Final Report on the Evaluation of Advanced Herbaceous Conservation Species at the Diamond Alaska Test Pits Near Tyonek, Alaska 1983 - 1987

Submitted by

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Division of Agriculture

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Introduction:

The North Latitude Revegetation and Seed Project at the Alaska Plant Materials Center (PMC), a section of the Alaska Department of Natural Resources, is responsible for developing new plant varieties (cultivars) for land reclamation, habitat enhancement, and erosion control. In addition to the development of new plant varieties, this project also is responsible for developing techniques for erosion control and reclamation, and to provide technical assistance to industry so that this technology is properly used. In order to accomplish these goals, it is beneficial for the PMC to work with industry. Resource extraction industries usually have disturbances on which these new varieties or techniques can be tested and demonstrated.

Purpose:

Mining and Industrial Evaluation Plots are usually designed for reclamation and/or erosion control and are located in diverse geographical and ecological locations. The plots are developed in a manner consistent with the cooperators' intended final management practice, i.e., "Fertilize it once and forget about it." The practice of minimal maintenance is generally necessary for industry to eliminate costly yearly maintenance programs. Therefore, the plots are established with minimal surface preparation and are fertilized only at the time of planting. The plantings are then evaluated for their ability to survive on these harsh sites with no maintenance. Top soil is not used, and the plantings are made on the substrate that is expected to be available when reclamation occurs.

These plots also serve as an advanced evaluation of plant materials that have been selected at the PMC for their outstanding performance. In addition, the program also evaluates new techniques for planting and maintenance which may make the entire reclamation or erosion control process more cost effective.

The cooperator is allowed to set some of the parameters in the testing procedures, so that the test will provide useful data for the cooperator's particular conditions or regulatory guidelines. These plots also allow the PMC to make meaningful recommendations when similar conditions are encountered by someone other than the original cooperator. This class of evaluation plots probably provides the most important and useful information to the North Latitude Revegetation and Seed Project.

Methods

Diamond Alaska Coal Company requested both woody and herbaceous plots. These plots were further modified to compare fall (dormant) versus spring plantings and level versus 3:1 slope plantings.

For evaluation purposes, the PMC is treating the plots as six plantings, two herbaceous plots and four woody plots.

This report will only deal with the herbaceous plantings. The final data for the woody plantings will be covered in a separate report.

On September 12, 1983, a dormant plot was planted near the "Red Pit" settling pond. On June 13, 1984, a traditional spring seeding occurred in the Red Pit.

Both plots contained the complete 1983 array of accessions (Figure 1). Because of space limitations, the dimensions and arrangement of accessions varied from that shown on Figure 1. This change should not have affected the results. Each plot was hand-seeded with pre-measured amounts of seed. The seeding rates for each plot were approximately 40 pounds per acre. Following seeding, the plots were fertilized with 20-20-10 fertilizer at a rate of 450 pounds per acre (90 pounds actual nitrogen, 90 pounds actual phosphorus and 45 pounds actual potash). After the plots were seeded and fertilized, the area was raked by hand to incorporate the seed and fertilizer.

On June 10, 1987, the plots received a supplemental fertilization (20-20-10 at 200 pounds per acre). This deviation from our standard methods was performed to determine effects on failing or poor performing accessions. Supplemental fertilization is a permitted procedure within the first five years of a surface mine reclamation project.

Final evaluation occurred on August 24, 1987.

