

Reclamation Plan  
Ray Westhoff #1 Well Pad  
Morgan County, Colorado



Prepared for:  
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Prepared by:  
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Date:  
October 24, 2018

# BASELINE INVENTORY

## RAY WESTHOFF #1 WELL PAD



### Site Description

The Ray Westhoff #1 well pad location was field investigated by a Duraroot Environmental Consulting, LLC (Duraroot) Reclamation Soil Scientist on October 24, 2018. The Ray Westhoff #1 well pad is in the NE ¼ of the NW ¼ of Section 33, Township 5N, Range 58W in Morgan County, Colorado (Figure 1). The current land use is native range.

During the field investigation, Duraroot collected four (4) soil samples and walked the facility perimeter to identify native plant species for seed mix development. Soil samples were analyzed to establish current soil physicochemical properties for reclamation planning (Table 1). Soil sample results indicate that soil pH is slightly elevated in soil samples collected on the well pad location (SS-1, SS-2, and SS-3). According to USDA-NRCS classifications, the Ray Westhoff #1 well pad soils are classified as slightly alkaline to moderately alkaline (7.8 to 8.0).

In addition, soil sample results indicate the location has suitable soil fertility and organic matter content (1.7-percent). Soil nitrogen (N) levels range from 28 to 48 lbs per acre, soil phosphorus (P) levels range from 33 to 57 ppm, and soil potassium (K) levels range from 432 to 512 ppm. There are no observed soil properties that should limit reclamation success on the Ray Westhoff #1 well pad. To account for site conditions at the Ray Westhoff #1 well pad, Duraroot has developed a reclamation guideline specific to the location.

**Table 1. Soil chemical and physical data.**

Sample ID	pH	EC	SAR	Organic Matter	Lime	Sand	Silt	Clay	Texture	NO <sub>3</sub> - N	NO <sub>3</sub> - N	Mehlich-P	NH <sub>4</sub> OAC-K
		(dS/m)								ppm	lbs/acre		
SS-1	7.8	1.0	0.30	1.7	0.50	60	16	24	Sandy Clay Loam	27	48	44	512
SS-2	8.0	0.54	0.50	1.7	2.9	59	13	28	Sandy Clay Loam	16	28	57	432
SS-3	7.8	0.75	0.90	1.7	1.0	53	17	30	Sandy Clay Loam	21	38	33	463
SS-4	6.5	0.32	0.10	1.2	2.9	75	9.0	16	Sandy Loam	5.4	10	38	389

A recommended seed mix is provided in Table 2. The seed mix was developed using 60 pure live seed (PLS) per square foot and should also include a **mycorrhizal inoculum at the rate of 5.0 pounds per acre**. The seed mix considers seed availability and site conditions. Some species may need to be substituted based on availability at the time of seeding. The seed mix is specifically designed for coarse soil textures at the Ray Westhoff #1 well pad location.

**Table 2. Recommended seed mix for the Ray Westhoff #1 well pad.**

Common Name	Scientific Name	# PLS/acre	PLS/sq ft	% of Mix
Blue Grama	<i>Bouteloua gracilis</i>	0.63	12.0	20%
Sand Dropseed	<i>Sporobolus cryptandrus</i>	0.12	15.0	25%
Western Wheatgrass	<i>Pascopyrum smithii</i>	3.6	9.0	15%
Thickspike Wheatgrass	<i>Elymus lanceolatus</i>	2.5	9.0	15%
Sideoats Grama	<i>Bouteloua curtipendula</i>	2.1	9.0	15%
Indian Ricegrass	<i>Achnatherum hymenoides</i>	1.9	6.0	10%
<b>Total</b>	--	<b>11</b>	<b>60</b>	<b>100%</b>

Appropriate soil amendments, site preparation procedures, revegetation species, and a site specific Integrated Weed Management Plan (IWMP) should help expedite reclamation success at the Ray Westhoff #1 well pad location. A site-specific reclamation plan is provided on Pages 3 and 4.

