HERALD OILFIELD SERVICE RECLAMATION PROJECT

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ABSTRACT

The Herald Reclamation Project began in the summer of 1989 and, to date, has involved clean up of a 2 acre oil spill, salvage of metal equipment used by a now defunct oil cleaning business, and proper grading of roughly 5 acres of land. The Herald Oilfield Service site, located about 120 km NW of High Level, Alberta, was brought to the attention of the Land Reclamation Division of Alberta Environment by Alberta Forestry, Lands and Wildlife. The project was funded by the Alberta Heritage Savings Trust Fund Land Reclamation Program which has provided over $76,000.00, not including Government personnel and travel expenses. The oil spill was multi-layered: oil/water/oil/oil -contaminated soil and the oil was strewn with debris. These problems frustrated the clean up, which was completed after 14 days. Future reclamation alternatives for oil-contaminated soil stockpiled on site have been considered and a combined approach initiated.

INTRODUCTION

The Herald Oilfield Service site is an abandoned oil cleaning plant located on public land approximately 120 km NW of High Level in northern Alberta on LSD 5 of 13-116-5-W6M. The site is roughly 5 acres (2 hectares) situated in the Boreal Northlands ecoregion which consists mainly of Aspen and White Spruce on Gray Luvisolic soil.

The plant was operated by Mr. Herald Jung from sometime in the late 1960's to mid 1970's (according to local residents) until his death in 1985. Records with the Public Lands Division of Alberta Forestry, Lands and Wildlife (AFLW) indicate the land was first leased to Mr. Jung in 1980. A $100.00 security deposit was retained with the intent it would be refunded when the land was satisfactorily reclaimed by Mr. Jung after plant closure. The company was inherited by Mr. Jung's wife after his demise. Apparently, no attempts were made at any time by Mr. or Mrs. Jung to reclaim the site, although after Mr. Jung's death the "valuable"

chattels on the land were sold. Following numerous attempts to communicate with Mrs. Jung regarding the condition of the site and the need for reclamation the Alberta Government, through AFLW, took possession of the remaining chattels on September 1, 1989.

The condition of the site when first inspected by Alberta Environment (AE) Reclamation Branch staff on July 12, 1989 was poor to say the least. On the west side, three storage tanks, a boiler tank, a shed on skids, and many pipes and boards were surrounded by oil and water to a depth of 0.5 metre. The berm around this area had been opened at a gate on the west side and oil had run out to the west and south (Figure 1). There was wood, metal and plastic scattered along the edge of the west and south treelines, and in the NW corner of the site.

On the east side, a dilapidated trailer and shed were surrounded by metal and wood debris. A small slough about 0.3 metre deep was located north of these. To the south, an uncovered holding tank, containing water to an unknown depth and a skim of oil, was buried in the ground. South of this was a slough, and holding the water in the slough was a crescent-shaped berm. Beyond the berm was a large stand of foxtail bordered by dead trees. Along the edge of the east forest were two large boilers and loose piles of wood, plastic, metal and 45 gallon barrels.

Across the site bare patches of ground were intermixed with foxtail, bullrush, yellow sweet clover, and various weeds and grasses. The forest was beginning to grow into the area from the east and west. Little topsoil existed, and most of that was contaminated with oil or littered with debris.

Prior to any heavy equipment work, a number of soil and fluid samples were taken during two inspections and analysed to determine which contaminants, other than oil, existed. The results indicated some salinity and buried oil were present in localized areas, some petroleum based compounds in a few barrels, but no priority-pollutants, PCB's or other hazardous materials. The berm in the SE corner had a relatively high oil content. After the clean up had begun, water samples were taken from inside and outside the uncovered holding tank on the east side. Analyses indicated a moderately high salinity, but no other contaminants were present.

The basic reclamation plan first required containment of the oil spill on the west side, then pick up of all oil and removal to an oil cleaning plant about 10 km away. Oil contaminated soil was excavated and stockpiled, after which the site was graded to provide adequate drainage. All wood was burned, and all metals were washed, piled and

