ATIGUN PASS

REROUTE

REHABILITATION PROJECT

FINAL REPORT

1994

Prepared for
Alyeska Pipeline Service Company

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INTRODUCTION

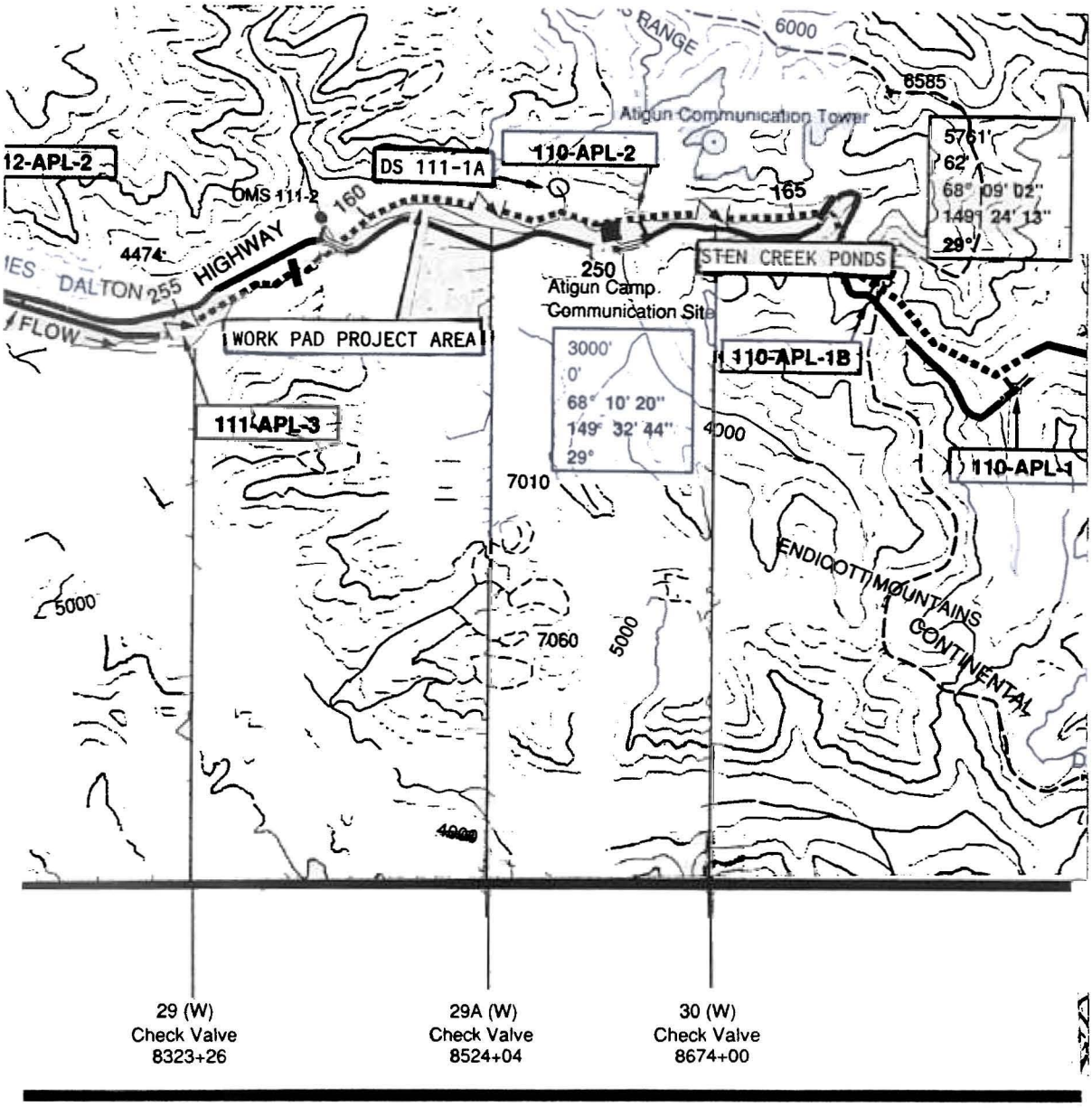
AND

PROJECT BACKGROUND

INTRODUCTION TO REPORT

This report presents the approved rehabilitation plan for the Atigun Reroute Project, and a narrative of work completed during the 1992-1994 seasons.

Figure 1. Atigun Project Area



REHABILITATION PLAN

INTRODUCTION TO REHABILITATION PLAN

Alyeska Pipeline Service Company pioneered most of the revegetation and rehabilitation techniques in the Arctic. Since the completion of TAPS, additional research in revegetation has occurred in Arctic regions of Alaska. While the basic concept of revegetation has not changed over the past 15 years, improvements have been made in plant materials and rehabilitation techniques.

