



GUIDELINE 28 – EVALUATING FINAL VEGETATIVE COVER OF CLOSED LANDFILL AREAS

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I. Introduction

Revegetating a closed landfill or portion of a landfill is one of the most important steps in a facility's design, operation and maintenance, to control water infiltration, reduce erosion, minimize leachate generation, limit long-term liability for the owner/operator, and protect the environment. Once a landfill area has been covered, the timely establishment of erosion control measures, cover crop seeding, and establishment of native grass is essential to stabilize and reclaim the site. This guideline is intended to help guide facility owners/operators reclaim facilities and assess whether the vegetative cover is effective. Design, slope and soil features common to landfills may make revegetation difficult.

For at least two to three years after site closure, the landfill facility should be checked monthly (except when frozen) to ensure vegetation reestablishment and to monitor any erosion or settling of the final cover. The closed landfill should continue to be monitored on a less frequent basis for up to 30 years after site closure, particularly after significant rainfall events. These inspections also are needed to check for dead or stressed vegetation due to landfill gas, leachate seepage, significant erosion, etc.

II. Evaluating the Final Vegetative Cover

Following the second growing season, use the following guidelines to determine adequacy of stands and if reseeding or reinforcement seeding is required:

- A. It should be recognized that environmental factors such as climate, insects, soils, and fertility affect time required for establishment of stands. Timeliness of precipitation, drought, extreme temperatures, severe winds, or late soil thaw can delay seedling (young grass grown from seed) emergence and/or development.
- B. Areas heavily vegetated with weeds may exhibit erosion and channelization. Native grasses and grasses in general have a much more fibrous root system than most weeds. Weeds are generally considered to have a taproot system. Fibrous root systems hold the soil in place much better than a taproot system. Erosion damage may not be easy to see in areas of weedy growth unless the site is walked.
- C. Rhizomatous (sod forming) grass species have roots that will spread and will continue to fill in the open spaces; whereas native bunchgrasses grow upright with spaces between each bunch. Bunchgrass stands may develop gaps if the initial establishment is sparse, but can help stabilize erosion prone areas.
- D. Native grass seedling emergence should be relatively uniform over the area. The density of established plants should be effective in minimizing soil loss due to erosion. Stand counts should indicate a density of at least 70 percent cover per square foot of area. If at least three rhizomatous species are present, the lower limit of 70 percent cover per square foot is

adequate. Ninety percent cover per square foot is necessary when all are bunchgrass species or a mixture of rhizomatous and bunchgrass species.

- E. The adequacy of a stand (a group of several grass plants growing together in one place) will be based on density of established plants and stage of morphological development needed to ensure perennality (lasting more than two growing seasons). To be considered established, a grass plant must have a well-developed root system and should exhibit signs of tillering (shoot growing from the base of a stem, especially the stem of a grass) or rhizome (thick underground horizontal stem that produces roots and has shoots that develop into new plants) development.
- F. Preliminary stand evaluation can be made four to eight weeks after germination; evaluate for progress and management problems (i.e., weeds, insects, etc.) – not for final establishment.
- G. Stands resulting from late fall (dormant) or spring seeding must go through the first growing season and subsequent winter; evaluation for establishment can be made any time during the second growing season.
- H. Stands resulting from late summer seeding cannot be evaluated for establishment until the end of the subsequent, full growing season.
- I. Most stands will require two growing seasons to become established; warm-season species may require three growing seasons for establishment.
- J. Stand counts may be done, using either a square foot frame or the row count method:
 - a. **If a frame count is used**, all plants rooted within the frame should be counted. A predetermined number of steps should be taken diagonal or perpendicular to the drill rows and the frame dropped at the toe of the foot on the final step. The frame should be dropped in a consistent alignment to the drill rows. (See description of how to do a frame count below.)
 - b. **If the row count method is used**, two side-by-side rows should be counted, the length to be determined by the row spacing. A 6-inch row spacing would require the observer to count all plants in two rows for a length of 12 inches; a 7-inch row spacing would require a 10.3-inch length of two rows; and an 8-inch row spacing would require a 9-inch length. The same procedure would be used for a row count as for a frame count. However, instead of dropping the frame at the toe of the foot, this point would then mark the beginning of the row count.
- K. The number of samples required depends on factors such as stand uniformity and the number of species to be counted. Generally, a minimum of 10 counts (or frames) per 10 acres or less of the field size would result in a representative sample. End rows, turn around areas or other areas that may have been double seeded should be avoided. Ten counts per 10 acres of field size should be used only as a starting point. For example, a 70- to 80-acre pasture planting with a uniform stand may be sampled accurately using 40 counts or less. Whatever the situation, enough counts must be taken so that a representative sample is obtained.

