SEEDING GRAVEL FILL ALONG BADAMI PIPELINE

1999 REPORT OF PROGRESS:
KADLEROSHILIK RIVER CROSSING

Steve McKendrick applying seed on Badami Pipeline helipad at west end of Kadleroshilik River crossing, 31 July 1999.

TO:
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INTRODUCTION

The Badami Pipeline was constructed in the winter of 1997 from an ice road. The pipeline was constructed on vertical support members (VSMs), and disturbance to the natural vegetation was minimal. Thus, revegetation is not a major issue for this pipeline. Exceptions were at river crossings and valve stations. Natural gravel and soil were used to backfill trenches cut at river crossings, and gravel fill was used in a few locations for helipads and valve stations. Three river crossings, Shaviovik, Kadleroshilik, and the east channel of the Sagavanirktok, have gravel fill that requires assisted revegetation to comply with permits. The gravel fill and backfilled trenches are the only sites needing revegetation assistance.

Although erosion of gravel has a low risk in the region for such sites in the Alaska tundra, it is required to be revegetated to improve aesthetic and wildlife habitat values. Owing to poor soil conditions, gravel fill becomes naturally revegetated very slowly. A case in point is the gravel fill along the Endicott Pipeline. Gravel has been there for nearly 16 years, and little plant establishment has occurred. Gravel in the region consists of 25-30 fines (particles < 2mm diameter). The fine fraction ranges from nearly pure sand to loamy sand in texture. This geologic material provides little silt- and clay-sized particles to hold nutrients and water for vascular plants. If the gravel is densely compacted to provide a stable surface for traffic and structures, then aeration and water penetration are reduced, limiting plant growth. These conditions produce a root environment that is drier and poorer in mineral nutrition for higher plants than typical coastal plain tundra soils. Consequently, the gravel fill along the Badami Pipeline is unsuitable for the wet sedge meadow vegetation occurring naturally along most of the route. Thus, there is little chance for adjacent plants to move onto either the gravel fill or the well-drained elevated backfill over the trenches. These are new habitats to the area and can only be vegetated with plants adapted to dry and gravel substrate. Such plant species occur naturally on the North Slope on gravel bars in braided stream channels. Few of these plants produce seeds that are readily dispersed by wind. The most promising are legumes, whose seeds generally fall near the mother plant. To accentuate the colonizing process, seed can be harvested from these natural stands and applied to revegetation sites. Seed must be harvested at least a year prior to application. The seed matures late in the growing season, and can be harvested, dried, threshed, cleaned and prepared for application the following year. Some years are poor production years due to weather, and conditions at the time of ripening may shatter the seed, preventing harvesting altogether.

This is a report on the 1998-99 harvesting, processing and applying of natural seed to the gravel fill at the Kadleroshilik River crossing of the Badami Pipeline.

OBJECTIVES

The objectives were:

- *To harvest seed from natural stands at the end of the 1998 growing season, dry, thresh, clean and prepare lots for application during the 1999 growing season.*
- *To apply seed and fertilizer to gravel fill in 1999 at the Kadleroshilik river crossing gravel fill sites.*
- *To harvest seed in 1999 for application in 2000.*

APPROACH

It is difficult to predict how much viable seed will be gathered and available for planting, until the seed is actually in hand. For that reason, it was necessary to compare our 1998 seed inventory after it was cleaned with the areas needing revegetation along the Badami Pipeline. With that information, target areas could be selected for seeding by matching the quantity of available seed with a comparable area to be seeded, and technical assistance and resources allocated to make the most efficient use of helicopter support to access the revegetation areas. Thus the Kadleroshilik gravel fill was identified as the target seeding area for 1999. Fertilizer and seed are generally applied at the same time and raked into the surface to cover the seed and incorporate the fertilizer. Fertilizer can be applied later if necessary, but the seed should go on during the growing season.

ACCOMPLISHMENTS

In 1998, the gravel fill sites along the Badami Pipeline were measured to acquire a site-specific inventory of areas needing treatment. Gravel fill areas at the Kadleroshilik crossing are listed in Table 1. The west end had 6,000 ft^2 of gravel and the east end 15,000 ft^2, for a total of approximately 0.48 a.

Table 1. Areas (ft^2) for gravel fill on east and west ends of Kadleroshilik River crossing for Badami Pipeline.