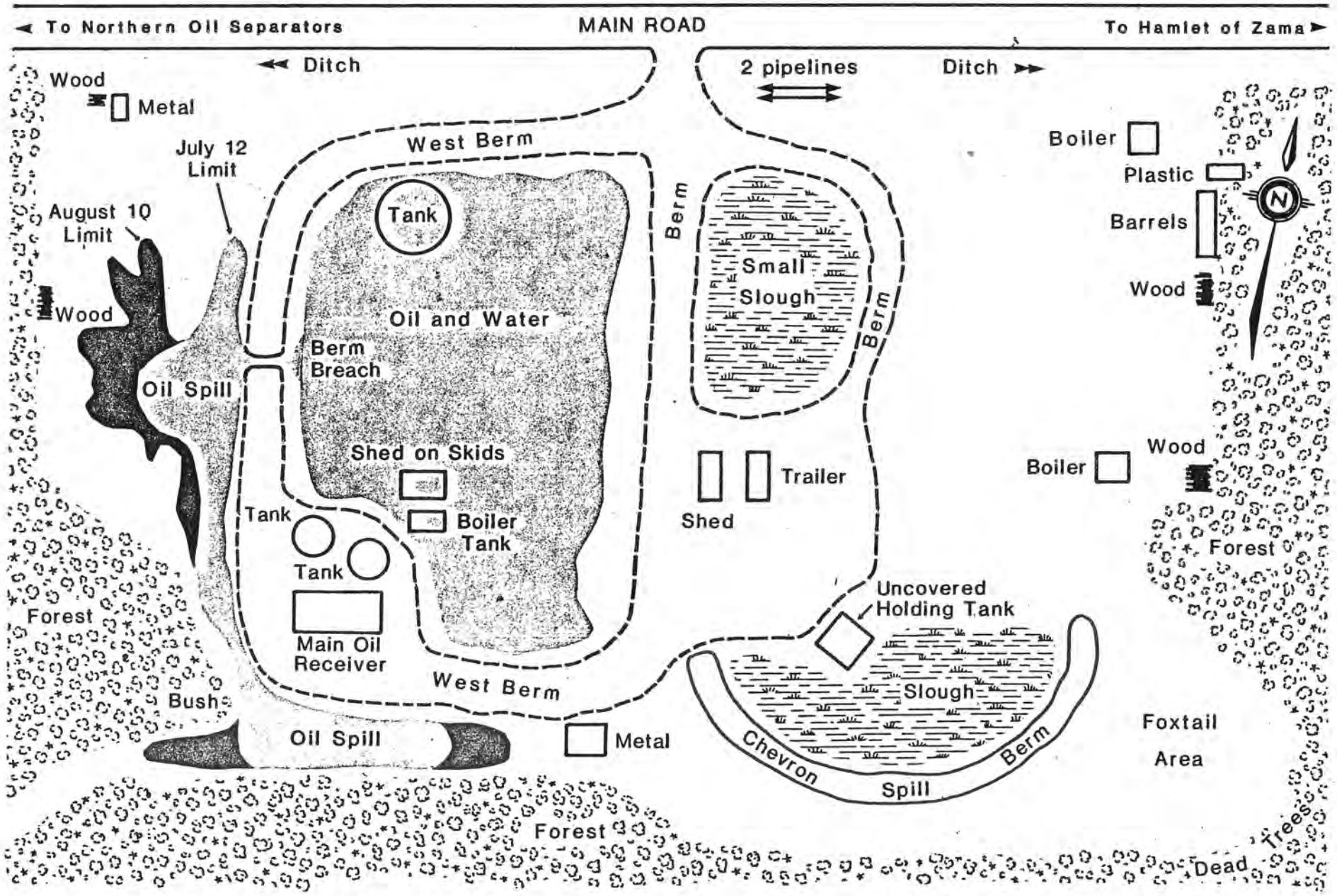

Figure 1. Condition of the Herald Site on July 12 and August 10, 1989.

hauled away by a salvage dealer. The site was left for the winter in a graded state providing positive drainage, with three piles of oil-contaminated soil.

SOIL/FLUID CHEMICAL ANALYSES

Sampling by Reclamation Branch staff began July 12, 1989. A water sample from inside the west berm was obtained with some difficulty due to floating oil. Analyses indicated conductivity to be 2.1 millisiemens/cm (mS/cm). Sodium (193 mg/L), calcium (158 mg/L) and chlorine (476 mg/L) were moderately low. No other parameters stood out. It was concluded the water inside the berm and in the small slough on the east side were mainly rain water and melted snow with some salt contamination.

A composite soil sample was taken from five locations on the SE berm. Analyses indicated fairly high electrical conductivity (E.C.=4.24 dS/m) and an oil content of 6.5%. Not surprisingly, the salinity of this soil was slightly high. Later discussions with local contractors confirmed the material was trucked in some years earlier from a nearby Chevron oil spill.