Typical Plot Layout

Nugget Kentucky Bluegrass	Merion Kentucky Bluegrass
Park Kentucky Bluegrass	Banff Kentucky Bluegrass
Sydsport Kentucky Bluegrass	Fylking Kentucky Bluegrass
Poa ampla	Troy Kentucky Bluegrass
Sherman Big Bluegrass	Canbar Canby Bluegrass
Tundra Bluegrass	Reubans Canada Bluegrass
Poa glauca T08867	Poa alpina
Agropyron subsecundum 371698	Sodar Streambank Wheatgrass
Nordan Crested Wheatgrass	Agropyron subsecundum Canada
Fairway Crested Wheatgrass	Agropyron violaceum
Summit Crested Wheatgrass	Agropyron boreal
Critana Thickspike Wheatgrass	Agropyron yukonese
Fults Alkaligrass	Vantage Reed Canarygrass
Climax Timothy	Engmo Timothy
Elymus arenarius	Elymus sibiricus 34560
Elymus sibiricus 1966	Elymus sibiricus 2144
Norcoast Bering Hairgrass	Tufted Hairgrass
Sourdough Bluejoint	Calamagrostis canadensis Delta
Meadow Foxtail	Alopecurus geniculatus
Garrison Creeping Foxtail	Arctared Red Fescue
Boreal Red Fescue	Festuca scabrella
Beckmannia	Pennlawn Red Fescue
Durar Hard Fescue	Highlight Red Fescue
Covar Sheep Fescue	Manchar Smooth Brome
Alyeska	Carlton Smooth Brome
Tilesy Sage	

Figure 1.

Advanced evaluation plots are evaluated at least once a year. The accessions are rated for vigor, percent stand, and numerous other factors such as hardiness, disease resistance, and related characteristics. However, we have found that vigor and percent stand are reliable indicators of how the different accessions compare with each other.

Figure 2 is an example of the evaluation sheets that will be presented in this report and can be found on page nine. The following numbers, followed by brief explanations, correspond to numbers on the example evaluation sheet:

1. Location and title of evaluation plot.

2. Number of evaluation blocks--This number may range from one to three blocks.

3. Year of Record--the year that evaluation data was collected.

4. Vigor--this number can range from one to nine. One is best and nine is the worst rating. If possible, this rating is determined by comparison with other accessions of the same species. The rating is based on color, height, health, flowering, and/or seed production, and on the evaluator's knowledge of the plant and its expected performance. If more than one block is planted, this number will be an average of the ratings for each block.

1	3									
	2 # of Blocks	4	5							
1	6									1
2	'Merion' Kentucky Bluegrass									2
3	'Banff' Kentucky Bluegrass									3
4	'Park' Kentucky Bluegrass									4
5	etc.									5
6										6
7										7
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52										52

Figure 2. Sample Advanced Evaluation Page.

5. Percent Stand--this number represents the percentage of the ground that is covered by the accession. Only live plant material is included; litter from previous year's growth and other species are not included. If more than one block is planted, this number will be an average of the ratings for each block.

6. The accession that is being rated. The accession is identified by its varietal and common name or its common name and its accession number.

Results

The first evaluation occurred on August 28, 1984. This evaluation indicated that all the accessions, except 'Banff' Kentucky Bluegrass in the fall plot became established.

Additional evaluations were conducted on August 30, 1985, August 20, 1986, and August 24, 1987. Abbreviated evaluation notes can be located on Figures 3 and 4.

By the final evaluation, 'Nugget', and 'Park' Kentucky Bluegrass, Glaucus Bluegrass T08867, 'Gruening' Alpine Bluegrass, Violet Wheatgrass T12050, 'Climax', and 'Engmo' Timothy, 'Norcoast' Bering hairgrass, Tufted Hairgrass 372690, 'Sourdough' Bluejoint, Meadow foxtail, 'Arctared' and 'Boreal' Red Fescue, Rough Fescue 236849, 'Egan' American Sloughgrass, 'Alyeska' Polar grass and Tilesy Sage T12052 provided excellent results.

In order to adequately determine long-term survival, the data must be reviewed for trends. As stated earlier in the report, the plots received supplemental fertilization on June 10, 1987. When 1986 and 1987 evaluation data is compared, the results will reflect the benefits of the added fertilization.