Current revegetation practices rely more on native species than traditional agricultural varieties. Willow plantings still rely on native species, however, more attention is given to selecting techniques for specific site conditions. During pipeline construction, rooted cuttings were used. Now dormant cuttings, seedlings, bundles, and older rooted cuttings are the accepted methods.

Re-establishing willow on disturbed sites along the Trans Alaska Pipeline was first attempted by Alyeska Pipeline Service Company in 1977. The initial project relied on locally collected, dormant cuttings of Feltleaf willow, *Salix alaxensis*. These cuttings were then rooted in make-shift, growth production facilities.

The actual rooting of the willow sprigs worked well, however, problems with water, lighting and insects caused a very high mortality rate in the cuttings prior to planting. The cuttings that survived the production phase were often planted in sites not suitable for willow growth. Because of the problems encountered in the 1977 willow program, a second planting was initiated by Alyeska in 1978.

The second willow reintroduction program was modified to use dormant, non-rooted cuttings. Also, planting sites were chosen based on suitability rather than arbitrary mandates. The 1978 plantings performed much better than the 1977 plantings.

In addition to Alyeska's 1978 willow program, the University of Alaska was contracted by Alyeska to conduct willow revegetation research addressing multiple variables in planting methods, material planted and source of plant stock. This research program continued for a period of three years, 1978-1980. Both seedlings and non-rooted cuttings became established. Cuttings collected immediately south of the Brooks Range performed the best.

GENERAL REHABILITATION PLAN FOR 1992

The primary concern for Alyeska Pipeline Service Company as stated in the stipulations, is to control and prevent erosion. However, the intent of this plan was to establish riparian plantings and provide shading and protection for fish.

The plan proposed in this report relied on past experience and research conducted along the Trans Alaska Pipeline right-of-way and willow research conducted elsewhere in Alaska by the Alaska Plant Materials Center (PMC).

The plan also considered the potential of willow to invade the site. The plan relied on using the minimal numbers of non-rooted Feltleaf willow cuttings to achieve plant cover adjacent to the Sten Creek Pond complex (a man-made fish enhancement project) and the reconstructed channels in the North Tie-in area.

In the areas where willow cuttings were scheduled for planting, non-rooted cuttings were selected because they are a simple, cost-effective plant material for the site.

Only two areas were identified to receive this treatment; the Sten Creek pond complex, and the reestablished overflow channels near the north tie-in. No other areas in the re-route were identified or selected by the PMC staff for willow plantings.

In addition to actual planting of willow, some areas were scarified and fertilized to encourage natural re-invasion of native plants including willow. The areas selected for this treatment will be addressed later in the plan.

The use of seeded grasses was limited in the project area. One area (Sten Creek pond complex), was selected for seeding with native grasses and forbs. These seedings, however, were out of compliance with the standard Alyeska seed mixes and rates, and the specified seed mix required agency approval.

Based on observations in other Arctic areas and the necessity to prevent competition, the recommended seed mix relied on non-sod forming, native species. The mix was applied at a very light rate (10 to 12 pounds per acre), which reduced the chance of any competition with the willow plantings. No seed was applied to the area where willow cuttings were planted.

EXPECTED RESULTS

Willow Sprigging

Planting non-rooted cuttings is a proven method to propagate willow. This method of planting does not require the expense of greenhouse production necessary for rooted cuttings. Using non-rooted cuttings also eliminated the conditioning or hardening off period needed for rooted cuttings. Transportation and handling problems are also simplified by using non-rooted cuttings.

Planting seedlings requires an expensive, program of harvesting seed and greenhouse production. Following germination and establishment, the seedlings require special handling and care.

Sten Creek Pond Complex

Planting willow at a high elevation Arctic site had never been documented, therefore the potential for success was difficult to predict. The site had some limitations, including the short growing season resulting from the high latitude and elevation. However, the site had adequate water, an important factor for plant survival and establishment.

Despite the unknown effect of the conditions found at Sten Creek, the moist substrate of the site provided more favorable growing conditions than were found at many of the sites planted in 1977-1978. Assuming that 90% of all Feltleaf willow cuttings can root and initiate growth when given favorable growing conditions, at least 40% of the cuttings planted at the Sten Creek complex were expected to survive.

North Tie-In Area

The characteristics of this site suggested that it was an extremely poor site for willow planting. The planting area was unprotected and exposed to downslope winds which could desiccate the willow cuttings before they became well established. The site was drier than the Sten Creek site. Surface water occurred in these overflow channels intermittently. Planting sites were carefully selected in order to take advantage of expected surface moisture. An optimistic survival rate of 15-20% was predicted.

Natural Reinvasion of Willow

Willow naturally recolonize disturbances, especially in riparian areas. Almost the entire Atigun Project area was within a zone suitable for willow invasion, either from naturally dispersed seed or vegetative material moved downstream during flood events. While natural invasion of the site could be expected, it could not be predicted.

