Section 2.05.4(2)(d)

Topsoil Handling, Stockpiling and Redistribution

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Topsoil Handling, Stockpiling and Redistribution

1.0 Introduction

All topsoil salvage information is located in Section 2.04.9 Soils Resource Information. The topsoil handling and stockpiling requirements of Rule 2.05.3(5) are addressed in this Section 2.05.4(2)(d). All topsoil replacement information is also in this Section. In 2008, this Section was modified under TR-57 to account for handling of prime farmland soils.

Western Fuels-Colorado's New Horizon 1 & 2 Mine is the former Peabody Coal Company's Nucla and Nucla East Mine which operated under the same permit. Peabody (New Horizon 1 & 2) and Intermountain Resource Inventories Inc. performed detailed soils and overburden studies at the New Horizon 1 & 2 mine areas (formerly called the Nucla and Nucla East mine areas respectively). The soils inventory of the permit area is included in Section 2.04.9 - Soils Resources.

This section outlines WFC's plan for removal, storage and redistribution of topsoil, subsoils and other material, to meet the requirement of Section 4.06. The plan addresses those reclamation activities that are conducted during and immediately after backfilling and grading (Section 2.05.4(2)(c)), but prior to revegetation (Section 2.05.4(2)(e)). The objectives of the plan are to reconstruct plant growth and aquifer mediums that are capable of supporting the postmining land uses. The plan presents an account of the plant growth material and aquifer medium requirements based upon current and projected disturbance acreage and plant growth material and aquifer medium availability based on topsoil depth mapping and overburden assessments. The plan also describes the procedural aspects of removal, storage, redistribution, and testing of topsoil materials.

2.0 New Horizon 2 Overburden and Interburden Characteristics

Overburden and interburden characteristics for New Horizon 2 are presented in Section 2.04.6, Geology Description. Overburden and interburden suitability and lithologic units for the New Horizon #2 Mine described in Section 2.04.6 are very similar to the shallow overburden units at the New Horizon #1 Mine area. The only significant difference between mine areas is the mean thickness of Unit 1 (Bench 1) which averages 5 feet at New Horizon #1 Mine compared to about 55 feet within the New Horizon #2 permit area. Approximately 83 percent of the overburden and interburden material at New Horizon 2, consisting predominantly of Units 1(Bench 1) and 3, is classified as suitable for root growth and aquifer medium material (Section 2.04.6). Unsuitable material was identified in the lower overburden and interburden (Units 2 and 4) within the proposed disturbance area (Peabody, Appendix 6-5).

3.0 Acid and Toxic-Forming Materials at New Horizon 2 Mine

Acid and toxic-forming materials were identified within the New Horizon 2 study area; however, only the acid-forming material occurs within the projected mining disturbance area (Peabody Appendix 6-5 and Map 2.04.6-1, Geologic Cross Section and Sample Locations for New Horizon 2 Study Area). Therefore, some ameliorating activity such as mixing, normal burial, or special handling will be required to replace a suitable four-foot root growth medium and to prevent leachates and runoff from entering the ground water system or discharging into the surface water system. No roads will be surfaced with the acid-forming material. Mitigation of all unsuitable zones within the underburden material (five percent of all unsuitable zones which were identified) will be by avoidance, i.e., these zones will not be disturbed by mining activities. Certain areas of overburden and interburden will also be avoided due to the projected disturbance area boundary described within this application (Map 2.05.3-1, Current Mine Plan - New Horizon 2) or excessive Dakota coal seam depths. These additional avoided areas comprise about 60 to 65 percent of all unsuitable zones which were identified.

Complete mixing of the thicker, calcareous overburden Unit 1 or Bench 1 (30.5 feet) and interburden Unit 3 (6.7 feet) with the thinner, acidic overburden/interburden Units 2 (4.5 feet) and 4 (2.9 feet) would produce a suitable alkaline spoil (see Section 2.04.6, Table 2.04.6-10). Partial mixing of alkaline and acidic materials is anticipated during cast blasting, dozer pushing, and shovel/truck handling due to the thinness of Units 2 and 4 and the stratification of alkaline and acidic strata. Normal overburden/interburden handling operations may also effectively bury the acid-forming strata.

Typical overburden/interburden handling operations are described in Section 2.05.3, Operation Plan and Section 2.05.4(2)(c), Backfilling and Grading.

Once topsoil is removed, soft upper overburden (Bench 1 or Unit 1 material) is normally removed by the truck-shovel fleet and taken to the back of the previous pit for backfilling using the same temporary road around the end of the pit. A significant amount of this Bench 1 material is normally placed immediately below the Lift A Topsoil, Lift B Topsoil or Mixed topsoil in all areas. The amount varies per area, however, the total amount of combined topsoil and Bench 1 Subsoil Substitute will be approximate 4 feet thick, except in the WFC property on the west side of the permit, as described earlier, which will be at least 3.5 feet thick. The Bench 1 material thickness does decrease going westward and WFC will attempt to utilize all the suitable Bench 1 to get the required thicknesses specified above.

Lower overburden (Bench 2) is usually cast blasted, dozed and loaded/hauled with shovel/trucks and placed in the previous mined out pit for backfilling purposes. As the overburden trucks dump off the backfill spoil dump, large dozer(s) will final grade the truck dump area into the final pre topsoiled contours.

The regraded spoil will be mechanically loosened and mixed by ripping, chiseling, or approved alternate forms of scarification. The major advantages of scarification are related to the physical properties of the spoil. The topsoil and spoil are scarified to decrease compaction, increase aeration and water movement, and increase plant rooting depths. Increased water movement may, to some degree, allow more downward leaching of carbonates. Therefore, although the greatest benefits of scarifying are related to the physical soil properties (density, porosity), a lesser geochemical benefit (increased rate of carbonate leaching due to increased water movement) may result.

4.0 Regraded Spoil Monitoring Program

In order to provide a feedback system to check the reliability of the overburden sampling and analysis program, a regraded spoil sampling program will be initiated. The upper four feet of regraded spoil will be sampled prior to topsoil replacement with a hydraulic soil sampler, a bucket auger, or other suitable equipment to ensure that a suitable root growth medium was provided. Two representative samples, each representing a two-foot depth increment, will be collected on a 1 hole per 5 acre grid. See Tables 2.05.4(2)(d)-1A and 1B.

The vertical sampling increments were 0.0 to 2.0 feet and 2.0 to 4.0 feet. Personnel will inspect the surface spoil between grid points. If a significant change in spoil characteristics is observed between grid points, additional sample sites will be located. Regraded spoil will also be visually inspected for compaction, possible root growth problems, and the potential for slippage at the topsoil/spoil interface. The lateral and vertical sampling intensities are closely evaluated once sufficient samples is collected to determine the degree of sample variability. This sampling program will ensure that the top four feet of regarded spoil is non-toxic and chemically/physically suitable to enhance plant growth.

Originally, the regraded spoil samples were analyzed for the following parameters to determine spoil suitability: pH, acid base potential, boron, particle size (texture), saturation percent, EC, and SAR. The parameter list is based upon the baseline information acquired during the pre-mine overburden sampling program (Section 2.04.6). As part of the spoil monitoring program, regraded spoil is analyzed for a list of parameters for suitability. One item in this list is boron. It is believed that Peabody included this parameter in the test list for spoil as a precautionary item since they used a dragline to move overburden at that time and they had no ability to segregate the Bench 1 material and place it below the topsoil zones. A study of all the past years analyses has shown that the Bench 1 material has always tested below 5 ppm, which is the normal threshold limit for boron in the subsoil. Nevertheless, it will continue to be studied in the spoil testing program.

However, based on the results of the extensive overburden suitable sampling program stated above, both the soil sample locations and analytical parameters changed in July of 1999. The sample grid is now oriented north-south and east-west to better reflect the current mining pattern, the sample grid is 600 feet by 600 feet, which is the same as 1 hole per 5 acres, and the soil samples are analyzed for boron, pH and EC. Table 2.05.4(2)(d)-1A and or B shows the Soil and Spoil Suitability Criteria for the reclaimed areas. These Tables were modified for PR 06 in 2010.

Table 2.05.4(2)(d)-1A Spoil and Soil Suitability Criteria (Morgan Prime Farmland) (Revised with NRCS and DRMS 2010)

Parameter	Unit	Threshold Levels			
		Lift A Topsoil and Mixed Topsoil	Lift B Topsoil	Bench 1 Surface Spoil	
				East Area* Subsoil Substitute	Remaining Area α
pH	standard units	<6.1, >8.4	<6.1, >8.4	<6.1, >8.4	<6.1, >8.4
Electrical Conductivity (EC)	mmho/cm	4 at any location	6 at any location or an average <5	6 at any location or an average <5	8 at any location
Saturation Percentage	%	<25, >80	<25, >80	<25, >80	
Sodium Adsorption Ratio (SAR)	Ratio	>4	>4	>4	
Exchangeable Sodium (ESP)	%	>15	N/A	N/A	
Calcium Carbonate	%	>15	>40	>40	
USDA Soil Texture (based on particle size analysis) Θ	All Except	S, LS, SC, SlC, C	S, LS, SC, SlC, C	S, LS, SC, SlC, C	
Boron	ppm	not tested		5	5
Rock Fragments	%	>15 and >10 for 3"+ Diameter	>35 in one location and >25 average	>35 in one location and >25 average	
Sample Grid		1 per 2.5 acres	1 per 2.5 acres	1 per 2.5 acres	1 per 5 acres
Sample Thickness		Total lift thickness; max 2-ft increment per sample	Total lift thickness; max 2-ft increment per sample	2-3 foot thickness; 1 sample increment	2, 2-ft increments

*"East Area" refers to those areas where Lift A Topsoil or Mixed Topsoil is placed directly on the Bench 1 surface spoil (no Lift B Topsoil Topsoil is present)

α "Remaining Area" refers to those areas where both Lift B Topsoil and Lift A Topsoil or Mixed Topsoil are replaced over Bench 1 "Spoil"

Θ USDA Soil Textures - unsuitable textures area: S-sand, LS-loamy sand, SC-Sandy clay: SlC-Silty clay, C-Clay

Table 2.05.4(2)(d)-1B Spoil and Soil Suitability Criteria (Other Areas) (Revised with NRCS and DRMS 2010)

Parameter	Unit	Benson-west, Lloyd, and WFC (Non-Prime)		WFC Prime Farmland		
		Mixed Topsoil	Surface Spoil	Mixed Topsoil (Upper 2 feet)	Mixed Topsoil (Below 2 feet)	Surface Spoil
pH	standard units	<6.1, >8.4	<6.1, >8.4	<6.1, >8.4	<6.1, >8.4	<6.1, >8.4
Electrical Conductivity (EC)	mmho/cm	6 at any location or 5.0 average/landowner	8	4 at any location	6 at any location or 5.0 average/landowner	8
Saturation Percentage	%	<25, >80		<25, >80	<25, >80	
Sodium Adsorption Ratio (SAR)	Ratio	>4		>4	>4	
Exchangeable Sodium (ESP)	%	N/A		>15	N/A	
Calcium Carbonate	%	N/A		>15	>40	
USDA Soil Texture (based on particle size analysis) Θ	All Except	S, LS, SC, SlC, C		S, LS, SC, SlC, C	S, LS, SC, SlC, C	
Boron	ppm		5			5
Rock Fragments	%	>35 in one location and >25 avg. for any one landowner	>35 in one location	>15 and >10 for 3"+Diam.	>35 in one location and >25 average per landowner	
Sample Grid		1 per 2.5 acres	1 per 5 acres	1 per 2.5 acres	1 per 2.5 acres	1 per 5 acres
Sample Thickness		Total lift thickness; max 2-ft increment per sample	2, 2-ft increments	Top 2 feet	Total lift thickness; max 2-ft increment per sample	2, 2-ft increments

The actual maximum acceptable salt level, measured by Electrical Conductivity, will depend on the plant species proposed in the revegetation plan and the potential for upward salt movement. As pointed out in the report in Attachment 2.05.4(2)(d)-1, Dave Dearstyne of the NRCS said that a level of 6.0 in the subsoil would **not** be detrimental to grasses or alfalfa. A study done by Curtis Swift, PhD, of Colorado State University (Attachment 2.05.4(2)(d)-2), titled **Salt Tolerance of Various Temperate Zone Ornamental Plants**, shows that alfalfa handles a soil conductivity of 4-8 mmhos/cm. The specific species cited is Medicago Sativa, which is exactly the same as that prescribed in the revegetation plan for irrigated cropland. Also, this reference does not differentiate between topsoil and subsoil. Based on this data, and NRCS recommendations, the limits for Electrical Conductivity are shown in Table 2.05.4(2)(d)-1 and 2, for the various topsoil and subsoil types. The averages will be reported for each landowner in the Soil Sampling Report.

Specific level depends upon clay mineralogy, soil texture, and saturation percentage according to Dollhopf et al., 1983.

The specific percentage of clay or sand allowed will depend upon clay mineralogy, organic matter content, consistence, soil lift, spoil characteristics, and size of sand fraction.

These values may vary depending upon the plant species proposed for revegetation in specific locations (e.g., a soil with a high coarse fragment content throughout its profile may be completely salvaged if used for rangeland versus cropland postmine land use). Prime farmland Lift A Topsoil will not have >10% cobbles and boulders (3 inches mean diameter and greater) and 15% coarse fraction (caught in a 2 millimeter sieve) by volume. The cobbles and boulders % is estimated visually (by volume) using standard charts while looking at the replaced soil profile or a sample of the material in the profile

The prime farmland Lift B Topsoil criteria and single lift criteria were developed in conjunction with Dave Dearstyne of the NRCS.

5.0 Unsuitable Spoil Mitigation Plan

In the event that any one spoil sample result exceeds the limits, WFC will implement the Unsuitable Spoil Mitigation Plan listed below.

If one or more parameters fall within the unsuitable range at a given grid point, a three-part mitigation plan will be implemented.

1. The area around a suspect hole will be sampled on a closer spacing interval in order to better define the lateral extent and variability of the unsuitable material. This sampling will be called the 2nd Phase sampling and the interval is one hole per 50 feet distance around the bad point in all directions for prime farmland, and one hole per 100 feet distance around the bad point in all directions for reclaimed irrigated pastureland and dryland pasture.

2. In those areas where exceedences are encountered, any followup sampling that results in an area of exceedence larger than 0.1 acres for prime farmland, 0.25 acres for reclaimed irrigated pastureland or 0.50 acres for dryland pasture, will be remediated.

3. For remediation, any area identified above which excceds the acreages stipulated above for unsuitable surface spoil material will be placed at least eight feet below the final soil surface. New soil material will be used in its place. This material will be tested according to the original grid (1 hole per 5 acres) to confirm its suitability.

4. If none of the above procedures satisfactorily mitigate a certain problem, the Division will be notified and recommended actions will then be implemented.

WFC will maintain and periodically review the existing quality control program used to evaluate overburden, interburden, and spoil handling activities at New Horizon Mine. WFC will maintain records of the sampling results for each logical reclamation unit. These records will be kept on file at the mine site and will be reported within the topsoil balance/spoil quality report to be submitted annually on April 15th of each year.

6.0 New Horizon #2 Mine Spoil Compatibility and Erodibility

Determining the compaction potential of disturbed overburden is important to assess postmine spoil conditions including: hydraulic conductivity, revegetation success, landscape stability, and equipment traffic. Generally, stability and/or compaction problems are related to soils high in shrink/swell clays, soils with large proportions of sand and clay (sandy clay texture), and soils with approximately equal proportions of the sand, silt, and clay-size particle fractions. These three conditions are not highly desirable since a high shrink/swell clay content in postmine landscapes causes poor stability and low permeability conditions, a sandy clay textured soil develops surface crusting problems, and an equal particle-size distribution causes excessive compaction which results in restricted water movement and root growth.

The first two considerations listed above were among those used for establishing the grading system for texture. Unsuitable clay textures were identified within two thin lenses of the upper overburden in the western half of the study area (Section 2.04.6). These clay lenses occur only near overburden Drill Site 870E (see Map 2.04.6-1, Geologic Cross Section and Sample Locations for New Horizon 2 Study Area). These clay lenses are in the projected mining disturbance area and when they are being excavated, they will be thoroughly mixed with non clay type overburden. The mixing and dilution process will be accomplished by: 1) blasting, which will start the mixing of clay lenses with non clay formations above and below the clay seam 2) the overburden shovel will be digging a full face through the clay lense from top to bottom to load each truck for transportation to the backfill, 3) and finally, the trucks with the diluted clay lenses on board will dump their load along a several hundred foot dump face. After this process, the concentration in any one spot of clay like material will be minimal and compatibility of the backfill will be negligible.