Some accessions were rapidly declining in vigor and percent stand by 1986. Supplemental fertilization appears to have reversed this trend. Without the added fertilizer, the following accessions would have likely either died or not have been rated very high. These include 'Park' Kentucky Bluegrass, Glaucus Bluegrass T08867, and 'Engmo' and 'Climax' Timothy.

Other accessions that provided acceptable performance were 'Sydsport' and 'Fylking' Kentucky Bluegrass, and Big Bluegrass 387931. 'Vantage' Reed Canarygrass exhibited such variable results between the spring and fall plantings that no conclusion can be reached. However, 'Vantage' generally has not performed well in other plots throughout south central Alaska.

Refer to Figures 3 and 4 for complete cover and vigor data.

Diamond Shamrock Coal Spring Planting		84		85		86		87		
	1 Block of Plantings	vigor	stand %	vigor	stand %	vigor	stand %	vigor	stand %	
1	'Nugget' Kentucky Bluegrass	5	60	1	90	3	100	1	100	1
2	'Merion' Kentucky Bluegrass	3	40	3	100	5	100	3	80	2
3	'Banff' Kentucky Bluegrass	1	70	1	100	7	100	7	90	3
4	'Park' Kentucky Bluegrass	3	40	5	70	7	40	1	100	4
5	'Sydsport' Kentucky Bluegrass	3	50	7	60	5	60	3	100	5
6	'Fylking' Kentucky Bluegrass	3	80	5	100	5	100	3	100	6
7	'Troy' Kentucky Bluegrass	3	25	9	30	5	100	5	80	7
8	Big Bluegrass 387931	6	15	3	95	3	70	3	100	8
9	'Sherman' Big Bluegrass	5	30	5	85	-	-	-	-	9
10	'Canbar' Canby Bluegrass	4	40	7	85	-	-	-	-	10
11	'Reubans' Canada Bluegrass	1	75	5	90	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	3	75	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	3	60	1	100	5	100	1	100	13
14	Alpine Bluegrass 235492, 236892	5	25	1	100	1	100	1	100	14
15	'Sodar' Streambank wheatgrass	3	40	9	30	-	-	-	-	15
16	Bearded wheatgrass 371698	5	10	3	30	-	-	-	-	16
17	Bearded wheatgrass 236693	5	20	3	60	-	-	-	-	17
18	'Nordan' Crested wheatgrass	4	30	7	15	-	-	-	-	18
19	'Fairway' Crested wheatgrass	3	50	9	25	-	-	-	-	19
20	'Summit' Crested wheatgrass	4	30	7	40	-	-	-	-	20
21	Violet wheatgrass T12050	5	15	5	30	3	40	3	80	21
22	Boreal wheatgrass T12048	4	20	1	70	-	-	-	-	22
23	Yukon wheatgrass T12051	4	15	1	50	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	4	15	9	50	-	-	-	-	24
25	'Fults' Alkaligrass	1	35	9	40	-	-	-	-	25
26	'Vantage' Reed Canarygrass	1	60	1	100	7	70	-	-	26
27	'Engmo' timothy	1	90	1	100	9	30	1	100	27
28	'Climax' timothy	1	98	1	100	7	40	3	70	28
29	Beach wildrye 345978	3	10	3	10	3	10	-	-	29
30	Siberian wildrye 345600	1	50	5	60	5	60	-	-	30
31	Siberian wildrye 2144	5	40	3	70	9	40	-	-	31
32	Siberian wildrye 1996	3	40	5	50	-	-	-	-	32
33	'Norcoast' Bering hairgrass	1	50	5	95	1	100	3	100	33
34	Tufted hairgrass 372690	3	50	1	100	3	100	3	90	34
35	Bluejoint	3	25	3	30	5	100	5	80	35
36	'Sourdough Bluejoint	5	20	3	70	3	100	3	100	36
37	Meadow foxtail	1	20	3	100	9	40	1	100	37
38	Geniculated foxtail 314565	3	75	1	100	-	-	-	-	38
39	Garrison Creeping foxtail	3	40	1	100	7	40	-	-	39
40	'Arctared' Creeping red fescue	1	40	2	100	3	100	1	100	40
41	'Boreal' Creeping red fescue	2	40	3	80	5	100	1	100	41
42	'Pennlawn' Creeping red fescue	2	40	3	90	7	100	3	100	42
43	Rough fescue 236849	1	60	5	90	3	100	1	100	43
44	American Sloughgrass T12053	4	30	1	100	3	50	3	100	44
45	'Durar' Hard fescue	5	30	7	50	-	-	-	-	45
46	'Highlight' Sheep fescue	3	40	7	60	8	100	1	100	46
47	'Covar' Sheep fescue	3	40	5	60	-	-	-	-	47
48	'Manchar' Smooth Brome	4	20	7	30	5	40	7	100	48
49	'Carlton' Smooth Brome	3	40	3	40	7	800	5	100	49
50	'Alyeska' Polar grass	5	25	1	90	1	100	1	100	50
51	Tilesy Sage T12052	3	60	3	90	1	90	1	100	51
52										52

