

## WHAT IS SUCCESSFUL RECLAMATION

### GOVERNMENT PERCEPTION

L.K. BROCKE

CHAIRMAN  
DEVELOPMENT AND RECLAMATION REVIEW COMMITTEE

The question being asked of this panel is what is successful reclamation. I have been asked to give the government's perception.

In general terms, reclamation is to rescue from an undesirable state or win back from vice or error or waste. Success is implicit in the definition and most certainly different people interpret its meaning in different ways. For example, the landowner may see reclamation as being successful if the land that was disturbed is returned to him in a condition that allows him to get the same production as before without having to increase his input. The other groups with an interest in reclamation are represented on this panel, and I'm sure will give their interpretation of reclamation and its success.

The Government's perception of successful reclamation may be different than that of the landowner or the operator or any of the other interest groups or all of them. It is not the government's role to necessarily please either the landowner or the operator. Rather, our role is to ensure that disturbed land is returned to its pre-disturbance state or equivalent so that the land base of Alberta will be maintained for the full benefit and enjoyment of present and future generations of Albertans.

That would be the favoured or desired result, the accomplishment of what was aimed at, in fact the government's perception of successful reclamation. However, I sense that the real question in the minds of many of us attending this symposium is rather how do you determine when reclamation is successful and more specifically, how does the government determine when reclamation is successful.

The responsibility for determining when reclamation is successful lies with the reclamation officers of the Land Conservation and Reclamation Council as appointed by the departments of Environment and Forestry, Lands and Wildlife. These individuals determine when reclamation is successful and issue reclamation certificates. The "how" of this process relies heavily on the experience and judgement of these individuals and is therefore somewhat subjective particularly in the cases where there is no prior approval required for the operation. In these cases, the reclamation officer is asked to judge when reclamation is successful based on what he sees after the operation is complete. Question such as: has topsoil been salvaged and replaced; has the site been regraded to prevent impedance of surface drainage in the area; is vegetation on the site performing to the same level as the adjacent

undisturbed area; are asked. In the absence of vegetation, the reclamation officer may judge that acceptable soil capability has been returned. When the reclamation officer judges these and other conditions to be satisfactory, he will issue a reclamation certificate and the reclamation is deemed to be successful.

In the cases where prior approval is required, the operation and reclamation is guided by conditions of approval and the "how" of the process tends to be more objective. In fact, the success of reclamation is based on compliance with the approved reclamation plan and conditions of approval.

The development and reclamation approval sets out conditions for conservation and replacement of soil materials; spoil placement, backfilling and recontouring and revegetation to ensure that the reclaimed land has characteristics and properties (topography, drainage, soils, vegetation) that provide for a return of equivalent land use capability.

Compliance with these conditions is monitored through regular inspections by the reclamation officers and review of the annual reports, which then become the basis for judging the success of the reclamation.

To further reduce the subjectivity of this process, the Council initiated a joint government/industry Steering Committee to develop a means of quantifying compliance with approval conditions. The efforts of the Steering Committee have centred on the development of a system for evaluating land capability that is workable on both pre- and post-disturbance land. It is the intent of the committee that the system adopted will be the tool required to provide the objectivity needed to be more quantitatively measure the success of reclamation.

So, heading into the 1990s, the success of reclamation will be measured objectively using the combined results of field inspections, annual reports, and land capability assessments to validate compliance with the approved plan.

## WHAT IS SUCCESSFUL RECLAMATION

### INDUSTRY PERCEPTION

P.D. LULMAN

COAL ASSOCIATION OF CANADA

### BACKGROUND

The Coal Association of Canada representing Coal Mining Operators in the mountains, foothills and plains of this Province has long stated the view that reclamation success is built of two parts:

1. Compliance with the Development and Reclamation Plan; and
2. The understanding that assumptions made in the plan are well founded and produce reclaimed land equivalent in capability to the land before mining.

