

Cloud Peak Energy Operations



Regulatory Requirements for Wyoming Coal Operators

Sagebrush is considered crucial forage in difficult winters for mule deer and antelope in the Powder River Basin

Current developments relating to sage grouse have placed additional emphasis on shrub reclamation

The Coal Industry, the Wyoming Department of Environmental Quality and Wyoming Game and Fish Department developed a sagebrush reclamation density requirement of 1 shrub/m²

Shrub Reclamation Basics

- 1) **Plant Phenology**; arid shrubs typically produce high volume low quality seed with very specific germination requirements (10 – 15%) and plant material is physically difficult to handle.
- 2) **Topographic positioning and moisture requirements**; deeper soil and higher soil profile moisture requirements
- 3) **Historical climate data**; development of optimal seeding windows and average number of potential seeding days
- 4) **Equipment**; understanding equipment limitations and abilities (multiple drills for flexibility)
- 5) **Seed quality and quantity**; not all seed is the same, careful plant material selection is key
- 6) **Time**; the five year clock



Shrub establishment process

Shrub establishment is a 3-phase approach:

Phase 1: Identify land areas with highest shrub establishment potential

Phase 2: Use of special features to enhance moisture collection and improve soil moisture conditions

Phase 3: Use of technology that targets optimal planting dates, planting rates, plant material selection and specialized drilling



Phase 1: Post mining landscape shrub site selection

- **Identify topographic locations that have the best attributes to maintain long term soil water reserves**
 - Areas that drift and hold snow resources
 - Small basins that can retain higher soil profile moisture conditions
 - Areas with cooler temperature slope aspects

- **Use of aerial photography following snow events can be used to identify high potential site selection**

- **Once selected, incorporation of micro topographic features**
 - Snow fencing
 - Rock pile development in reclamation

Drainage Aerial View



- Shrub planting catch basins
- Designed rock structures



ANTELOPE MINE

Post mining landscape shrub site selection

SCALE not to scale

FILE NAME Shrub planting locations

Phase 2: Micro topographic Feature Enhancement

- **Develop and improve available features**
 - Small relief basins and slope terracing that help catch and hold subsurface moisture
 - Larger scale rock structures in reclamation to enhance and hold snow in strategic areas
 - Snow or drift fencing at the top of the drainage basins to improve snow retention
- **Rock structures/Snow Fence can passively drift and hold snow thereby enhancing soil water profile conditions**
- **Shrubs planted down gradient of these features to take advantage of improved deep soil water conditions**



Phase 3: Specialized Planting Techniques

- Specialized planting techniques

 - High quality seed sources

 - Custom tillage and drilling techniques (e.g. use of frozen ground)

 - Specifically timed planting dates and interseeding opportunities

- Use of high quality genotypes, with different optimal germination requirements, when preparing single species mix

 - Wyoming

 - Great Basin

 - Southern Utah

- Use of seed mixture ensures that at least one third of seeded area should have optimal germination conditions, as weather patterns are highly variable

% Pure	Common Name	Variety	G + D or H	Origin
13.58	WYOMING BIG SAGEBRUSH	Powder River	77 -TZ	WY
12.16	WYOMING BIG SAGEBRUSH	VNS	86 + 0 -TZ	UT
0.01	Other Crop			
74.26	Inert Matter			
0.00	Weed Seed			

Date Tested: 10-JAN-11
 % Hard Seed: 0.00
 Restricted Weed: None

Net Weight: 10.46 Lbs. PLS 50.00 Lbs. Bulk

NOTICE TO BUYER LIMITATIONS OF WARRANTIES AND REMEDIES

Phase 3: Specialized Planting Techniques

- **Timing is important**

Shrub species in general require a cold cycle to break the seed coat & improve germination rate (except for Winterfat)

Antelope Mine seeds during warm days in December, January & February based on weather events

Winterfat is seeded in the spring due to warmer conditions as it is susceptible to the cold

- **Use of custom Brillion and Truax seeder**

Mechanically modified with larger openers and higher speed gearing

Seeds large areas in a short period of time (300 lbs. in 15 minutes)



Interseeding Strategies

■ Plant Community Dynamics

Community composition (bunch grasses vs. sod formers)

Plant density and available open space between plants

Ecological health of the plant community

Invasive weed competition

Grazing practices

Equipment selection



Antelope Coal LLC's Strategy is Transferable to Shrub Establishment on Non-Mine Operations



- **Three phase shrub establishment strategy is Transferable**

Micro and macro topography planning

Identification of optimal seeding times and conditions

Use of high quality plant materials

Equipment modification

Equipment calibration and monitoring

Hands on job

Long Term Benefits

- **Successful establishment of shrubs:**
 - Improved overall species diversity and stand longevity
 - Robust wildlife habitat
 - Ability to meet species of high importance habitat criteria
- **Reclamation stands with developed shrub communities provide**
 - More diverse landscape and improve winter habitat for elk, deer, and antelope
 - A means to improve habitat for sage grouse



Questions?

