THE WHITEWOOD MINE LAKE CONSTRUCTION PROJECT

by

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Abstract. Alberta's regulatory process for coal mine reclamation utilizes a cooperative approach. The value of this approach will increase through the 1990s as demand for public participation increases. The Alberta Government Development and Reclamation Review Committee, the County of Parkland, and TransAlta Utilities Corporation cooperated to ensure that a useful lake and surrounding landscape would be constructed to replace two lakes that had to be drained in advance of mining at the Whitewood Mine. The goal of the reclamation process is to achieve sustainable development. This ensures that present day use of resources does not compromise future land use. The replacement lake occupies 18.5 hectares within a reclaimed area of 126 hectares. The lake and adjacent land will be exchanged with the Alberta Government for the land under the two drained lakes, as well as an additional quarter section of land required by TransAlta for future mining. The overall exchange will be for equivalent land areas. Through numerous meetings of the three principals, the lake site was designated to have the potential for development as a put-and-take fishery, wildlife habitat area, day-use recreation area, and parkland area. Special features incorporated in the lake design were a picnic area, campsite, boat launch and beach. The design process was started in 1982, construction was carried out in 1987/88, and the area surrounding the lake was revegetated in 1988/89. Monitoring of lake development and revegetation is on-going.

Introduction

The demands placed on our land resource base are varied and often in conflict with one another. In recognition of the need to provide for the orderly development of our natural resources and the protection of our environment, most jurisdictions have established regulatory regimes.

These regimes can be categorized as either authoritative or negotiative approaches. Authoritative approaches involve win-lose decisions that are imposed after bureaucratic, political, or judicial review of the information provided. On the other hand, decisions reached through negotiation and cooperation are win-win decisions that avoid the resentment, challenges, and delays common to authoritarian decisions.

Alberta's regulatory process for coal mine reclamation utilizes a cooperative, negotiative approach (Brocke 1990). The value of this

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approach, to both the regulator and the proponent, will increase through the 1990s as public demand for involvement in resource management and decision making increases.

The objective of this paper is to demonstrate how Alberta's cooperative regulatory process produced a win-win solution to a multi-stakeholder situation. The situation involved replacement of two lakes that were to be mined through for coal recovery. The stakeholders included the company (TransAlta Utilities Corporation), the local municipality (County of Parkland), and several provincial government departments and agencies (Environment; Recreation and Parks; Forestry, Lands and Wildlife; and the Energy Resources Conservation Board).

The regulatory process in Alberta supports the goal of sustainable development, which can be defined as development which ensures that the utilization of resources and the environment today do not damage prospects for their use by future generations (National Task Force on Environment and Economy 1987). Reclamation planning for the lake replacement project ensured equivalent land capability in the reclaimed landscape.

The Stakeholders

TransAlta Utilities Corporation is the operator of the Whitewood Mine, located about 50 km west of Edmonton, Alberta. The mine supplies about 3 million tonnes/year of coal to the Wabamun Generating Plant (569 megawatt capacity). As operator of the mine, TransAlta must ensure an orderly delivery of coal to the generating plant and provide for proper land reclamation. As part of reclamation planning, TransAlta was seeking approval of the plan for the final cut of their East Pit. The local municipality, the County of Parkland, was the level of government with the most direct control and interest in land use planning and zoning. Any reclamation plan would have to be compatible with County land use plans and by-laws. The government departments and agencies, through what is known as the Development and Reclamation Review Committee, were responsible for ensuring that a properly planned and designed lake was established. The committee had to ensure that equivalent land capability was returned in the post-mining landscape. The multidisciplinary, interdepartmental structure of the committee allowed discussions and resolutions of technical issues associated with the plan.

As administrator of the Development and Reclamation Review Process, Alberta Environment was charged with coordinating the design and approval process for the lake. Within the department, Water Resources Administration Division, Standards and Approvals Division, and Land Reclamation Division provided technical input on lake design and reclamation matters. Alberta Forestry, Lands and Wildlife had two divisions with a key interest in the lake. First, Public Lands Division, through a land exchange for the two drained lakes, would become owner of the lake and a portion of the surrounding watershed. They wanted to ensure that the lake had features suitable to potential use of Crown Land in the area. Second, Fish and Wildlife Division wanted to optimize opportunities for habitat design for both fisheries and wildlife resources. Alberta Recreation and Parks, through their expertise on recreation and parks planning, provided technical input on design features that would enhance potential use by the public and developers. The Energy Resources Conservation Board, through its expertise on mining methods, was available to provide technical advice on equipment and materials handling.