I am going to describe, in more detail, these two features of reclamation success as viewed by the coal industry and at the same time express our view that compliance with plans and evaluation of planning assumptions could apply to any disturbed site in Alberta, not just coal mines.

To put the definition of reclamation success in perspective, I am going to describe briefly the land reclamation process in Alberta and the steps through which we believe we proceed from the initial planning of a coal mine through to the final certification of the reclaimed area.

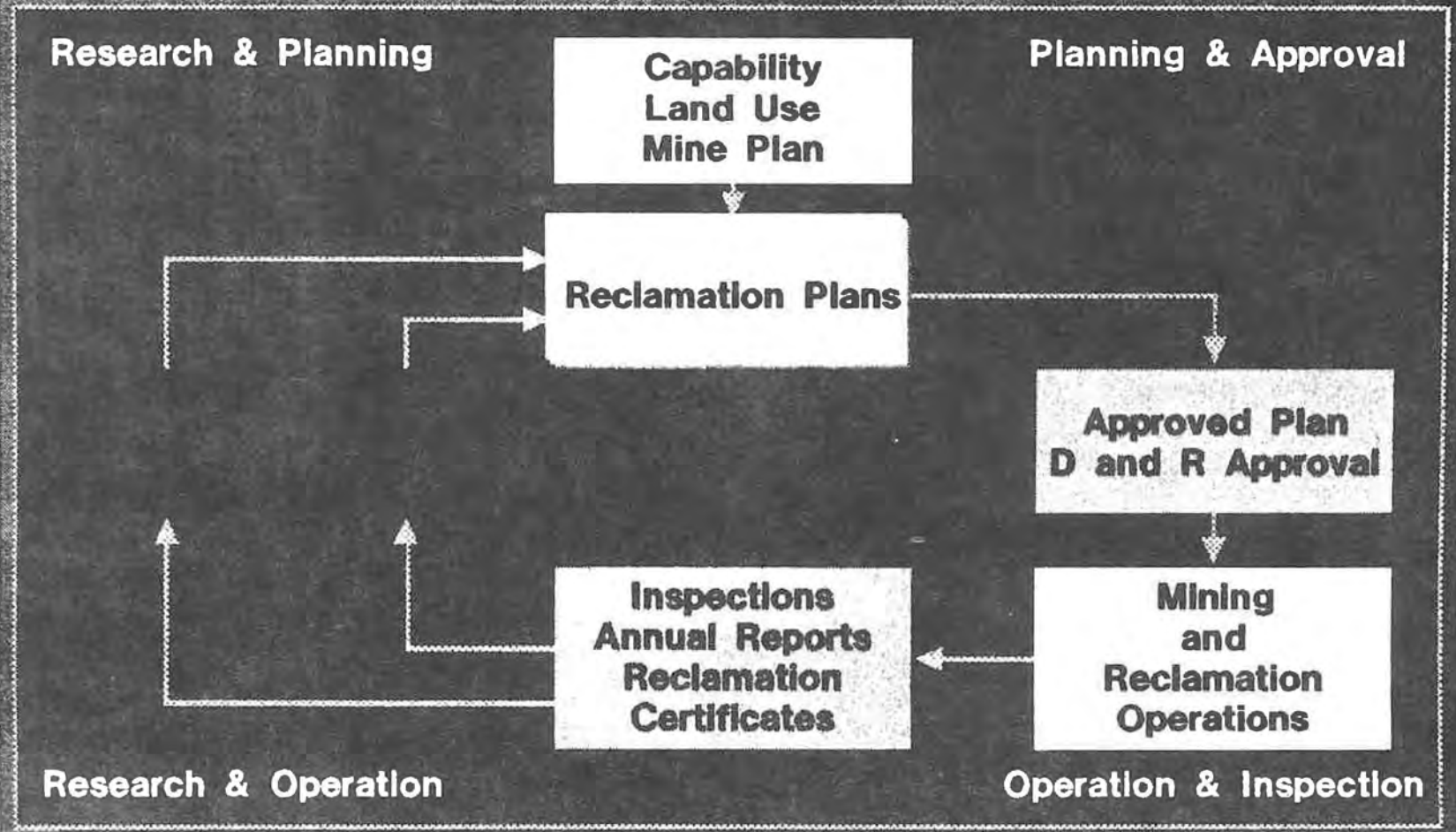
### RECLAMATION PROCESS

As shown in the accompanying figure, there are four specific parts to reclamation. Each one requiring specialized knowledge and detailed insights on both the objectives and the potential results. First, we must plan land use, followed by mining and reclamation plans which describe the physical steps needed to reclaim the land with the assumption that equivalent capability will be returned. Development and Reclamation plans are submitted for approval by Alberta Environment and, if approval is granted, these plans become the working document around which all operating practices in reclamation are focused. The plans specify topography, drainage, soil quality, soil salvage depth, soil replacement depth, and revegetation materials and techniques.

The second step is to put the approved plan into practice with day-to-day and year-to-year operations salvaging suitable soil, removing the coal, contouring the land, replacing the soil and managing the reclaimed surface. While this is proceeding, we of course encourage the regular inspection of the development by the Reclamation Council Officers who provide updated reports on

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# Land Reclamation Process



our progress. In addition, the operators prepare detailed statements in annual reports on progress made against the original Development and Reclamation Plan.

The third step is taken when, as determined by the operator, land is reclaimed and ready for final assessment and certification. The certification we believe is based upon our compliance during the operation with the original approved Development and Reclamation Plan and in this sense, when the certificate is issued, we consider that the reclamation has indeed been successful.

