

# TOP Operating Co.

## Reclamation Plan Knox 1-23 Well Pad



Prepared for:  
TOP Operating Company

Prepared by:  
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# BASELINE INVENTORY

## KNOX 1-23 WELL PAD



### Site Description

The Knox 1-23 well pad location was field investigated by a Duraroot Environmental Consulting, LLC (Duraroot) Reclamation Soil Scientist on November 30, 2018. The Knox 1-23 well pad location is in the SW ¼ of the NW ¼ of Section 23, Township 2N, Range 67W in Weld County, Colorado (Figure 1). The pre-disturbance land use was dryland crop and the area encompass approximately 2.2 acres.

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 the location has coarse soil textures with elevated sand content (> 80-percent) and less than optimal organic matter (< 1.0-percent) content. Elevated sand content and coarse soil textures will contribute to lower soil water holding capacity and moisture availability for seed germination and seedling establishment, as well as low nutrient retention and availability. Soil nitrogen (N) levels range from 3.0 to 12 lbs per acre, soil phosphorus (P) levels range from 29 to 84 ppm, and soil potassium (K) levels range from 132 to 257 ppm. In addition, soil nitrogen levels are less than ideal. To account for these limitations to reclamation, Duraroot has developed a reclamation guideline specific to the Knox 1-23 location. There are no other observed soil properties that should limit reclamation success on the Knox 1-23 well pad.

**Table 1. Soil chemical and physical data. Parameters shown in red may impede reclamation success.**

Sample ID	Depth	pH	EC	SAR	Organic Matter	Lime	Sand	Silt	Clay	Texture	NO <sub>3</sub> - N	Olsen-P	NH <sub>4</sub> OAC-K
	inches		dS/m		%						lbs/acre	ppm	
WEST-OFF	0 to 6	6.9	0.30	0.20	0.90	2.0	79	10	11	Sandy Loam	6.0	84	257
WEST-ON	0 to 6	7.8	0.58	0.10	0.80	1.9	79	6.0	15	Sandy Loam	12	29	246
EAST-OFF	0 to 6	6.9	0.25	0.10	0.60	0.90	84	9.0	7.0	Loamy Sand	3.0	34	173
EAST-ON	0 to 6	7.4	0.39	0.20	0.70	4.0	81	10	9.0	Loamy Sand	5.0	40	132

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 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 on the Knox 1-23 well pad location.

**Table 2. Recommended seed mix for the Knox 1-23 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 Knox 1-23 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 Knox 1-23 location with soil sample points.

Table 3. Location coordinates for the individual Knox 1-23 location soil samples.

Sample ID	Latitude	Longitude
West-Off	40.12570	-104.86555
West-On	40.12573	-104.86500
East-Off	40.12581	-104.86348
East-On	40.12581	-104.86422

# RECLAMATION PLAN

## KNOX 1-23 WELL PAD



### (1) Soil Amendments

Soil amendment application is recommended on the Knox 1-23 well pad to improve soil structure and organic matter content due to elevated sand content. It is recommended that 5.0 tons per acre of cornstalks be applied to the Knox 1-23 well pad. Improved soil structure and organic matter content in coarse textured soils will improve the soil's water holding capacity and nutrient retention capabilities. To offset nitrogen immobilization due to the organic carbon additions, it is recommended that 75 pounds per acre of nitrogen be applied. The cornstalks and nitrogen 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.

- Remove residual road base material from former access and pad locations and import approximately 484 cubic yards of suitable topsoil to replace removed material. Level the location to grade.
- Rip soil resources to a minimum depth of 18-inches using a parabolic ripper or equivalent equipment to reduce 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 improve soil structure.
- Apply recommended fertilizer, discussed above, to promote germination and vegetative proliferation.
- 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 equipment appropriate for soil conditions and the seed mix provided in Table 2. On coarse textured soils of moderate slope an imprint seeder could be used to establish micro-habitats for seed placement and water retention. Imprint seeding will also help protect seed and young, newly emerged plants from wind damage and moving sand particles. If imprint seeding is not an option, seeding should be conducted using a drill seeder capable of direct seed placement in coarse textured soils. Drill seeding should occur using a drill equipped with an agitator, double disc opener, wheel press, and depth bands to mix seed and ensure proper seeding depths. Seed depth is critical for most native grass species. Seeds should be planted to the depth specified by the vendor to ensure proper germination and emergence. It is recommended that the seed be placed no deeper than ½-inch below ground surface.

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 and Fencing

If drill seeding, application of straw mulch is recommended to reduce potential water and wind erosion. Recommended straw mulch application rates are between 2.5 to 3.0 tons per acre. This will provide 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 using a straight disc crimper with approximate 8.0-inch spaced tines. 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. If the area is grazed, install and 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*) and musk thistle (*Carduus nutans*) were 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 should be diligent during the first two (2) seasons following reclamation to improve establishment of seeded grasses and to prevent weedy species infestation.

# RECLAMATION PLAN

## KNOX 1-23 WELL PAD



Table 4. Reclamation prescription for the Knox 1-23 well pad location.

	ACTION	SPECIFICATION	PURPOSE
<b>RECLAMATION</b>	Compaction Relief	Deep rip soil 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 5.0 tons per acre cornstalks.	Cornstalks will improve soil structure in coarse textured soils.
	Fertilizer	Apply 75 pounds per acre of nitrogen.	Nitrogen will offset immobilization and supply critical macro-nutrients to the seeded vegetation for successful germination and proliferation.
	Seedbed Preparation	<ul style="list-style-type: none"> <li>• Remove residual road base material, import suitable topsoil, and grade.</li> <li>• 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.</li> </ul>	Discing will break up soil clods, incorporate soil amendments, and enhance seed to soil contact.
	Seeding ( <i>see preferred seeding dates</i> )	<p>Imprint seed into the soil surface using the recommended seed mix and rate in Table 2.</p> <p>OR</p> <p>Drill seed into the soil surface no deeper than ½-inch using the recommended seed mix and rate in Table 2.</p> <p>Seed mix should include mycorrhizal inoculum at the rate of 5.0 pounds per acre.</p>	<p>Imprint seeding provides protected micro-habitats to support seed germination and seedling emergence.</p> <p>Drill seeding enhances seed to soil contact.</p>
	Stormwater BMPs and Erosion Control	Crimp straw mulch at a rate of 2.5 to 3.0 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 and musk thistle were identified on-site.	Weedy species will compete with seeded grass species for important resources required for germination and seedling establishment.

# BASELINE PHOTOS KNOX 1-23 WELL PAD



Photo 1. Photo point for the Knox 1-23 location, November 30, 2018.

Coordinates: 40.12573, -104.86515 Cardinal Direction: North



Photo 2. Photo point for the Knox 1-23 location, November 30, 2018.

Coordinates: 40.12573, -104.86515 Cardinal Direction: East



Photo 3. Photo point for the Knox 1-23 location, November 30, 2018.

Coordinates : 40.12573, -104.86515 Cardinal Direction: South



Photo 4. Photo point for the Knox 1-23 location, November 30, 2018.

Coordinates: 40.12573, -104.86515 Cardinal Direction: West