PROJECT

SPECIFICATIONS

TECHNICAL SPECIFICATIONS FOR PROJECT

Scarification

All areas requiring scarification for either seeding or willow planting, will be ripped or heavily raked (scarified) using standard construction equipment capable of penetrating the surface eight to twelve inches. Spacing on scarification teeth shall not exceed 18 inches. Scarification should be completed prior to June 15, but no more than one year in advance of the planting. Areas scarified during 1991 need not be re-scarified.

Fertilizer

All fertilizer shall be a free-flowing, granular type similar to that used by Alyeska in past seeding projects. All fertilizer will be applied with standard broadcast or drop applicators. For those areas scheduled for seeding and/or willow planting, fertilizer should be applied prior to seed application or willow sprigging.

Fertilizer for Sten Creek Area

The formulation used at DS 111-1A shall be 20% Nitrogen, 20% Phosphorus and 10% Potassium (20-20-10) applied at a rate of 500-600 pounds per acre.

Fertilizer Formulation for Other Sites

On segments of the work pad scheduled for scarification, the fertilizer formulation will be 8% Nitrogen, 32% Phosphorus and 16% Potassium (8-32-16). All fertilizer used in these areas will be applied at a rate of 500 to 600 pounds per acre using standard broadcast or drop application methods.

Seed Specifications

All seed shall meet or exceed quality standards for certified seed and shall comply with all state and federal seed laws. Seed will be mixed prior to bagging. Following the application of seed, the area should be lightly raked or harrowed to incorporate and cover the seed. All other specifications for seed and seeding shall comply with standard Alyeska specifications.

Sten Creek Area Seed Mix

In the areas where seeding is specified, the following mix will be used:

60%	'Tundra' glaucous bluegrass, *Poa glauca*
20%	'Norcoast' Bering hairgrass, *Deschampsia beringensis*
15%	'Gruening' alpine bluegrass, *Poa alpina*
5%	'Caiggluk' tilesy sagebrush, *Artemisia tilesii*

If, for reasons of limited availability, the seed mix may be adjusted by the PMC.

Seed will be applied at a rate of 10 to 12 pounds per acre. No seeding will occur within the band (15 feet back from water's edge) of willow sprigs. If, however, wind drift occurs and some seed is deposited within the willow planting band, it is not reason for concern. All efforts should be made to prevent excessive drifting of seed.

Willow Sprig Specifications

All willow sprigs shall be dormant, unrooted cuttings of at least second-year wood, 8 to 12 inches long and less than 3/4 inch in diameter. The preferred species is Feltleaf willow, *Salix alaxensis*. Care shall be exercised so that the natural stands are not decimated by the collecting activity. All cuttings will be collected prior to spring recovery of the parent material (prior to May 15). If cuttings are stored prior to planting, they shall be kept at a temperature of less than 35 degrees F but no colder than 0 degrees F. The cuttings must also be protected from desiccation while in storage. This can be accomplished by placing the cuttings in plastic bags. If the cuttings are stored frozen, small amounts of snow should be added to the plastic bags.

When the cuttings are planted, they shall be placed right-side-up in prepared holes to a depth of no less than 3/4 of their length. Care will be exercised to assure good soil/stem contact by slightly compacting the area around planted cuttings.

Willow Collection Site

Extensive Feltleaf willow stands occur along the work pad in the vicinity of Pipeline MP 190 - 196. This area appears to be an excellent site for collecting willows.