Situation

Pre-Mining Conditions

The Whitewood Mine is located in gently undulating landscape with aspen forest dominating on the higher ground and numerous ponds and sloughs occurring in the low lying areas. Small parcels of land have been cleared and developed for hay crops. Prominent features of the mine permit area were two lakes - the larger Whitewood Lake, 40 hectares in area, and the smaller Lake A, 22 hectares in area. The lakes provided aquatic and wetland habitat that supported recreation and wildlife/waterfowl land uses. The value of these habitats resulted in the need to ensure that a lake was replaced in the reclaimed landscape.

The two waterbodies were surrounded by boggy vegetation, (primarily cattails (*Typha* spp), sedges (*Carex* spp), and willows (*Salix* spp)) and small areas of cultivated mineral soils. These lakes were perched above the water table and supplied with water from adjacent bogs. Only rarely did water drain from Whitewood Lake south to the nearby, and much larger, Wabamun Lake. Both lakes were shallow, with the maximum depth of water in Whitewood Lake about 3.5 metres and in Lake A, about 1.5 metres. Whitewood Lake had supported a permanent northern pike-yellow perch fishery until the early 1950s, and a put-and-take rainbow trout fishery in the mid-1950s. However, the lake could not support any fishery in the 1980s because the shallow water tended to be relatively warm in

the summer and deprived of oxygen in winter. Whitewood Lake was used occasionally for water skiing. The last building in a small cottage development was demolished in 1983.

Mining Methods and Mine Plans

The Whitewood Mine is a strip mine operation using a dragline to remove overburden and shovels to excavate and load coal into bottom dump haulers. The active mine pit is confined at any one time to a strip 45 metres wide and 2800 metres long with spoil piles on one side and cleared, drained land on the opposite highwall side. In an average year, 2.8 million tonnes of coal are delivered to the Wabamun Generating Plant (569 megawatt capacity), and approximately 40 hectares of land are mined and reclaimed.

In 1982, the last coal was removed from the mine area at the east end of the Whitewood Mine, known as the East Pit; all mining and coal deliveries have since been made from the west mine area. The mined-out East Pit included unreclaimed spoil and a final open mine cut 100 metres wide and 1450 metres long surrounded on both sides by spoil piles. This final cut is the focus of attention for the lake construction project.

To ensure that an adequate supply of coal will be delivered to the Wabamun Generating Plant each year to meet electricity demand forecasts, both short-term and long-term planning is conducted. The plans identify the requirement for tree clearing, surface drainage, topsoil salvage, and overburden stripping.

In 1981, the long range mine plan showed that drainage of Whitewood Lake and the smaller Lake A would be essential to recover the 16 million tonnes of underlying coal. In 1982 TransAlta applied to Alberta Environment to drain the lakes and a licence was issued on the condition that a replacement lake would be constructed. The drainage of Whitewood Lake and Lake A commenced in 1983. The lake basins are kept drained with a network of ditches and sumps. The mine is just beginning to progress through the lakes.

Solutions

Lake Design Process

A key feature of the design and construction process was the high level of interaction among the stakeholders. At all stages of the design process (feasibility study, potential uses, and design criteria) documents were submitted and thoroughly reviewed by all parties. At least one meeting was held during each stage. Any information gaps were identified to TransAlta who then undertook to provide the additional information. A key element of the process was on-site tours prior to, during, and after lake construction. This facilitated information exchange, issue identification, and resolution of concerns. The on-site tours provided the flexibility to assess and resolve concerns in the field, where the actual conditions and work could be seen and evaluated. The open and cooperative attitude of TransAlta was essential for the success of the process.

The first stage in the process assessed and confirmed the feasibility of constructing a new lake. Five potential sites were identified and the decision was made that the East Pit end cut would be the preferred site. This site would become the East Pit Lake.