Figure 3.

Diamond Shamrock Coal Fall Planting		84		85		86		87		
	1 Block of Plantings	vigor	stand %	vigor	stand %	vigor	stand %	vigor	stand %	
1	'Nugget' Kentucky Bluegrass	3	60	3	90	1	100	1	100	1
2	'Merion' Kentucky Bluegrass	3	40	3	100	3	90	3	80	2
3	'Banff' Kentucky Bluegrass	-	-	-	-	-	-	-	-	3
4	'Park' Kentucky Bluegrass	1	50	1	100	7	80	3	60	4
5	'Sydsport' Kentucky Bluegrass	1	70	5	80	3	100	3	100	5
6	'Fylking' Kentucky Bluegrass	3	80	1	95	5	100	5	100	6
7	'Troy' Kentucky Bluegrass	3	35	7	30	9	70	8	50	7
8	Big Bluegrass 387931	5	15	3	60	3	80	1	100	8
9	'Sherman' Big Bluegrass	3	25	7	10	-	-	-	-	9
10	'Canbar' Canby Bluegrass	5	25	7	30	-	-	-	-	10
11	'Reubans' Canada Bluegrass	3	70	5	50	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	3	25	9	10	-	-	-	-	12
13	Glaucus Bluegrass T08867	1	50	1	80	5	80	3	80	13
14	Alpine Bluegrass 235492, 236892	3	35	1	100	1	100	1	100	14
15	'Sodar' Streambank wheatgrass	5	15	7	10	-	-	-	-	15
16	Bearded wheatgrass 371698	3	25	1	75	3	20	-	-	16
17	Bearded wheatgrass 236693	5	20	1	50	5	30	-	-	17
18	'Nordan' Crested wheatgrass	3	25	9	5	-	-	-	-	18
19	'Fairway' Crested wheatgrass	3	25	5	10	-	-	-	-	19
20	'Summit' Crested wheatgrass	1	85	7	10	-	-	-	-	20
21	Violet wheatgrass T12050	3	45	1	90	3	100	1	100	21
22	Boreal wheatgrass T12048	3	35	3	40	-	-	-	-	22
23	Yukon wheatgrass T12051	1	75	1	90	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	3	75	-	-	-	-	-	-	24
25	'Fults' Alkaligrass	5	10	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	3	10	1	100	1	100	1	100	26
27	'Engmo' timothy	3	60	1	100	3	100	3	100	27
28	'Climax' timothy	1	95	3	100	3	90	1	100	28
29	Beach wildrye 345978	3	30	1	60	3	90	-	-	29
30	Siberian wildrye 345600	1	90	5	90	5	80	-	-	30
31	Siberian wildrye 2144	3	80	7	30	5	40	-	-	31
32	Siberian wildrye 1996	5	10	-	-	-	-	-	-	32
33	'Norcoast' Bering hairgrass	3	80	1	100	1	100	1	100	33
34	Tufted hairgrass 372690	1	90	1	100	1	100	1	100	34
35	Bluejoint	5	15	3	35	5	60	3	100	35
36	'Sourdough Bluejoint	5	10	3	20	1	80	1	100	36
37	Meadow foxtail	3	65	3	90	3	100	1	100	37
38	Geniculated foxtail 314565	1	100	1	100	-	-	-	-	38
39	Garrison Creeping foxtail	3	45	3	70	5	40	-	-	39
40	'Arctared' Creeping red fescue	9	75	1	100	1	70	1	100	40
41	'Boreal' Creeping red fescue	3	80	1	75	3	100	3	100	41
42	'Pennlawn' Creeping red fescue	1	90	3	100	-	-	-	-	42
43	Rough fescue 236849	3	60	3	100	1	100	1	100	43
44	American Sloughgrass T12053	1	90	1	100	3	80	1	100	44
45	'Durar' Hard fescue	5	10	7	30	-	-	-	-	45
46	'Highlight' Sheep fescue	3	75	7	30	5	80	-	-	46
47	'Covar' Sheep fescue	5	10	9	5	-	-	-	-	47
48	'Manchar' Smooth Brome	5	15	7	40	7	70	9	80	48
49	'Carlton' Smooth Brome	3	30	5	60	9	20	7	30	49
50	'Alyeska' Polar grass	3	50	1	100	1	100	1	100	50
51	Tilesy Sage T12052									51
52										52