We also recognize, however, that we must continue to research better methods for reclamation and that research should be paralleled by evaluation of the reclamation and certified sites. The results of both the research and evaluation, the fourth step, will lead back to subsequent reclamation plans which will be improved to provide greater assurance of returning land to equivalent capabilities.

The cycle is repetitive on a five-year schedule determined by the Development and Reclamation Approvals. Based on our experience so far, we can say that successful planning in reclamation is at our fingertips and compliance with approved Development and Reclamation Plans leads to certification. However, research and evaluation will help in streamlining and perfecting the planning process leading to reclamation success in future field operations.

### CONCLUSIONS

The reclamation process in Alberta is viewed in four parts:

1. Development and reclamation planning to specified land uses;
2. Reclamation operations and inspections to meet an approved plan;
3. Assessment and certification of reclaimed sites; and
4. Reclamation research and evaluation.

To be successful, we must carry out reclamation with two objectives in mind:

1. Comply with the conditions of an approved Development and Reclamation plan; and
2. Continue research and evaluation of reclaimed sites to be sure that equivalent capability is being returned as it is assumed to be when complying with approved plans.

WHAT IS SUCCESSFUL RECLAMATION  
A BIOLOGIST'S PERCEPTION

D. PARKINSON

KANANASKIS CENTRE FOR ENVIRONMENTAL RESEARCH  
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The reclamation of degraded land basically involves the restoration of soil fertility (including soil structure), the successful establishment of suitable plant species, and subsequent management. The success of reclamation practices should be viewed from the ecosystem viewpoint, in particular that above-ground processes (primary production) and below-ground processes (organic matter decomposition and nutrient cycling) must be efficiently linked.

With respect to restoration of soil fertility in mine spoils, it is generally accepted that it is necessary to restore stable carbon "pools" in the spoil (through amendment with organic matter with high cellulose, lignin and chitin contents), to introduce and establish a diverse decomposer microflora and invertebrate fauna (via the organic amendments) and to ensure good mycorrhizal development on the roots of the colonizing plant species (either through the planting of previously inoculated seedlings or ensuring that appropriate mycorrhizal inoculum exists or is introduced into the amended spoil).