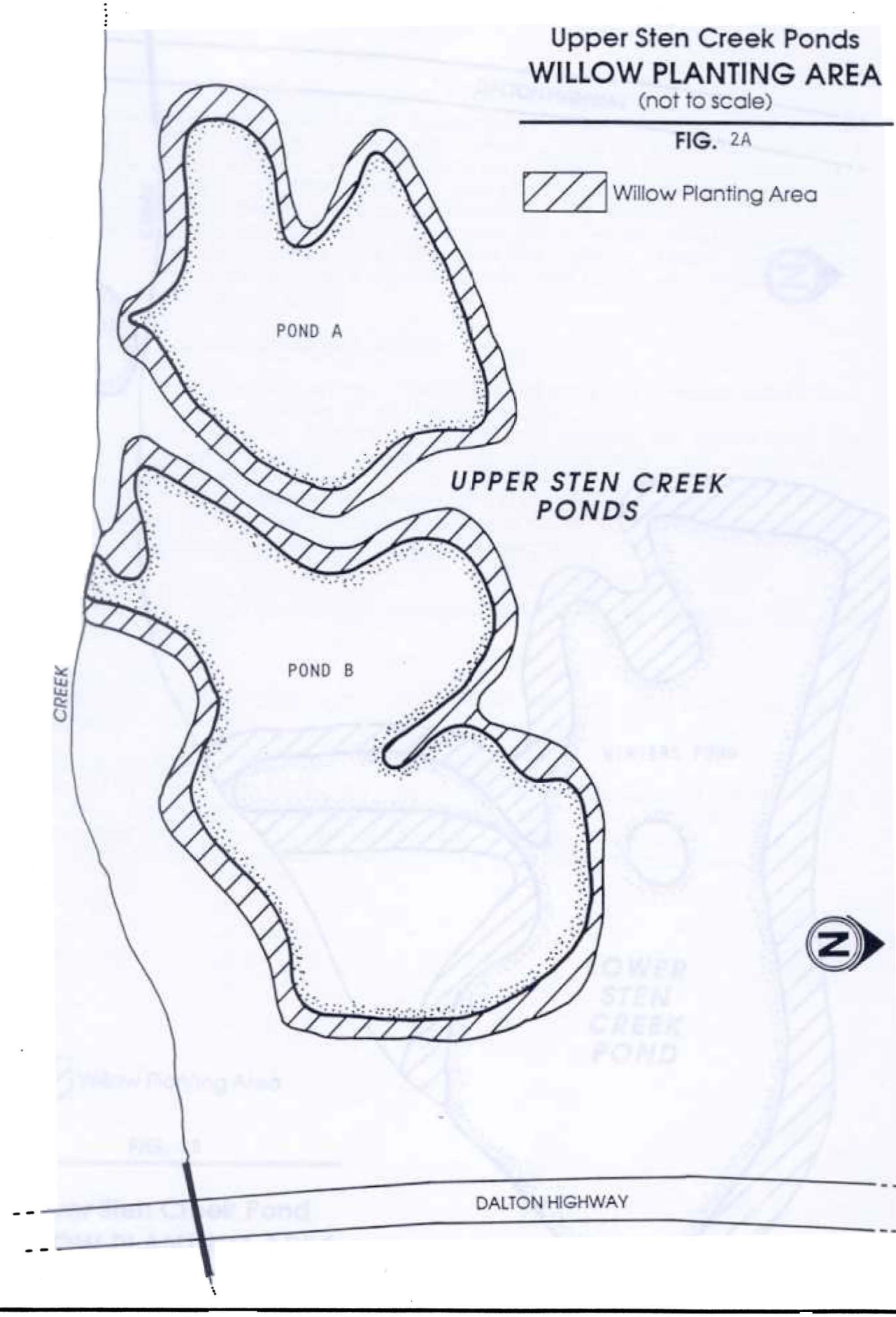
Spacing of Willow Sprigs

Sten Creek Ponds

The willow sprigs planted adjacent to the Sten Creek Ponds will be placed in two rows from the ponds edge outward (figures 1 and 2). Spacing between rows will vary from two to three feet randomly to prevent the visual lines. Spacing between sprigs within rows will be approximatly five feet. A total of approximately 1,900 willow sprigs will be planted in the Sten Creek Area.

North Tie-in Overflow Channels

Willow sprigs used along the overflow channels will be planted in a single row at the crests on each edge of the channel. Spacing between sprigs within the row will be approximately five feet. Approximately 1,700 willow sprigs will be planted in the North Tie-in area.


Upper Sten Creek Ponds
WILLOW PLANTING AREA
(not to scale)
FIG. 2A
Willow Planting Area
POND A
POND B
UPPER STEN CREEK PONDS
CREEK
N
DALTON HIGHWAY

