

THE SUDBURY REGIONAL LAND RECLAMATION PROGRAM - A PLANNER'S PERSPECTIVE*

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ABSTRACT

In 1975, over 400 square kilometres of environmentally desecrated landscape existed in the Sudbury area, primarily as a result of past mining and forestry activities. As a result, a very negative national image was Sudbury's legacy which hindered future growth and development of the Region. From a planning perspective, this environmental issue had become one of the foremost critical problems facing the Region and a classic problem solving exercise of major proportions. Although much of the basic and some of the applied research had been completed, the question of how to put these findings into operation on a community wide basis remained. Crucial in addressing this question was how to organize the program and obtain the necessary resources to actually reclaim the barren landscape.

This paper indicates how these issues were addressed and some planning inferences which helped to ensure program success.

BACKGROUND

The Regional Municipality of Sudbury is located in Northeastern Ontario approximately 400 kilometres north of Toronto in Central Canada. Built into a northern landscape comprised of beautiful lakes, rocky outcrops and forested valleys, Sudbury is a vibrant urban centre of 157,000 people. It lies on the southern portion of Canada's PreCambrian Shield in a vegetation transition zone between the eastern deciduous forests of the south and coniferous forests of the north. In spite of its beautiful surroundings, a significant portion of the Regional Municipality has been disturbed by past forestry and mining industrial activities. So drastic was the environmental damage that a widespread negative image of the Sudbury community had developed. This image resulted in considerable difficulty in attracting new investment and interest in the area.

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Logging activity beginning in the early 1870's, brush fires as a result of lumbering and prospecting, and sulphur dioxide emissions from open roast smelting beds or more modern smelters at Copper Cliff, Coniston and Falconbridge, have interacted to create dramatic vegetation alteration. Following the loss of trees and other ground cover, soil erosion increased and was unchecked across much of the area. Rich soil horizons along with important nutrients were washed away. Continued acidification and increased metal toxicity of the soil from smelter emissions further added to the problem. As a result, a serious breakdown in plant-soil relationships occurred; Winterhalder (1984). By 1972, it was estimated that 104 square kilometres of the Sudbury area were completely barren and approximately 363 square kilometres were semi-barren or moderately impacted; DeLestard (1967).

In order to improve the area's environment, large scale reductions in air pollution and major land reclamation efforts were necessary. Air quality improvements have been undertaken. However, these actions alone were not enough in many barren locations where the normal cycles of plant establishment had been broken. Here, some type of land reclamation effort was necessary to reestablish plant communities.

Most successful early reclamation attempts relied on importing soil and traditional landscaping techniques. Because of the high expense, this practice was limited to key locations, such as parks. For larger relatively flat locations such as fields or tailings areas, direct seeding techniques using agriculture methods and equipment proved feasible. Subsequently, a great deal of mining land has been reclaimed using these techniques. However, the majority of local barren lands consisted of rocky, sloping terrain with limited topsoil. Here the application of agricultural techniques was confined to limited specific locations. As a result, prior to 1978, almost all rocky terrain remained untreated.

In 1973, when Regional Government was officially established, a large percentage of the major road corridors and neighborhoods in and around the community were still barren. To help counteract this problem, the Region established a multidisciplinary technical advisory group for the purpose of revegetating barren areas. The Vegetation Enhancement Technical Advisory Committee, as it is called today, was made up of members from Laurentian University, the mining companies - Inco Limited and Falconbridge Limited, the Ontario Ministries of Environment, Natural Resources and Northern Development and Mines, the Local Conservation Authority, and local and Regional governments.

An initial action of this group was to commission further research

by K. Winterhalder of Laurentian University to determine the extent of barren areas along regional highways. This study also set up additional research test plots to determine the type of soil amendment required to support plant growth on relatively steep slopes and barren bogs. Earlier research had shown that the major limiting factors of plant growth were low pH and elevated copper and nickel levels. Soil amendments of lime and fertilizer were shown to have positive results on plant germination and growth. This latter research indicated that direct manual liming, fertilization and seeding of these areas without additional site preparation produced apparently good revegetation success.

Later in 1977, Regional Council through its Regional Plan officially set out to enhance the Region's visual quality and image by means of land reclamation efforts on disturbed lands. To accomplish this, Council committed itself to encourage research and support projects which aided this process. In spite of the fact that a great deal of community and regional concern existed regarding the appearance of the area, relatively little had actually been accomplished to change it. By late 1977, eight years of study had resulted in little actual change in the community's visual environment. Although the basic research necessary for landscape improvement was done, the major issue remaining was how to put these findings into operation on a large scale.

