPORTING REQUIREMENTS/ADDITIONAL COMMENTS

MINNESOTA SAMPLE RECEIPT INFORMATION

IR Gun (circle): 80512447, (88A9121675047) 72337080 Correction Factor: -0.2 Sample Matrix: SL

Cooler Temp Read (°C): 0.6	Cooler Temp Corrected (°C): 0.4	Filtred volume rec'd for dissolved tests:	Yes __ No __ NA ✓
Arrived on Ice:	Yes ✓ No __	Samples pH have been checked:	Yes __ No __ NA ✓
Custody Seal Present:	Yes ✓ No __	Trip Blank Present:	Yes __ No __ NA ✓
Short Hold Time Requested < 72 Hours:	Yes __ No ✓	Trip Blank Custody Seals Present:	Yes __ No __ NA ✓
Rush TAT Requested:	Yes ✓ No __	Pace Trip Blank Lot #:	
Sufficient Sample Volume:	Yes ✓ No __	Sample Composites Required:	Yes __ No __ NA ✓
Samples Arrived within Hold Time:	Yes ✓ No __	Report Samples:	Wet Wt. __ Dry Wt. __
Containers Intact:	Yes ✓ No __	Reporting Units:	

CUSTODY TRANSFER

Relinquished by/Affiliation	Date	Time	Accepted By Affiliation	Date	Time
Sherri Cline	9-24-13	15:30	JH/Pace	9/25/13	9:20

CLIENT NOTIFICATION/RESOLUTION

Person Contacted: ______________________ Date: ______________

Comments/Resolution: ______________________

Project Manager Review: [signature] Date: 9-25-13