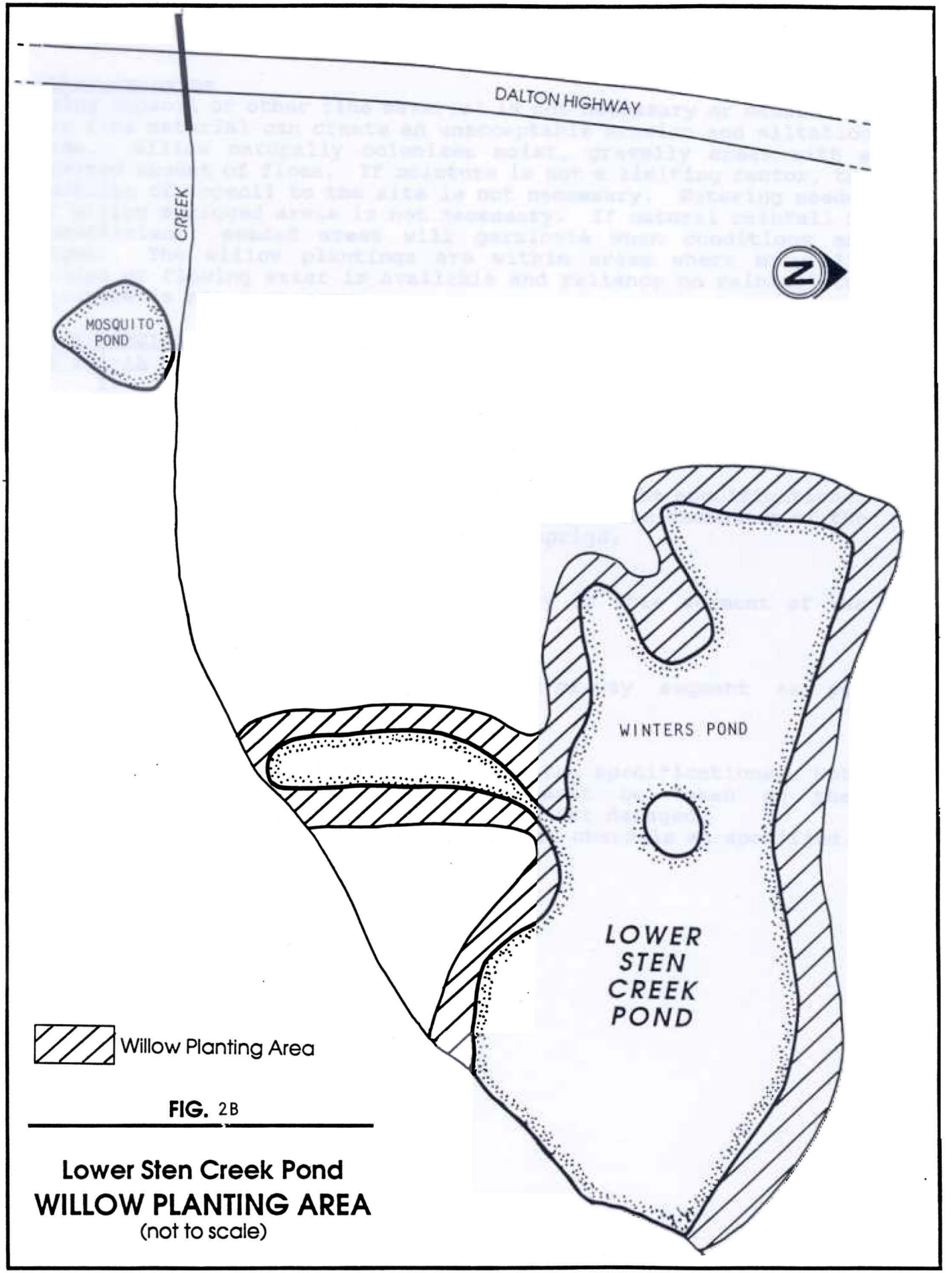


FIG. 2B

Lower Sten Creek Pond
WILLOW PLANTING AREA
(not to scale)

Other Concerns

Using topsoil or other fine material is not necessary or desirable. The fine material can create an unacceptable erosion and siltation risk. Willow naturally colonizes moist, gravelly areas with a limited amount of fines. If moisture is not a limiting factor, the addition of topsoil to the site is not necessary. Watering seeded or willow sprigged areas is not necessary. If natural rainfall is insufficient, seeded areas will germinate when conditions are right. The willow plantings are within areas where naturally ponded or flowing water is available and reliance on rainfall for moisture is not necessary.

SITE SPECIFIC REHABILITATION PLANS

DS 111-1A

1. Do not scarify site. Recent activity to create ponds has left the site in a suitable condition.
2. Plant willow sprigs adjacent to ponds as specified in Figures 1 and 2 and as described in technical specifications.
3. Fertilize entire disposal site as per the specifications.
4. Seed all areas within DS 111-1A with the exception of the corridor planted with willow sprigs.

South Tie-In to MP 161

1. No rehabilitation work is necessary in this segment of right-of-way.

MP 161 to 159

1. Scarify and fertilize the right-of-way segment as specifications.

North Tie-In Area

1. Scarify and fertilize as stated in the specifications. Note when scarifying an area, care must be taken so that reestablished overflow channels are not damaged.
2. Sprig edges of reestablished overflow channels as specified.

METHODS

THE 1992 FIELD SEASON

Willow Sprig Collection

During the last week in April 1992, two PMC staff members, one person from the Bureau of Land Management's Pipeline Coordinator's Office, and two to four Alyeska contract laborers collected more than 5,000 Feltleaf willow cuttings. Cuttings were collected along the workpad from Pipeline Milepost 185 to 191. The cuttings were stored in a refrigerated van at Pump Station 4 until planting.

Site Preparations and Planting

In late June, 1992, two Plant Materials Center employees and one Bureau of Land Management representative coordinated the activities of three Alyeska laborers and one equipment operator in order to carry out the contract as specified.

In 2 1/2 days (June 24 - 26, 1992) all work scheduled for the Sten Creek Pond complex was completed. Fertilization and planting of the willow sprigs and grass seed was carried out without any problems. On the afternoon of June 26, 1992, willow sprigs were planted on the margins of the recreated overflow channels. Less plant material was needed than expected because fewer channels were constructed than were specified in the plans. The plantings on the overflow channels was completed before noon on June 27, 1992 (figure 3 and 4).

Work Pad Scarification and Fertilization

On the morning of June 27, 1992, work began on scarifying and fertilizing the specific portions of the work pad. This operation was initially supervised by PMC personnel; supervision was turned over to Alyeska personnel on June 28, 1992. All work was completed within one week.

