RECLAMATION OF MINED LANDS, GREAT CANADIAN OIL SANDS LTD. LEASE SITE, TAR ISLAND, ALBERTA

D.J.Klym & C.B.Berry Great Canadian Oil Sands Limited Fort McMurray, Alberta

Introduction

In the open pit method of mining oil sands at the Great Canadian Oil Sands (G.C.O.S.) lease site, two operations are performed, creating a land disturbance and other environmental impacts. Overburden is placed in waste dumps in areas uneconomical to mine. The oil extraction process produces large quantities of tailings sand used in dyke building for impoundment of liquid tailings. The tailings sand dyke and overburden waste dump are illustrated in Figures 1 and 2, respectively.

Tailings sand is a fine-textured, high pH (8.0-8.5), low nutrient and poor water holding material. Overburden spoil, generally, is saline, above neutral in pH, high in clay content, low in organic matter, low in fertility, and may contain a small percentage of oil sands. The overburden component muskeg, usually a sedge or moss peat, is the principal amendment used to improve the adverse characteristics of tailings sand and overburden spoil.

Our reclamation program is designed around the primary short-term objective of erosion control and secondary objectives of establishing a self-supporting vegetative cover, improving aesthetics and providing a habitat for wildlife.

Description of Program

1. Revegetation Progress from 1969 to 1975

Growth room experiments were initiated in co-operation with the Alberta Department of Agriculture in 1969, followed by field verification in 1970. Applying the recommendations of the laboratory and field work, operational revegetation commenced on our tailings dyke in 1971. To date 140 acres are under vegetation.

In 1974, laboratory experiments by the Alberta Environment and field testing by the Alberta Forest Service set the basis for revegetation of 40 acres of an overburden waste dump in 1975.

To date, 35,000 trees and shrubs have been planted on the tailings dyke and overburden waste dumps in various experimental combinations. The afforestation program, in co-operation with the Alberta Forest Service, serves a twofold purpose at this stage - the actual afforestation of these areas and field experimentation.

2. Methods

A four(4) inch cover of muskeg is incorporated with fertilizer into the tailings sand slope at a volumetric ratio of one-to-one by using a rotovator. Seeding was initially accomplished by hydroseeder; however, better results were obtained with a Brillion Grass Seeder (see Figure 3 for seeding and fertilizer rates and mixtures).

The overburden waste dump was handled differently, using a disc and/or harrows to mix fertilizer and muskeg into the slope surface. Seeding and fertilizing was accomplished by a Cyclone Broadcaster mounted on the rear of a Bombardier. Seed and fertilizer was harrowed into the seedbed.

Maintenance fertilizer was initially applied manually, then by broadcaster on Bomtardier, and by helicopter once the areas were large enough to be economical.

Trees and shrubs are generally planted at a density of 430 per acre. The ratio of coniferous to deciduous species has been about 2 to 1. As suitable nursery stock becomes available this ratio will be changed to 1.to 4. Native stock propagated from locally collected cuttings and seed, now introduced as propagative technology, is being developed. Trees and shrubs are generally planted in established grass and legume cover with scarification at each seedling planting site. All seedlings, container and bare-root, are hand planted and watered if required at time of planting.

3. Results

By the end of the second growing season the grass and legume cover is dense and uniform enough to control water and wind erosion on the tailings sand slopes. Generally, the proportion of grasses in the plant cover, in the second season, is 50%. After the second growing season the legumes are phased out with Creeping Red Fescue becoming the dominating species. There is evidence of invasion by native species as well as volunteer growth, probably propagating from vegetative material in the muskeg.

The tree and shrub survivals have been increasing as methods improve, more adaptable species are available and nursery stock of good quality becomes available. Figure 4 represents survival rates of various species planted over the past four years. To date, lack of moisture (in 1972 and 1973) and mouse damage have been the major contributing factors to mortality. Other factors affecting survival and growth which are being studied are species suitability, time of planting, type of herbaceous cover, uncontrolled water erosion, quality of nursery stock and nutrient status.

4. Government Involvement

Government activity has been at a high level recently with most of the ongoing projects now being directed through the Alberta Oil Sands Environmental Research Program. This program is a joint agreement established last year between the federal and provincial governments to undertake the task of researching environmental problems associated with oil sands development.

Major ongoing projects are summarized as follows:

- <u>Alberta Forest Service</u>: testing of native and introduced tree and shrub species.
- <u>Alberta Agriculture</u>: testing of native and introduced grass and legume species.
- University of Alberta Soil Science Department: fertility studies, soil properties, nutrient movement.
- <u>Canadian Wildlife Service</u>: small mammals study to control mouse problem on vegetated dyke slopes.

Other agencies involved, in the past, were the Alberta Agriculture Soils Division, Alberta Environment Earth Licensing Division and Environment Canada Forestry Service.

Future Considerations

- The major cost of reclaiming oil sands mined land is the handling of muskeg. More needs to be known of storage effects and investigation into handling methods.
- We will have to intensify research into the testing of native vegetation, technology of seed production and handling and establishment of a source of supply in hopes of achieving a self-supporting plant cover.
- Nore attention must be devoted to the control of surface water runoff on tailings sand slopes. This problem overlaps into engineering aspects of dyke design and construction. We are planning the installation of a comprehensive surface drainage system in 1976.