The New Horizon 2 postmine spoil textures will typically be loamy with an approximate particle size distribution of 65 percent sand, 25 percent silt, and 10 percent clay (Section 2.04.6, Geology Description). Surface crusting, which is critical to seedling emergence, is discussed in the Soil Survey (Section 2.04.9), Revegetation Plan (Section 2.05.4(2)(e)), and Topsoil Management of this Section. Since clay percentages and shrink-swell potentials are low, stability and trafficability problems are not anticipated.

The resultant loamy textured spoil will possess suitable physical qualities which are conducive to plant growth. The available water holding capacity will likely be moderately low to moderate (approximately 0.07 to 0.11 inches of water per inch of soil), permeability moderate to moderately rapid (about 1.0 to 6.0 inches per hour), and cation exchange capacity low to moderately low (5 to 10 milli-equivalents per 100 grams). Since the overburden contains a mixture of soft, slightly hard, hard, and extremely hard rock fragments, the spoil will generally possess acceptable root growth and water holding characteristics.

The chemical properties of the overburden/interburden are also quite favorable. Sodicity and salinity levels are low to moderate in the New Horizon 2 permit area and should pose no severe problem to successful reclamation. Salinity levels in the upper four feet of regraded spoil will likely be comparable to premining values.

The uppermost overburden transitions into the subsoil gradually on the majority of the permit area. Much of this upper overburden (also called Bench 1 material) is suitable subsoil. For the area west of 2700 Road, it is standard practice that suitable Bench 1 substitute subsoil material will be used to supplement the subsoil to provide the best chance for reclamation success. The topsoil replacement calculations discussed later in this Section accounts for the use of some of this suitable material.

7.0 New Horizon 2 Mine Topsoil Management Plan General Considerations

The following subsections have been revised for TR-57 in 2008 and PR-06 in 2010, which addresses the topsoil replacement for the whole permit area, including the change in handling procedures due to the determination of prime farmland soils in the western portion of the permit in February 2008.

The New Horizon 2 Mine topsoil handling procedures, based upon the detailed soil survey information contained in Section 2.04.9, were developed to insure that the topsoil resources within the disturbance area are salvaged and replaced. The plan outlined in the following subsections focuses on the topsoil replacement that has already occured (as of June 2010) and describes salvage depths and techniques, storage, redistribution, and maintenance or testing procedures necessary to restore the disturbed areas to the desired postmine land use.

Topsoil handling will be minimized to the extent possible, utilizing direct lay down as much as possible. All of the soils on the Morgan property, which are designated as prime farmalnd, will be stripped in 2 lifts and will meet prime farmland specifications. A minimum of 3.0 feet of suitable subsoil (Bench 1 subsoil substitute material) will provide an additional subsoil base over the prime farmland soil area on the Morgan property. The prime farmland on the Morgan property will receive the same topsoil that was present on the property prior to mining. All Bench 1 material stripped after June 2010 on the Morgan property will be salvaged and restored to the Morgan property.

Map 2.05.4-4 shows the required reclamation thicknesses for all subsoil, topsoil and mixed lift soils over the entire permit area.

8.0 Topsoil Storage

All efforts will be made to direct haul and place all topsoil excavated. When the direct haul of topsoil is not feasible, the topsoil will be stored in stockpiles.

Stockpiling of topsoil will be required for topsoil removal in the initial box cut, haul road, spoil stockpile areas, sediment pond, shop area, and final pit/highwall reduction areas. Topsoil stockpiles will either be located in areas that will not be disturbed by the ongoing mining operation or in freshly backfilled areas prior to topsoiling. This will be necessary especially at the end of mine life and on Morgan property prime farmland in order to insure that topsoil is placed correctly for the post mine land sue. Stockpiles will also be place in areas where the stored topsoil will not be lost to wind erosion or surface runoff. When a topsoil stockpile is placed, it will not be moved until soil is needed for distribution on graded areas, or is consolidated into other existing stockpiles. Stockpile locations were also evaluated and selected to minimize truck travel distance, to reduce equipment cost, and to increase efficiency.

Mine personnel are instructed that topsoil stockpiles are not to be disturbed or contaminated. Signs will serve as continuing reminders to personnel that stockpile areas are to be preserved and undisturbed.

Any topsoil stockpile which will remain in place less than 90 days will not be revegetated. The surface of each pile will be left in a roughened condition to retard wind and water erosion. A self-contained grader ditch or berm will be constructed around the perimeter of the stockpile to prevent loss of the topsoil resource.

Any topsoil stockpile which will remain in place 90 to 180 days will be stabilized by utilizing an annual grain (barley, oats or wheat) cover crop. The seeding rate will be 70 pound per acre broadcast.

Protection and maintenance of "long-term" topsoil stockpiles will begin when a stockpile is temporarily or fully completed and no more additions or withdrawals of topsoil are to be made within a 180 day time period. Topsoil stockpiles will be stabilized primarily by perennial plant establishment. The seed mixture, and seeding rate for long-term topsoil stockpiles is described in the Revegetation Plan, Section 2.05.4 (2)(e).

Establishing vegetative cover will aid in overall stabilization and erosion control of stockpiles. Vegetative cover will aid in reducing runoff and raindrop impact and will increase moisture infiltration by maintaining the upper soil surfaces in a friable, noncrusted condition. Organic matter, soil nitrogen, and microorganism activity will be maintained or enhanced by the seeding of deep rooted species or species with fibrous root systems.

A topsoil storage breakdown as of February 2008 can be seen in Table 2.05.4(2)(d)-2. A topsoil storage breakdown, including proposed stockpiles, as of June 2010 can be seen in Table 2.05.4(2)(d)-2A.

Table 2.05.4(2)(d)-2 Topsoil Stockpile Inventory (February 2008)

Topsoil Pile Name	Type of Topsoil	Volume (CY)	Location
A	Mixed	200	East Side of 27 Road
B	Mixed	4,330	East Side of 27 Road
C	Lift A Topsoil	6,210	East Side of 27 Road
D	Mixed	5,015	East Side of 27 Road
E	Lift A Topsoil	2,990	East Side of 27 Road
F	Mixed	22,740	East Side of 27 Road
G	Mixed	35,280	East Side of 27 Road
H	Lift B Topsoil	41,760	East Side of 27 Road
I	Mixed	3,150	East Side of 27 Road
J	Mixed	5,780	East Side of 27 Road
K	Mixed	550	East Side of 27 Road
Sub Total		128,005	East Side of 27 Road
1	Mixed	0	West Side of 27 Road
2	Mixed	9,410	West Side of 27 Road
3	Prime Farmland Pond 013	6,210	West Side of 27 Road
4	Prime Farmland Pond 013	8,520	West Side of 27 Road
5	Mixed	124,225	West Side of 27 Road
6	Mixed	8,050	West Side of 27 Road
7	Mixed	0	West Side of 27 Road
8	Mixed	0	West Side of 27 Road
9	Mixed	0	West Side of 27 Road
10	Mixed	0	West Side of 27 Road
11	Lift A Topsoil	146,337	West Side of 27 Road
12	Lift B Topsoil	221,516	West Side of 27 Road
13	Mixed	36,750	West Side of 27 Road
Sub Total		561,018	West Side of 27 Road
TOTALS		689,023	

All of the topsoil in the above listed stockpiles numbered A through K will be used in final reclamation of the area east of 2700 Road. This includes the area of the overburden stockpile, the haul road, the BB Detour Road and some other minor disturbance. All stockpiles have slopes less than 3H:1V and have been seeded and mulched in the past. All have reasonable vegetation cover and are not experiencing excessive erosion. The runoff from all stockpiles is handled in designed sediment ponds. There is adequate topsoil in these piles to perform the required placement in these areas according to the thicknesses shown on Map 2.05.4-4.

8.1 Topsoil Storage on Prime Farmlands- Morgan Property

There are 107.96 acres of Prime Farmland on the Morgan property south of BB Road and west of 2700 Road. The topsoil replacement thicknesses can be seen on Map 2.05.4-4. In order to satisfy the DRMS requirements related to Prime Farmland, the topsoil on the Morgan property that is excavated after February 2008 will be salvaged in two lifts. Since the prime farmland determination was not made until February 2008, portions of the Morgan property have been retopsoiled with Bench 1 Substitute Subsoil and Mixed Topsoil. Map 2.04.9-2 shows the topsoil status of the Morgan property at the time.

Due to the complexity of the topsoil replacement plan on the Morgan property, a layout of the different topsoil/subsoil areas based on their current status in reclamation has been constructed. This is Map 2.05.4-6. Additionally, this map contains calculations demonstrating the topsoil balance for the entire 107.96 acres. The current volume of the existing stockpiles, the volume of the existing stockpiles and the approximate volume of new stockpiles that have not yet been constructed can also be seen on Map 2.05.4-6.

A list of both existing and proposed stockpiles (as of June 2010) can be found in Table 2.05.4(2)(d)-2A. The location of all stockpiles in Table 2.05.4(2)(d)-2A can be seen on Map 2.05.4-9.

As of June 2010, 51.7 acres of the Morgan property have been backfilled with Bench 1 material as a substitute subsoil. See Attachment 2.05.4(2)(d)-1 for the Walsh Environmental Scientist and Engineers Report on the sampling, testing and evaluation of the subsoil placement on the Morgan property.

8.2 Topsoil Storage Prime Farmland - WFC Property

An area (4.76 acres) of 98A soils in the northwest corner of the WFC property west of 2700 Road has been identified as prime farmland soils. The construction of the Pond 013 led to the distrurbance of 3.96 acres of this area. The disturbance is a mix of Pond 013 itself, the prime farmland soil stockpile, and areas that are within the disturbance boundary but not excavated.

The determination of prime farmland soils was made in 2008, after Pond 013 had been constructed. Therefore, the prime farmland soils were all salvaged in a single lift. The prime farmland soils are stockpiled in stockpile #3 and #4. These stockpiles total 14,730 cubic yards. These stockpiles can be seen on Map 2.05.4-7 and Map 2.05.4-9. They can also be found listed in Table 2.05.4(2)(d)-2A.

Since Pond 013 will be in place well after the surrounding land has been reclaimed, the prime farmland will be reclaimed as a new 3.96 acre area of Irrigated Cropland post-mine land use can be found in Section 2.05.4(2)(e).The 3.96 acres of Irrigated Cropland will be a combination of 1.13 acres of prime farmland soils that stockpile #4 was placed on, and 2.83 acres of prime farmland constructed from stockpiled Pond 013 topsoil. Map 2.05.4-8 shows the layout of this area and its surroundings for reference.

8.3 Topsoil Storage Non-Prime Farmland Areas

Topsoil salvaged for Non-prime Farmland areas will be salvaged according to Section 2.04.9. Most topsoil will be directly placed on the backfilled areas that follow the mining pit across the permit. Some topsoil will be stockpiled for ponds and for the final topsoil replacement at the end of mine life. The locations and size of these stockpiles can be seen on Map 2.05.4-7. Additionally, these stockpiles can be seen listed in Table 2.05.4(2)(d)-2A.

Stockpiles A-K are all located on the east side of 2700 Road, and have been in place for some time. No new stockpiles are proposed on the east side of 2700 Road. The proposed stockpiles are for the reclamation of Pond 012 and the reclamation of the final mining cut. Most of the existing stockpiles east of 2700 Road will also be used in the reclamation of the large overburden stockpile (Mt. Nucla), mine roads and other disturbances to the east. If any excess topsoils are available from the east area, it will be placed on the dryland pasture area north of BB Road and west of 2700 Road.

Table 2.05.4(2)(d)-2A Topsoil Stockpile Inventory (June 2010)

Topsoil Pile Name	Type of Topsoil	Volume (CY)	Location/Comments
A	Mixed Topsoil	200	East Side of 2700 Road
B	Mixed Topsoil	4,330	East Side of 2700 Road
C	Lift A Topsoil	6,210	East Side of 2700 Road
D	Mixed Topsoil	5,015	East Side of 2700 Road
E	Lift A Topsoil	2,990	East Side of 2700 Road
F	Mixed Topsoil	22,740	East Side of 2700 Road
G	Mixed Topsoil	35,280	East Side of 2700 Road
H	Lift B Topsoil	41,760	East Side of 2700 Road
I	Mixed Topsoil	3,150	East Side of 2700 Road
J	Mixed Topsoil	5,780	East Side of 2700 Road
K	Mixed Topsoil	550	East Side of 2700 Road
Sub Total		128,005	East Side of 2700 Road
These stockpiles are all east of 2700 Road			

Topsoil Pile Name	Type of Topsoil	Volume (CY)	Location/Comments
Prime Farmland - Morgan Property			
1	Mixed Topsoil	0	(No longer exists)
5	Mixed Topsoil	124,225	East end of Morgan Property
6	Mixed Topsoil	8,050	East end of Morgan Property
11	Lift A Topsoil	146,337	East end of Morgan Property
12	Lift B Topsoil	221,516	East end of Morgan Property
14	Lift A Topsoil	35,450	Middle of Morgan Property (Proposed)
15	Lift B Topsoil	191,840	Middle of Morgan Property (Proposed)
17	Pond 011 - Lift B Topsoil	8,860	Immediately east of Pond 011(Proposed)
18	Pond 011 - Lift A Topsoil	7,250	Immediately east of Pond 011 (Proposed)
19	Pond 011 - Bench 1 Spoil	13,260	Immediately east of Pond 011 (Proposed)
Sub Total		756,788	
Prime Farmland - WFC			
3	Mixed Topsoil	6,210	Southeast of Pond 013
4	Mixed Topsoil	8,520	Immediately east of Pond 013.
Sub Total		14,730	

Topsoil Pile Name	Type of Topsoil	Volume (CY)	Location/Comments
Non-Prime Farmland Areas			
2	Mixed Topsoil	9,410	West Side of 2700 Road
7	Mixed Topsoil	0	Removed
8	Mixed Topsoil	0	Removed
9	Mixed Topsoil	0	Removed
10	Mixed Topsoil	0	Removed
13	Mixed Topsoil	36,750	West end of Lloyd Property
20	Pond 012 - Mixed Topsoil	2,740	Immediately southwest of Pond 012 (Proposed)
21	Pond 012 - Mixed Topsoil	15,970	Immediately southwest of Pond 012 (Proposed)
22	Mixed Topsoil	17,890	West end of WFC property (Proposed)
Sub Total		82,760	West Side of 27 Road
TOTALS		**982,283**	

9.0 General Topsoil Handling & Placement Procedures Prior to February 2008

The mine was initially started in a box cut in the southeast corner of the permit area. Mixed Lift Topsoil and Lift A topsoil was placed in Stockpiles C, D, E and H as shown on Map 2.05.4-9. Additional stockpiles were created as the mine advanced. Once these stockpiles were created, almost all additional topsoil was excavated and directly placed on regraded spoil behind the active pit.

Prior to February 2008, some topsoil was stripped and replaced on the reclaimed area in a single lift and other areas (the majority) was stripped in 2 lifts and replaced in 2 lifts. A minimum of three feet of Bench 1 material was placed beneath the topsoil. Map 2.05.4-4 shows the actual topsoil material replacement thicknesses for the permit area. All of the area east of 2700 Road was re-topsoiled prior to February 2008. The February 2008 date is important since the topsoil on the eastern portion of the Morgan property was stripped in a single lift up to that date and it was only at that time that the NRCS determined that the 98A and 98E soils were prime farmland soils. Since the majority of the Morgan property in the permit area were 98E soils, it was ruled by the NRCS that the entire fields would be considered prime farmland soils. Since the historical management of the fields was substantial and since adequate water was available for irrigation, all of the Morgan fields were considered prime farmlands.

Also, WFC had stripped a small area for Pond 013 in the northwest corner of the permit area, where 98A soil was present. This topsoil was also ruled to be prime farmland soil and had to handled accordingly. The topsoil was stripped in a mixed lift and was placed in Stockpiles 3 and 4 totaling 14,730 cubic yards.