Soil samples were also taken from the NE and NW corners of the site at depths of 0-10, 25-35, and 50-60 cm and from the central area at 50-60 cm. Other than slightly high salinity (E.C.), no data stood out.

Two fluid samples were taken from inside the uncovered holding tank in the SE corner and from the slough beside it. Analyses showed the electrical conductivities of both to be fairly high (4.4 mS/cm and 3.8 mS/cm, respectively). Chloride inside the tank was 1480 mg/L and outside the tank 980 mg/L.

Finally, four soil samples were collected September 21, 1989 from three oil-contaminated soil stockpiles. These were analysed by the Soil Protection Branch of AE in Lethbridge. As expected, the samples were heterogeneous, giving average hydrocarbon contents ranging from 0.2% to 6.8%. Light ends ($< C_{10}$) were notably absent. This coincides with the popular belief that light ends weather away with time. A large proportion of the hydrocarbons were in the C_{20} to C_{28} range, except for one sample which contained a majority of C_{12} to C_{18} hydrocarbons.

OIL CLEAN UP

The first priority was to contain the oil spill on the west side. The oil had approached the forest to the west and south, but had not entered it. On September 8, 1989 a Caterpillar D7 bulldozer was used to

build a 0.5 metre high windrow around the spill. The windrow joined the west berm on the west and south sides. About 1/4 acre (1000 m^2) was contained within the windrow.

At the same time, a Case 580 loader-backhoe was used to dig 14 test holes 2.5 metres deep at locations outside the west berm in an attempt to find buried oil. Oil to a depth of 1 metre was found beside the uncovered holding tank and to a depth of 1.5 metres beside the small slough.

On the south side of and inside the west berm was a 3-celled, partially buried tank assembly covered with layers of planks and plywood. Labourers disassembled and piled this oily wood to the side for later burning. Underneath the wood were oil-soaked logs and two portable sumps dug 2 metres into the ground with a 2.5 metre wide log-lined space between them. This was the main oil receiver tank. Labourers piled wood which was scattered around the site in two other locations as well. These were burned later.

Oil pick up was first attempted using tank trucks. The spill area outside the berm was the first priority as the weather was threatening rain and snow which would complicate the clean up. It is well known oil viscosity increases as temperature decreases. Since the air temperature was below $0^{o}C$ each night, oil pick up was very slow and difficult in the morning. As the sun and air temperature rose, the oil would become less viscous. Thus, a work shift of 9 a.m. to 9 p.m. was adopted instead of the usual 7 a.m. to 7 p.m. Nevertheless, since the light ends were absent, the oil never flowed as anticipated.

Tank trucks use a mechanical pump to create suction. The teeth in the pump are made of rubber, so it is necessary to screen all material being picked up to avoid destroying them. A 15 cm diameter screen with 1 cm holes is attached to the end of the intake hose and pushed into the oil. This system works well in "clean" oil, but it was soon learned the oil at the Herald site was not clean. Grass, leaves, twigs, sticks, and other debris would clog the screens, greatly reducing oil uptake. The drivers were forced to clean the screens approximately every minute, resulting in effective suction for only a fraction of the time. Pre-screening was attempted while sucking oil out of the main receiver tank where the oil was about 0.6 metre deep. This, however, proved to be difficult and ineffective. It was obvious the clean up would take a long time using tank trucks, and with unfavorable weather threatening and winter approaching the decision to use vacuum trucks was made.

Vacuum trucks create a vacuum inside the truck tank by pumping air out. This results in greater sucking power than can be produced by tank trucks. As no rubber teeth are involved, screening is not necessary so grass, twigs, etc. can be picked up with the oil. However, these trucks

present their own problems. The hoses used with a vacuum truck are necessarily bigger and heavier due to the greater suction produced. When they are full of oil, and they must be full in order to maintain suction, two or three men are required to move the intake end.

Despite this greater sucking power and efficiency, since the oil remained quite viscous throughout the day, it was necessary to spray hot water on the oil to lower its viscosity. This would soften the oil permitting it to flow better, but it still needed the encouragement of men with squeegies.