Future Considerations (continued)

4. A word or two should be said on our long-range plans. In preparation for a long-range reclamation plan, muskeg and/or topsoil material will be inventoried and sampled this winter. The reclamation of 200 acres of tailings dykes and overburden waste dumps and the planting of 100,000 trees and shrubs would not be an unrealistic projection for the next five years. Larger areas will be reclaimed as mining advances and the mine pit is backfilled with tailings sand.

Conclusion

This report presents the G.C.O.S. Reclamation Program in a nutshell. As is evident from the problems described herein, more research is required. However, we are optimistic that a total effort by government, industry and others concerned could reclaim mined oil sands land to an ecologically acceptable condition.



- 18

8



- 82 -



F



IGURE 3 (a) SEEDING MIXTURES & RATES

| | TAILINGS DY | KE - 1974 | WASTE DUMP - 1975 | | |
|----------------|-------------|-----------|-------------------|---------|--|
| SPECIES | % BY WEIGHT | RATE IN | % BY WEIGHT | RATE IN | |
| | IN MIXTURE | LB/AC | IN MIXTURES | LB/AC | |
| Grasses | - | 15 | - | 18 | |
| Bromegrass | 34 | - | 20 | - | |
| Crested Wheat- | | | | | |
| grass | 27 | - | 17 | - | |
| Creeping Red | | | | | |
| Fescue | 15 | - | 6 | - | |
| Slender Wheat- | | | | | |
| grass | - | - | 17 | - | |
| | | | | 10. | |
| Legume | - | 5 | | 12 | |
| Sweet Clover | 7 | - | 17 | - | |
| Alsike Clover | 7 | - | 13 | - | |
| Alfalfa | 10 | _ | 10 | | |

FIGURE 3 (b) FERTILIZER COMPOSITION & RATE

| | TAILINGS SAND | | OVER BURDEN LBS/AC | | | |
|-------------|---------------|------|-----------------------|-----|------|-----|
| SPECIES | LBS/AC | | | | | |
| | N | P205 | К20 | N | P205 | K20 |
| lst Growing | | | | 13 | | |
| Season | | | | | | 1 |
| Starter | 12 | 48 | 48 | 23 | 23 | 0 * |
| Mid-Summer | . 40 | | - | 2.3 | 23 | 0 |
| Maintenance | 40 | 30 | 20 | 60 | 50 | 50 |
| | | | | | | |

* No potassium was applied because soil tests showed sufficient available potassium.

TAR ISLAND TAILINS DYKE TREE AND SHRUBS FIGURE 4 (a) PLANTED IN 1972

| C PE C IL S | "/" SURVIVAL | | | |
|-----------------------------------|--------------|------|------|-------|
| STECIES | 1472 | 1973 | 1974 | 1975 |
| Caragana arborescens | 56.6 | 45.0 | 45.0 | 45.0 |
| Poplar-Populus griffichi | 62.,0 | 17.0 | 17.0 | 17.0 |
| Aspen-Populus tremoloides | 24.0 | 2.0 | 0.0 | 0.0 |
| Birch-Betula papyifera | 52.0 | 16.0 | 15.0 | 15.0 |
| Elm, Manchurian-Ulímus pumila | 99.0 | 80.Q | 79.0 | 60.0 |
| Pincherry-Prunus pensylvanica | 74.0 | 33.0 | 25.0 | 17.0 |
| Choke Cherry-Prunus virginiana | 36.0 | 28.0 | 25.0 | 7.0 |
| Buffalo Berry-Shepherdia argentea | 15.0 | 0 | 0 | 0 |
| Wolf Willow-Elacagnus commutata | 28.0 | 2.0 | 2.0 | - 2.0 |
| Willow-Salix app | 28.0 | 28.0 | 25.0 | . 7.0 |
| Jackpine-Pinus banksiana | 15.0 | 15.0 | 15.0 | 15.0 |
| White spruce-Pices glaucs | 9.0 | 9.0 | 9.0 | 9.0 |

FIGURE 4(b) PLANTED IN 1973

1 2

| | | " SURVIVAL | | | |
|------------------|------|------------|------|--|--|
| SPECIES | 1973 | 1.9.7.4 | 1975 | | |
| Poplar-Russian | 36.0 | 13.0 | 8.0 | | |
| Willow-Salix spp | 60.0 | 28.0 | 17.0 | | |

FIGURE 4 (c) PLANTED IN 1974

| EDECIES | */* 5 | M. SURVIVAL | | |
|-------------------------------|-------|-------------|--|--|
| SPECIES | 1974 | 1975 | | |
| Aspen-Populus tremuloides | .50.0 | 32 | | |
| Poplar-Balsam-populus | 4.0 | 2 | | |
| balsmifera | | | | |
| Birch-Betulm papyrifera | 24.0 | 19 | | |
| Willow-Salix spp | 4.0 | 2 | | |
| Spruce-Pices glauca | 92.0 | 88 | | |
| J.Pine-Pinus banksiana | 72.0 | 66 | | |
| Lodgepole Pine-Pinus contorta | 44.6 | 43 | | |
| Pine-Hyb rid | 48.0 | 45 | | |
| Balsam Fir-Abies balsamea | 30.0 | 4 | | |