It was decided at that time by the Division that an immediate revision to the topsoil handling procedures was needed to address the requirements for prime farmland soil handling. Considerable time was spent by the Division, NRCS, the landowner and WFC in determining what procedures were needed for topsoil handling and what the final reclamation of these fields would be.

Technical Revision 57 was submitted to the Division in April of 2008 and after extensive adequacy review, was approved in early 2009. The revision outlined new procedures for stripping the topsoil in 2 lifts on the remainder of the Morgan property. In February of 2008, approximately 35.5 acres of the eastern Morgan property had placement of a large thickness of Bench 1 material, of which the upper zone was tested for suitability under the requirements in Table 2.05.4(2)(d)-1A. The testing and final report showing that this material met the suitability requirements is found in Attachment 2.05.4(2)(d)-1. Also, by February of 2008, 7.6 acres of the eastern portion of the Morgan property had received a Mixed Topsoil lift placed on top of the Bench 1 subsoil substitute. Approximately 17 inches of mixed topsoil were placed on this acreage, as shown on Map 2.05.4-6. As of February 2008, the remaining undisturbed topsoil on the Morgan property was stripped in 2 lifts immediately, as prescribed by the NRCS, based on determined stripping depths outlined in section 2.04.9. In other words, this 2 lift stripping was not started after TR-57 approval, it was started immediately after the prime farmland soils were identified.

Details of historic soil salvaging can be found in Section 2.04.9.

All of the topsoil preparation procedures outlined in Section 13.0 have been carried out in these areas, such as ripping, rock picking, land leveling, disking, and harrowing, with the exception of the fertility testing and fertilization, which was initially done for those areas east of Pond 7. Once the fertilizer prices rose dramatically, WFC and most other farmers in the area, severely cut back on the fertilizer applications, as a normal husbandry practice.

10.0 General Topsoil Handling & Placement Procedures After February 2008

After February 2008, soil types 98A and 98E were determined to be prime farmland soils. New stripping procedures were outlined by the NRCS and immediately adopted, based on color change in the soils. These Lift A and Lift B topsoils were placed in stockpiles, as described in Subsection 8.0.

Many of the elements of this topsoil handling and redistribution plan that was approved in TR-57 were further modified for Permit Revision 06.

Topsoil will be replaced only when the approved postmine contours are achieved and when no additional disturbance is anticipated. Topsoil will not be replaced on temporary reclamation sites such as haul road ditches, cut, slopes and fill slopes, pond embankments and spillways, and diversion ditches. Temporary reclamation sites will be seeded and stabilized as described in Section 2.05.3(2)(e) Revegetation. Topsoil will be replaced within the aforementioned areas once final reclamation is achieved. Topsoil shall be replaced along the contour, whenever feasible, to minimize potential erosion and topsoil/spoil interface slippage problems. This practice will be discontinued on steep slopes where the safety of the equipment operator is in jeopardy.

The mine sequence is to first remove the topsoil (Lift A Topsoil and Lift B Topsoil or Mixed) with the truck-shovel fleet and hauled it to the regraded area behind the pit to be spread or stockpiled. A temporary haul road around the end of the pit is used for this operation. In some cases, the topsoil is temporarily pushed in advance of the pit in a temporary elongated moving stockpile, which is eventually loaded and hauled to the regraded backfill for permanent or temporary placement. As described in Attachment 2.05.3(3)-7 Small Area Exemptions, a small topsoil catchment berm/ditch is placed at the advance edge of the pit so that all surface water runoff (precipitation or snow melt) from the topsoil excavation area is trapped by this berm. Map 2.04.9-2 shows this berm in advance of the pit.

11.0 Topsoil Replacement

The topsoil replacement for the mine is divided into the three original topsoil study areas. These are discussed in the following subsections.

11.1 Topsoil Replacement - 1988 and 1995 Study Areas

These study areas are located east of 2700 Road. As of February, 2008, this area has been stripped, replaced and reclaimed. The various tracts had different topsoil placement thicknesses depending upon landowner and land use. The material replaced, as reported in the Annual Reports, is shown on Map 2.05.4-4. As is seen from the Map, most of the area was stripped and replaced in 2 lifts. In some cases, the combined lift thickness is reported on the Map.

During the topsoil stripping, a deficit was encountered in the amount stripped compared to the amount predicted from the soil survey. WFC proposed the use of selected overburden or interburden materials, approximately 33,600 cubic yards as topsoil substitutes or plant seedbed media for this area, which is 9.7 acres immediately north and west of Pond 07. See Map 2.05.4-4. This is based on the fact that this area had poor topsoil in the beginning (Soil Unit 810), and the lower than anticipated recovery of 80 percent for the remaining Soil Units 1E, 1EW, 808, 30C in the surrounding area. The substitute soil was shown to be suitable and has been acceptable in the reclamation. This change was approved and the replacement work was completed. As of February, 2008, these reclaimed areas appear to be doing well and will meet the bond release criteria.

As of June 2010, much of the area has obtained or is about to obtain Phase 2 bond release.

11.2 Topsoil Replacement - 1998/1999 Study Area

Map 2.05.4-9 shows the areas which have been retopsoiled as of June 2010. This map also shows the location of the pit and the areas that have received topsoil and subsoil as of this date. These areas include A) the Benson property and other properties north of BB Road and east of 2700 Road, B) Benson property north of BB Road and west of 2700 Road, C) a portion of Lloyd property north of BB Road and East of 2700 Road.

Since it was determined in February, 2008 by the NRCS that soils 98E and 98A were prime farmland soils, a revised topsoil stripping and replacement policy was needed for those areas. This policy is described in detail below in Subsection 12.0. These soils exist primarily south of BB Road and west of 2700 Road on the Morgan property. In addition, a small area of prime farmland soil exists in the northwest corner of the permit area, where Pond 013 was constructed.

12.0 June 2010 Topsoil Balance, Sequence and Volumetrics

This section describes the topsoil balance calculations for all areas west of 2700 Road, including discussions on the sequence and volumes needed to provide the required thicknesses.

12.1 Prime Farmland Soils Balance, Sequence and Volumetrics

This section will demonstrate that all prime farmland replacement requirements of Rule 2.06.6 are met. Once the prime farmlands were identified in February of 2008, all topsoil handling procedures changed to comply with this Rule.

12.1.1 Morgan Property Prime Farmland

As described in Subsection 9.0, as of February 2008, approximately 35.5 acres of the eastern Morgan property had placement of a large thickness of Bench 1 material, of which the upper zone was tested for suitability under the requirements in Table 2.05.4(2)(d)-1A. The testing and final report showed that this Bench 1 material was found to be suitable as Bench 1 subsoil substitute. Also, by February of 2008, 7.6 acres of the eastern portion of the Morgan property had received a Mixed Topsoil lift placed on top of the Bench 1 subsoil substitute. As of June 2010, this area has expanded to 12.2 acres, with approximately 17 inches of mixed topsoil placed, as shown on Map 2.05.4-6.

After February, 2008, all prime farmland soils have been salvaged in 2 lifts. All prime farmland soils and Bench 1 material excavated from the Morgan property will be replaced on the Morgan property.

Map 2.05.4-6 shows the status of the Morgan Property topsoil and subsoil replacement as of June 2010. This map also shows the topsoil and subsoil stockpile amounts and balance calculations.

The Morgan property topsoil replacement is broken down into five different zones of topsoil redistribution. The bases of creating these topsoil lay down zones was to ensure what was done prior to February 2008 will meet the criteria outlined by the NRCS for the restoration of Irrigated Cropland (Prime Farmland) in this area and maximize the quantity of Lift A Topsoil, Lift B Topsoil, Mixed Topsoil and finally Bench 1 Subsoil Substitute to use and optimize the existing topsoil volumes over the largest area possible to grow alfalfa on the land to the highest productivity level. All areas must have minimum combined topsoil and subsoil thickness of 48 inches to qualify as Prime Farmland Soil.

DRMS provided WFC with the topsoil and subsoil replacement guidelines for the Morgan property prime farmland. Listed below are the five zones of topsoil redistribution on the Morgan Prime Farmland and how they have, and will, meet those DRMS requirements:

- **Zone 1** is a 12.21 acre field that currently has 17 inches of Mixed Topsoil overlying 33 plus inches of a Bench 1 Subsoil Substitute. Four inches of Mixed Topsoil will be added to get the total Mixed Topsoil thickness to 21 inches. Total combined soil thickness will be 54 inches.

- **Zone 2** is a 7.84 acre field that will receive 21 inches of Mixed Topsoil and currently has 33 inches of Bench 1 Subsoil Substitute. Total combined topsoil thickness will be 54 inches.

- **Zone 3** is a 31.68 acre field that will receive 21 inch of Mixed Topsoil and 33 inches of Lift B Topsoil. Total combined topsoil thickness will be 54 inches.

- **Zone 4** is a 54.33 acre field that will receive 24 inches of Lift A Topsoil along with 33 inches of Lift B Topsoil. Total combined topsoil thickness will be 58 inches.

- **Zone 5** is a 1.90 acre piece that was left undisturbed because it was needed as a blasting buffer zone around Frank Morgans home. This zone was only included to account for the total acreage of land within Morgan permitted land as 107.96 acres.

The topsoil and subsoil balance for the Morgan property prime farmland can be seen on Map 2.04.5-6 and Table 2.05.4(2)(d)-3. Currently (June 2010) some material is stockpiled on the eastern side of the Morgan property, some material is already placed in its appropriate location, and some material is yet to be excavated. Map 2.04.5-6 and Table 2.05.4(2)(d)-3 are designed to show that the above discussed topsoil replacement plan for each zone can be accomplished with the Mixed Topsoil, Lift A Topsoil, Lift B Topsoil, and Bench Substitute Subsoil available on the Morgan Property.

Table 2.05.4(2)(d)-3 Topsoil and Subsoil Balance on Morgan Property

Topsoil/Subsoil Requirements									
		Mixed Topsoil		Lift A Topsoil		Lift B Topsoil		Bench 1 Substitute Subsoil	
Zone	Area (acres)	CY	Thick (in.)	CY	Thick (in.)	CY	Thick (in.)	CY	Thick (in.)
Zone 1	12.21	34,472	21					54,171	33
Zone 2	7.84	22,135	21					34,783	33
Zone 3	31.68	93,702	21			140,554	33		
Zone 4	54.33			175,304	24	241,044	33		
Zone 5	1.90	N/A		N/A		N/A		N/A	
Total	**107.96**	**150,309**		**175,304**		**381,598**		**88,954**	

See Table C from Map 2.05.4-6 for the calculations used to generate these values.

Topsoil/Subsoil Available June 2010				
	Mixed Topsoil	Lift A Topsoil	Lift B Topsoil	Bench 1 Spoil/Substitute Subsoil
Already Placed	27,906			88,954
Ahead of Pit		31,593	172,113	
Stockpile 5 & 6	132,271			
Stockpile 11		146,337		
Stockpile 12			221,516	
Total	**160,177**	**177,930**	**393,629**	**88,954**

See Table B from Map 2.05.4-6 for the calculations used to generate these values.

As can be seen from Table 2.05.4(2)(d)-2A, there is sufficient topsoil and subsoil volume between stockpiles and currently (June 2010) undisturbed areas to replace the prescribed thicknesses over the Morgan property.

Calculations demonstrating the quantities for the reclamation are shown on Map 2.05.4-6 and are described below:

Topsoil Volumes Available

The remaining area to be stripped in front of the active disturbance is as follows:

Lift A Topsoil

Lift A: 29.3 acres - 3.19 acres already stripped for Pond 013, = 26.11 acres.

Lift A volume available from additional stripping = 26.11 acres x 9 inches avg. thickness = 31,593 cy. The total Lift A available is 31,593 cy (from new stripping) + 146,337 cy from Stockpile #11 = 177,930 cy. Lift A Topsoil in front of the June 2010 active pit will be combined with stockpiled Lift A Topsoil and spread over the 54.33 acres of Zone 4 to attain a thickness of 24 inches.

Stockpile #14 will also be created from final cut stripping, which will be approximately 35,450 cy, which will be used to reclaim Zone #4.

A small stockpile of Lift A material will remain after final backfilling and filling to reclaim Pond 011, as shown on Map 2.05.4-6. This is Stockpile #18, which will contain approximately 7,250 cy.

Lift B Topsoil

Lift B: 29.3 acres - 3.19 acres (pond 013) + 1.72 acres additional area on east edge of stripping area = 27.83 acres.

The remaining Lift B Topsoil to be stripped in front of the June 2010 active pit = 27.83 acres x 46 inch average thickness = 172,113 cy.

The total Lift B available is 172,113 cy (from new stripping) + 221,516 cy from Stockpile #12 = 393,629 cy. Lift B Topsoil in front of the June 2010 active pit will be combined with stockpiled Lift B Topsoil to provide 33 inches thickness over Zones #3 and #4. Table 2.05.4(2)(d)-2A shows that this required volume is 381,598 cy and the available volume of 393,629 is more than adequate. All topsoil salvaged will be placed, therefore, if 393,629 cy is available, the final thickness of Lift B over the area will be slightly greater than 33 inches.

Stockpile #15 will also be created from final cut stripping, which will be approximately 191,840 cy, which will be used to reclaim Zone #4.

A small stockpile of Lift B material will remain after final backfilling and filling to reclaim Pond 011, as shown on Map 2.05.4-6. This is Stockpile #17, which will contain approximately 8,860 cy.

Mixed Topsoil

The total mixed topsoil available for the property is 132,271 cy from Stockpiles #5 and #6, and 27,906 cy from the 17 inches thickness placed in Zone 1 (12.21 acres) = 160,177 cy.

All the Mixed Topsoil will be spread evenly across the remaining disturbed areas (Zone 1-3) that have had subsoil placed, but still require topsoil. Calculations showed that the Mixed Topsoil will be spread at an average 21 inch thick over Zones 1 through 3 (51.73 acres). The required amount to do this is 150,309 cy. Therefore, the volume of 160,177 cy is more than adequate.

Bench 1 Subsoil Substitute

By utilizing some excess Lift B material to cover areas east of the existing pit, the area needed for Bench 1 Subsoil Substitute material is lessened. Only Zones 1 and 2 require Bench 1 Subsoil Substitute material. The required thickness is 33 inches over a combined area of 20.05 acres. For this, 88,954 cy is needed. This material was already placed as of February, 2008 and it was actually placed to a far greater thickness. The results of this testing revealed that the Bench 1 Subsoil Substitute was primarily suitable for all tested criteria. Two samples exceeded the conductivity standard by a small amount. This report is included as Attachment 2.05.4(2)(d)-1. It has been revised in July of 2008 to include subsoil testing of pH and EC utilizing the paste method. Additional results and discussion have been added to Attachment 2.05.4(2)(d)-1 to address the samples that showed high results. Please refer to Attachment 20.5.4(2)(d)-1 page 18 for further discussion.

A large stockpile of Bench 1 spoil will be created east of the final 3 mining cuts as shown on Map 2.05.4-6. This stockpile will contain approximately 133,222 cy of Bench 1 spoil which will be used to backfill Zones 3 and 4 prior to topsoil placement. This is not required for the NRCS topsoil thicknesses, but this is being done at the request of the landowner. All Bench 1 material excavated on the Morgan property will be returned to the Morgan property. WFC will make every attempt within reason to see that the upper portion of the Bench 1 spoil will have the best quality. An additional stockpile of Bench 1 of 13,260 cy will be used to reclaim Pond 011, when it is allowed by the Division.

Finally, 1.90 acres of the Morgan property will not be disturbed, as shown on Map 2.05.4-6. This brings the total of all five zones to 107.96 acres of Prime Farmland on the Morgan property.

All Lift A Topsoil, Lift B Topsoil, Mixed Topsoil, and Bench 1 Subsoil Substitute for the Morgan property will be tested as described in the soil suitability criteria in Table 2.05.4(2)(d)-1A. All other areas west of 2700 Road will follow the suitability criteria in Table 2.05.4(2)(d)-1B.

