Proceedings of the 7th Annual British Columbia Mine Reclamation Symposium in Victoria, BC, 1983.
The Technical and Research Committee on Reclamation

HYDROSEEDING AND HELICOPTER SEEDING OF ROADSIDE RIGHT-OF-WAYS

Paper Presented
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INTRODUCTION

The stabilization of cut and fill slopes is a basic and primary consideration in highways construction, particularly in the mountainous terrain encountered over much of British Columbia. In more recent years, considerable focus has also been placed on general rehabilitation of all lands disturbed because of road building. The engineering and aesthetic aspects of this type of work are as varied as the land through which a highway may pass.

Our presentation this morning will deal briefly with one phase of such work: namely, the establishment of vegetative cover on highway rights-of-way, both by hydraulic ground seeding and by helicopter air seeding. I have broken this talk into several key component areas and I will attempt to illustrate certain examples with the aid of photographic slides. I have deliberately avoided discussion of hydroseeding technique per se, as most of you are, I'm sure, familiar with hydroseeder applications.

HYDROSEEDING

The Ministry of Transportation and Highways has been involved in hydraulic seeding operations since the early 1960's. Our initial attempts at establishing stands of grass on the generally inhospitable side slopes were usually "hit or miss" operations, owing to the fact that little was known about adaptable seed varieties, seeding rates, proper use and acceptable formulations of fertilizer, or the application of suitable mulches. Between 1964 and 1967, hundreds of test plots were established throughout British Columbia to determine the suitability of various grasses, legumes and fertilizers (and to some extent, mulches) for the diverse conditions encountered along roadsides. Factors such as soil conditions, exposure, annual precipitation and elevation were considered. Individual native and agronomic species were seeded along with combinations of compatible grasses and legumes. Evaluations of these field trails, many of which are intact today, served as the basis for selecting suitable varieties.

SEED SELECTION

Currently, the Ministry uses four general seed mixtures:

1. Dry Land Mix
   - 38% Tall Wheatgrass
   - 25% Crested Wheatgrass
   - 15% Hard Fescue
   - 10% Canada Bluegrass
   - 10% Rambler Alfalfa
   - 2% Red Top

2. Forest Land Mix
   - 30% Slender Wheatgrass
   - 23% Perennial Ryegrass
   - 20% Creeping Red Fescue
   - 15% Canada Bluegrass
   - 10% Rambler Alfalfa
   - 2% Red Top

3. Northern Mix
   - 40% Creeping Red Fescue
   - 30% Canada Bluegrass
   - 15% Brome Grass
   - 10% Red Top
   - 5% White Clover

4.	Coastal Mix	45%	Kentucky Bluegrass
		40%	Creeping Red Fescue
		10%	Red Top
		5%	White Dutch Clover

Naturally, situations are encountered where a standardized seed mix does not fit the bill and special treatment is indicated. Experimentation over the years with various native and exotic leguminous species and nursecrop and special purpose type grasses has resulted in alternatives for these difficult areas.

For example, stands of crownvetch and flat pea have been established in several areas and are showing good perennial performance. Nurse crops such as Fall Rye are used routinely for problem situations where quick cover is essential.

We've only had limited success in establishing woody perennials by direct seeding but several have shown promise, including wild rose, locust and broom.

Although aesthetic qualities of plants established on highway right-of-way are secondary in importance to their erosion control characteristics, numerous "wild flower" type seedings are being experimented with in rehabilitation projects. We have had some success with California and Shirley Poppy, Dwarf Nasturtium and Lupine. The perennial lupine (Lupinus perrenne) in particular is performing well and, in addition to the show of colour, has a substantial root system.

SEEDING RATES

The optimum rate at which seed is to be sown is difficult to predict. Seed varies considerably in size, weight and viability and its application rate, especially as a component of a mixture, will change according to desired crop stand, time of year applied, anticipated losses, etc. We currently apply our grass and legume seed mixtures at rates anywhere from 50 to 100 kg or more per hectare.

A recent report on hydroseeding recommends higher rates to compensate for losses due to:

Pump Damage (10%)
Damage by fertilizer (10%)
Loss by erosion, animals (10%)
Overspray (10%).

Conversely, it has been argued that excessive seeding rates can result in too many plants per unit area which can be more detrimental than too few plants. When sub-optimum plant numbers are present, individual plants will usually enlarge to fill the vacant space but when plant populations exceed optimum levels, all the plants are stressed and stunted by competition.

A study by the University of Massachusetts supports this; their results demonstrated that a seeding rate of 84 kg per hectare (75 lbs. per acre) gave as good a cover as 196 kg per hectare (175 lbs. per acre).

FERTILIZATION

As with seeding rates, determining the amount of fertilizer to use to establish vegetation is difficult.