FIGURE 4 (d) PLANTED IN 1975

| SPECIES | | */. SUR VIVAL | |
|-----------------------------|--|---------------|--|
| | | | |
| Pinus bankstana-Containers | | 49 | |
| Pinus contorta - Containers | | 51 | |
| Picea glauca | | 51 | |
| Picea mariana | | 36 | |
| Alder - Native | | 24 | |
| Willow - Salix spp | | 88 | |
| Maple - Acer negundo L. | | 77 | |

OVERBURDEN WASTE DUMP No 7 SEEDLINGS FIGURE 4 (e) PLANTED IN 1974

| SPECIES | */ SURVIVAL | | |
|---------------------------|-------------|------|--|
| | 1974 | 1975 | |
| Spruce - Pices glauca | 96 | 94 | |
| J. Pine - Pinus banksiana | 72 | 55 | |

FIGURE 4 (1) PLANTED IN 1975

| URVIVAL | SPECIES | |
|---------|--|--|
| 975 | | |
| l . | Lodgepole Pine - Pinuscontorta | |
| | J. Pine - Pinus banksisna | |
| | Pruce - Pices glauca | |
| 3 | - Pices mariana | |
| - | Spruce - Picea glauca - Picea mariana | |

Proceedings of the Inaugural Meeting Canadian Land Reclamation Association DECEMBER 1975

> Design Planning Research Practice Education

Crop Science Department Ontario Agricultural College University Of Guelph Jelph, Ontario, Canada March 1976

FORMERLY PROCEEDINGS OF THE ONTARIO COVER CROP COMMITTEE

3.67.0 M 2 19 2 17 7 12

Digitized by the Internet Archive in 2025 with funding from University of Alberta Library

and interesting means to sever the taken whether with interesting the mean taken

at the the the haseracion will gran and levelon the a visble organization capable of fulling the next withduffe there of the chertur differences. The degree of success will be conclusione when the effort and input of engineers, socronomists, investors and sum utscholing from which will industry and government.

https://archive.org/details/proceedingsofina00cana

PROCEEDINGS OF THE INAUGURAL MEETING OF THE CANADIAN LAND RECLAMATION ASSOCIATION

Table of Contents

| | Page |
|---|------|
| President's message | i |
| Aims and objectives of the C.L.R.A | ii |
| Chairman of the Membership Committee's message | iii |
| Sample of Application for Membership | iv |
| Editor's message | ٧ |
| Minutes on meeting attended by a group of persons interested in forming a Canadian Association for Land Reclamation (Dec.9/75). | vi |
| Minutes of meeting held on Wednesday, December 10, 1975, during the 5th Annual Workshop, Ontario Cover Crop Committee, at the Arboretum Centre, University of Guelph | vii |
| Canadian Land Reclamation Association - 1st business meeting - Thursday, December 11, 1975, Arboretum Centre, University of Guelph, Guelph, Ontario | x1 |
| Proposed Constitution of the Canadian Land Reclamation Association, for ratification at the 1st Annual Meeting, late November/early December, 1976, Guelph, Ontario, Canada | xiii |

(continued)

Table of Contents (continued)

Papers presented at the Ontario Cover Crop Committee, December, 1975 Page Stable seed sheets - an alternative F.D.Bayles & M.A.Dudley, Canada Wire approach to revegetation & Cable Technology Dev.Dept., Pointe 1 Claire, P.O. Seeds for reclamation. J.W.Curtis, Kemptville College of Agricultural Technology, Kemptville, Ont. 18 The application of processed organic G.Courtin, Department of Biology, waste to acid mine tailings. Laurentian University, Sudbury, Ont. 26 Questions and answers about Prillcote seed G.Eros, Oseco Ltd., Brampton, Ontario 28 Growth of plant cover on an electric power underground transmission prototype - the effect of thermal stress. F.S.Spencer, Ontario Hydro, Toronto, Ont.33 Reclamation research at a mine site in J.V.Thirgood, Faculty of Forestry, north coastal British Columbia - a five-University of British Columbia, year progress report . . . 47 Vancouver, B.C. Properties of slow-release fertilizers . . R.W.Sheard, Land Resource Science, University of Guelph, Guelph, Ont. 58 Keith Winterhalder Reclamation studies on industrial barrens"in the Sudbury region - a Department of Biology. progress report. Laurentian University, Sudbury, Ont. 65 Paul Ziemkiewicz, Faculty of Forestry, Reclamation research methods on coal mine wastes with particular reference University of British Columbia, to species evaluation and assessment Vancouver, B.C. 69 D. J. Klym & C.B.Berry Reclamation of mined lands, Great Canadian Oil Sands, Ltd., - lease site -Great Canadian Oil Sands Limited, Tar Island, Alberta 77 Fort McMurray, Alberta

List (only) of papers presented before the Ontario Cover Crop Committee, 1971/1974. . . . 85