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12.1.2 WFC Prime Farmland

The total area of the 98A soil designated prime farmland soils on the WFC property North of BB Road and East of 2700 Road is 4.76 acres. Of this amount, 2.06 acres were disturbed to construct Pond 013 prior to the ruling of this area being designated as prime farmland soils. The average stripping depth was less than 6.0 feet since the pond has mild slopes and not all of the area was fully excavated. See Map 2.05.4-8. The Map shows other areas disturbed that total 3.96 acres. Actually, these areas are minor ditches which cross the lower edge of the area but the topsoil was never stripped from any area greater than 2.06 acres. All of the material excavated from this area is Lift A Topsoil and B mixed material and has been stockpiled in Stockpiles #3 and #4. This volume is 14,730 cy. Stockpile #4 is also located on undisturbed 98A topsoil, as shown on Map 2.05.4-8. Therefore, since Pond 013 will be in place for many years, the best plan for reclamation is to construct a new prime farmland area totaling 3.96 acres near Pond 013, using 1.13 acres of area where Topsoil Stockpile #4 sits on unexcavated 98A soil, combined with a reconstructed prime farmland area of 2.83 acres, where the total prime farmland reclaimed will be 3.96 acres. All topsoil stockpiled from the excavation of Pond 013 will be used to construct the additional prime farmland attached to the undisturbed prime farmland area adjacent to Pond 013.

The prime farmland area details on the WFC property are shown on Map 2.05.4-6. The area of the topsoil replacement is shown on this Map and Map 2.05.4-7 as well, where the area for the prime farmland replacement is shown as Zone 8 on Map.

In order to restore this prime farmland, the following calculations and steps are provided:

Step 1: Place 18 inches of Bench 1 subsoil substitute on 2.83 acres, which is then tested for suitability as subsoil under the same parameters as the Bench 1 Subsoil Substitute on the Morgan property, according to Table 2.05.4(2)(d)-1A. This is a volume of 6,848 cy. This material will be live hauled from the last 3 cuts of mining on the WFC property.

Step 2: Place the stockpiled 14,730 cy of mixed Lift A and Lift B topsoil from Stockpiles #3 and #4 on the 2.83 acre area. This will allow a mixed topsoil thickness of 38 inches over this area. This combined with the 18 inches of Bench 1 Subsoil Substitute results in a total thickness of 56 inches. This Bench 1 material will be obtained from the mining of the last 3 mining cuts on the WFC property.

The adjacent 1.13 acres will have undisturbed prime farmland soil (once Stockpile #4 is removed). This area will require disking and replanting for rejuvenation.

No additional stripping in the area of the 98A soil is planned for the remainder of the life of the mine. No more excavation will occur in the pond area, therefore, if this material is replaced in the area it was removed, the prime farmland soil handling requirements will have been met. The two stockpiles will need to be moved prior to reclamation of Pond 13. The piles will be moved to the backfilled area of the pit near the pond, as mining approaches. The soil will not be mixed with any other soil from the mining area.

12.2 Non-Prime Farmland Soils

These lands include all lands north of BB Road and west of 2700 Road except for the 4.64 acres of prime farmland soils previously described. As of June 2010, there is approximately 107 acres of land that has been backfilled and topsoiled with Mixed Topsoil that covers all of Benson West and about half of the Lloyd property. This is shown on Map 2.05.4-7 as Zone 6. The replacement thicknesses for this area are 15" to 24" of Lift A Topsoil material over approximately 30" of Bench 1 spoil. Although this material is likely to meet the requirements for subsoil suitability, this material will not be tested according to the parameters in Table 2.05.4(2)(d)-1 for subsoil suitability. It will be tested for spoil suitability. Some samples of the Bench 1 material were taken in 2008 from this area and tested for suitability, however, no additional testing will be done on this material in this area. For the remaining areas north of BB Road and west of 2700 Road on the remaining Lloyd and WFC properties, called Zone 7, the replacement thicknesses for this area are 12" to 20" of Mixed Topsoil over approximately 24" of Bench 1 spoil.

Once spoil has been placed and graded, it will be ripped to at least 24 inches below grade before the Mixed Topsoil placement. Map 2.05.4-7 shows these areas with the calculated acreage and replacement thicknesses.

The calculations for the replacement of the these areas are shown below:

Zone 6 (106.8 acres) - Topsoil: 15 to 24 inches (21 in. avg.) of Mixed Topsoil over at least 30 inches of Bench 1 Spoil.

Zone 7 (100.6 acres) - Topsoil: 12 to 20 inches (13 in. avg.) of Mixed Topsoil over at least 24 inches of Bench 1 Spoil.

Zone 8 is prime farmland soil and is discussed in Subsection 12.1.2.

Topsoil Stockpiles #13 of 36,750 cy and proposed Stockpile #22 of 17,890 cy of Mixed Topsoil will be used to reclaim the last 3 cuts of the mining area, once the area has been backfilled from Mount Nucla and the Bench 1 spoil has been placed.

Table 2.05.4(2)(d)-4 Topsoil Balance for Area North of 2700 Road (WFC, Lloyd, & Benson W)

Non-Prime Farmland Area						
		Topsoil Required		Stockpiled Topsoil	Directly Placed Topsoil	Net
Zone	Area (acres)	CY	Thick (inches)	CY	CY	CY
Zone 6	106.8	301,532	21	9,410		
Zone 7	100.6	175,826	13	36,750		
Total		**477,358**		**46,160**	**431,198**	0

The area north of 2700 Road is divided into three zones for the purpose of topsoil replacement planning, as can be seen on Map 2.05.4-7. Zones 6 & 7 are not Prime Farmland areas, while Zone 8 is a small Prime Farmland area to be constructed as part of the reclamation of Prime Farmland soils related to the excavation of Pond 013 and is not covered in this subsection. For more details on the

WFC prime farmland near Pond 013 related Prime Farmland, see Map 2.05.4-8 and subsection 12.1.2.

In order to provide the required 477,358 cy for topsoiling of this area, it will be obtained from the following:

Existing Topsoil Stockpiles #13 of 36,750 cy
Existing Stockpile #2 of 9,410 cy
Area already topsoiled with mixed topsoil: all of Zone 6 thickness of 21" - 301,532 cy
Area not yet stripped of topsoil: 54.56 acres x 18 avg. thickness = 132,035 cy

Therefore, the total material available is 479,727 cy.

All of the topsoil above is a mixed topsoil stripped in a single lift. Therefore, the total mixed topsoil available is adequate to perform the required reclamation.

Topsoil Quantity Requirements by Landowner West of 2700 Road (Non Prime Farmland)

Table 2.05.4(2)(d)-5 shows the topsoil and Bench 1 spoil by landowner for the entire area west of 2700 Road for lands other than prime farmland. Subsection 12.0 describes how these thicknesses are achieved.

Table 2.05.4(2)(d)-5 Non Prime Topsoil & Subsoil Placed West of 2700 Road By Property

AREA (AC)	DISTURBED AREA IN PERMIT	THICKNESS TOPSOIL Top Lift (IN)	THICKNESS Topsoil Bottom Lift (IN)	VOLUME TOPSOIL Top Lift (CY)	VOLUME Topsoil Bottom Lift (CY)	COMMENTS
	BENSON WEST					
65.44	BENSON ALL TOPSOILED ALL ZONE 6	21 Mixed Topsoil	30 Bench 1 spoil	184,759	263,941	NON PRIME Bottom lift is Bench 1 Spoil
65.44	**TOTAL BENSON**	**21**	**30**	**185,747**	**265,353**	
	AVERAGE THICKNESS REPLACED	**21 Mixed Topsoil**	**30 Bench 1 spoil**			**THE AVERAGE TOTAL IS 51 INCHES FOR BENSON**
	LLOYD					
41.39	LLOYD BACKFILLED AND TOPSOILED Zone 6	18 Mixed Topsoil	30 Bench 1 spoil	100,164	166,940	NON PRIME MIXED TOPSOIL
26.74	LLOYD PARTIALLY TOPSOILED ZONE 7	13 Mixed Topsoil	24 Bench 1 spoil	46,736	86,281	NON PRIME MIXED TOPSOIL
68.13	**TOTAL LLOYD**			**146,899**	**253,221**	
	AVERAGE THICKNESS REPLACED FOR LLOYD			**16.0**	**27.6**	**THE AVERAGE TOTAL IS 51 INCHES FOR BENSON**
	WFC					
73.89	WFC SOME UNDISTURBED SOME IN ACTIVE PIT ALL ZONE 7	13 Mixed Topsoil	24 Bench 1 spoil	129,143	238,418	NON PRIME MIXED TOPSOIL NON PRIME
73.89	**TOTAL WFC**			**129,143**	**238,418**	
	AVERAGE THICKNESS REPLACED FOR WFC NON PRIME			**13.0**	**24.0**	NON PRIME MIXED TOPSOIL
275.6	**GRAND TOTAL**			**608,689**	**1,010,213**	

13.0 Topsoil Preparation Procedures Prior to Seeding

This discussion has been divided into each of the three main post-mine land uses.

13.1 Irrigated Cropland (Prime farmland) Topsoil Preparation Procedures

Topsoil replacement operations may be carried out during most of the year, the exception being those periods when wet conditions would preclude handling of the topsoil materials.

1- Ripping - Prior to replacement of topsoil, the graded spoil (Bench 1 material) will be ripped to reduce compaction. This will be done to a depth of 2 feet. This will be done by dozer with rippers or a chisel plow. Where the Bench 1 material is used as suitable subsoil, on the east side of the Morgan property, ripping will occur to a depth of 4 feet and cross ripping will be employed. The 4 feet of ripping with cross ripping will also be used in any area of irrigated Cropland where heavy traffic has also occurred. Upon placement of the Lift B subsoil, this material will also be ripped after placement to a depth of 24-30 inches, depending on the depth of the soil placement.

2 - Land leveling - WFC uses a blade of 16' to 24' width pulled behind a farm tractor to level the topsoil surface and allow a smoother surface for seeding.

3 -Rock picking - WFC will use a mechanical device such as a Vermeer rock picker that is pulled behind a tractor that rakes up large rocks over approximately 2.5 inches in diameter. Rocks up to approximately 24" diameter can be picked up by the device although there should be no rocks of this size in the topsoil. The rocks are removed from the field.

4 - Fertility testing - This test is conducted within 3 months of topsoil placement. Three soil samples will be obtained from the top 2 feet of soil in the field to be tested. The field is basically defined as that area that has recently been topsoiled. Samples will be taken and analyzed by a lab using the standard soil test for pH, salts, organic matter, nitrogen, potassium, and phosphorous. The lab will be informed that the desired crop is alfalfa and that the desired 1st cut production is 2.00 tons per acre.

5 - Disking and chisel plowing - Prior to final seedbed preparation, soil conditioning and weed control tillage will be carried out through the use of chisel plowing and/or disking. Chisel plowing will relieve any topsoil compaction, will aid in controlling weedy species, and will leave the site in a temporary toughened condition reducing wind and water erosion potential. Disking will be used to condition soil, break up clods, and control weeds through tillage prior to seeding. If annual weeds are a problem, several tillage operations may be required to get adequate control.

6. Final Seedbed Preparation -(For sideroll irrigated areas) Harrowing and cultipacking prior to seeding will be conducted as needed in order to provide the smooth, firm seedbed required. In any areas that may be poorly drained, tillage will be timed in order to reduce bogging, excessive compaction and excessive cloddiness caused by tillage when soils are wet. The best period for tillage in these areas may be in the early spring prior to the irrigation season (prior to mid-April). (For flood irrigated areas) - A plow pulling a standard marker will create furrows of approximately 4" to 6" depth on 30" centers, which is standard for the gated pipe used for the flood irrigation.

7. Initial Fertilizer Application - Based on the results of the fertility testing, fertilizer of the designed type will be applied at the rate specified from the lab testing. The fertilizer is in solid form and will be applied by small tractor with a broadcast spreader. The fertilizer will be applied in the Spring of the same year that the initial fertility testing is done. Ongoing fertility testing after initial seeding is described in Section 2.05.4(2)(e) Revegetation.

13.2 Reclaimed Irrigated Pastureland Topsoil Preparation Procedures

Topsoil replacement operations may be carried out during most of the year, the exception being those periods when wet conditions would preclude handling of the topsoil materials.

1- Ripping - Prior to replacement of the single lift topsoil, the graded spoil (Bench 1 material) will be ripped to reduce compaction. This will be done to a depth of 2 feet. This will be done by dozer with rippers or a chisel plow.

2 - Land leveling - WFC uses a blade of 16' to 24' width pulled behind a farm tractor to level the topsoil surface and allow a smoother surface for seeding.

3 -Rock picking - WFC will use a mechanical device such as a Vermeer rock picker that is pulled behind a tractor that rakes up large rocks over approximately 2.5 inches in diameter. Rocks up to approximately 24" diameter can be picked up by the device. The rocks are removed from the field.

4 - Fertility testing - This test is conducted within 3 months of topsoil placement. Three soil samples will be obtained from the top 2 feet of soil in the field to be tested. The field is basically defined as that area that has recently been topsoiled. Samples will be taken and analyzed by a lab using the standard soil test for pH, salts, organic matter, nitrogen, potassium, and phosphorous. The lab will be informed that the desired crop is irrigated pasture grass mix and that the desired 1^{st} cut production is 1.75 tons per acre.

5 - Disking and chisel plowing - Prior to final seedbed preparation, soil conditioning and weed control tillage will be carried out through the use of chisel plowing and/or disking. Chisel plowing will relieve any topsoil compaction, will aid in controlling weedy species, and will leave the site in a temporary toughened condition reducing wind and water erosion potential. Disking will be used to condition soil, break up clods, and control weeds through tillage prior to seeding. If annual weeds are a problem, several tillage operations may be required to get adequate control.

6. Final Seedbed Preparation -(For sideroll irrigated areas) Harrowing and cultipacking prior to seeding will be conducted as needed in order to provide the smooth, firm seedbed required. In any areas that may be poorly drained, tillage will be timed in order to reduce bogging, excessive compaction and excessive cloddiness caused by tillage when soils are wet. The best period for tillage in these areas may be in the early spring prior to the irrigation season (prior to mid-April). (For flood irrigated areas) - A plow pulling a standard marker will create furrows of approximately 4" to 6" depth on 30" centers, which is standard for the gated pipe used for the flood irrigation.

7. Initial Fertilizer Application - Based on the results of the fertility testing, fertilizer of the designed type will be applied at the rate specified from the lab testing. The fertilizer is in solid form and will be applied by small tractor with a broadcast spreader. The fertilizer will be applied in the Spring of the same year that the initial fertility testing is done. Ongoing fertility testing after initial seeding is described in Section 2.05.4(2)(e) Revegetation.

13.3 Dryland Pasture Seedbed Topsoil Preparation Procedures

a) For areas less than 15% slope, where irrigation may be used in the future if water becomes available, the following procedures will be followed:

1- Ripping - Prior to replacement of the single lift topsoil, the graded spoil (Bench 1 material) will be ripped to reduce compaction. This will be done to a depth of 2 feet. This will be done by dozer with rippers or a chisel plow.

2 - Land leveling - WFC uses a blade of 16' to 24' width pulled behind a farm tractor to level the topsoil surface and allow a smoother surface for seeding.

3 -Rock picking - WFC will use a mechanical device such as a Vermeer rock picker that is pulled behind a tractor that rakes up large rocks over approximately 2.5 inches in diameter. Rocks up to approximately 24" diameter can be picked up by the device. The rocks are removed from the field.

4 - Fertility testing - This test is conducted within 3 months of topsoil placement. Three soil samples will be obtained from the top 2 feet of soil in the field to be tested. The field is basically defined as that area that has recently been topsoiled. Samples will be taken and analyzed by a lab using the standard soil test for pH, salts, organic matter, nitrogen, potassium, and phosphorous. The lab will be informed that the land use is dryland pasture with a mixture of grasses and forbs.

5 - Disking and chisel plowing - Prior to final seedbed preparation, soil conditioning and weed control tillage will be carried out through the use of chisel plowing and disking. Chisel plowing will relieve any topsoil compaction, will aid in controlling weedy species, and will leave the site in a temporary toughened condition reducing wind and water erosion potential. Disking will be used to condition soil, break up clods, and control weeds through tillage prior to seeding. If annual weeds are a problem, several tillage operations may be required to get adequate control.

6. Final Seedbed Preparation - Harrowing and cultipacking prior to seeding will be conducted as needed in order to provide the smooth, firm seedbed required. In any areas that may be poorly drained, tillage will be timed in order to reduce bogging, excessive compaction and excessive cloddiness caused by tillage when soils are wet. The best period for tillage in these areas may be in the early spring prior to the irrigation season (prior to mid-April).