(From USDA-NRCS, North Dakota, May 2008, FOTG, Section I, Plant Materials, Herbaceous Vegetation Establishment Guide.)

III. Frame Count Measurement of Groundcover:

Use a folding rule to create a 12- x 12-inch square. Stand over this area, look directly down, and estimate the amount of ground that is covered by plants. Take a photo of the square for documentation. For each square, record groundcover at about 30 random locations, look at the variation (highest and lowest values) and calculate the average. Also, look for more visual signs of erosion and soil loss such as gullies, rills and tunneling; washing of soil; litter along fence lines and around plants; muddy and silted dams; and muddy streams with high sediment loads. Monitor groundcover regularly to assess progress. *Source: Greg Lodge, NSW DPI*

At 20% groundcover

Runoff water loss = 160mm per year
Soil loss = 8.5mm per year
Poor plant production and sustainability
Low green leaf and plant vigor
Low water infiltration
Plants exposed to temperature extremes
Low litter
Low microbial activity
Poor organic matter content
Poor soil structure and surface sealing of soil

At 70% groundcover

Runoff water loss = 10mm per year
Soil loss = 0.3mm per year
Good plant production and sustainability
High green leaf and plant vigor
High water infiltration
Plant bases protected from temperature extremes
High litter levels
Good microbial activity
High organic matter content
Good soil structure and soil surface

At 40% groundcover

Still too low
Runoff water loss = 90mm per year
Soil loss = 4mm per year
Poor pasture and soil health

At 90% groundcover

Reduced runoff water and soil loss
On slopes, groundcover should target 100% to retain top soil nutrients and to promote stable pasture conditions
Weed colonization will be reduced when bare ground is removed

(From a Joint Initiative of Australian Wool Innovation and Meat & Livestock Australia; Making More from Sheep, Copyright 2008; www.makingmorefromsheep.com.au/healthy-soils/tool_6.2.htm.)

IV. Maintaining Final Cover

The closed landfill site would benefit from mowing, haying or light grazing, depending on the post-closure use that has been approved. Grazing would be limited to an approved NRCS grazing plan

1. **Weed Control** - During the establishment period, excessive amounts of competitive weeds must be controlled. Control weeds that compete with seedlings for sunlight and/or moisture during the growing season of the species planted. The first weed control operation will be needed as recommended or prior to weed seed maturity. Repeated weed control operations may be needed. Competitive weeds can be controlled either mechanically or chemically, or by a combination of these methods.
2. **Mechanical** - When controlling competitive weeds by clipping or mowing, adjust the equipment to cut above the new seedlings, and clip before the weeds set seed or mature. If the clippings are dense enough to smother the new seedlings, promptly remove clippings from the field.
 - a. **Mowing Height**. Eight to 10 inches is the preferred stubble height. This will be over the