OPERATIONALIZING THE RESEARCH

Opportunity to operationalize the program occurred in the fall of 1977 when INCO announced the first of several major workforce reductions. At that time, representatives of the Regional Planning and Development Department and several other Departments formed a task force to determine means which would help reduce the community impact of INCO employment reductions. One of the suggestions put forward by the Planning Department was the idea to utilize student labour to help reclaim barren locations if a program could be put together. It was discovered that a Federal Program (Young Canada Works) could be utilized to fund the labour component if projects that met the program guidelines were submitted (e.g. maximum \$25,000 per project).

Taking this information, B. Lautenbach and K. Winterhalder put together eight different \$25,000 components for submission to the Federal Government. These submissions together formed one major land reclamation program. Following this application, the Regional Municipality of Sudbury gave a budgetary commitment of \$55,000 to help cover a portion of the capital cost required for the proposed program. With the Regional commitment secured, the Ontario Ministry of Northern Affairs was approached for a matching \$55,000 grant to

cover the balance of the capital cost necessary to operate the program. In the Spring of 1978 both the Federal and Ontario Governments agreed to commit their portions of the funding required, allowing the Regional Land Reclamation Program to begin.

That summer, 175 students were hired by the Regional Municipality to clean up vegetational debris and to lime, fertilize, and seed barren areas. Two highly impacted locations near the local airport and along the Trans-Canada Highway were selected for treatment on the premise that successful results would have an immediate and dramatically obvious effect. By summer's end, 115 hectares of barren area had been grassed and 200 hectares cleared of dead standing debris. The remarkable restoration of vegetation in these locations clearly demonstrated that significant landscape improvement was possible in the Region. These results successfully launched what was to become a major ongoing Regional program.

Since that first summer, the Regional Municipality has operated a major land reclamation program each year (1979-1987). Over that period numerous variations in the annual operation of the program have occurred. However, the basic conceptual framework established in 1978 has remained intact. The most significant variations have included:

- 1) establishing a full time coordinator to manage the day to day aspects of the program;
- 2) adapting the job creation aspects of the program not only to students but also to unemployed individuals and welfare recipients;
- 3) including tree planting as a major component of the program;
- 4) broadening the range of revenue sources tapped for program funding;
- 5) developing long range planning initiatives to ensure that long term program objectives are met; and
- 6) focussing on neighbourhood improvement initiatives as well as highway corridor improvements for visitors.

In all, eleven different projects have been part of the Region's land reclamation program. Five projects — grassing and greening, site improvement, tree planting, planning and mapping, and monitoring and assessment — form the operational core. Six other projects — native seed collection, experimental transplanting, wildflower planting, reclamation research trials, and forest assessment — have been experimental or research oriented. For more information with respect to program detail, planting procedures, yearly operations or overall accomplishments, refer to the Region's summary report; Lautenbach (1985).

PLANNING PERSPECTIVES

Although putting the basic research into operation was the main planning imperative, several other important planning considerations emerged during the process. Six substantive issues are briefly discussed under appropriate subheadings. Hopefully the elements chosen and the insights gained will be beneficial and transferable to projects of a similar nature.

A. Organizing for Delivery

In order for the Region to undertake a program of this magnitude, a major organizational commitment was required. As sponsor of the program the Region had to submit funding proposals, provide project supervisors, and provide operating support services for numerous projects and hundreds of new employees. To facilitate this, the program was administered under the Region's Chief Administrative Officer with a land reclamation coordinator appointed to oversee the operation. As well, Regional employees were loaned to the program each year to assist in field supervision. In addition, most personnel, safety training, payroll, accounting, purchasing, equipment pool, and legal services are provided through existing Regional departments. As all individuals hired became temporary employees of the Region, and as a wide range of materials and supplies were required, these support services have proved most useful.

The availability of an umbrella organization or lead agency was critical in mobilizing support, focussing energy and providing legitimacy to the task. It was also useful to have an organization which was already incorporated and had the necessary Worker's Compensation Board registration, liability insurance and tax numbers.

Organization of outside contributors was also required to match assistance and timing of help with program requirements. This coordination was essential in order to maximize project benefit. This task was primarily the responsibility of the program coordinator.

B. Long Range Perspective

One of the key planning inferences which emerged after the first year of operation, was the need for a longer range perspective. Given the enormity of the task, clear targets were required if the majority of the areas' barren landscape was to be successfully reclaimed. To fill this gap, long term plans were necessary to define the scope of the problem and a possible agenda for action to

guide politicians and administrators and to inform the general public. Long term funding commitment was also critical.