Figure 4.

Conclusions and Recommendations

The conclusions drawn in this report are based on non-replicated plots, but the information is consistent with other plots on the Kenai Peninsula and in South Central Alaska. The Plant Materials Center will stand by these methods and recommendations when applied to the specific micro climates found at the proposed mine site.

Based on the data obtained in this study, including the declining vigor observed prior to the application of supplemental fertilizer, the Alaska Plant Materials Center recommends that any or all of the following commercial cultivars should be included in seed mixes for use in the Diamond Alaska Mine area:

Species	Comments
1. 'Nugget' Kentucky Bluegrass	seed available
2. 'Gruening' Alpine Bluegrass	very limited seed supply
3. 'Norcoast' Bering hairgrass	seed available
4. 'Arctared' Red Fescue	seed available
5. 'Boreal' Red Fescue	seed available
6. 'Sourdough' Bluejoint	very limited seed supply
7. 'Egan' American Sloughgrass	limited seed supply
8. 'Alyeska' Polar grass	limited seed supply

There are many commercially available species or cultivars other than those tested. It would be impossible to test each and every one. The species and varieties tested by the PMC were considered at the time the plots were established, to be the hardiest and most readily available species and varieties, and therefore, the most likely to be used by someone attempting erosion control or reclamation seedings. A land user may elect to use other varieties, but these should be equal or superior to those listed or in a mix containing a large proportion of the listed cultivars.

It is also recommended that evaluations be continued on the woody plant material planted at the site. Continued evaluation will then be conducted on the herbaceous material as well and provide useful long-term information not usually obtained from these types of plantings.

The final recommendation is that a continued cooperative effort exist between Diamond Alaska Coal Company and the North Latitude Revegetation and Seed Project at the Alaska Plant Materials Center. Hopefully, the continued efforts will result in rational and cost-effective reclamation and erosion control through the use of both herbaceous and woody species.

APPENDIX

Costs

Date	Activity	Travel	Per Diem	Other
9-12-83	Plant	0	0	45.00
6-12-83	Plant	0	0	50.00
8-24-84	Evaluate	0	0	0
8-30-85	Evaluate	0	0	0
8-20-86	Evaluate	0	0	0
6-10-87	Fertilize	0	0	15.00
8-24-87	Evaluate	0	0	0
	Sub Totals	0	0	110.00

Total $ 110.00