7. Initial Fertilizer Application - Based on the results of the fertility testing, fertilizer of the designed type will be applied at the rate specified from the lab testing. The fertilizer is in solid form and will be applied by small tractor with a broadcast spreader. The fertilizer will be applied in the Spring of the same year that the initial fertility testing is done. Ongoing fertility testing after initial seeding is described in Section 2.05.4(2)(e) Revegetation.

B) For areas greater than 15% slope, the following procedures will be followed:

1. Scarification - The single lift topsoil will be scarified (ripped) to its placement depth using a motor grader with rippers which will operate perpendicular to the slope, creating rough surfaces to trap moisture and prevent soil erosion along ths lope. An example of an area where this

would be employed is the north edge of the Benson West, the Lloyd and the WFC property, where there is a significant steeper slope in these areas.

14.0 Topsoil Suitability Criteria and Testing Plan for Reclaimed Soils

Prior to distribution of topsoil, all graded mined areas (on which topsoil is to be applied) will be sampled to confirm spoil suitability (see Regraded Spoil Monitoring Plan in Subsection 4.0 for more details). The density and physical characteristics of the replaced topsoil and upper spoil will be observed.

The suitability criteria is required to ensure that no poor topsoil or subsoil is placed near the surface of any reclaimed area and that prime farmlands are restored to strict standards for high productivity.

Prime Farmlands

All replaced soils on the Morgan property will be tested according to the suitability criteria in Table 2.05.4(2)(d)-1A. The WFC prime farmland soil must meet the suitability criteria outlined in Table 2.05.4(2)(d)-1B. Depth measurements shall be taken at the same locations as the original sample sites. Replacement depth information shall include separate thicknesses of Lift A Topsoil and Lift B Topsoil for those areas (prime farmland) where the 2 lift replacement applies. This topsoil salvage and replacement depth information will be kept on file at the mine office and will be submitted with the Annual Topsoil Balance/Spoil Quality Report. Topsoil recovery depths will be adjusted if warranted by the site conditions. Sample frequency is as shown in the table for each material type.

As described in earlier subsections, a separate category in Table 2.05.4(2)(d)-1A has been established for the eastern portion of the Morgan property, where Bench 1 material is used as Bench 1 subsoil substitute.

Non Prime Farmlands

Soil suitability criteria for all non prime farmland areas west of 2700 Road are addressed in Table 2.05.4(2)(d)-1B. These areas will be stripped and replaced in a single lift of mixed topsoil.

15.0 Topsoil Remediation Plans

In the event that any one spoil sample result exceeds the limits, WFC will implement the Unsuitable Spoil Mitigation Plan listed below.

If one or more parameters fall within the unsuitable range at a given grid point, a three-part mitigation plan will be implemented.

1. The area around a suspect hole will be sampled on a closer spacing interval in order to better define the lateral extent and variability of the unsuitable material. This sampling will be called the 2nd Phase sampling and the interval is one hole per 50 feet distance around the bad point in all directions for prime farmland, and one hole per 100 feet distance around the bad point in all directions for reclaimed irrigated pastureland and dryland pasture.

2. In those areas where exceedences are encountered, any followup sampling that results in an area of exceedence larger than 0.1 acres for prime farmland, 0.25 acres for reclaimed irrigated pastureland or 0.50 acres for dryland pasture, will be remediated.

3. For remediation, any area identified above which excceds the acreages stipulated above for unsuitable surface spoil material will be placed at least eight feet below the final soil surface. New soil material will be used in its place. This material will be tested according to the original grid (1 hole per 5 acres) to confirm its suitability.

4. If none of the above procedures satisfactorily mitigate a certain problem, the Division will be notified and recommended actions will then be implemented.

WFC will maintain and periodically review the existing quality control program used to evaluate overburden, interburden, and spoil handling activities at New Horizon Mine. WFC will maintain

Any remedial backfilling and/or burial will be completed in a manner that results in final surface elevations and topography that are consistent with the approved reclamation plan and are compatible with the post mining land use for the remediated area. Any remedial backfilling and/or burial will be completed in a manner that results in final surface elevations and topography that are consistent with the approved reclamation plan and are compatible with the post mining land use for the remediated area.

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Attachment 2.05.4(2)(d)-1

Walsh Report on Subsoil Suitability

February 2008 (Revised July 2008)

Walsh
Environmental Scientists and Engineers, LLC

August 12, 2008

Mr. Ross Gubka
Western Fuels Colorado LLC
Box 628
Nucla Colorado 81424

Subject: REVISED Subsoil Suitability Study
New Horizon Mine
Walsh Project No. 7873-010

Dear Mr. Gubka:

Walsh Environmental Scientists & Engineers, LLC (Walsh) has performed a limited soil investigation and inspections of operations at the New Horizon Mine in Nucla, Colorado. Work was conducted under contract to Western Fuels – Colorado LLC (WFC). This letter describes investigation techniques, results, and their implication to mine operations and is a revision of the original soil investigation dated March 20, 2008. Revisions are based on comments received from the Division of Reclamation, Mining, and Safety (DRMS) in a letter dated May 28 2008.

Background
The New Horizon Mine mines coal under a DRMS permit. The permit defines soil handling procedures that have been followed by WFC. Prior to February 2008, the permit did not recognize any soil within the permit boundary as being "prime farmland" as defined in the DRMS regulations and by the National Resource Conservation Service (NRCS). Soil handling was consistent with the permit and the NRCS ruling prior to permit issuance that there were no prime farmland soils within the permit area. In February 2008, the NRCS determined that some of the soil within the permit boundary qualified as prime farmland. Some of that prime farmland had been mined and reclaimed, some had been mined but had not yet been fully reclaimed, and some of the material has not yet been mined. WFC has chosen to take steps to ensure that the unreclaimed mined area that has been reclassified as prime farmland is replaced with soil and subsoil that is suitable to restore prime farmland characteristics.

Mining Operations
Coal is mined by stripping topsoil in one or two lifts, mechanically stripping subsoil and weathered Dakota Formation bedrock overburden, blasting remaining bedrock overburden, and mining coal. The mining pit is backfilled first with the interburden and blasted overburden followed by placement of the weathered bedrock overburden, and finally the soil lift(s).

The working face of the mine reveals 10 to 30 feet of weathered sandstone and shale bedrock that has decomposed and is mostly friable (see photos). This material is called "Bench 1" or "overburden unit 1" material in the permit and by WFC. It grades imperceptibly into the overlying soil, and contains

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root structures to a depth of greater than 10 feet depth. A single discontinuous layer of broken angular rock about six to twelve inches thick is present within much of the observed cut face. This is the only competent rock in the bench 1 cut face. The bench 1 material overlies competent overburden, which overlies the coal seams that are mined (see Photo 1). Bench 1 material is mechanically removed as a separate unit and is the last overburden unit to be placed over the reclaimed mine. As such there are generally several or more feet of the bench 1 material underlying replaced topsoil in the reclaimed areas.

Part of the area of the mine south of BB Road and west of 2700 Road (reclassified as prime farmland) and part of the area north of BB Road (non-prime farmland) have been mined and have had overburden placed, but have not had topsoil replaced (Figure 1). The suitability of the Bench 1 subsoil for use as the lower layer of prime farmland soil is the focus of this study.

Preliminary Investigation

On January 31, 2008, WFC personnel obtained six soil samples from the upper two feet of overburden (samples 101 through 106, Figure 1). The soil was analyzed for texture, conductivity, pH, nitrogen, organic matter, some anions and cations, calcium carbonate, moisture, and sodium adsorption ratio. A summary of results relevant to prime farmland soil is presented in Table 1 and the lab data sheet is attached to this letter. These samples were all within suitability criteria established in the permit and by the NRCS for prime farmland subsoil for target analytes with the exception of one sample which exceeded the electrical conductivity (soluble salts) suitability standard of 4.0 with a reading of 4.1 micromhos/cm.

Second Investigation

After a meeting with the DRMS, NRCS, WFC, and other personnel, WFC agreed to further analyze the condition of the subsoil by examining the soil in pits placed on a 2.5-acre grid (330 feet per side). These grid points were sequentially numbered across the portion of the mine that had been mined and partially reclaimed. Of the 34 grid points, twenty were within areas that had been brought to grade with overburden and were accessible (e.g. not covered with topsoil piles). These locations had soil pits excavated, with 13 south of BB Road (in prime farmland) and seven north of BB Road (in non-prime farmland) (sample points numbered 1 through 34, Figure 1). All pits were excavated in areas that had been brought to grade with overburden, but had not been prepared for topsoil placement or had topsoil placed. WFC dug pits using a backhoe to a depth of three to four feet. Walsh personnel visited the site on March 5, 2008 and described soil color, texture, percent coarse fraction (gravel, cobbles, stones, and boulders), and hardness. Information was recorded into a field notebook and transferred to Table 2. No boulders (>25 inches) were observed in any soil pit.

Soil samples were obtained from the upper two feet of the exposed soil. Samples from the prime farmland area and select samples from the non-prime farmland area were sent to Servi-Tech Laboratories of Hastings, Nebraska for pH, texture, calcium carbonate, and exchangeable sodium percentage (ESP) and other analyses. Laboratory results are summarized in Table 2. Selected lab analyses were based on discussions with David Dearstyne of the NRCS Montrose office. Mr. Dearstyne stated in an email dated February 20, 2008 that soil deeper than 24 inches in prime farmland should be tested for these parameters and compared to standards (shown on Table 2). If the soil is within these criteria it would provide suitable subsoil (copy of email correspondence is attached).

USDA criteria for prime farmland state that the total topsoil plus subsoil depth must equal or exceed 40 inches. These criteria were used to modify the soil suitability criteria table (Table 2.04.9-2) in the DRMS permit.

All soil samples during the March 5 sampling event were within suitable ranges for selected analytes and field parameters. The upper two feet of subsoil was investigated, but there was no change observed to the total soil pit depth in any soil pit, suggesting that the soil suitability criteria would be met in the three to four feet of observed subsoil at all or most sampling locations.

Re-sampling for pH and Electrical Conductivity

Comments from the DRMS in a letter dated May 28, 2008 revealed that the March 5 subsoil analyses utilized 1:1 extract for the soil pH and electrical conductivity (EC), rather than the permit-required paste method for these analytes. Walsh discussed the situation with DRMS and NRCS personnel and determined that there is a proportional relationship between 1:1 extract and paste extract EC results. A published formula was applied to the 1:1 EC results, and revealed that up to four sample points may exceed the paste EC criteria of 4.0 (samples 21, 26, 32, and 33). Based on this, the eight sample points that had 1:1 EC higher than 1.2 were resampled and analyzed for paste EC (Table 2). WFC personnel resampled soil at the original sampling points using a 2" hand auger for a total depth of 24". A fraction of the extracted sample was placed in a zip-loc bag and shipped to Servi-Tech Labs of Hastings, Nebraska. The sampling points were located with a survey-grade GPS to match the March 5, 2008 sampling points. The sampled areas had not yet had topsoil placed at the time of sampling.

Of the eight samples obtained, two exceeded the topsoil permit criteria of 4. These were sample 21 with a paste EC of 4.34 and sample 32 with a paste EC of 7.33. The sample 32 location is near a top-soil pile, which may have affected this location. The samplers noted that as many as five attempts were made at sample 32 to get a complete hole due to refusal of the hand auger. This suggests that sample 32 may not be representative of the subsoil in the area.

Discussion

The original soil survey (Intermountain Resource Inventories, Inc., 1998) performed laboratory analyses on three soil profiles within the prime farmland unit south of BB Road. Of these three, four individual soil horizons from the approximately 24-48 inch subsoil interval were analyzed. Paste EC ranged from 0.7 to 3.8, with an average of 1.9. Percent $CaCO_3$ ranged from 3 to 36%, with an average of 17%. No cobbles, stones, or boulders were observed in the horizons, and lab analysis of gravel ranged from 9.1 to 31.5%, with an average gravel content of 20.7%. This indicates that the replacement subsoil has higher average paste EC (3.1%), lower $CaCO_3$ (2%-4%), and lower coarse fraction (11.7%) than the original tested subsoil. Sample averages are shown on tables 1 and 2.

Walsh discussed the impact of EC on crops with Mr. Dave Dearstyne of the NRCS, who indicated that crops are more sensitive to elevated EC in topsoil than in subsoil. Elevated EC in subsoil can impact established crops but not establishing crops, and established crops are generally more tolerant of elevated EC than establishing crops. Mr. Dearstyne stated that subsoil with a paste EC up to 6 would not be detrimental to grasses or alfalfa. As such, establishing a paste EC criterion of 6 for subsoil in prime farmland for the permit may be appropriate.

The bench 1 material that has been used as top dressing prior to soil placement has characteristics of suitable subsoil for use during reclamation, with the exception of elevated EC at one or two locations. There is sufficient bench 1 material available to provide 24 inches or more top dressing across the prime farmland areas that have been mined as of February 14, 2008. There may be sufficient bench 1 material to also place at least 12 inches on the non-prime farmland areas for use as suitable subsoil.

Please contact me at (970) 241-4636 if you have any questions on this matter. Thank you for selecting Walsh for your project.

Sincerely,
Walsh Environmental Scientists & Engineers, LLC

Edward M. Baltzer, CPG, CHMM
District Manager

Attachments:
- Figure 1
- Photos
- Tables
- Laboratory analytical data
- NRCS email

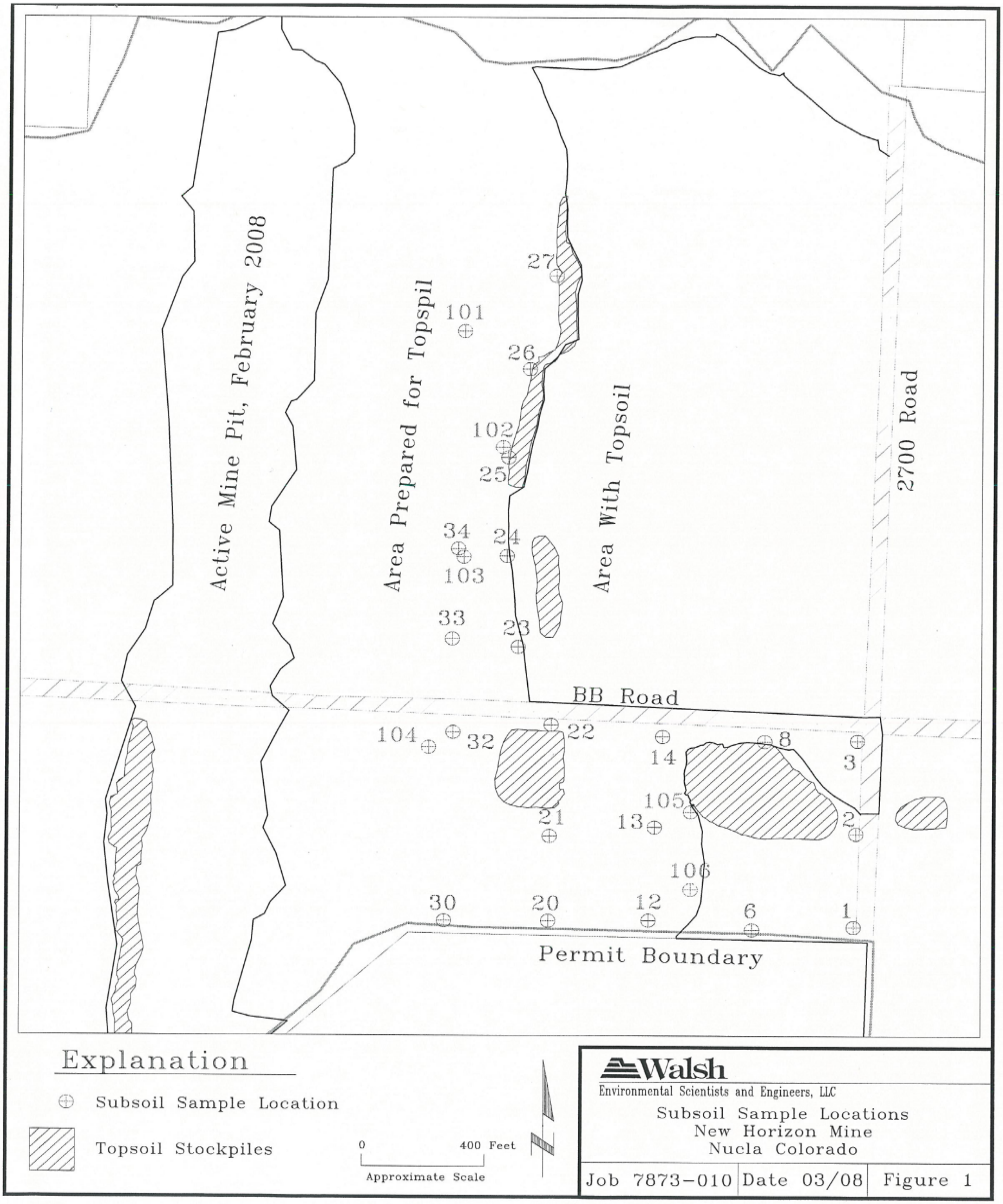
Active Mine Pit, February 2008
Area Prepared for Topspil
Area With Topsoil
2700 Road
BB Road
Permit Boundary
27
101
26
102
25
34
24
103
33
23
104
32
22
14
8
3
105
13
21
2
106
30
20
12
6
1
Explanation
Subsoil Sample Location
Topsoil Stockpiles
0
400 Feet
Approximate Scale
Walsh
Environmental Scientists and Engineers, LLC
Subsoil Sample Locations
New Horizon Mine
Nucla Colorado
Job 7873-010
Date 03/08
Figure 1

Photo 1: View of mine face showing Bench 1 material (upper face) and lower overburden material.