The question is further complicted when one considers existing fertility levels, analysis of fertilizer used, crop to be planted, moisture availability and numerous other factors.

Timing of fertilizer applications often appears to be even more important than the amount of fertilizer used.

According to some recent studies, fertilizer applied at the time of seeding is of little benefit if nutrient losses due to leaching, denitrification and degradation are such that little is available when seedlings are at the stage where nutrients are most needed.

Last year, in the Kelowna area (annual precipitation approximately 300 mm), several extensive plots were seeded in the spring without fertilizer and the nutrient applied in the fall when the seedling grasses were well along. The "catch" of grass on these slopes is excellent and no deleterious effects have been observed.

However, a similar experiment was conducted in the Revelstoke-Mica area (annual precipitation 1200 mm or more), with contrary results. The seedlings appeared stressed and chlorotic within a few weeks after planting. Nutrient deficiencies were unmistakable. On fertilizer application, the stand revived. However, plant populations were noticeably reduced.

Nutrient levels in both soils were minimal and, even allowing for the different seed mixtures used in these two experiments, our results suggest that, in drier areas, it may indeed be of little benefit to apply fertilizer at the time of seeding since seed germination is slow. Conversely, in areas of greater rainfall, it is vital the nutrient be available to the seedlings at the onset.

Further, while there is probably room for arguing the merits of fertilization at the time of seeding, our experience has shown that fertilizer applications made to actively growing seedlings is necessary to their long term survival. At the seedling stage, given adequate nutrients, roots reach subsurface moisture horizons, allowing plants to become firmly established. Subsequent periodic refertilization assures vigourous and hardy growth. In the past, we have seen many of our immature grass stands succumb to drought when, no doubt, a timely application of fertilizer, not water, could have saved them.

Fertilizer formulations used will, ideally, vary with existing site fertility levels, climate and, of course, the crop to be sown or refertilized. Numerous soil tests have been carried out on highway cut and fill slopes throughout the province to determine optimum fertilizer analyses to be used. Not surprisingly, the "basement" soils encountered in almost all cases were inherently deficient in nitrogen and usually low in the other essential elements. Because of the impracticality of ordering numerous custom blend fertilizers for specific sites, a general fertilizer blend, adequate for the majority of areas, has been formulated.

We recently modified our fertilizer blend to include nitrogen, phosphorus and potassium in a 3-2-1 ratio. Currently, we are using 27-18-9 fertilizer at an approximate rate of 200 kg per hectare for initial establishment of vegetation. Refertilization is carried out

as part of a carefully considered slope maintenance program where obvious nutrient deficient areas are treated with an application of ammonium sulphate or ammonium nitrate at 200 kg per hectare. Our 1982 refertilization costs were approximately $150.00 per hectare.

MULCHING

Mulches have proven beneficial in particular circumstances when establishing vegetation from seed. A thin layer of mulching material covering the soil surface can insulate the soil from extreme sun exposure, minimize raindrop impact, prevent soil surface crusting and reduce the velocity of surface waterflow which might otherwise carry off soil and seed. Mulch may also reduce evaporation rate, although there have been suggestions that a layer of wood fibre mulch may act as a wick and actually increase evaporation.

The Ministry currently uses mulches which can be hydraulically applied including:

- -treated wood cellulose
- -combination straw, recycled paper and fibre types
- -chemical "tacker" agents.

We generally apply mulches only to highly erodible sands, silts and silty clays. Where granular soils or mixtures such as glacial till are treated, application of seed and fertilizer alone usually suffices. When the use of mulch is indicated, application rates for a wood fibre type would be in the order of 1200 kg per hectare. A synthetic polymer tacker or other chemical binder is sometimes added to the fibre mulch at rates of approximately 22 kg per hectare.

Mulching increases seeding costs considerably and its benefits should be carefully weighed against alternatives such as increasing initial seeding rates or simply reseeding at another optimum time. Still, under certain conditions, where loss of valuable surface soil and expensive seed cannot be gambled and time is of the essence, mulch can be an ideal solution.

In 1982, our costs of slope seeding with mulch were approximately $1,500.00 per hectare.

EQUIPMENT

The Ministry currently employs four hydroseeders in sizes ranging from 5600 litres to 7500 litres capacity and treat in excess of 3000 hectares of right-of-way annually. Occasionally, for particularly difficult conditions such as are found on old, dry slopes, we have used a Klodbuster to break up the hard, dry crust. In this operation, fertilizer can be incorporated with the soil and the seed lightly covered. A Klodbuster has also been used to work sawdust in with soil to create a more favourable seedbed.

HELICOPTER SEEDING

We use helicopters to seed and fertilize areas which are inaccessible to the conventional truck-mounted hydroseeder of which pose exceptional safety hazards such as perilous footing and rock fall if hoses were to be pulled on the slope. When new slopes are seeded by helicopter, two passes are necessary since seed and fertilizer are applied separately. Two different apparatus, a Chadwick seeder and a barrel seeder, have been used.