Gravel Fill	West end of crossing	East end of crossing
Helipad	4,500	4,500
Riser pipe	1,500	1,750
Backfill over trench		8,750
Total Gravel Fill Area	6,000	15,000

Seeds from five indigenous plant species: *Artemisia boreale*, *Aster sibiricus*, *Castilleja elegans*, *Hedysarum mackenzii*, and *Oxytropis boreale* were harvested in the fall of 1998 at several locations along the Sagavanirktok River. These are all broad-leaved flowering plants that commonly colonize gravel fill. *Hedysarum mackenzii* and *Oxytropis boreale* are members of the legume family and have the capacity to fix atmospheric nitrogen. It is expected that these species will enrich the soil nutrient pool in the gravel fill over time. No targeted grass species were successfully harvested. Wind shattered the seed as it ripened. There was some contamination of *Oxytropis boreale* seed with red fescue, (*Festuca rubra*) due to the co-mingling of those plants in the field at one harvest location. However, *Festuca rubra* was not a targeted grass for seed harvesting. We did not attempt to separate the fescue from the legume seed, and perhaps some fescue may establish on the Kadleroshilik gravel fill as a result. However, by keeping the fertilizer application minimal, it will not encourage this grass as much as if more fertilizer had been applied.

The harvest areas extended south from Deadhorse between TAPS MP 17 to MP 40. Seedheads were cut by hand and placed in cloth bags and air dried. After the collections were dried, they were threshed by hand, screened and cleaned with a blower. Subsamples of the cleaned seed were examined, sorted under a dissecting microscope and categories weighed to determine the percentage of filled (matured) seed. Based on that information, quantities of each species were weighed and individually

packaged for each of the five gravel fill areas at the Kadleroshilik river crossing.

Table 2 contains information on the species of plants seeded to the site and quantities applied. Approximately 100 seeds per square foot were applied with a hand seeder. *Oxytropis boreale* and *Castilleja elegans* (27 seeds/ft^2 and 58 seeds/ft^2, respectively) were the two predominant species in the application. Two of the five areas seeded (riser pipe on west end, and mound next to river channel on backfilled trench) was not raked after fertilizer and seed applications, to evaluate the effect of not raking.

Table 2. Listing of seed applied to gravel fill at Badami Pipeline, Kadleroshilik River crossing, 31 July 1999.

Plant species	Seed used (grams)	Live seed/ft^2
Artemisia boreale	632	8.2
Aster sibiricus	59	0.7
Castilleja elegans	244	27.4
Hedysarum mackenzii	434	4.8
Oxytropis boreale	2,065	58.5
Totals	3,434	99.6

Three hundred pounds per acre of 10-20-20 fertilizer was applied to these gravel fill sites on 31 July 1999. That delivered about 60 lb/a P_2O_5 or 30 lb/a of elemental P.

Seed harvesting continued in the fall of 1999, in preparation for application in 2000. The 1999 seed collection has been dried, threshed and is in the cleaning process. At this stage, it is not possible to know how much seed will eventually be available for the year 2000 applications. These collections were primarily *Oxytropis boreale*. *Hedysarum mackenzii* was shattered by wind before it could be harvested. The 1999 growing season was not as favorable as the 1998 season for *Castilleja elegans*.

OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

At the time of seeding, there was a light NE breeze, and temperatures were mild. The river was low enough for us to wade it and carry equipment across, saving a helicopter trip. Having favorable weather was helpful, particularly in applying the seed. Under windy conditions, seed can be carried beyond the target area and thus is ineffective.

Several indigenous plant species were flowering along the river at the time we treated the gravel fill. These were: *Astragalus eucosmus, Androsace chamaejasme, Polemonium acutiflorum,* and *Oxytropis nigrescens*. *Oxytropis nigrescens* also had previously flowered and formed seedpods. This species is one of the earliest flowering legumes in the region. Plants form cushions on the soil surface. It occurs on dry, sandy and gravelly soils. Seedpods are large and lie directly on the soil surface, making mechanical harvesting nearly impossible, in contrast to *Oxytropis boreale* and *Hedysarum mackenzii*, whose seedpods form on aerial stems (Figure 1). We have found *Oxytropis nigrescens* to be very suited to gravel revegetation in tests at Prudhoe Bay, with major drawbacks being difficulty of harvesting seed

and unreliability of seed development. Seed is produced by this plant on a very irregular basis, probably due to weather variations. One problem with *Oxytropis boreale* seed production is insect predation. Wasps lay eggs in the flower, and their larvae hatch inside the ovules, feeding on the endosperm of the seed. When the populations of these insects is high, they markedly reduce the quantities of seed that can be harvested from natural stands.