- top of most 1- to 2-year-old forb and legume species in early summer. Certain species are especially sensitive to clipping height, and removal of the basal leaves may result in death of the plant. Some grass species such as switchgrass have high growing points, and once established should not be mowed at a height less than 10 inches until after the growing season.
- b. **Equipment.** Swathers generally work best because of operator visibility, maneuverability and ease of height adjustment. The operator can quickly raise or lower the platform. If the windrows are heavy enough to smother new seedlings, they should be promptly removed. Sickle bar mowers are good if an adequate, consistent stubble height can be maintained. Rotary mowers can work well if they are set at the highest wheel setting. This will usually result in about an 8-inch clipping height. A level mowing height should be maintained and travel speed as appropriate to disperse the clippings. A sharp blade is essential.
 - c. **Timing.** Mowing must be done early enough in the season before most of the weed seed becomes viable and so the seeded species can still benefit from the “opened canopy” and put on new growth before fall. Multiple mowing in a season may be necessary with high density/biomass weed competition. Mowing in late summer or early fall provides little benefit to the seeded species and probably causes more harm than good. Check local/state regulations of individual conservation practices for the earliest allowable mowing dates. Whenever a new seeding is mowed, some injury occurs to the seeded species. Young forb and legume seedlings are especially vulnerable and may be killed by driving over them. If weeds are a competition problem to the new seeding, then mowing is probably justified. Spot mowing is encouraged whenever possible. This eliminates damage to the seeded species in areas where you don’t have to mow, and maintains the taller wildlife cover. Spot mowing also creates “edge” structure which enhances landscape diversity within the field and may provide additional wildlife benefits.
3. **Chemical** -To control competitive weeds with herbicides, use the appropriate herbicide(s) applied according to the manufacturer=s label. The best control will generally be obtained when weeds are in the early stages of growth. Precautions should be taken to ensure that grass or legume seedlings are not injured by the selected herbicide(s). Refer to North Dakota State University, Agricultural Weed Control Guide (Cir. W-253 Rev.) for specific herbicide recommendations on forage crops in North Dakota.
 4. **Noxious weeds** must be controlled in accordance with state law.
 - a. **Insect Control.** Insects can be a threat to seedlings. Contact the County Extension Service for recommendations on control of specific insects affecting seeded species.

CAUTION: When using any pesticides (herbicides or insecticides), read and follow the manufacturer=s label recommendations. Read and follow all directions and precautions on the label. Use of pesticides must be consistent with the label and in accordance with state and federal laws and regulations.

(From USDA-NRCS, North Dakota, May 2008, FOTG, Section I, Plant Materials, Herbaceous Vegetation Establishment Guide.)

V. Repairing Final Cover

As appropriate, the landfill site may need additional covering applied, additional erosion control structures or measures installed, and/or reseeding of the vegetative cover. See the North Dakota Department of Environmental Quality's "General Native Grass Seeding" guideline for recommendations.

1. If evaluation reveals a marginal stand, consideration should be given to allowing a second growing season for establishment. Seedings that contain a high **percentage of "hard seed" are more likely to produce new seedlings during the** second growing season.
2. The alternative of a partial reinforcement seeding, in lieu of the full seeding rate, should be considered during the evaluations.
3. "Spot" seeding weak areas may be a logical alternative in the case of spotty or intermittent stands, in lieu of whole field reseeding.

(From USDA-NRCS, North Dakota, May 2008, FOTG, Section I, Plant Materials, Herbaceous Vegetation Establishment Guide.)

VI. References

1. A Joint Initiative of Australian Wool Innovation and Meat & Livestock Australia - Making More from Sheep, Copyright 2008.
2. North Dakota Department of Environmental Quality, Division of Waste Management, General Native Grass Seeding.
3. North Dakota State University, Agricultural Weed Control Guide (Cir. W-253 Rev.).
4. USDA-NRCS, North Dakota, May 2008, FOTG, Section I, Plant Materials, Herbaceous Vegetation Establishment Guide.
5. USDA-NRCS - North Dakota, August 2002, FOTG, Section IV, Conservation Practices, Conservation Practice Standard 342. Crotoqa; Area Planting.