There were a variety of factors that favoured the site. It was the largest of the available sites and had the earliest creation date. Its east-west orientation was favourable in terms of maximizing sunlight on lake and shore areas, as well as promoting wind-generated mixing of the lake. The site had immediate access to a secondary highway that in turn had good access to a major highway (Highway 16). In addition, an existing haul road on the south side of the lake would be readily adaptable to link the lake area to the secondary highway. The site was the furthest removed from mining activities in the short-term and long-term and thus would be buffered from effects of mining activities, including potential dewatering of the lake to the active pit. Like the majority of other sites, the East Pit site was groundwater fed. This was desirable in terms of water level management and nutrient and sediment loading. In addition, the direction of groundwater flow was from undisturbed land to the north, therefore, any detrimental effects of flow through spoil materials would be minimized. In terms of shoreline development, the site had four access roads which could be developed into small inlets or bays along the lake or swales leading to the lake. In terms of overall cost, the use of the end pit minimized material handling and made the East Pit the most economic site.

In the second stage, the potential uses of the replacement lake were identified as recreation and wildlife opportunities. These would involve fishing, wildlife habitat, nature viewing, and a day-use area including a beach, picnic area, and camping area. The design criteria to meet these potential uses were then determined and agreed to by all participants.

Following this agreement in 1983, TransAlta Utilities started to prepare the conceptual design features of the lake and the schedule for construction, revegetation and land exchange. An application for amendment to the Development and Reclamation Approval for the mine was submitted to Alberta Environment in 1986 and included the design criteria, proposed topography and lake morphometry, revegetation plan, and schedule. The approval was granted in the spring of 1987, and construction work started immediately.

Lake Design Criteria

The design was to serve two purposes. First, it would meet the requirements of the drainage licence and the Development and Reclamation Approval and second, it would provide the basis for awarding the management and construction contract.

After three months of detailed work and frequent communications, the final design of the replacement lake showed that there would ultimately be 18.5 hectares of surface water at a predicted elevation of 772.5 metres above sea level. The maximum length of the lake would be about 1,450 metres and the average width about 100 metres. The lake filled with groundwater and small quantities of surface runoff from the surrounding slopes. Special design features of the lake included a beach 250 metres long and 40 metres wide, a boat launch ramp at the west end, parking areas, a picnic and camping area of approximately 4 hectares, a shoreline length of 3500 metres, and water depths up to 7.8 metres toward the centre and east end of the lake. Littoral zones (areas less than 2 metres deep) would occupy about one-third of the surface area of the lake. The design features of the lake were selected to ensure that a fishery could be managed and maintained year round (adequate depth and littoral zone), that boating would be possible on the lake, and that low-intensity recreation such as walking, picnicing, and camping in the summer and cross country skiing in the winter would be practical. Although a permanent fishery would be possible, it was recognized that the fishery management for the lake would likely be based on a put-and-take basis for rainbow trout. This was due to the proximity of the lake to a large urban area, Edmonton and surrounding area (population approximately 650,000), and the demand for good quality sport fishing.

Consideration was given to public safety by reducing the slope angles in most places to 10° (18%; 6:1) or less. Also, at the shoreline, underwater slopes to a depth of two metres were designed to be no steeper than 3° (5%; 19:1). This would provide a safe and comfortable zone for wading and swimming.

An overflow channel was provided at 773 metres elevation and, together with the shallow beach angles, will help ensure that the beach area will not be compromised by water levels that vary from the design level of 772.5 metres.

Construction

During 1987, water that had previously collected in the end cut was pumped out to allow the beach slopes and border of the lake to be contoured to provide safe and accessible underwater slopes. Construction of the replacement lake was started using a dragline and dozers to modify spoil piles, to fill in major depressions, and to create the boat launch area and the picnic and campsite areas. By October of 1987, the dragline had handled close to 1.3 million bank cubic metres of material. All remaining spoil handling and contouring was completed using dozers and scrapers. Throughout the winter of 1987/88, smaller areas of spoil and shoreline features were contoured and developed using dozers and a backhoe.

Final contouring of all the slopes was completed after 1988 spring runoff, followed by seeding in spring and summer. Revegetation was completed in 1989 with the planting of trees and shrubs.