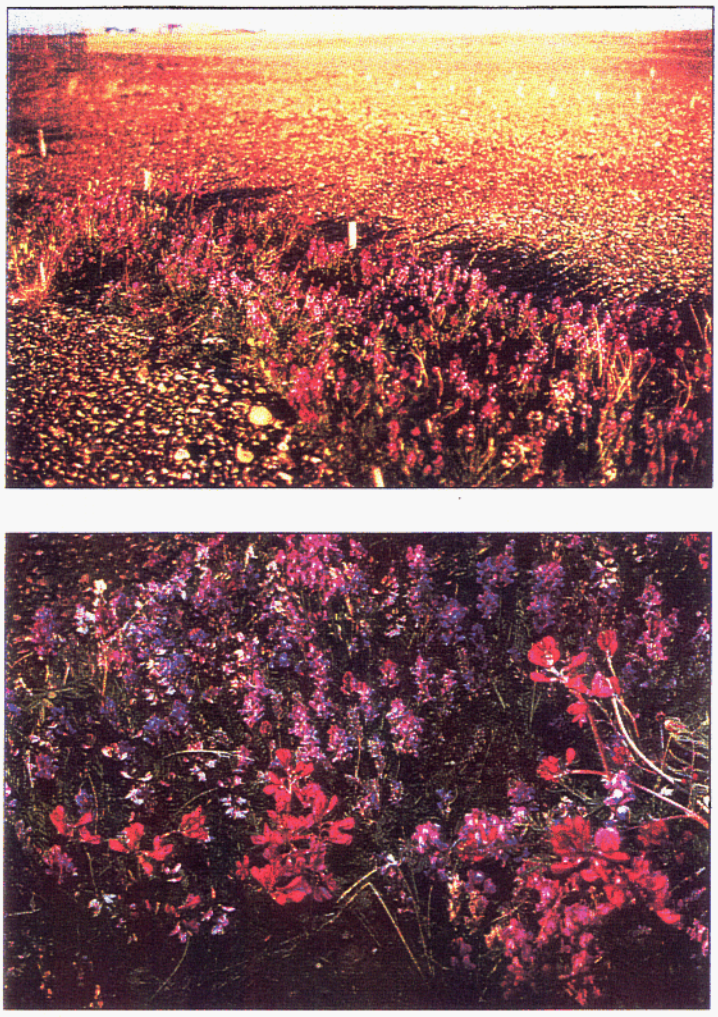

Figure 1. Flowering stand of indigenous plants established on gravel test plots at the BP Put River No. 1 drilling pad, Prudhoe Bay. Blue flowers are Oxytropis boreale and red are Hedysarum mackenzii. This stand was seeded in 1991 and photographed July 12, 1999.

Three species of plants that dominated the gravel test plots at Prudhoe Bay have been *Oxytropis boreale*, *Hedysarum mackenzii*, and *Castilleja elegans* (Figures 2 and 3). These species do not reach maturity until 5-7 growing seasons after establishment. They were visible in the test plots after two growing seasons and attained prominence within the mixed stands after three growing seasons. Flowers of *Oxytropis boreale* and *Hedysarum mackenzii* are grazed by ground squirrels. Seed o *Hedysarum mackenzii* are harvested by these animals. For the past two growing seasons, a duck has nested in these gravel revegetation plots a Prudhoe Bay (McKendrick, 1999). Thus, from a wildlife perspective, establishing vegetation on the gravel fill has definite potential for improving wildlife habitat.

Figure 2. (Left) Flowers of Hedysarum mackenzii on gravel plots at BP Put River No. 1. (Right) Seed pods of H. mackenzii. These seed pods disarticulate (break apart) between each segment.

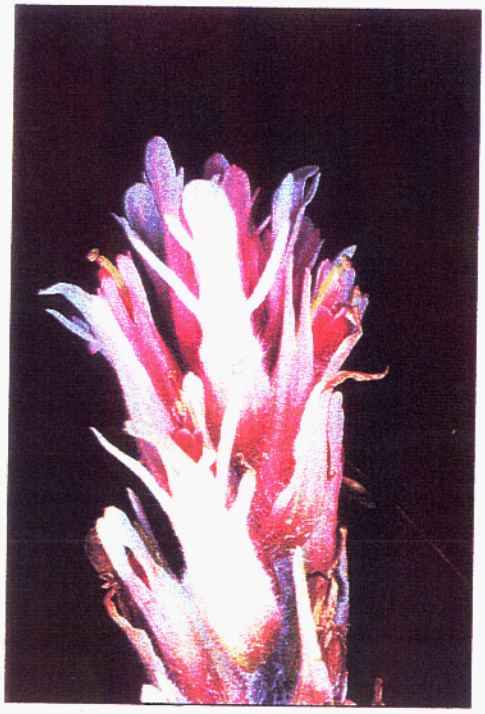

Figure 3. Closeup view of Castilleja elegans flowers on BP Put River No. 1 plots.

Figures 1 through 3 show the natural beauty of *Oxytropis boreale*, *Hedysarum mackenzii*, and *Castilleja elegans* on the gravel fill at test plots at Prudhoe Bay. These plants display aesthetically pleasing foliage and flowers which, once developed, should markedly improve the appearance of gravel fill along the Badami Pipeline.

We recommend continuing this process until all the gravel fill along the Badami Pipeline has been seeded. With favorable seed production and harvesting, that could be completed in two more growing seasons.

ACKNOWLEDGEMENTS

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REFERENCE

McKendrick, J.D. 1999. Wildlife and vegetation find habitat niches on oil field gravel pad. *Agroborealis* 31(1):36-38.