To achieve this perspective, grassing and tree planting plans for the next five years were developed which identified areas for reclamation and made prescriptive recommendations. Using these plans, manpower requirements and funding needs could be calculated on an annual basis depending on revenue availability. These plans also formed the basis for selecting annual reclamation priorities.

Once the 5 year plans were completed, the Region approached the Ministry of Northern Development and Mines to secure long term core funding. On the basis of the proposed plan and the apparent need, a five year commitment was generally agreed to, with the exact dollar amounts negotiated annually. This commitment provided incentive for the Region to budget matching amounts of money each year and helped to lever funds from other sources.

C. Partnership

The value of meaningful partnership arrangements was critical to the success of the program. From the very beginning, the Region had the benefit of being able to draw on the talent, skills and resources of numerous individuals and agencies. Federal and Provincial agencies and personnel, INCO and Falconbridge, Laurentian University, various Regional Departments, the Union locals etc. all made meaningful contributions to the program. These included contributions such as: use of equipment, use or access to key staff resources, use of facilities, use of support services (e.g. accounting, personnel, legal), lobbying assistance, and financial support. These in kind contributions, made possible because of informal partnership commitment and a shared sense of vision, were critical elements in the program.

Technical advice and support were also made possible through formalized partnership. The Region's Vegetation Enhancement Technical Advisory Committee, consisting of interested individuals from business or agencies involved in some aspect of vegetation enhancement, provided Regional Council with program recommendations. The Committee also provided consulting expertise and guidance concerning numerous technical aspects of the projects undertaken. As well, the Committee provided the Region with key contacts, specialized skills, access to additional support services and research capability. Examples of this include: access to unknown Ontario Hydro funding for tree replacement that was worth \$26,000; monitoring development and assistance through Laurentian University's Biology Department; use of an INCO hydro-seeder as required; and, establishment of Ministry of Natural Resources' tree planting test plots.

D. Program Flexibility

Keeping flexibility within the structure was key to meeting many program objectives. This was particularly applicable to funding arrangements which varied greatly from year to year. Flexibility allowed the Region to move from source to source as the need arose without compromising program objectives, even though each source often had unique requirements. For example, significant funding might be available for students one year, unemployed youth ages 15 to 25 the next year, and unemployed miners collecting unemployment insurance the next. By keeping delivery mechanisms flexible, the Region was able to target grant sources and adapt the program to fit the funding source requirements.

Similarly with respect to projects, the program was broad enough in scope to be able to shift yearly emphasis from grassing or tree planting toward monitoring or planning as funding requirements or capital availability dictated. Seasonal flexibility was also built into the program to allow certain aspects to be carried out during colder periods. As well, project durations were designed to meet worker requirements for Unemployment Insurance benefits or agency placement requirements through variable starting and finishing dates. By allowing for multiple objectives within the program the Region was able to shift emphasis, meet needs and make the program fit in response to emerging conditions.

E. Program Monitoring

To ensure that program objectives are being met, some type of monitoring or feedback mechanism is necessary. In this case, external monitoring was undertaken to determine how previous grassing and tree plantings were progressing. Growth parameters, survival rates and trends were investigated to indicate the need for operational adjustments or additional maintenance inputs. Monitoring of other biological parameters was also carried out by Laurentian University to assess whether functioning stable communities were occurring.

To date the results are encouraging. Although some changes have been made with respect to seed mixtures used and tree species planted, additional follow up maintenance has not been required. As well, more diversified ecological environments are developing in these areas.

Internal monitoring was also required to ensure that program objectives were achieved, that plans were followed, that key sites were reclaimed, that welfare case loads were reduced, and that the program remained labour intensive and cost effective. Subcommittees

on grassing and tree planting were established and provided input on many of these aspects. On this basis, several experimental projects - native grass seed collection, wildflower seeding, and composting projects - were curtailed as benefits did not justify the cost.

F. The Community Development Imperative

Inherent within the program was the desire for community improvement. Successful implementation of the program helped to create an atmosphere of pride within the community and helped to illustrate what can be possible when a community has a desire and determination to address current problems.

As the area became progressively greener, many residents began to improve their properties (building or landscape) near reclaimed sites. There was now concrete evidence that local improvements could make a difference. New possibilities for some vacant reclaimed sites also emerged as owners and developers viewed these properties in a new light.