The Chadwick seeder is suspended beneath the helicopter from 6 metre cables. It applies an even swath approximately 20 to 25 metres in width by means of a spinner powered by a small gas engine which runs continuously. The seed is discharged through an adjustable electric door which is operated from inside the helicopter. The Chadwick spreader is refilled in two to three minutes from a hopper holding up to 1000 kg of material which is usually mounted on the rear of a flat deck truck.

The barrel seeder consists of two 170-litre drums equipped with a hinged door on top for loading and a manually controlled sliding door on the bottom for discharging. The barrels are mounted on each side of the chopper. An even swath of approximately 14 metres is applied. Reloading takes about four minutes.

The Chadwick seeder is superior to the barrel seeder in that it provides a better, faster and more efficient means of application.

Following is a comparison of our 1982 costs of helicopter seeding, machine hydroseeding and seeding by hosework. In this illustration, it should be noted that the helicopter seeding was done at a distance of some 125 kilometres from the helicopter base and therefore, costs are higher due to increased ferrying time.

1982 HELICOPTER COSTS

75 hectares (185 acres): 4 days work -

Materials

Seed	@ 70 kg/ha = 5,250 kg x $2.42/kg	= $12,705.00
Fertilizer	@ 200 kg/ha =15,000 kg x $0.27/kg	= $ 4,050.00

-Equipment

Helicopter	21.6 hrs.	@ $415.00/hr	= $8,964.00
Fuel	1,897 litres	@ $ 0.50/1	= 948.50
Oil	21.6 litres	@ $ 1.00/1	= 21.60
Flat Deck	8.0 hrs.	@ $ 24.40/hr.	= 195.20
Pickup	28.0 hrs.	@ $ 4.10/hr.	= 114.80

-Labour

3 people x 4 days x 9 hrs. = 108 hrs. @ $13.50/hr = $1,458.00

-Living Expenses

3 people x 4 days = 12 days	@ $60.00/day	= $ 720.00
	Total:	$29,177.10

Total Cost = $389.03 per hectare ($157.71 per acre)

1982 HOSEWORK COSTS

75 hectares (185 acres): 15 days work -Materials

Seed	@ 70 kg/ha = 5,250 kg x $2.42/kg	=$12,705.00
Fertilizer	@ 200 kg/ha =15,000 kg x $0.27/kg	=$ 4,050.00

Equipment

Hydroseeder	105 hrs.	@ $41.50/hr.	=$ 4,357.50
Flat Deck	105 hrs.	@ $24.40/hr.	=$ 2,562.00
Pickup	105 hrs.	@ $ 4.10/hr.	=$ 430.50

-Labour

4 people x 15 days x 9 hrs. = 540 hrs. Q $13.50/hr.	=$ 7,290.00

-Living Expenses

4 people x 15 days = 60 days @ $60.00/day	=$ 3.600.00
Total:	=$34,995.00

Total Costs = $466.60 per hectare ($189.16 per acre)

1982 MACHINE HYDROSEEDING COSTS

75 Hectares (185 acres): 5 days work

- Materials

Seed	0 70 kg/ha = 5,250 kg x $2.42/kg	=$12,705.00
Fertilizer	0200 kg/ha =15,000 kg x $0.27/kg	=$ 4,050.00

- Equipment

Hydroseeder	40 hrs. @ $41.50/hr.	=$1,660.00
Flat Deck	40 hrs. @ $24.40/hr.	=$ 976.00
Pickup	40 hrs. @ $ 4.10/hr.	=$ 143.50

- Labour

3 people x 5 days x 9 hrs. = 135 hrs. @ $13.50/hr.	=$1,822.50

- Living Expenses

3 people x 5 days = 15 days 0 $60.00/day	=$ 900.00
Total:	$22,257.00

Total Cost = $296.76 per hectare ($120.31 per acre)

GRAVEL PIT RECLAMATION

Recognizing that gravel pit reclamation will be discussed by Mr. Beswick later this morning, we will briefly touch on the work which the Ministry of Transportation and Highways does in this field. Annual gravel usage by the Ministry in construction and maintenance totals approximately four million cubic metres. As you can appreciate, use of these amounts of material has profound visual and ecological impacts. To minimize these effects, a program of regrading, contouring, seeding and planting was initiated a few years ago. In conjunction with this, a philosophy of progressive reclamation is being promoted. The old practice of "dig now, worry later" is discouraged. With proper exploration and evaluation of the deposit prior to commencement of mining, an orderly development scheme can be established. Working the minimum possible area with simultaneous extraction and rehabilitation of the disturbance will result in an efficient and safe mining site which is environmentally acceptable.

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