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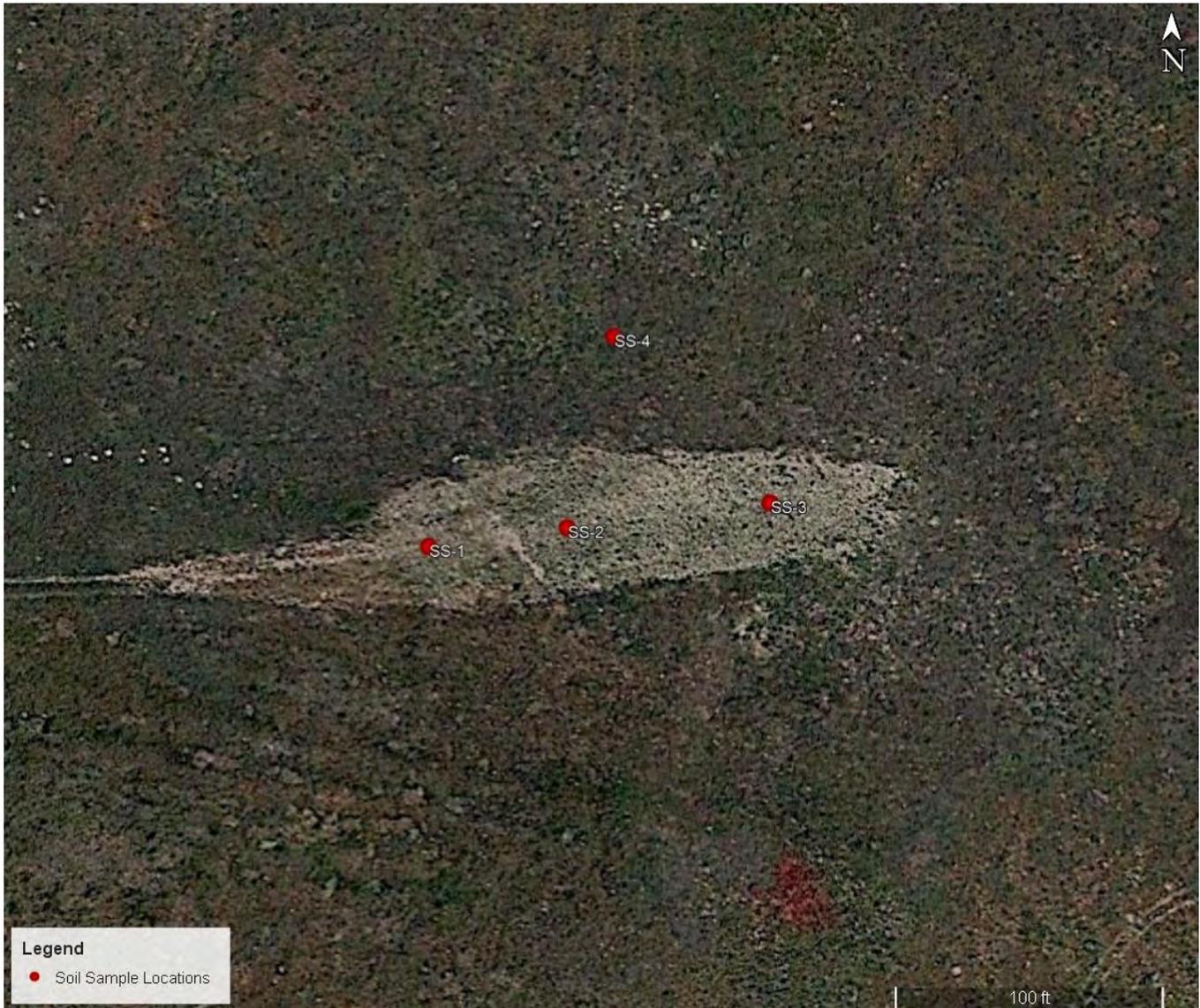


Figure 1. Aerial image of the Ray Westhoff #1 well pad with soil sample locations.

Table 3. Location coordinates for the individual Ray Westhoff #1 well pad soil samples.

Sample ID	Latitude	Longitude
SS-1	40.36195	-103.87368
SS-2	40.36197	-103.87349
SS-3	40.36199	-103.87322
SS-4	40.36216	-103.87343

# RECLAMATION PLAN

## RAY WESTHOFF #1 WELL PAD

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### (1) Soil Amendments

Soil amendment application is recommended on the Ray Westhoff #1 well pad to reduce soil pH and improve nutrient availability. It is recommended to apply elemental sulfur at a rate of 0.5 ton per acre to the Ray Westhoff #1 well pad. Amendment application rates were calculated to amend the top 6.0 inches of soil, assume a product purity of 90 percent, and include a 25 percent mixing factor. Soil amendments should be applied and incorporated into topsoil resources to a depth of 4.0 to 6.0-inches during seedbed preparation activities.

### (2) Seedbed Preparation

These recommended site preparation steps will aid in successful reclamation. Steps may be omitted, conducted in different order, or changed to optimize success and efficiency depending on field conditions, sub-soil properties, and local terrain.