Therefore, measurement of the reclamation success or otherwise cannot be assessed by considering above-ground productivity over the short term, but should involve considerations of soil biological parameters. There is a growing belief that parameters such as microbial biomass development and activity rates, microbial biomass carbon to total organic matter carbon ratios, and rates and types of mycorrhizal (both ecto- and VA-) infection are important as both early and later indicators of reclamation success or failure. Over recent years there has been an increasing use of such microbial process parameters in European studies of land reclamation success. For the last two decades, particular attention has been given to the value of mycorrhizal fungi in aiding plant establishment and productivity during land reclamation. Now attention is being directed to the choices of most efficient species of mycorrhizal fungi and also the possibilities for genetic manipulation of specific mycorrhizal fungi (i.e., one impact of biotechnology on land reclamation). Similarly, the introduction of symbiotic dinitrogen fixing microbial inoculum into the root regions of appropriate shrub species used in land reclamation has been used for several decades. Now attention is focussed on the use of combined inoculations of such species with the  $N_2$ -fixing actinomycete *Frankia* and an appropriate VA mycorrhizal fungus. The possibilities of also using phosphate solubilizing bacteria and bacteria which enhance root growth are being followed up and provide more scope for biotechnological approaches.

The foregoing brief comments have concentrated on approaches and possibilities in the reclamation of land disturbed by open-pit mining activities. However, there is an increasing amount of land degradation caused by input of chemicals into the soil. While many of the comments made above also apply to the chemically degraded ecosystems, it should be noted that in these ecosystems the use of specific naturally occurring microorganisms or "bioengineered" microorganisms, specifically designed for the efficient degradation of the contaminant chemicals, could be of great value. The development of bioengineered microorganisms is certainly feasible but their widespread use will await appropriate legislation. Obviously the key to their use will be their survival and environmental impacts.



WHAT IS SUCCESSFUL RECLAMATION  
A LANDSCAPE ARCHITECTS PERCEPTION

L.R. PATERSON

LOMBARD NORTH GROUP (1980) LTD.  
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As people in the world become more numerous, our uses of land are intensifying; growing demands for food, living space, materials and energy are exerting pressures on the resources of the earth. Corresponding with a need to conserve and yet develop land resources is a heightened appreciation for quality in our living, working and recreation spaces.

Landscape Architecture is a profession concerned with creating useful and beautiful places in harmony with the natural processes of the environment. As such, it plays an integral role in the planning and design of living spaces - a role that has become more relevant today than ever before.

Among planning and design professionals, Landscape Architects are unique in working from a foundation in both the natural and social sciences. A knowledge of ecology, biology, horticulture and the humanities allows Landscape Architects to link human needs to natural systems. Reclamation projects provide landscape architects with the opportunity to create or re-create landscapes to serve different functions.

Alberta Environment states that reclamation is the recovery of neglected land. I suggest that this definition is only partially correct and that reclamation is far more reaching than mere recovery. My perception is that reclamation is the re-creation of landscape in the holistic sense and this includes the visual as well as the physical environment. Success is measured by the quality of the end product and how soon the area can meet its intended objective. This may occur at any stage for if the principles are well founded so will be the end product. There should never be any such thing as aesthetics vs ecology vs function. They are all components of a larger picture and each has an equal role to play in the reclamation of landscapes. Although each may involve the expertise of different disciplines, together they combine to ensure success.

A basic design principle of Landscape Architecture is that man-made features can be successfully integrated with natural environments. The integration requires the careful consideration of many factors such as: economics, operational, ecological, recreational and aesthetic values as well as construction and maintenance techniques. In the natural context of parks, for example, the realization of such a principle provides a balance between facility requirements, natural environments and park users.

When this principle is applied to a project in the area of reclamation, the primary aims of Landscape Architecture are to:

1. Create an environment which reflects the natural character of the surrounding territory;
2. Increase the aesthetic quality of the visual environment;
3. Accommodate the functional and environmental requirements of other disciplines; and
4. Establish a self-sustaining landscape.