Control Willow Plantings at Palmer

Because fewer overflow channels were constructed, a surplus of willow cuttings existed after all areas had been planted. This allowed the PMC personnel to transport one box of 500 cuttings to Palmer for evaluation of rooting under controlled greenhouse conditions. Out of the one box of 500 cuttings, 300 sprigs were randomly selected and placed in a standard, automatically-watered, sand propagation bed. They were then monitored until rooting occurred or the sprigs were determined to be dead.

Figure 3. Overflow channel being planted with willow sprigs.

Figure 4. A typical willow sprig at planting.

RESULTS 1992

1992 FIELD EVALUATION

On August 11, 1992, one PMC representative evaluated the results in all areas where work was specified. This activity was completed by mid morning on August 12th.

Willow Sprig Evaluation

Initial reports from Alyeska and other agencies indicated a high survival rate for the willow sprigs. This was confirmed during the PMC evaluation on August 11, 1992. However, actual percentages of survival were somewhat lower than suggested by the early reports. Most of the cuttings appeared to be healthy (figures 5 and 6). Table 1 lists the percent of cuttings that survived by site and the range of the growth of new shoots.

TABLE 1.

PERCENTAGE OF WILLOW INITIATING GROWTH		
Site	% Growing	Range of Growth
Upper Pond Complex Pond A		
Site 1	81	3"-5"
Site 2	85	3"-4"
Site 3	82	3"-5"
Pond B		
Site 1	83	4"-7"
Site 2	77	2"-5"
Site 3	83	3"-5"
Lower Pond Complex Winters		
Site 1	92	2"-5"
Site 2	88	3"-6"
Site 3	88	3"-6"
Mosquito Pond	96	4"-6"
Overflow Channels		
Channel D	73	3"-8"
Channel C1-C1A	68	3"-6"
Channel B3	80	4"-6"
Channel B	82	2"-4"
Channel A	75	2"-4"
PMC Control Planting	97	Not measured

Figure 5. Willow sprig, August 11, 1992, on edge of overflow channel.

Figure 6. Willow sprig, August 11, 1992, adjacent to Sten Creek Pond.

Fluctuating water levels had not been expected in the pond complexes. Approximately 50% of the cuttings were in water at the upper complex on August 12, 1992 (figure 7). The water rose approximately three to four inches after planting. Both Winters Pond and Mosquito Pond also had elevated water levels but fewer cuttings were affected. The higher water levels are not expected to cause problems if they fluctuate seasonally. However, long-term flooding of the root zones may reduce the chances of survival. Documentation of water levels and cutting survival continued through 1994.

Native Grass and Herbaceous Species Seeding

The seeded areas at the Sten Creek Ponds produced very good first-year stands in most areas (figure 8). 'Norcoast' Bering hairgrass, *Deschampsia beringensis*, was the dominant seeded species. Both 'Tundra' glaucous bluegrass, *Poa glauca*, and 'Gruening' alpine bluegrass, *Poa alpina*, were present. 'Caiggluk' tilesy sagebrush, *Artemesia tilesii*, was very prominant throughout the site. The seed mix did not become established on excessively compacted areas.

Work Pad Areas

Areas that were scarified and fertilized to encourage natural invasion of willow, were evaluated during the August site visit. The sites appear to be well prepared, however seedlings were not detected.

Figure 7. Willow sprigs in standing water, August 11, 1992.

Figure 8. A dense, first-year stand of seeded grasses. Note *Artemisia*.

SUMMARY OF FIRST-YEAR OBSERVATIONS

On all sites, performance of the plant materials was better than expected. This is especially true of the willow sprigs. Slightly over 75% of the plantings at the north tie-in areas initiated growth. Initial projections suggested only a 15-20% survival rate should be expected. The Sten Creek pond complex first-year survival rate exceeded 85%. A projected survival of 40% was originally suggested. Herbaceous cover on the Sten Creek Complex performed adequately. A percent cover of less than 10% can be expected when light seeding rates are used.

RESULTS 1993

1993 FIELD EVALUATIONS

One evaluation trip occurred during August 2-3, 1993. During this period, all sites planted and or scarified were evaluated.

Willow Sprig Evaluations **(Sten Creek Ponds)**
During the summer of 1993, reports were received by the PMC suggesting that the plantings were growing well. During the evaluation on August 3, a decline in the number of surviving willow sprigs was noted. Additionally, the overall vigor of the surviving willow appeared to be in decline. Whether this was a result of temporary seasonal climatic stress or actual site conditions was not determined. It was noted that some new (1993) willow growth was developed on the previous year's growth. Some of the plantings had lost the 1992 shoot growth and new growth was originating from the main stem and other cuttings continued their growth from the 1992 branches (figures 9 and 10).