Photo 2: Bench 1 cut face cross-section; face is about 20 feet high.

Table 1 - Subsoil Sample Results, January 31, 2008

Sample	pH	EC	Saturation	SAR	CaCO3	SE	Texture
	(unitless)	mmhos/cm	(percent)	(unitless)	(percent)	(ppm)	(lab)
CRITERIA*	**6.1-8.4**	**0-4.0**	**25-80**	**0-4.0**	**0-15.0**	**0-2.0**	**
44946 (101)	8.0	2.9	55.0	1.7	2.1	<1.0	SCL
44947 (102)	7.8	3.3	53.0	0.9	2.0	<1.0	SCL
44948 (103)	7.9	2.4	56.0	0.7	1.3	<1.0	SCL
44949 (104)	7.7	3.5	45.0	0.9	2.9	<1.0	SCL
44950 (105)	7.6	**4.1**	63.0	0.9	1.4	<1.0	SCL
44951 (106)	8.0	2.3	42.0	1.0	2.2	<1.0	SCL
Average	7.8	3.1	52.3	1.0	2.0	<1.0	SCL

Notes:
Bold indicates exceedance of suitability criteria
* Based on Table 2.04.9-2 Criteria for Evaluating Soil Suitability
** All soil types are acceptable except for s, 1s, sc, sic, & c
NA indicates that sample was not analyzed for specific parameter
Sample numbers in parentheses are numbers shown on Figure 1

Table 2 - Subsoil Sample Results, March 5 and June 25, 2008

Sample	pH	Colors	1:1 EC	Paste EC	texture field*	texture lab*	ESP	% $CaCO_3$	%Gravel (2mm-3")	%Cobbles (3"-10")	%Stones (10"-25")	%Rock Frag's	Consistence
1	7.9	10YR 2/1; 10YR 6/3; 10YR 6/4	1.36	2.72	SCL	SCL	2	6.1	5	10	0	15	S/VH
2	8	10YR 5/2	1		SCL	SCL	2	1.7	3	5	0	8	S/H
3	7.6	NA	1.07		CL	SCL	1	1.3	20	2	1	23	
6	8.2	2.5YR 4/4; 7.5YR 4/1;7.5YR 7/3	0.52		NA	SCL	1	12.8	2	2	0	4	EH
8	7.9	7.5YR 4/4; 10YR 2/1	1.08		CL	SCL	1	2.5	10	5	1	16	L
12	8.1	10YR 3/1; 10YR 6/6	0.72		SL	SL	1	10.1	5	2	0	7	S/R
13	7.8	varied	0.94		L	SCL	1	3.8	5	10	2	17	HA
14	8.2	10YR 5/6	0.55		NA	SL	1	1.8	10	15	5	30	L
20	7.9	7.5YR 4/4; 7.5YR 3/1	1.36	3.43	SCL	SCL	1	11.9	5	4	0	9	SH/EH
21	8	3.5YR 4/3; 10YR 5/2	2.19	**4.34**	CL	SCL	1	2.5	2	2	0	4	SH
22	7.9	5YR 5/4; 10YR 5/6; 10YR 3/1	1.24	3.99	SL	SL	1	5.7	5	5	1	11	VH
23	7.9	NA	1.22	3.86	NA	SCL	1	2	5	5	2	12	SH
24	7.9	NA	0.85		NA	SL	1	4.5	5	5	1	11	HA
25	8.3	10YR 4/4; 10YR 8/1	0.33		SiL	SCL	2	1	5	15	2	22	HA
26	7.8	NA	1.64	3.66	NA	SCL	1	3.3				0	
27	8.2	104R 4/2	0.42		SCL	SCL	1	1.8	3	3	1	7	S/VH
30	7.9	10YR 4/3; 10YR 4/4; 5YR 5/3	1.03		CL	SCL	1	5.3	2	1	0	3	MH
32	8	10YR 2/1; 10YR 7/6; 10YR 3/1	1.54	**7.33**	CL	SCL	3	2.5	10	5	1	16	HA
33	7.9	NA	1.71	3.97	NA	SCL	1	4.8	5	5	1	11	MH
34	8	5YR 5/8	1.14		CL	SCL	1	4.2	5	2	0	7	SH
Average	7.97		1.1				1.25	4.48	5.89	5.42	0.95	11.65	
Suitability	4.5-8.4	none		< 4	* s, ls, sc, sic, c		<15%	<40%	total < 50%; <25% ave				

Notes: Soils compared to the USDA Soil Classification System; refer to this system for definition of terms and abbreviations
Suitability based on Table 2.04.9-2 *Criteria for Evaluating Soil Suitability*
* All soil types are acceptable except for s, ls, sc, sic, & c
NA indicates that sample was not analyzed for specific parameter
Not all analytical data are shown; see attached lab data sheets for additional analytes
No boulders were observed in any soil pit; as such they are not shown in this table.
Coarse fragment values are based on visual estimate of cobble and stone volume and on sieve volume estimate of gravel.

SOIL ANALYSIS REPORT

WESTERN FUELS-COLORADO
NEW HORIZON MINE
PO BOX 628
NUCLA, CO 81424

Servi-Tech Laboratories
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Hastings, NE 68902
800.557.7509
402.463.3522
Fax 402.463.8132

LAB NO:	44946 ·
INVOICE NO:	672153
DATE RECEIVED:	02/01/2
DATE REPORTED:	02/08/2

YSIS RESULTS FOR: WESTERN FUELS-COLORADO

FIELD IDENTIFICATION:

SED:

mple ID	Sample Depth	1:1 Water-Soil Soil pH	Buffer pH	1:1 Water-Soil Sol. Salts mmho/cm	Excess Lime	Mod. WB % Organic Matter	Cd Reduction Nitrate-Nitrogen ppm	Cd Reduction Nitrate-Nitrogen lb. N/A	Mehlich 3 Phosphorus ppm P	Potassium ppm K	Sulfur ppm	Sulfur lb. S/A	Ammonium Acetate Calcium ppm Ca	Ammonium Acetate Magnesium ppm Mg	Ammonium Acetate Sodium ppm Na	Zinc ppm Zn	Iron ppm Fe	Manganese ppm Mn	Cc pp
-01	0 - 0	8.0		1.08	Hi	0.2	2	0	5	141	469	<1	3962	984	138				
-02	0 - 0	7.8		1.74	Hi	0.4	3	0	4	134	1240	<1	4738	711	83				
-03	0 - 0	7.9		0.77	Lo	0.3	3	0	4	127	352	<1	3508	741	60				
-04	0 - 0	7.7		1.29	Hi	0.3	<1	<0	6	75	1440	<1	5162	542	69				
-05	0 - 0	7.6		1.94	Lo	0.4	3	0	6	142	2660	<1	4518	1254	101				
-06	0 - 0	8.0		0.73	Hi	0.3	2	0	5	88	214	<1	3721	469	69				

SED:

ple	Sample Depth	Soil Textural Classification	Hydrometer Sand %	Hydrometer Silt %	Hydrometer Clay %	0.4 N Acetic Acid CaCO3 %	Sat. Paste Saturation % Moist.	Soil pH	Electrical Conductivity mmho/cm	Calcium mg/L Ca	Magnesium mg/L Mg	Sodium mg/L Na	Sodium Adsorption Ratio				
-01	0 - 0	Sandy Clay Loam	58	14	28	2.1	55	7.8	2.86	410	210	167	1.67				
-02	0 - 0	Sandy Clay Loam	60	16	24	2.0	53	7.87	3.29	590	250	108	0.94				
-03	0 - 0	Sandy Clay Loam	58	16	26	1.3	56	7.73	2.36	370	170	62	0.67				
04	0 - 0	Sandy Clay Loam	68	12	20	2.9	45	7.55	3.60	560	340	108	0.89				
05	0 - 0	Sandy Clay Loam	51.9	16.1	32	1.4	63	7.57	4.09	530	490	118	0.89				
06	0 - 0	Sandy Clay Loam	64	16	20	2.2	42	7.84	2.29	360	150	88	0.98				

RECOMMENDATIONS:

POUNDS ACTUAL NUTRIENT PER ACRE

le	Crop To Be Grown	Yield Goal	Lime, ECC Tons/A to raise pH to: 6.0	6.5	7.0	N	P_2O_5	K_2O	Zn	S	Mn	Cu	MgO	B	Ca	Cl
01																
02																
03																
04																
05																
06																

Cation Ex Capac

CEC	%H	%K	%
29	0	1	
30	0	1	
24	0	1	
31	0	1	
34	0	1	
23	0	1	

presentative of the samples submitted   Samples are retained 30 days after report of analysis   Explanations of soil analysis terms are available upor

Reviewed and Approved By: Hans Burken, Agronomist

Page ·
02/08/2008

SOIL ANALYSIS REPORT

CLIENT: 21490	WESTERN FUELS-COLORADO LLC. NEW HORIZON MINE 27646 W 5TH AVE PO BOX 628 NUCLA, CO 81424-0628

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Hastings, NE 68902
800.557.7509
402.463.3522
Fax 402.463.8132

LAB NO:	48981 - 48990
INVOICE NO:	672472
DATE RECEIVED:	03/12/2008
DATE REPORTED:	03/19/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO — FIELD IDENTIFICATION: MORGANS PRIME FARMLAND

METHOD USED:			1:1 Water-Soil		1:1 Water-Soil						Ammonium Acetate										
Lab Number	Sample ID	Sample Depth	Soil pH	Buffer pH	Sol. Salts mmho/cm	Excess Lime	% Organic Matter			Phosphorus ppm P	Potassium ppm K	Sulfur ppm	Sulfur lb. S/A	Calcium ppm Ca	Magnesium ppm Mg	Sodium ppm Na	Zinc ppm Zn	Iron ppm Fe	Manganese ppm Mn	Copper ppm Cu	Boron ppm B
48981	SS-01	0 - 24	7.9		1.36	Hi					140	1030	7420	5028	565	114					
48982	SS-02	0 - 24	8.0		1.00	Lo					102	970	6980	3716	725	94					
48983	SS-03	0 - 24	7.6		1.07	Lo					119	1920	13800	4000	1186	80					
48984	SS-06	0 - 24	8.2		0.52	Hi					128	260	1870	4701	466	57					
48985	SS-08	0 - 24	7.9		1.08	Lo					114	940	6770	4128	776	72					
48986	SS-12	0 - 24	8.1		0.72	Hi					73	790	5690	4574	380	36					
48987	SS-13	0 - 24	7.8		0.94	Hi					105	1460	10500	5077	626	57					
48988	SS-14	0 - 24	8.2		0.55	Lo					51	225	1620	2488	254	48					
48989	SS-20	0 - 24	7.9		1.36	Hi					140	1020	7340	5399	819	70					
48990	SS-21	0 - 24	8.0		2.19	Lo					126	4370	31500	8220	850	107					

METHOD USED:				Hydrometer			0.4 N Acetic Acid	Sat. Paste				
Lab Number	Sample ID	Sample Depth	Soil Textural Classification	Sand %	Silt %	Clay %	CaCO3 %	Saturation % Moist.	Calcium mg/L Ca	Magnesium mg/L Mg	Sodium mg/L Na	Sodium Adsorption Ratio
48981	SS-01	0 - 24	Sandy Clay Loam	60	20	20	6.1	41	510	230	167	1.54
48982	SS-02	0 - 24	Sandy Clay Loam	60.1	14.9	25	1.7	42	470	320	136	1.19
48983	SS-03	0 - 24	Sandy Clay Loam	54	18	28	1.3	46	480	500	106	0.81
48984	SS-06	0 - 24	Sandy Clay Loam	60	16	24	12.8	38	300	108	62	0.78
48985	SS-08	0 - 24	Sandy Clay Loam	60	16	24	2.5	40	480	320	94	0.82
48986	SS-12	0 - 24	Sandy Loam	70	16	14	10.1	34	500	180	54	0.53
48987	SS-13	0 - 24	Sandy Clay Loam	57.9	18.1	24	3.8	41	440	270	74	0.68
48988	SS-14	0 - 24	Sandy Loam	76	10	14	1.8	34	233	101	57	0.78
48989	SS-20	0 - 24	Sandy Clay Loam	54.1	16	29.9	11.9	49	470	250	80	0.74
48990	SS-21	0 - 24	Sandy Clay Loam	58	18	24	2.5	47	470	380	142	1.18

Analyses are representative of the samples submitted. Samples are retained 30 days after report of analysis. Explanations of soil analysis terms are available upon request.

Reviewed and Approved By: Hans Burken, Agronomist

SOIL ANALYSIS REPORT

CLIENT: 21490

WESTERN FUELS-COLORADO LLC.
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402.463.3522
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LAB NO:	48981 - 48990
INVOICE NO:	672472
DATE RECEIVED:	03/12/2008
DATE REPORTED:	03/19/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO **FIELD IDENTIFICATION:** MORGANS PRIME FARMLAND

FERTILIZER RECOMMENDATIONS: POUNDS ACTUAL NUTRIENT PER ACRE — Cation Exchange Capacity

Lab Number	Sample ID	Crop To Be Grown	Yield Goal	Lime, ECC Tons/A to raise pH to: 6.0	6.5	7.0	N	P_2O_5	K_2O	Zn	S	Mn	Cu	MgO	B	Ca	Cl	CEC	%H	%K	%Ca	%Mg	%Na
48981	SS-01																	31		1	82	15	2
48982	SS-02																	25		1	73	24	2
48983	SS-03																	31		1	65	32	1
48984	SS-06																	28		1	84	14	1
48985	SS-08																	28		1	74	23	1
48986	SS-12																	26		1	87	12	1
48987	SS-13																	31		1	82	17	1
48988	SS-14																	15		1	84	14	1
48989	SS-20																	34		1	78	20	1
48990	SS-21																	49		1	84	14	1

SPECIAL COMMENTS AND SUGGESTIONS:

Lab Number(s):48981, 48989, 48990
WARNING: Soluble salts level indicates potential salinity problems. Please call if you wish us to run a soil salinity test or for additional information.

Lab Number(s):48981, 48982, 48983, 48984, 48985, 48986, 48987, 48988, 48989, 48990
CEC calculated by cation summation may overestimate true CEC and underestimate exchangeable sodium percentage (ESP) in soils containing excess lime.

Lab Number(s):48981, 48982, 48983, 48984, 48985, 48986, 48987, 48988, 48989, 48990
Servi-Tech Laboratory fertilizer recommendations were not requested.