However, a larger community planning inference can also be drawn from the program: The model utilized for this program can be tailored to other community projects. Projects such as waterway improvements, wildlife habitat improvement and neighbourhood development projects all have components which involve partnership, have labour intensive requirements, offer long term benefits and require community initiative to carry them out. It is hoped that the projects listed above can be undertaken within Sudbury by utilizing the lessons learned from its Land Reclamation Program.

PROGRAM SUMMARY

To date, the Region's land reclamation program has employed 1,290 students and 1,710 unemployed individuals for 45,000 work weeks. Grassing and greening, site improvement, tree planting, and monitoring and assessment projects accounted for most of this employment commitment.

Total cost of all projects undertaken between 1978 and 1986 was \$13,118,000, of which \$9,876,000 was for wages and benefits and \$3,191,000 for equipment, transportation, materials and other capital costs necessary to carry out the work. These funds were supplied from a wide range of sources and programs, including:

- 1) Canada Employment and Immigration Commission:
 - a. Summer Canada Program/Challenge Program \$2,238,000
 - b. Canada Community Development Program 117,000
 - c. ILAP/Canada Works Program 183,000

d. UI/IC Forestry Sector Program	35,000
e. Mining Sector Work Program	1,184,000
f. Canada/Ontario Employment Development Program	3,116,000
2) Canadian Forestry Service	61,000
3) Ontario Ministry of Northern Development & Mines	632,000
4) Ontario Ministry of Natural Resources: Mining Sector Work Program	625,000
5) Ontario Ministry of Labour: Canada/Ontario Employment Development Program	3,116,000
6) Ontario Ministry of Skills Development	
a) Ontario Youth Corp Program	348,000
b) Futures Program	32,000
7) Ontario Ministry of Municipal Affairs and Housing	763,000
8) Regional Municipality of Sudbury	624,000
9) Private Sector Donations	44,000
	<u>\$13,118,000</u>

As a result of these initiatives, 2,600 hectares of barren landscape have been grassed and restored to a more natural setting. An additional 980 hectares have been site-improved with the removal of unsightly vegetational debris. As well, 625,000 small tree seedlings have been planted in areas previously reclaimed; Appendix A.

It is estimated that approximately 26 square kilometres of barren land has been successfully reclaimed using labour intensive techniques. More significantly, this total includes almost all of the key visual corridors along major highways and almost all of the barren sites within residential neighbourhoods. This dramatic landscape restoration is doing a great deal to change Sudbury's negative image and restore a degraded environment. These improvements, along with the Region's continuing drive to diversify its local economy, are progressively changing the image and perception of the entire area.

References Cited

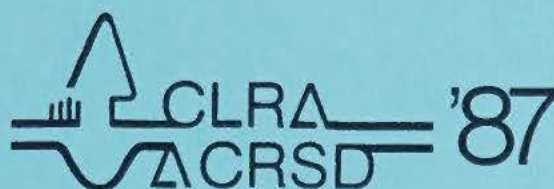
- DeLestard, L.P.G. 1967. A History of the Sudbury Forest District. Department of Lands and Forests Ontario: District History Series No. 21. 90 pp.
- Lautenbach, W.E. 1985. Land Reclamation Program 1978-1984. Regional Municipality of Sudbury. 65pp.
- Winterhalder, K. 1984. "Environmental degradation and rehabilitation in the Sudbury Area." Laurentian University Review. 16(2): 15-47.

APPENDIX A
LAND RECLAMATION PROGRAM ACHIEVEMENTS
1978 - 1986

Year	Amount Limed in Hectares	Amount Fertilized in Hectares	Amount Seeded in Hectares	Amount Site Improved in Hectares	Number of Trees Planted	Other Achievements As Specified
1978	114.8	114.8	114.8	206.3	-	30,000 pH and nutrient samples 365 kilograms of native seed collected 11000 trees, shrubs and plants transplanted 122 composting test plots
1979	478.6	466.6	420.2	295.9	4,250	420 hectares sampled for pH 425 kilograms of native seed collected 20,000 trees, shrubs and plants transplanted Monitoring and assessment begun.
1980	331.0	299.3	299.3	258.7	1,300	Land reclamation data assembled and computer coded. 2,000 pH samples taken 5 Year Land Reclamation Plan Developed
1981	208.0	173.4	173.4	9.8	4,600	5 Year Plan updated Monitoring and assessment records processed 29 research plots established
1982	362.4	342.4	305.2	199.2	-	Dismantled 2.4 km of abandoned trestle and improved tailings wildlife area
1983	1,084.0	934.6	935.4	-	228,080	Established 10 wildflower experimental test plots.
1984	57.7	188.4	215.9	7.5	149,350	Timber cruised 3,213 hectares Transplanted 400 trees Updated all mapping records Compiled second 5 year grazing plan.
1985	112.0	106.0	106.0	-	154,600	Native shrub seed sources identified. Land Reclamation Summary Report 1978-1984 published
1986	24.0	30.0	30.0	-	80,300	5 year Tree Planting Plan developed Monitoring survey of trees planted 1978-1985 completed. Forest management report prepared
TOTALS	2,772.5	2,655.2	2,600.2	977.4	622,380	