Willow Plantings **(Overflow Channels)**
During the design phase of this project, it was suggested that the overflow channels were not suited for willow sprigging. By agency insistence, the channels were sprigged. Initial estimates of survival for the willow sprigs ranged fro 15 to 20%. Actual survival as recorded in 1993, ranged from 10 to 20%. The vigor of the surviving willow sprigs was rated as being low. It appeared that the majority of the loss could be attributed to erosion of the banks of the channels (figure 11).

Figure 9. Willow showing new growth from main stem.

Figure 10. Willow showing new growth from previous year's growth. Note *Artemisia*.

Figure 11. Eroded banks of overflow channel.

Table 2. Summary of data collected during the 1993 evaluation of willow plantings.

Percentage of Willow Surviving		
Site	% Survival	Height Range
Upper Sten Creek Ponds		
Pond A		
Site 1	73	7-13"
Site 2	75	9-20"
Site 3	80	8-24"
Pond B		
Site 1	82	7-12"
Site 2	54	7-10"
Site 3	70	8-10"
Lower Sten Creek Ponds		
Winters Pond		
Site 1	60	6-9"
Site 2	73	7-10"
Site 3	52	7-11"
Mosquito Pond	68	6-12"
Overflow Channels		
Channel D	12	7-8"
Channel C1-C1A	18	9-12"
Channel B3	15	7-14"
Channel B	10	6-8"
Channel A	20	7-10"

Grass Cover **(Seeded at Sten Creek Ponds)**
Plant cover for the seeded areas around the Sten Creek ponds, continued to increase. The upper pond complex supported approximately 40% cover in 1993. The vigor of the grass was rated good to excellent. The most vigorous growth occurred on the mound area west of Pond A (figures 12 and 13). The drier, gravelly sites had the poorest vigor and lowest ground cover.

The light seeding used in the area allowed invasion of native species including River Beauty, *Epilobium latifolium*, and willow, *Salix* sp., (figure 14). In some areas, 30% of the vegetation was composed of invading species.

In 1993, the lower pond area continued to show poor performance. This, in part, can be attributed to the highly compacted site. The overall cover for the lower pond was 30%, and vigor was rated poor (figure 15). The previously (1978) seeded areas adjacent to the lower pond responded very well to the fertilizer application. Growth and vigor of the plants increased markedly from the previous year.

Work Pad Reinvasion **(MP 161 North to Transition)**
By August 1993, the areas scarified and fertilized in 1992 were starting to show signs of reinvasion. The percent cover was not estimated since it appeared to be less that one percent. The species noted included hairgrass, *Deschampsia* sp., bluejoint, *Calamagrostis* sp., sedges, *Carex* sp., River Beauty, *Epilobium latifolium*, sagebrush, *Artemisia* sp., poppy, *Papaver* sp., and vetch, *Oxytropis* sp. (figures 16 and 17).

Figure 12. Upper pond complex seeding after two full growing seasons.

Figure 13. Upper pond area, 1993.

Figure 14. Reinvasion of native species on open areas where seed did not establish.

Figure 15. Lower pond areas in 1993.

Figure 16. Scarified work pad reinvasion, 1993.

Figure 17. Scarified work pad south of bridge, 1993.

SUMMARY OF 1993 OBSERVATIONS

On August 2-3, 1993, the Atigun Pass Reroute Rehabilitation Project was evaluated. Plant cover varied from poor to excellent in the areas around the Sten Creek ponds and consisted of grasses seeded in 1992 and native species which had invaded the site.

The other areas that received rehabilitation treatments included the work pad from MP 161 north to the tie-in and the constructed overflow channel crossing the work pad. The majority of the work pad surface in this area was scarified and fertilized. Rehabilitation relied on the invasion of native species. The results in 1993, were much better than expected; however, only a few willow seedlings appeared in this area.

The willow sprigging effort along the margins of the overflow channel did not perfrom well (15 to 20% survival). This poor performance was anticipated prior to planting.

RESULTS 1994

1994 FIELD EVALUATIONS

Final evaluations occurred on August 10, 1994. The willow plantings, seedings and scarified sites were all evaluated

Willow Sprig Evaluations (Sten Creek Ponds)
Pond A in the upper complex, continued to support a good stand of willow. Survival ranged from 30 to 80%. Vigor of the surviving cuttings was rated highest at this pond (figure 18).

Pond B had a slightly lower survival rate, 20 to 80%. Overall, vigor exhibited by the willow at Pond B was lower than Pond A (figure 19).

The lower pond area was rated significantly less successful than either pond in the upper area. Survival ranged from 10 to 60% and vigor was rated as being poor. Both size and appearance of the willow was measurably less than the upper ponds.

Table 3 will give an overview of data collected during the 1994 evaluation.

Willow Planting (Overflow Channels)
The willow plantings placed along the overflow channels were no longer present when the 1994 evaluation occurred.

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Table 3. An overview of 1994 willow survival data.