SOIL ANALYSIS REPORT

CLIENT: 21490	WESTERN FUELS-COLORADO LLC. NEW HORIZON MINE 27646 W 5TH AVE PO BOX 628 NUCLA, CO 81424-0628

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800.557.7509
402.463.3522
Fax 402.463.8132

LAB NO:	48991 - 49000
INVOICE NO:	672472
DATE RECEIVED:	03/12/2008
DATE REPORTED:	03/19/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO FIELD IDENTIFICATION: MORGANS PRIME FARMLAND

METHOD USED:

			1:1 Water-Soil		1:1 Water-Soil						Ammonium Acetate										
Lab Number	Sample ID	Sample Depth	Soil pH	Buffer pH	Sol. Salts mmho/cm	Excess Lime	% Organic Matter			Phosphorus ppm P	Potassium ppm K	Sulfur ppm	Sulfur lb. S/A	Calcium ppm Ca	Magnesium ppm Mg	Sodium ppm Na	Zinc ppm Zn	Iron ppm Fe	Manganese ppm Mn	Copper ppm Cu	Boron ppm B
48991	SS-22	0 - 24	7.9		1.24	Hi					81	1110	7990	4795	402	62					
48992	SS-23	0 - 24	7.9		1.22	Lo					92	2000	14400	4945	550	78					
48993	SS-24	0 - 24	7.9		0.85	Hi					81	1080	7780	4930	332	49					
48994	SS-25	0 - 24	8.3		0.33	Lo					137	84	605	2997	758	89					
48995	SS-26	0 - 24	7.8		1.64	Lo					170	2290	16500	6360	1313	83					
48996	SS-27	0 - 24	8.2		0.42	Lo					126	97	698	3206	568	61					
48997	SS-30	0 - 24	7.9		1.03	Hi					141	650	4680	5038	567	69					
48998	SS-32	0 - 24	8.0		1.54	Lo					130	1850	13300	4430	823	204					
48999	SS-33	0 - 24	7.9		1.71	Hi					95	2520	18100	6680	806	99					
49000	SS-34	0 - 24	8.0		1.14	HI					104	1470	10600	5465	623	60					

METHOD USED:

				Hydrometer			0.4 N Acetic Acid	Sat. Paste				
Lab Number	Sample ID	Sample Depth	Soil Textural Classification	Sand %	Silt %	Clay %	CaCO3 %	Saturation % Moist.	Calcium mg/L Ca	Magnesium mg/L Mg	Sodium mg/L Na	Sodium Adsorption Ratio
48991	SS-22	0 - 24	Sandy Loam	70.1	13.9	16	5.7	34	450	190	86	0.86
48992	SS-23	0 - 24	Sandy Clay Loam	64.9	15.1	20	2.0	35	460	280	111	1.01
48993	SS-24	0 - 24	Sandy Loam	68	16	16	4.5	31	500	160	67	0.67
48994	SS-25	0 - 24	Sandy Clay Loam	54.1	15.9	30	1.0	51	90	40	59	1.30
48995	SS-26	0 - 24	Sandy Clay Loam	51.9	20.1	28	3.3	48	400	350	82	0.72
48996	SS-27	0 - 24	Sandy Clay Loam	56	16	28	1.8	52	110	40	43	0.89
48997	SS-30	0 - 24	Sandy Clay Loam	56	19	25	5.3	40	500	170	85	0.84
48998	SS-32	0 - 24	Sandy Clay Loam	59.9	18.1	22	2.5	42	450	340	330	2.86
48999	SS-33	0 - 24	Sandy Clay Loam	62	13	25	4.8	38	450	350	139	1.19
49000	SS-34	0 - 24	Sandy Clay Loam	62	16	22	4.2	35	450	250	72	0.67

Analyses are representative of the samples submitted Samples are retained 30 days after report of analysis Explanations of soil analysis terms are available upon request

Reviewed and Approved By: Hans Burken Agronomist

SOIL ANALYSIS REPORT

CLIENT: 21490	WESTERN FUELS-COLORADO LLC. NEW HORIZON MINE 27646 W 5TH AVE PO BOX 628 NUCLA, CO 81424-0628

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800.557.7509
402.463.3522
Fax 402.463.8132

LAB NO:	48991 - 49000
INVOICE NO:	672472
DATE RECEIVED:	03/12/2008
DATE REPORTED:	03/19/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO **FIELD IDENTIFICATION:** MORGANS PRIME FARMLAND

FERTILIZER RECOMMENDATIONS: POUNDS ACTUAL NUTRIENT PER ACRE — Cation Exchange Capacity

Lab Number	Sample ID	Crop To Be Grown	Yield Goal	Lime, ECC Tons/A to raise pH to: 6.0	6.5	7.0	N	P_2O_5	K_2O	Zn	S	Mn	Cu	MgO	B	Ca	Cl	CEC	%H	%K	%Ca	%Mg	%Na
48991	SS-22																	28		1	86	12	1
48992	SS-23																	30		1	83	15	1
48993	SS-24																	28		1	89	10	1
48994	SS-25																	22		2	68	29	2
48995	SS-26																	44		1	73	25	1
48996	SS-27																	21		2	75	22	1
48997	SS-30																	31		1	82	15	1
48998	SS-32																	30		1	73	23	3
48999	SS-33																	41		1	82	16	1
49000	SS-34																	33		1	83	16	1

SPECIAL COMMENTS AND SUGGESTIONS:

Lab Number(s):48991, 48992, 48993, 48994, 48995, 48996, 48997, 48998, 48999, 49000
CEC calculated by cation summation may overestimate true CEC and underestimate exchangeable sodium percentage (ESP) in soils containing excess lime.

Lab Number(s):48991, 48992, 48993, 48994, 48995, 48996, 48997, 48998, 48999, 49000
Servi-Tech Laboratory fertilizer recommendations were not requested.

Lab Number(s):48995, 48998, 48999
WARNING: Soluble salts level indicates potential salinity problems. Please call if you wish us to run a soil salinity test or for additional information.

Analyses are representative of the samples submitted. Samples are retained 30 days after report of analysis. Explanations of soil analysis terms are available upon request.

Reviewed and Approved By: Hans Burken, Agronomist

Edward Baltzer

From: Dearstyne, David - Montrose, CO [David.Dearstyne@co.usda.gov]
Sent: Wednesday, February 20, 2008 10:47 AM
To: Edward Baltzer
Cc: Boyd, Jim - Norwood, CO; fcompton@walshenv.com; rgubka@wfcnucla.org
Subject: RE: New Horizon Mine

Hi Edward,

I could suggest sampling for the following items, pH, EC, texture estimate (using the ribbon or similar method), soil color, effervescence (presence or absence of carbonates), estimate of % RF's (rock fragments) - sizes and amount by volume. I would split any layers within this subsoil that are contrasting (came form different replacements) in any of these characteristics. If your sample indicates significant effervescence using HCL (1N), or visual observations of significant calcium carbonate (masses, threads, coats on frags) you may opt to collect a sample and run a calcimeter to determine the $CaCO_3$ equivalent. This is a simple test that usually takes about 3 to 5 minutes to run and requires just a couple of test items and chemicals (10% HCL). It is usually run inside. This is a more comprehensive list. If you just wanted to describe essentials only, they would be in my estimation texture, pH, EC if pH is above 8.4, and amount and sizes of RF's.

Using this information, you can then compare to the requirements for Prime Farmland and to the soil descriptions of the original soils found on the site (In this case the Barx or Devinny soils). You also have the data collected by Intermountain Resources to help you as a baseline for comparison. I would suggest keeping in mind some of the conversations we had during our meeting on the 15th, when comparing the replaced subsoil with the PF requirements. For most agricultural uses, the topsoil is much more significant than the subsoil (though in our conversations you can't assume that anything replaced will suffice for subsoil requirements). Hope this helps. If you have difficulties developing a list of parameters for subsoil replacement characteristics using this information, please feel free to contact me and we can discuss this further.

Dave

From: Edward Baltzer [mailto:ebaltzer@walshenv.com]
Sent: Monday, February 18, 2008 9:50 AM
To: Dearstyne, David - Montrose, CO
Cc: fcompton@walshenv.com; rgubka@wfcnucla.org
Subject: New Horizon Mine

Dear David:

We are proposing to sample the top two feet of subsoil that has been placed over the 98E (Prime Farmland) mined portion of the New Horizon Mine. It will have approximately two feet of reclaimed topsoil placed over it.

Please provide an analyte list that you think is appropriate to determine if the placed suboil is appropriate for the lower horizons of soil. THank you for your time.

Sincerely,

Edward M. Baltzer
Walsh Environmental Scientists & Engineers, LLC
535 Grand Avenue
Grand Junction, Colorado 81501-2790
(970) 241-4636
ebaltzer@walshenv.com

3/17/2008

Resampling of Suitable Subsoil on Prime Farmland Soil Areas and Corresponding Results

As is seen from the lab results of 6/27/08, eight samples were re-run based on saturation paste extract for conductivity in the placed subsoil in prime farmland soils prior to February 2008. Seven of these samples were acceptable, as seen in the included lab sheet, page Attachment 2.05.4(2)(d)-1-14 . One sample, #32, still showed a high level of 7.33 mmhos/cm. Surrounding samples were then taken according to the procedures outlined in the approved permit at the time. The surrounding remediation test samples (4) around site #32 passed. See lab results on page Attachment 2.05.4(20(d)-1-19&20. Since the surrounding test sites passes, no further testing or action was needed for that site.

Sample site #32 will be resampled under the new second phase sampling procedures outlined in Permit Revision 06, and will be remediated if necessary.

There was some question about sample site #21 being elevated, so four more remediation test samples were taken and those passed as well. See lab results on page Attachment 2.05.4(2)(d)-1-19&20. The results on the following pages all show acceptable results in the surrounding area.

SOIL ANA /SIS REPORT

CLIENT:	
21490	WESTERN FUELS-COLORADO LLC. NEW HORIZON MINE 27646 W 5TH AVE PO BOX 628 NUCLA, CO 81424-0628

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LAB NO:	59586 - 59593
INVOICE NO:	673621
DATE RECEIVED:	08/18/2008
DATE REPORTED:	08/26/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO **FIELD IDENTIFICATION:**

METHOD USED:

Lab Number	Sample ID	Sample Depth	Soil pH	Buffer pH	Sol. Salts mmho/cm	Excess Lime	% Organic Matter	Phosphorus ppm P	Potassium ppm K (Ammonium Acetate)	Sulfur ppm	Sulfur lb. S/A	Calcium ppm Ca (Ammonium Acetate)	Magnesium ppm Mg (Ammonium Acetate)	Sodium ppm Na (Ammonium Acetate)	Zinc ppm Zn	Iron ppm Fe	Manganese ppm Mn	Copper ppm Cu	Boron ppm B
59586	SS-21WEST	0 - 24							71	1911	13800	5870	380	62					
59587	SS-21EAST	0 - 24							87	1493	10800	4419	551	101					
59588	SS-21NORTH	0 - 24							103	4251	30600	48240	750	93					
59589	SS-21SOUTH	0 - 24							65	1516	10900	4056	495	96					
59590	SS-32NORTH	0 - 24							75	1036	7460	5770	428	51					
59591	SS-32WEST	0 - 24							86	1473	10600	4747	652	161					
59592	SS-32EAST	0 - 24							64	973	7010	4169	429	85					
59593	SS-31	0 - 24							67	2365	17000	6181	455	151					

METHOD USED:

Lab Number	Sample ID	Sample Depth	Soil Textural Classification	Sand % (Hydrometer)	Silt % (Hydrometer)	Clay % (Hydrometer)	$CaCO_3$ % (0.4 N Acetic Acid)	Saturation % Moist. (Sat. Paste)	Soil pH (Sat. Paste)	Electrical Conductivity mmho/cm (Sat. Paste)	Calcium mg/L Ca (Sat. Paste)	Magnesium mg/L Mg (Sat. Paste)	Sodium mg/L Na (Sat. Paste)	Sodium Adsorption Ratio (Sat. Paste)
59586	SS-21WEST	0 - 24	Sandy Loam	69	12	19	2.1	39	7.68	3.23	910	390	75	0.52
59587	SS-21EAST	0 - 24	Sandy Clay Loam	63	16	21	1.6	38	7.5	3.58	590	290	101	0.85
59588	SS-21NORTH	0 - 24	Sandy Clay Loam	63	12	25	2.7	41	7.78	4.00	590	440	92	0.70
59589	SS-21SOUTH	0 - 24	Sandy Clay Loam	65	14	21	1.7	38	7.68	3.49	580	300	104	0.87
59590	SS-32NORTH	0 - 24	Sandy Clay Loam	64	15	21	4.4	38	7.8	3.04	640	216	47	0.41
59591	SS-32WEST	0 - 24	Sandy Clay Loam	64	15	21	1.8	43	7.76	3.92	570	370	160	1.28
59592	SS-32EAST	0 - 24	Sandy Loam	69	12	19	2.4	42	7.8	3.27	590	260	85	0.73
59593	SS-31	0 - 24	Sandy Loam	69	12	19	2.3	39	7.81	3.68	560	290	172	1.47

Analyses are representative of the samples submitted   Samples are retained 30 days after report of analysis   Explanations of soil analysis terms are available upon request

Reviewed and Approved By: Hans Burken, Agronomist

SOIL ANA YSIS REPORT

CLIENT: 21490	WESTERN FUELS-COLORADO LLC. NEW HORIZON MINE 27646 W 5TH AVE PO BOX 628 NUCLA, CO 81424-0628

Servi-Tech Laboratories
www.servitechlabs.com

1602 Park West Drive
PO Box 169
Hastings, NE 68902
800.557.7509
402.463.3522
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LAB NO:	59586 - 59593
INVOICE NO:	673621
DATE RECEIVED:	08/18/2008
DATE REPORTED:	08/26/2008

SOIL ANALYSIS RESULTS FOR: WESTERN FUELS-COLORADO **FIELD IDENTIFICATION:**

FERTILIZER RECOMMENDATIONS: POUNDS ACTUAL NUTRIENT PER ACRE

Lab Number	Sample ID	Crop To Be Grown	Yield Goal	Lime, ECC Tons/A to raise pH to:			N	P_2O_5	K_2O	Zn	S	Mn	Cu	MgO	B	Ca	Cl	Cation Exchange Capacity					
				6.0	6.5	7.0												CEC	%H	%K	%Ca	%Mg	%Na
59586	SS-21WEST																	33		1	89	10	1
59587	SS-21EAST																	27		1	81	17	2
59588	SS-21NORTH																	248		0	97	3	0
59589	SS-21SOUTH																	25		1	81	17	2
59590	SS-32NORTH																	33		1	88	11	1
59591	SS-32WEST																	30		1	79	18	2
59592	SS-32EAST																	25		1	84	14	1
59593	SS-31																	36		0	87	11	2

SPECIAL COMMENTS AND SUGGESTIONS:

Lab Number(s):59586, 59587, 59588, 59589, 59590, 59591, 59592, 59593

Servi-Tech Laboratory fertilizer recommendations were not requested.

Analyses are representative of the samples submitted   Samples are retained 30 days after report of analysis   Explanations of soil analysis terms are available upon request

Reviewed and Approved By: Hans Burken, Agronomist

Attachment 2.05.4(2)(d)-2

Attachment 2.05.4(2)(d)-2

Salt Tolerance of Plants

Electric Conductivity (EC)

Electric Conductivity (EC) of plants.

An internet search on plant tolerance of Electric Conductivity (EC) was performed and the Alberta Canada Agriculture and Rural Development paper on Salt Tolerance of Plants study appeared. **(http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex3303)**. Within this document the author stated on page 1, Table 2 that Alfalfa, Birdsfoot Trefoil, and Bromegrass forage had a salt tolerance $EC_{ds/m}$ value of 8. Tall Wheatgrass, Russian Wildrye and Slender Wheatgrass had a salt tolerance $EC_{ds/m}$ of 16 and Crested Wheatgrass and Intermediate Wheatgrass had a Moderate ($Ec_{ds/m}$=4).

`

A second internet search from Colorado State University revealed the conversion between $EC_{cds/m}$ and $EC_{SP\ (mmho/cm)}$. The conversion is a 1:1. See below:

(http://www.ext.colostate.edu/PUBS/crops/00506.html)

Agriculture and Rural Development

Search

Alberta.ca > Agriculture and Rural Development

Salt Tolerance of Plants

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Plant species vary in how well they tolerate salt-affected soils. Some plants will tolerate high levels of salinity while others can tolerate little or no salinity. The relative growth of plants in the presence of salinity is termed their salt tolerance.