These aims embody the essence of Landscape Architecture. Ours is not a profession of gardeners for the rich. It is a profession of skilled practitioners able to communicate with many different disciplines to create harmonious landscapes which become a part of the environmental fabric.

The process of landscape design is very similar to engineering design. Both are based upon thorough analysis and the application of proven techniques. Generally the landscape design process proceeds from the large scale environment to the site specific problem. This enables designers to include regional and localized parameters in the development of site specific solutions.

When I speak of principles, parameters, and techniques I am referring to a system which allows Landscape Architects to divide the tasks of landscape design into identifiable components.

Principles are defined as those elements which embrace Landscape Architectural concepts as they apply to the natural environment. Principles are statements of intent and should precede any design or planning work. For example, a principle may be stated as: The achievement of aesthetic, recreational, and land rehabilitation objectives will be taken with due recognition of environmental, safety, cost and timing objectives.

Parameters are the major, or controlling factors which may affect the development of design/rehabilitation options. Collectively, parameters are the terms of reference which make it possible to successfully achieve the overall intent. An example of a parameter would be to identify patterns and significant elements of existing landscapes and describe their susceptibility to impact by development.

Techniques are methods employed by Landscape Architects to design, implement, and maintain the landscape in a manner consistent with the stated principles and parameters of the project. An example of a technique is contour grading to reflect the natural landform.

To illustrate this process of landscape design as it may apply to the reclamation of an area and therefore illustrate my perception of what makes reclamation successful, I would like to review a recent project undertaken in Banff National Park. This project is a borrow pit - one that was required by the twinning of the Trans Canada Highway. It is located on the north side of the highway at kilometre twenty-seven at the intersection of the Sunshine Ski Area overpass. It's called the Healy Pit.

Healy Pit existed before the twinning project was conceived. It had been required for the original highway construction and had been in use for a number of years as a borrow area for the park and as a waste and storage area. The land around the pit was known to house a large population of elk who were in need of replacement of habitat which would be lost due to highway construction. A proposal was made to expand the existing pit and extract more gravel thereby impacting the area even further. The initial review of the project prior to any planning and design was that the extraction of the type envisioned would result in unacceptable long term impacts to wildlife and aesthetic values that would persist for fifty to seventy-five years. The project was rejected.

The "Principle" was then to create a more expansive elk range by reclaiming the old borrow area and by developing a new area of sufficient size to provide the required amount of gravel and yet be rehabilitated to suitable elk habitat. The team approach was used. Environment Canada - Parks established the "parameters" for the requirements of the elk, Public Works Canada supplied the borrow requirements and the test logs for the borrow analysis and the Landscape Architects designed the borrow area to meet the given parameters. These included the clearing of some three hectares of forest, the removal of about 30 000 cubic meters of overburden and the extraction of over 400 000 cubic meters of gravel.

The "techniques" used to create the design included a thorough site analysis to determine landform characteristics, and viewsheds; an analysis of the test logs to determine the best areas for extraction of the gravel resource and the integration of this data with the requirements for elk habitat. Conceptual ideas were generated to graphically illustrate the overall character desired for the borrow area. These were then reviewed with respect to the anticipated operation of the pit and an extraction plan prepared. This plan was directed specifically at maximizing the use of the gravel resource and maximizing the opportunity to create a naturally appearing area of elk habitat. The result was a series of seven interconnected cells each sized to the environmental requirements for elk and each shaped to take advantage of the location of the gravel. Plans prepared included: inventory and analysis; phased extraction drawings; and borrow area rehabilitation

These were then reviewed by a series of committees and the final approval was given to proceed. What started out as an outright rejection of an idea now had enthusiastic support as the results were pre-designed to be positive

and make all participants winners. During construction, regular monitoring took place by all concerned and direction given as required to account for changes in site conditions.