- Rip soil resources to a minimum depth of 18-inches using a parabolic ripper or equivalent equipment to reduce post-construction soil compaction and improve drainage. The shanks on the back of a grader or dozer should NOT be used to reduce soil compaction.
- Apply recommended soil amendments, discussed above, to reduce soil pH and improve nutrient availability.
- Finally, disc the site to a depth of 4.0 to 6.0-inches to incorporate soil amendments and to create a seedbed conducive to seedling establishment (disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions).

### (3) Seeding

Seeding should be conducted using a drill seeder capable of direct seed placement into medium textured soils and the seed mix provided in Table 2. Seed depth is critical for most native grass species. It is recommended that the seed be placed no deeper than ½-inch below ground surface. The recommended seed mix provides approximately 60 PLS per square foot.

Seeding should occur within ideal seeding windows for greatest success. In Colorado, this is after September 15 for late fall, dormant seeding (preferred) and from spring thaw to June 1, for spring seeding. If reclamation is completed outside of the ideal seeding season, a cover crop should be seeded to provide quick vegetation establishment and more immediate ground cover and protection.

### (4) Straw Mulching

Application of straw mulch is recommended on level topography to reduce potential water and wind erosion. Recommended straw mulch application rates are between 1.5 to 2.0 tons per acre. This will provide ground coverage of approximately 80 to 90 percent of the ground surface prior to crimping. Once applied the straw mulch should be crimped into the soil. Upon successful crimping the straw mulch should be standing vertically with approximately 40 to 60 percent of the ground surface covered. Straw mulch should be at least 6.0 inches in length. Straw mulch should be crimped sufficiently to cause vertical cover that will not be dislodged by light breezes. Maintain perimeter fencing to prohibit grazing for the first two growing seasons.

### (5) Weed Management

A site specific IWMP should be developed once weedy species can be identified. Russian thistle (*Salsola tragus*) was observed during the field investigation. The site could be mowed prior to flowering and seed head production of weedy species. Mowing will reduce competition with desirable species and allow greater opportunity for reclamation success. In addition to mowing, herbicides appropriate for the identified weedy species could be applied to eradicate any problematic species. Application timing and rates for herbicides should follow the manufacturer's recommendations. At a minimum, weed management during the first two (2) seasons following reclamation should be diligent to improve establishment of seeded grasses and to prevent weedy species infestation.

Table 4. Reclamation prescription for the Ray Westhoff #1 well pad.

	ACTION	SPECIFICATION	PURPOSE
<b>RECLAMATION</b>	Compaction Relief	Deep rip subsurface soil, prior to topsoil application, to a minimum depth of 18-inches using a parabolic ripper or equivalent equipment.	Ripping will reduce soil compaction and improve drainage and root development.
	Soil Amendments	Apply 0.5 ton per acre elemental sulfur.	Elemental sulfur will lower soil pH while effectively improving soil nutrient availability.
	Fertilizer	NA	NA
	Seedbed Preparation	Disc the site to a depth of 4.0 to 6.0-inches using a disk and harrow, field cultivator, vibra-shank, or other alternative suitable to site conditions.	Discing will break up soil clods, incorporate soil amendments, and enhance seed to soil contact.
	Seeding ( <i>see preferred seeding dates</i> )	Drill seed into the soil surface no deeper than ½-inch using the recommended seed mix and rate in Table 2. Seed mix should include mycorrhizal inoculum at the rate of 5.0 pounds per acre.	Drill seeding enhances seed to soil contact. Drill seeding may be unsafe on slopes ≥ 3:1.
	Stormwater BMPs and Erosion Control	Crimp straw mulch at a rate of 1.5 to 2.0 tons per acre.	Crimped straw mulch will stabilize and protect soil resources until seed germination and grass establishment occurs. Straw mulch will also protect seeds from desiccation until germination occurs.
	Weed Management	Develop a site-specific IWMP. Russian thistle ( <i>Salsola tragus</i> ) was identified on-site.	Weedy species will compete with seeded grass species for important resources required for germination and seedling establishment.

# BASELINE PHOTOS RAY WESTHOFF #1 WELL PAD



Photo 1. Photo point for the Ray Westhoff #1 well pad, October 23, 2018.

Location: N 40.36201 W 103.87332 Cardinal Direction: North



Photo 2. Photo point for the Ray Westhoff #1 well pad, October 23, 2018.

Location: N 40.36201 W 103.87332 Cardinal Direction: East



Photo 3. Photo point for the Ray Westhoff #1 well pad, October 23, 2018.

Location: N 40.36201 W 103.87332 Cardinal Direction: South



Photo 4. Photo point for the Ray Westhoff #1 well pad, October 23, 2018.

Location: N 40.36201 W 103.87332 Cardinal Direction: West