Percentage of Willow Surviving		
Site	% Survival	Height Range
Upper Sten Creek Ponds		
Pond A		
Site 1	50	12-15"
Site 2	30	4-12"
Site 3	80	10-24"
Pond B		
Site 1	80	4-8"
Site 2	20	9-20"
Site 3	50	4-7"
Lower Sten Creek Ponds		
Winters Pond		
Site 1	60	6-12"
Site 2	30	4-6"
Site 3	10	4-5"
Mosquito Pond	43	6-15"
Overflow Channels		
Channel D	-0-	-
Channel C1-C1A	-0-	-
Channel B-3	-0-	-
Channel B	-0-	-
Channel A	-0-	-

Grass Cover **(Seeded at Sten Creek Ponds)**
The overall cover at the upper pond area ranged from 30 to 80%. The vigor was rated fair to excellent. The best performance was noted at the mound area west of the Pond A (figure 20), and the poorest overall performance was noted on southern and western aspect of the cut and fill slopes around the ponds.

Plant cover ranged from 0 to 50% and vigor was poor at the lower pond area. The lower area contained compact soils and many southern and western aspect cut slopes. These conditions were not as favorable for plant growth as those found in the upper pond area.

Native species including bluejoint, *Calamagrostis* sp., River Beauty, *Epilobium latifolium*, and willow, *Salix* sp. seedlings were colonizing both the upper and lower areas (figure 21). The upper pond area exhibited greater diversity and some wetland species such as sedge, *Carex* sp., and rushes, *Juncus* sp.

Work Pad Reinvasion **(MP 161 North to Transition)**
In 1994, the natural recolonization of the workpad Mile Post 161 north to the transition, was excellent. In selected areas, vegetation cover exceeded 10%. In specific sites, estimates of cover approached 40% (figure 22). Based on observations of natural recolonization in other areas along the pipeline or elsewhere in the state, the process of native plant invasion along this section of workpad appeared to have occurred relatively swiftly and supported numerous plant species.

Species noted along this section of the workpad include; River Beauty, *Epilobium latifolium*, sagebrush, *Artemisia tilesii*, Glaucous bluegrass, *Poa glauca*, bluegrass, *Poa* sp., red fescue, *Festuca rubra*, fescue, *Festuca* sp., Arctic reedgrass, *Calamagrostis inexpansa*, holygrass, *Hierochloe* sp., hairgrass, *Deschampsia* sp., horsetail, *Equisetum* sp., vetch, *Oxytropis* sp., poppy, *Papaver* sp., and willow, *Salix* sp.

Figure 20. Mound area west of Pond A in upper complex in 1994 Excellent stand of seed grasses.

Figure 21. Upper pond complex colonization by native species in 1994.

Figure 22. Scarified work pad in 1994 showing extent of colonization.

Wash Out of Sten Creek Ponds

Heavy rains at the end of August 1994 caused Sten Creek to overflow resulting in a massive land slip and breach of the Dalton Highway. Most of the Sten Creek pond area and rehabilitation effort was destroyed by the occurrence (figures 23 and 24).

Figure 23. Upper Sten Creek ponds after flooding. Photo by Mike Thompson.

Figure 24. Lower pond area after flooding. Photo by Mike Thompson.

CONCLUSIONS

AND

RECOMMENDATIONS

CONCLUSIONS BASED ON OBSERVATION 1992 - 1994

1. Willow sprigging on the work pad failed. The initial plan recognized the problems associated with the concept of planting willow adjacent to the overflow channels. The data seems to show that the practice of sprigging or planting willow on the work pad will fail.

2. Willow plantings adjacent to permanent water bodies such as the Sten Creek ponds, have a better chance of survival.

3. Work pad scarification combined with the application of fertilizer produced good results. Recolonization with high levels of species diversity seemed to be accelerated with this practice. Survival of the plant material was higher than willow sprigs at either Sten Creek or the overflow channels.

4. Light seeding rates with non-aggressive species appears to allow a relatively rapid reinvasion of native species. The seed mix prescribed at the Sten Creek ponds worked well to provide cover and allow native species to invade.

5. Results from the plantings on this project and past experiences, indicate that sprigging willow should not be undertaken unless a survival rate of 40 percent or less is acceptable.

RECOMMENDATIONS BASED ON OBSERVATIONS

1. Based on performance of willow plantings on the work pad during the 1977-1978 efforts and the 1992 effort, it is recommended that the practice of willow sprigging be stopped.

2. Light seeding or no seeding should replace the practice of seeding with heavy rates of red fescue/sod-forming grasses on non-erodible sites.

3 Site preparation (scarification) and fertilization appears to be an appropriate approach to encourage natural recolonization of disturbed areas when erosion is not a potential problem. The technique should be used in place of willow sprigging.

4. Prior to future willow plantings, more consideration should be given to that appropriateness of using willow. Scarification seems to produce better results.