Once the pit had been excavated and all material uses accounted for, the overburden was replaced and the area contour graded to the desired landscape forms. Contour grading was done under the guidance of the Landscape Architects working on the project. It allowed for the burying of rubble and debris, and the trimming of slopes to minimize erosion. The entire area was then dry seeded with a palatable grass mixture, fertilized, planted with trees in selected locations and left to allow nature to take its course.

The entire process of extraction and rehabilitation had taken just over two years and although the grass seeded last fall has not become established as yet, the prospects are excellent and everyone involved is pleased with the results. Within a few years the area will return to a very natural site with little evidence that it was significantly altered by man.

The original "principle", extraction to meet a specific environmental objective, will have been met once the area is firmly established and being used by elk. I have every belief that this will occur over the next couple of years. What was envisaged as 50 to 70 years of detrimental impact will have been reduced to less than five years during which time the area was changed from one landscape function to another. As an added benefit of the rehabilitation design, water is accumulating in ponds which are groundwater fed and exist for most of the summer adding to the ability of the area to support elk.

I appreciate the opportunity of speaking to you today and thank you for your attention.

**WHAT IS SUCCESSFUL RECLAMATION****THE PUBLIC'S PERCEPTION****CLIFF WALLIS****DIRECTOR  
ALBERTA WILDERNESS ASSOCIATION  
CALGARY, ALBERTA****ABSTRACT**

Land reclamation in Alberta has come a long way since the 1960s. However, several problems remain. These include: scarcity of funding for reclaiming areas which were never adequately reclaimed prior to current legislation and techniques; lack of protection for some areas which are reclaimed; the lack of diverse and abundant native seed; the invasion by non-native species into native habitats; poor preplanning of certain land uses and developments; and lack of attention to White Zone (settled area) problems.

There is no question that land reclamation in Alberta has come an incredibly long way since the bad old days of the 1960s when industry and government had little incentive to do much of anything in terms of reclamation. As with anything else, however, the situation can be improved.

It is not that the existing approach is bad everywhere, but using the existing approach everywhere is bad. There is probably not enough flexibility in the system or adequate appreciation of a range of other values besides forest and agriculture production.

From our association's viewpoint, an overriding concern is that just because an area can be reclaimed does not mean that it will satisfy the wilderness user. There are aesthetic problems which cannot always be solved and there are motorized access problems which could be worked out but, on this subject, the government has shown decided foot-dragging because of flak from off-highway vehicle users.

The larger problem is the lack of good land use planning or development preplanning, not in follow-up reclamation. Once a significant ecosystem is upset, it is very difficult to replace, even though sufficient vegetation has reestablished itself to meet reclamation standards. While reclaimed areas support several species of wildlife and native plants, they often favour more common species and do little to enhance areas for rare species. Little work is being done on reclamation for smaller species of wildlife and native plants.

We are very concerned about developments which affect ecological values and wildland recreational use. Some areas should not be disturbed in the first place because they are prime wildlife or wilderness lands and that is their "highest" and best use.

When projects are allowed, proper preplanning, such as timing development for the winter months, can allow construction to have minimal impact and very little terrain damage. The same activities when carried out in a wet spring can be devastating. When done properly, some areas need not be reclaimed in the traditional sense. If activities are planned carefully, invasion of native species can proceed without seeding. This was tried with good success in Dinosaur Provincial Park for a pipeline right of way and in natural gas wells along the Milk River Canyon.

In other areas, adequate techniques do not exist for proper reclamation. For example, badland areas are particularly problematical, for both engineering and aesthetic reasons. Efforts should be made to avoid such lands.

Several non-native species should be considered undesirable in many instances. The sweet clovers (Melilotus spp.), crested wheat grass (Agropyron cristatum), and timothy (Phleum pratense) are among the worst offenders. At the very least some of these are persistent and do not permit invasion by native species. Others tend to be invasive and spread to nearby natural lands. In some cases, they outcompete the native plants and may be the cause of endangerment of some species.