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TABLE OF CONTENTS

TABLE DES MATIERES

	PAGE
Foreword	vi
Avant-propos	vii
 <u>SESSION A</u> Update on Sudbury I - Sudbury aujourd'hui I	
Reclamation Programs and Research at Falconbridge Limited's Sudbury Operations (R.E. Michelutti)	1
A Conceptual Model of Streamflow Chemistry in an Acid Metal-contaminated Watershed Treated with Limestone (D. Skraba and K. Winterhalder)	11
The Sudbury Regional Land Reclamation Program - a Planner's Perspective (W.E. Lautenbach)	22
Tree Planting Activities of the Sudbury Regional Land Reclamation Program - an Evaluation (P.J. Beckett)	32
 <u>SESSION B</u> Slope Revegetation - Révégetation des talus	
Revegetation of Alpine Disturbances (W.A. Berg, M. Guillaume and J.T. Herron)	42
Slope stabilization - Parliamentary Precinct, Ottawa (E.E. Mackintosh and B. Miller)	52
Soil Erosion and its Control in Iceland (S. Greipsson)	65
Revegetation of Sandy Slopes (T.W. Hilditch, J.E. Gruspier and D.F. McQuay)	73

SESSION C Update on Sudbury II - Sudbury aujourd'hui II

The Sudbury Regional Land Reclamation Programme - an Ecologist's Perspective (K. Winterhalder)	81
Stabilization of Stressed Lands in the Sudbury Basin by Inco Limited (D.M. Bolton)	93
The Hardening-off and Performance of Mine-grown Coniferous Seedlings in the Reclamation of Anthropogenically Disturbed and Stressed Lands (G.M. Courtin and N. Naumenko)	98

SESSION D Coal - houillères

Native Grasses in Reclamation: What they Can and Cannot Do (P.F. Ziemkiewicz)	114
The Recovery of Earthworm Populations after Opencast Mining (A.D. Martin)	138
Weathering and Properties of Coal Minespoils in the Rocky Mountain Foothills Region of Alberta (D.J. Thacker)	148

SESSION E Microbiology of Acid Wastes - microbiologie
des résidus acides

Bactericides: a Modern Approach to Reclamation (R.J. Bohac and V. Rastogi)	157
Control of Acidic Drainage from Waste Rock and Sulphur Tailings by Chemical Inhibition of Iron-oxidizing Bacteria (G.R. Watzlaf)	168
Amelioration of Mine Tailings with Local Peat Soils in Southern Canadian Shield (A. Brown, D.J. Kushner and S.P. Mathur)	179
Biological Polishing of Acidic Seepage Creeks (M. Kalin)	189

SESSION F Landscape Ecology and Planning - écologie des paysages et planification

The Visual Impact of Reclamation (L.R. Paterson)	193
Landscape Architecture: Continuing Investigations into Creative Site Design for Surface Mining and Post Mining Land Use (J.B. Burley and C. Thomsen)	203
Planning Disposal of Drilling Wastes in Alberta - an Environmental Perspective (L.A. Leskiw)	217

SESSION G Pits, Quarries and Mine Wastes - sablières, carrières et déchets miniers

Update on Ontario's Aggregate Resources Management Program (B. Messerschmidt)	222
Revegetation of Quarries in France - an Example of Research Applied to the Upgrading of Deficient Ecosystems (J.J. Brun)	232
New Methods of Cultivation of Degraded Soils and Steep Slopes Resulting from Mining (B. Nille)	242

SESSION H Poster - affiche

Early Successional Rhizosphere Fungal Populations in Disturbed Semi-arid Ecosystems (P.R. Fresquez, B.R. Sabey and D.A. Klein)	249
--	-----

APPENDIX

List of Registrants - répertoire de participants	255
--	-----

INDEX

Index of authors - répertoire d'auteurs	260
---	-----