Progress and Prospects

The long-term goal of reclamation in the East Pit area is to establish self-sustaining plant cover consistent with a day-use recreation area, wildlife habitat, and a parkland landscape. The grass/legume mixture seeded in 1988 was successfully established by 1989, however, fertilizing and reseeding was done in areas where initial establishment was poor. Fertilizer was not broadly applied to the project area in 1989. During 1989 trees and shrubs were planted in the project area and included Northwest poplar (*Populus* spp), willow (*Salix* spp), chokecherry (*Prunus virginiana*), dogwood (*Cornus stolonifera*), green ash (*Fraxinus pennsylvanica*), white spruce (*Picea glauca*), and lodgepole pine (*Pinus contorta*). Approximately 30,000 stems were planted over a total area of 23.5 hectares. General observations of the condition of the grass/legume mixture and survival of trees and shrubs are conducted annually.

In 1989, several small gullies were repaired, mulched, and reseeded. Fascine drains and willow

cuttings planted in wet areas along the north slope in November 1988 have sprouted and appear to be stabilizing the slope and reducing excess moisture.

Water quality monitoring was carried out during 1989 and 1990, and will continue in 1991. Samples were collected in fall and winter at two sites and the results forwarded to the Controller of Water Resources. Typical data are presented in Table 1. Results of the sampling to date indicate that most characteristics are within water quality guidelines. However, mercury and copper exceed the Canadian Water Quality Guidelines (Canadian Council of Resource and Environment Ministers 1987) of 0.1 ug/L and 4 ug/L, respectively, for the protection of aquatic life. Several studies suggest that mercury levels rise, at least initially, in newly flooded reservoirs (Bodoly et al 1984; Munro 1985). With respect to potential fish stocking in the lake, mercury concentration in the food chain is focussed on older fish while the fisheries management of East Pit Lake would involve a put-and-take situation. Nevertheless, the situation warrants continued monitoring.

Preliminary biological surveys have shown that littoral zones are beginning to be colonized by submergent and emergent aquatic plants. The following aquatic vascular plants and macro algae have been observed: mare's tail (*Hippuris vulgaris*), coon tail (*Ceratophyllum demersum*), Richardson's pondweed (*Potamogeton richardsonii*), small-leaf pondweed (*Potamogeton pusillus*), bur reed (*Sparganium* spp), cattail (*Typha latifolia*), bullrush (*Scripus* spp), duckweed (*Lemna* spp), stonewart (*Chara* spp). A variety of macro-invertebrates are abundant in the shoreline habitats, as are stickleback fish (*Culaea* spp) in the small bays and coves.

Continued water quality monitoring and biological monitoring will be needed to assess lake development and determine any lake management measures that may be necessary. The lake appears suitable for the development of a put-and-take recreational fishery in terms of littoral zone development and open-water dissolved oxygen levels. At present, winter oxygen levels must be confirmed to accurately assess the lake's ability to overwinter fish. If a year-round fishery is considered, further winter studies, and likely regular monitoring of and control of aquatic macrophytes, will be required.

Some shoreline areas are subject to erosion by wave action. These areas may need to be armored with cobble materials. In addition to reducing erosion, these materials would add some diversity to lake substrates that currently consist almost entirely of fine materials.

Final Disposition

Three years will have passed for the lake basin to fill with water. At present, the lake is at an elevation of 772 metres and is within 0.5 metre of the predicted final elevation of 772.5 metres. Although the initial water level recovery has been rapid, it is expected to take at least 15 to 20 years to reach the final water level elevation.

When the ground cover, trees, and shrubs are successfully established, an area of 126 hectares, including the lake, will be fenced to mark the boundary of land which will eventually be transferred to the Alberta Government. At that point, TransAlta will apply for a reclamation certificate. The transfer will be in exchange for the Crown Land under Whitewood Lake and Lake A, as well as an additional quarter section of Crown Land required by TransAlta for future mining. The net result is a transfer of equivalent land areas. After the transfer, the future development and management of the lake and surrounding land will be the responsibility of the Alberta Government. Private development opportunities would be available on the Crown Land.

At the present time, Alberta Tourism has engaged a consultant to conduct a feasibility study to identify potential tourism opportunities for the Whitewood Mine site. A key feature in the feasibility study is the existence of the lake, which will be an integral factor in any potential opportunities. These opportunities may range from relatively passive concepts to full scale commercial developments and would not exist without the replacement lake.