Salt tolerances are usually given in terms of the stage of plant growth over a range of electrical conductivity (EC) levels. Electrical conductivity is the ability of a solution to transmit an electrical current. To determine soil salinity EC, an electrical current is imposed in a glass cell using two electrodes in a soil extract solution taken from the soil being measured (soil salinity). The units are usually given in deciSiemens per metre (dS/m).

Table 1 categorizes salinity into general ranges from non- saline to very strongly saline. These values are used for plant selection for saline soils. Salinity levels vary widely across a saline seep. Salinity also varies from spring to fall. Salinity usually appears on the soil surface just after spring thaw.

A high salt level interferes with the germination of new seeds. Salinity acts like drought on plants, preventing roots from performing their osmotic activity where water and nutrients move from an area of low concentration into an area of high concentration. Therefore, because of the salt levels in the soil, water and nutrients cannot move into the plant roots.

As soil salinity levels increase, the stress on germinating seedlings also increases. Perennial plants seem to handle salinity better than annual plants. In some cases, salinity also has a toxic effect on plants because of the high concentration of certain salts in the soil. Salinity prevents the plants from taking up the proper balance of nutrients they require for healthy growth.

Extensive research on salt tolerance for prairie conditions was done in 1988 (Table 2). It should be noted that crop tolerances developed for chloride-dominated soils, such as those in California, may not be applicable to crops grown on the sulphate-dominated soils typically found in western Canada.

Table 1. Salinity rating and electrical conductivity value

Soil Depth	Non-Saline	Weakly Saline	Moderately Saline	Strongly Saline	Very Strongly Saline
0-60 cm (0-2 ft)	<2 ds/m*	2-4 ds/m	4-8 ds/m	8-16 ds/m	>16 ds/m
60-120 cm(2-4 ft)	<4 ds/m	4-8 ds/m	8-16 ds/m	16-24 ds/m	>24 ds/m

* ds/m = decisiemens per metre.

The dominant salts in prairie saline seeps are calcium (Ca), magnesium (Mg), sodium (Na) cations and sulfate (SO4) anions. If Na levels are high or not balanced with the Ca and Mg, soil tilth can also be effected. The positively charged Na cations attach to the negatively charged clay particles in the soil, causing the soil to be sticky when wet, and hard and impermeable when dry.

Table 2 gives salinity tolerance ratings for a range of plant species and a range of salinity levels. New research underway may modify the rating of some plant types. As a general rule, plants that have low drought tolerance will have low salinity tolerance.

Table 2. Salt tolerance of various types of plants

Salt Tolerance EC (ds/m)	Field Crops	Forages	Vegetables	Trees, Shrubs
Very High 20		beardless wildrye fulks altai grass levonns alkaligrass alkali sucatan		
High 16	kochia sugar beets	altai wildrye tall wheatgrass Russian wildrye slender wheat grass		Siberian salt tree sea buckthorn silver buffaloberry
8	6-row barley safflower sunflower 2-row barley fall rye winter wheat spring wheat	birdsfoot trefoil sweetclover alfalfa bromegrass	garden beets asparagus spinach	hawthorn Russian olive American elm Siberian elm villosa lilac laurel leaf willow
Moderate	oats yellow mustard	crested wheatgrass intermediate wheatgrass	tomatoes broccoli	spreading juniper poplar
	meadow fescue flax	reed canary grass	cabbage	ponderosa pine apple

A third internet search revealed a document from Colorado University that lists some trees, shrubs, flowers, grasses and other ground cover vegetation that have different salt tolerance (EC). Alfalfa, and some species of grasses WFC plants are in in this list. (www.coopext.coloradostate.edu/tra/plants/stable.html)(See the Reports below.

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Comments are
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SALT TOLERANCE OF VARIOUS TEMPERATE ZONE ORNAMENTAL PLANTS

Prepared by:

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Colorado State University Extension
Tri River Area

An Introduction

Soluble salts can cause harm to plants if they are in high enough concentration in water or soil. This effect is mainly indirect by pulling moisture out of roots and reducing the uptake of water and nutrients to affected plants. Some salts can be toxic to root tissue. Tip and edge burn of leaves, slow growth, nutrient deficiencies, wilting and eventual death of the plant can occur if the salt level is excessive for the plant and the problem is not corrected. To avoid plant loss in salty sites, a **soil test** should be done to determine the soil salt level and plants selected based on their salt tolerance.

Soil testing laboratories will report the salinity (conductivity) of soil in decisiemens per meter (dS/m) (equivalent to the old measure of millimhos per centimeter). The salinity of irrigation water is typically reported in micromhos per centimeter (umhos/cm) or microsiemens per meter (uS/m) .

Conductivity is defined as the ability of a solution to conduct an electrical current, or the reciprocal of the solution's ability to resist the current. This current is conducted by electrically charged particles called ions, which are present in almost all solutions. Different solutions have different kinds and amounts of ions: distilled water has very few ions, and therefore a low conductivity, while sea water has a large number of ions, and a high conductivity. The greater the conductivity of the solution the higher the reading.

Publications Available Elsewhere

The following references on salts are available from the Colorado State University Publications on Line Site:

1. **Salt-affected soils** - an explanation of saline, sodic and saline-sodic soils and their treatment
2. **Management of salt- and sodium-affected soils** - covers problem diagnosis, reclamation treatments and prevention and control
3. **Crop tolerance to soil salinity** - provides some data on the salt tolerance of field, forage, vegetable and fruit crops
4. **Irrigation water quality criteria** - explains the four basic criteria for evaluating water quality for irrigation purposes - salinity and sodium hazard, toxic elements and bicarbonate concentration
5. **Growing turf on salt-affected (alkali) sites** - provides information on the salt tolerance of various cool-season grasses used for turf and provides information on which turf grasses to choose based on the salt level in the soil. How to reduce the salt level in the soil is also discussed.

To access these publications contact the Colorado State University Extension Web site. To read some of these publications you will need to download Acrobat Reader. A link to Acrobat Reader is provided from CSU's site. If you live in Colorado these publications are available from any CSU Extension office.

The Plant List

The following information was gleaned from various publications and personal experiences of nurseryman in Western Colorado's Tri River Area and is suggested as a guide when recommending trees, shrubs, vines and herbaceous plants for salty sites. Information regarding other temperate zone plants and their salt tolerance would be appreciated. Please send comments and additional references to cswift@coop.ext.colostate.edu .

Trees and their salt tolerances

Deciduous Trees

High Tolerance - up to 8 mmhos(mS)

Acer plantanoides - Norway Maple
Aesculus hippocastanum Common Horsechestnut
Ailanthus altissima - Tree of Heaven
Amelanchier canadensis - Shadblow
Crataegus crus-galli - Cockspur Hawthorn
Elaeagnus angustifolia - Russian Olive - possibly up to 10 mmhos
Gleditsia triacanthos - Honeylocust
Quercus alba - White Oak
Quercus robur - English Oak
Quercus rubra - Red oak
Robinia pseudoacacia - Black Locust
Ptelea trifoliata - Wafer Ash

Moderately High Tolerance - up to 6 mmhos

Acer negundo - Box-elder
Acer ginnala - Amur maple
Betula lenta - Sweet Birch
Betula populifolia - Grey Birch
Betula alleghaniensis - Yellow Birch
Betula papyrifera - Paper Birch
Fraxinus americana - White Ash
Populus alba - White Poplar
Populus deltoides - Eastern Cottonwood
Populus grandidentata - Large-toothed Aspen
Populus nigra - Lombardy Poplar

Populus tremuloides - Trembling (Quaking) Aspen
Prunus padus - European Bird Cherry
Prunus serotina - Black Cherry
Prunus virginiana - Choke Cherry
Salix alba `Tristis' - Golden Weeping Willow
Salix alba `Vitellina' - Golden Willow
Salix nigra - Black Willow
Sophora japonica - Japanese Pagoda Tree
Ulmus pumila - Siberian Elm

Moderate Tolerance - up to 4 mmhos

Catalpa speciosa - Northern Catalpa
Celtis occidentalis - Hackberry
Celtis reticulata - Netleaf hackberry
Cercis occidentalis - Western Redbud
Fraxinus anomala - Singleleaf Ash
Fraxinus excelsior - European Ash
Fraxinus pennsylvanica - Green Ash
Ginkgo biloba - Maindenhair Tree
Koelreuteria paniculata - Goldenrain Tree
Maclura pomifera - Osage-Orange
Pyrus species - Pear
Ulmus americana - American Elm

Slight Tolerance - up to 2 mmhos

Quercus palustris - Pin Oak
Malus species and cultivars - Apple and Crabapple

Sensitive or Intolerant

Acer rubrum - Red Maple
Acer saccharinum - Silver Maple
Acer saccharum - Sugar Maple
Cercis canadensis - Eastern Redbud
Juglans nigra - Black Walnut
Plantanus acerifolia - London Plane
Sorbus aucuparia - European Mountain-Ash
Tilia americana - American linden
Tilia cordata - Littleleaf Linden

Coniferous Trees

High Tolerance - up to 8 mmhos

Juniperus chinensis - Pfitzer juniper
Picea glauca ` densata' - Black Hills Spruce
Pinus mugo - Mugho Pine
Pinus nigra - Austrian Pine

Moderately High Tolerance - up to 6 mmhos

Pinus ponderosa - Ponderosa Pine
Pinus thunbergiana - Japanese Black Pine
Thuja occidentalis - American Arborvitae

Slight Tolerance - up to 2 mmhos

Picea albies - Norway Spruce
Pinus strobus - Eastern White Pine
Pinus sylvestris - Scot's Pine
Pseudotsuga menziesii - Douglas Fir
Taxus cuspidata - Japanese Yew

Sensitive or Intolerant

Abies balsamea - Balsam Fir
Pinus resinosa - Red or Norway Pine
Tsuga canadensis - Canadian Hemlock

Shrubs and their salt tolerances

Very High Tolerance - Up to 10 mmhos

Atriplex canescens - Fourwing Saltbush
Atriplex convertifolia - Shadscale Saltbush
Atriplex corrugata - Mat Saltbush
Atriplex nuttalli - Nuttall Saltbush
Atriplex nuttalli cuneata - Castle Valey Clover
Atriplex nuttalli gardneri - Gardner Saltbush
Baccharis emoryi - Emory Baccharis
Baccharis glutinosa - Seep-Willow
Ceratoides lanata - Common Winterfat
Chrysothamnus greenei - Greene Rabbitbrush
Chrysothamnus linifolius - Flaxleaf Rabbitbrush
Ephedra species - Mormon Teas
Ephedra torreyana - Torrey Ephedra
Kochia americana - Greenmolly Summercypruss
Sarcobatus vermiculatus - Black Greasewood
Tamarix pentandra - Five-Stamen Tamarix, Tamarisk

High Salt Tolerance - up to 8 mmhos

Caragana arborescens - Siberian Peashrub
Chrysothamnus albidus - Alkali Rabbitbrush
Cytisus scoparius - Scotch Broom
Elaeagnus commutata - Silverberry
Elaeagnus multiflora - Cherry Elaeagnus
Euonymous japonica - Spindle Tree
Halimodendron halodendron - Salt-tree
Hippophae rhamnoides - Sea Buckthorn
Juniperus chinensis - Pfitzer Juniper
Lonicera tatarica - Tararian honeysuckel
Rhamnus cathartica - Common Buckthorn
Rhus trilobata - Squawbush
Rhus typhina - Staghorn Sumac
Rhamnus frangula - Glossy Buckthorn
Shepherdia canadensia - Buffaloberry
Spiraea vanhouttei - Van Houtte Spirea
Symphoricarpuos albus - Snowberry
Syringa amurensis japonica - Japanese Tree Lilac
Syringa vulgaris - Common Lilac
Potentilla fruiticosa `Jackmanii' - Jackman's potentilla
Tamarix gallica - Manna Plant - Tamarisk

Moderately High Tolerance - up to 6 mmhos
Artemisia frigida - Fringed Sagewort
Artemisia spinescens - Bud Sagebrush
Artemisia tridentata - Basin Big Sagebrush
Buxus microphylla - Japanese Boxwood
Chrysothamnus nauseosus - Rubber Rabbitbrush
Chrysothamnus visci diflorus - Douglas Rabbitbrush
Ephedra nevadensis - Nevada Mormontea
Forsythia x intermedia - Showy Border Forsythia
Juniperus communis - Common Juniper
Philadelphus coronarius - Sweet Mockorange
Purshia glandulsa - Desert Bitterbrush
Pyracantha fortuneana - Pyracantha
Rhus glabra - Smooth Sumac
Rhus trilobata - Skunkbush Sumac - Three-leaf Sumac
Shepherdia rotundifolia - Roundleaf Buffaloberry
Spirea `Froebel's' - Froebel's spirea

Slight to Moderate - up to 4 mmhos
Artemisia cana - Silver Sagebrush
Berberis fremontii - Fremont Barberry
Robinia neo-mexicana - New Mexican Locust
Rosa woodsii - Wood's Rose
Salix exigua - Coyote Willow

Slight Tolerance - up to 2 mmhos
Chaenomeles speciosa - Flowering Quince
Ligustrum vulgare - Common Privet
Rosa rugosa - Rugosa Rose - may be slightly tolerant
Viburnum opulus - High Bush Cranberry

Sensitive or Intolerant
Cornus racemosa - Grey Dogwood
Cornus stolonifera - Red-osier dogwood
Rosa - Rose

Vines and their salt tolerances

High Tolerance - up to 8 mmhos
Lonicera tataricum `Zabelii' - Zabel's Honeysuckle
Parthenocissus quinquefolia - Virginia Creeper - Woodbine

Slight Tolerance - up to 4 mmhos
Lonicera japonica - Japanese Hall's Honeysuckle

Flowers and their salt tolerances

High to Moderate - 6 to 8 mmhos
Aquilegia micrantha - Cliff Columbine
Machaeranthera xylorrhiza - Common Woody Aster
Psilostrophe bakerii - Paperflower
Stanley pinnata - Prince's Plume - a good indication that the soil is high in selenium

Moderate Salt Tolerance - 4 to 6 mmhos

Fallugia paradoxa - Common Apache
Oenothera caespitosa - Tufted Evening Primrose
Sphaeralcea coccinea - Scarlet Globemallow
Yucca elata Soaptree - Yucca
Yucca glauca - Small Soapweed

Slightly Tolerant - 2 to 4 mmhos

Argemone species - Prickly Poppies
Calochorutus species - Mariposa Lilly
Chyrsopsis villosa - Hairy Goldenaster
Gallardia pennatifida - Cutleaf Blanketflower
Mentzelia species - Blazing Stars
Physaria australus - Twinpod

Grasses and other Ground Covers and their salt tolerances

High tolerance - 14 to 18 mmhos

Agropyron elongatum - Tall Wheatgrass
Agropyron smithii - Western Wheatgrass
Distichlis - Saltgrass
Elymus triticoides - Beardless wildrye
Lotus corniculatus = Birdsfoot trefoil - a legume
Puccinellia - alkaligrass
Sporobolus airoides - Alkali sacaton

Moderately High - 12 to 8 mmhos

Bromus marginatus - Mountain brome
Lolium perenne - Perennial ryegrass
Melilotus alba - White sweet clover
Melilotus officinalis - Yellow sweet clover
Trifolium fragiferum - Strawberry clover

Moderate - 8 to 4 mmhos

Agropyron cristatum - Crested Wheatgrass
Agropyron riparium - Streambank Wheatgrass
Agropyron trachycaulum - Slender Wheatgrass
Arrhenatherum elatium - Tall meadow oatgrass
Bromus inermis - Smooth brome
Buchloe dactyloides - Buffalograss
Dactylis glomerata - Orchardgrass
Elymus giganteus - Mammoth wildrye
Elymus junceus - Russian wildrye
Festuca arundinacea - Tall Fescue
Medicago sativa - Alfalfa
Phalaris arundinacea - Reed Canarygrass

Low salt Tolerance

Alopecurus pratensis - Meadow foxtail
Festuca rubra - Red fescue
Festuca elatior - Meadow fescue
Poa pratensis - Kentucky Bluegrass
Trifolium pratense - Red clover

Trifolium repens - White clover

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to the Soils of Western Colorado Home Page

Placed on the Internet April 13, 1997

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