While we were happy to see some of initial efforts in native plant inventories (Watson et al. 1980), more research is needed as is greater support for use of native plant materials in reclamation. Unfortunately, there is still a shortage of types and stocks of native seeds for all climatic regions and soil types.

While we generally strive to stabilize soils, it should not always be seen as good. A concern right now is that several rare native plant species may be threatened by stabilization of what were once active sand dune habitats. This includes natural invasion of active sand dune areas by native species and also stabilization by invading non-native species which are being used for reclamation work in adjacent areas. Naturally eroding sites such as dune sand and badlands should be incorporated into reclamation plans. Right now, the existing regulations do not seem to allow for much creativity in this regard.

Our prime concern is to make linear disturbances penetrating wildlands inaccessible to motorized traffic for erosion and aesthetic reasons. We would like more input into decisions in which disturbances are to be reclaimed, at least in our areas of concern.

There is still a lot of cleanup to do from past disturbances during the "bad" times. This will require additional monies from sources such as the Heritage Savings Trust Fund. However, the lack of legislation to protect backcountry areas, even after reclamation is done, compounds the problem due to motorized access into these areas along former seismic lines, pipelines, logging roads, well site roads and the like. These are not only unsightly but they allow continuing erosion and provide easy access into remote wildlife habitat. They are not even producing forest growth. Money spent on

reclamation is wasted if no follow up control of motorized access is undertaken. More public education about the benefits of reclamation is also needed to prevent further abuses.

The AWA has been very happy with some of the strides made by the Alberta Forest Service in reclamation of old seismic and oil and gas areas. However, reforestation is a form of reclamation that also needs to be done on areas where previous replanting was inadequate or where trees did not survive.

The White Zone (settled part of Alberta) is in much worse shape than the Green Zone yet it receives little attention. This will probably become more of an issue as the public is drawn to the prairie and parkland region and away from the mountains. We should be appalled at the proliferation of vehicle trails and the non-native species being used for reclamation within prairie wildlands. In addition, government funded range improvement programs support a form of "reclamation" with non-native species. Due to heavy grazing and inappropriate cultivation, there has been a heavy loss of soils across the prairies and parklands but very little is being done to maintain the existing soil base let alone reclaim impacted areas.

We are concerned that governments do not police themselves to the same extent as they do industry. They do not seem to be subject to the same regulations or at least the stringency of evaluation is less. A good example is the attitude of Alberta Transportation in development and reclamation along our highways. This should be compared with the excellent preplanning and post-construction reclamation undertaken by Public Works Canada for the twinning of the Trans-Canada Highway through Banff National Park.

There is still a public perception that reclamation is bad. This is not usually the case, although it still happens. Rather, the public does not want to see any disturbance in favorite recreation areas and they will have a negative attitude because of landscape impacts or subtle wildlife impacts, even though reclamation results in adequate vegetation cover, well-controlled soil erosion, high water quality, and enhancement of habitat for some wildlife.

It has to clearly be identified what we are restoring the land to equal or better condition for. Our association might like to see it turned into wildlife habitat -- but what kind of wildlife habitat - for small birds, mammals, reptiles and amphibians or for big game animals? If the goals of reclamation are clearly stated and communicated to the public then there could be more improvements made and there would probably be fewer negative attitudes about some developments.

We believe that the current position of the government on reclamation should not be softened. Past history here and in other jurisdictions shows what can happen when standards are relaxed or when the industry is allowed to police itself. Many companies are very responsible but there are always a few

who are willing to take advantage of a situation. The problems created would be far more costly over the long term. Money spent on reclamation now is money well spent.

In conclusion, we are generally supportive of current reclamation programs. However, just because an area can be reclaimed is not sufficient justification for a project to proceed. All values need to be carefully weighed and we have to ask ourselves what we are going to reclaim the area for. Our attitudes about reclamation need to be broadened so that interactions with natural ecosystems are recognized. We also need an even greater commitment from the government and industry in order to undo the wrongs of the past and prevent future recurrences.