Summary and Conclusions

The Whitewood Mine has been operating since 1962 to deliver coal to TransAlta's Wabamun Generating Plant. The efficient recovery of coal required the drainage of two shallow lake basins, Whitewood Lake and Lake A. The approval for drainage was given by the Alberta Government on the condition that a replacement lake would be constructed. A site for the replacement lake was selected in 1983, design concepts were approved in 1987, and lake construction was started in 1987. The lake was essentially complete in 1990, including revegetation. With successful revegetation and approval of a reclamation certificate, a total of 126 hectares of land, including 18.5 hectares of water, will be exchanged with the Alberta Government for

Table 1: Typical Water Quality in the East Pit Lake[1] (all values in mg/L unless otherwise stated)

BASIC CHEMISTRY	
pH (units)	7.6 - 8.2
Alkalinity	131 - 250
Bicarbonate	130 - 310
Total Dissolved Solids	302 - 523
Total Suspended Solids	< 1 - 9
Hardness	212 - 350
Electrical Conductivity (umhos/cm)	487 - 680
Total Organic Carbon	3 - 27
Total Phosphorous	< 0.01 - 0.017
Potassium	6.2 - 8.6

METALS	
Aluminum	< 0.020 - 0.250
Arsenic (ug/L)	< 0.50 - 0.80
Boron	< 0.10 - 0.20
Beryllium	< 0.001
Cadmium	< 0.001
Chromium	< 0.001 - 0.010
Copper	< 0.010 - 0.036
Iron	< 0.003 - 0.170
Lead	< 0.001 - 0.050
Mercury (ug/L)	0.2 - 0.6
Nickel	< 0.010 - 0.079
Silver	< 0.001
Zinc	< 0.010 - 0.040

[1]Samples collected in late winter and fall of 1989 and 1990 at two sites.

the land underlying Whitewood Lake and Lake A basins, as well as an additional quarter section of Crown Land to ensure an equivalent area of land transfer.

The design and construction of the replacement lake has been an excellent example of an integrated regulatory approval process and a cooperative effort between numerous Provincial Government departments and agencies, the County of Parkland and TransAlta Utilities.

All the stakeholders are winners. TransAlta will be able to recover 16 million tonnes of coal underlying the lakes and to complete a land transfer that will provide an additional quarter section of Crown Land for potential mining activities. The Government and citizens of Alberta will see the return of a high quality reclaimed area with fisheries, wildlife, and recreation capabilities. These capabilities will offer potential tourism opportunities that did not exist in the pre-mining setting. The County of Parkland will see the diversification of recreation potential in their land base. Should tourism opportunities be pursued on the reclaimed site, benefits will accrue to the County tax base.

As a final note, the Alberta Chamber of Resources awarded TransAlta Utilities the 1990 Reclamation Award for their efforts on the East Pit Lake construction project.

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References

Brocke, L.K. 1990. Alberta's Regulatory Process for Coal Mine Reclamation: A Cooperative Approach. IN: Proceedings 1990 Mine and Reclamation Conference, American Society for Surface Mining and Reclamation, Charleston, West Virginia, April, 1990.

Bodoly, R.A., R.E. Hecky, and R.J.P. Fudge. 1984. Increase in Fish Mercury Levels in Lakes Flooded by the Churchill River Diversions, Northern Manitoba. Can. J. Fish -Aquat. Sct. 41: 682-691.

Canadian Council of Resource and Environment Ministers. 1987. Canadian Water Quality Guidelines of the Canadian Council of Resource and Environment Ministers, Water Quality Objectives Division, Water Quality Branch, Inland Waters Directorate, Environment Canada, Ottawa, Ontario.

Munro, D.J. 1985. Report on Mercury in Cookson Reservoir. Environment Canada, Environmental Conservation Services, Inland Waters Directorate, Western and Northern Region, Water Quality Branch, Regina, Saskatchewan, Report W9B-WNR-85-02, 25 p.

National Task Force on Environment and Economy. 1987. Report of the National Task Force on Environment and Economy, Submitted to: Canadian Council of Resource and Environment Ministers, September 24, 1987. 17 pp.