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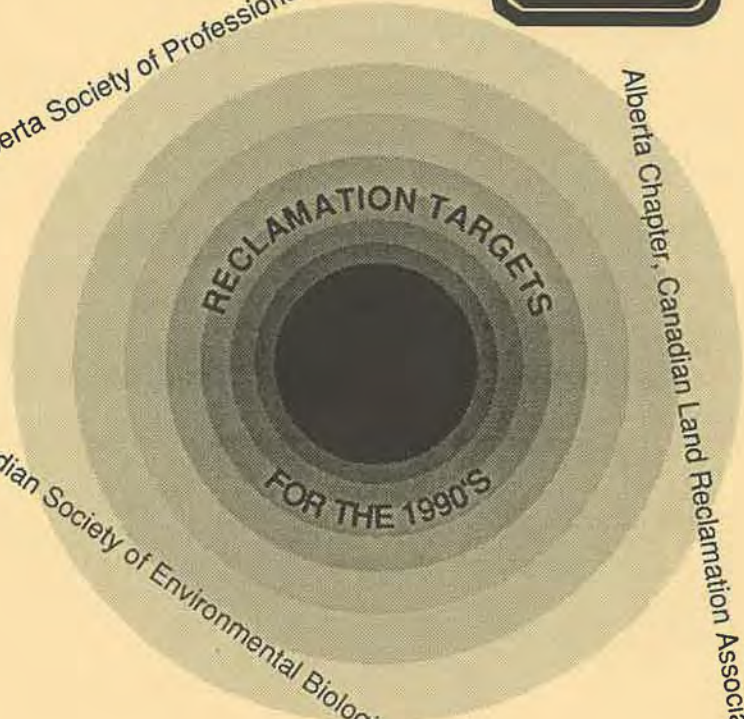
# Proceedings of a Symposium



The Alberta Society of Professional Biologists



The Canadian Society of Environmental Biologists, Alberta Chapter



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RECLAMATION TARGETS FOR THE 1990s

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Alberta Environment, Research Management Division

And a special thank you to our two guest speakers:

Dr. David Samuel, University of West Virginia who spoke on Reclamation to Wildlife Habitat in the United States

Dr. Larry Holbrook, Biotechnica International of Canada, Calgary, Alberta who spoke on Biotechnology and Biologists

- and -

to the Hon. Ken Kowalski, Minister of Environment, for delivering the opening address.

## MESSAGE FROM THE ORGANIZING COMMITTEE

Reclamation practitioners and researchers have gone a long way to solving the problems posed by such disturbances as mining, drilling and pipeline construction. The future challenge for reclamation lies in applying our expertise in other areas such as industrial site decommissioning, habitat creation and restoration, and urban design.

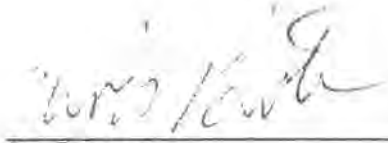
The Symposium was designed to expose participants to a wide variety of "new" areas where reclamation science could be applied. These were the "targets" referred to in the Symposium title. The speakers did an excellent job in meeting this goal. Some of the participants felt the Symposium had not provided enough information on new methods to be employed in reclaiming these new disturbance types. While this was not the goal of the Symposium it remains a valid concern that should be addressed in a future symposium.

Finally, the Hon. Ken Kowalski, Minister of Environment, encouraged all participants to get out and preach the need for, and successes of, reclamation, and indeed all environmental programs. Telling ourselves in conferences how wonderful we are is preaching to the converted. We need to let those who benefit from our labours, that amorphous group known as the public, know what we have done for them. This, too, should be the topic of a future symposium.


The papers in this proceedings have been edited and retyped into a common format. The contents of the papers are essentially unchanged from the submitted manuscripts of the authors.



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