The most confounding problem faced at the Herald site was oil below the standing water. This was also found at another reclamation project in the Zama area, confirming not all oil floats on water. The result was a four layer oil spill: oil/water/oil/oil-contaminated soil. This "heavy" oil was considerably more viscous than the "surface" oil. Experimentation indicated it was impossible to position the vacuum truck hose to skim one layer off of another, so all three "fluid" layers were picked up at once. Unfortunately, the "heavy" oil would sink inside the truck tank and prohibit dumping of the water. This resulted in far more water being taken to the oil cleaning plant than desired, and a related cost increase. When hot water was used to assist oil movement, all the oil would rise inside the truck tank if left standing for a short time.

The hot water was then reused to soften more oil. However, similar problems occurred inside the truck tank once the water cooled slightly. The "heavy" oil would again sink, prohibiting dumping of water.

All oil, water, and oil sludges (fluid oil/soil) were taken to Northern Oil Separators (N.O.S.), an oil cleaning plant about 10 km west of the site. This company's cleaning charges were \$38.00 per m^3 water/oil and \$50.00 per m^3 oil/sludge in September, 1989. They offer a rebate of \$100.00 per m^3 useable oil, the volume of which they estimate by taking a "cut" from tank trucks. As the Herald project required the use of vacuum trucks we could not take advantage of the rebate. Vacuum trucks are not "cut". Any useable oil the company acquires is sold to an oil company for profit. N.O.S. also sells hot water for \$8.50 per m^3.

Analyses indicated the water in the uncovered holding tank was fairly clean except for a moderately high salt content. Thus, it was decided to pump this water into the already salt-affected area to the south east. Approximately 2 metres of water (70,000 litres) were pumped out of the tank using a 3-inch trash pump followed by approximately 40,000 litres from the slough beside it. At the bottom of the tank was about 1 metre of wet, oily-looking muck. An attempt was made to pick this up with vacuum trucks, but only the water and oil would move. The intake hoses would plug in the muck and pick up would cease. A Komatsu 220 backhoe was used to push the muck to one side of the tank, squeezing

much of the water and oil out. This was then picked up by vacuum truck. Upon closer inspection, the muck was determined to be drilling mud which now contained very little oil. After removal of the metal tank sides (there was no bottom), the muck was mixed with clean, dry soil as when oil sumps are reclaimed. The hole was filled and compacted.

All "fluid" oil was softened with hot water and picked up by vacuum truck until only oil-contaminated soil remained. Simultaneously, all metal was steam cleaned or pressure washed and piled for salvage. This is described in the next section. Once the metal, wood, and other debris were piled out of the way the backhoe with a 1 metre wide clean-out bucket and a Caterpillar D6 bulldozer were used to trim the oil-contaminated soil and stockpile it. Contaminated soil depth ranged from 10 cm to 30 cm in the spill area and from 10 cm to 4.5 metres inside the west berm. The oil-contaminated soil found beside the uncovered holding tank and beside the small slough were also excavated and stockpiled. Three stockpiles were made.

METAL CLEAN UP

Considerable time and effort were spent attempting to separate the metal, wood and plastic at the site into different piles. Nevertheless, some mixing was inevitable. Labourers picked up all light metals, washed them with steam or a pressure wash, and placed them in small piles around the site. This included a search 10 metres into the forest. A pickup truck was then used to consolidate these into three piles. Labourers also disassembled pipes and opened boilers so they could be washed and piled. Large metal objects were winched to accessible areas using the D6 bulldozer, cleaned, and then pushed into one of the piles. Very large metal objects were excavated and moved with the backhoe and a Caterpillar D8 bulldozer. Included were the portable sumps of the main receiver and the sides of the uncovered holding tank. The metal piles were situated to allow easy access for a local salvage dealer who was contracted to remove all metal from the site after the earthwork was completed.

EARTHWORK

While the "fluid" oil was being picked up on the west side, the small slough on the east side was squeezed with the D6 bulldozer into a nearby ditch. Part of the berm around the slough was saved for backfilling. After this, the 1.5 metre deep oil-contaminated soil was excavated and stockpiled, and the remainder of the slough berm used for backfilling.

Once all the oil-contaminated soil was stockpiled and the metal, wood and plastic placed in piles, the wood was burned. AFLW personnel at High Level and Rainbow Lake were notified in writing about one week

ahead and verbally about one day ahead of the burning. The site was then levelled using both the D6 and D8 bulldozers. The whole site was scalped to generate enough material to fill all the holes and low spots. All berm material was used in the process. The site was left slightly high-centered to provide positive drainage. Access to the site was left intact for later use and as two pipelines were buried under the access road.

During the summer of 1990, all remaining debris was buried, the slough in the S.E. corner was squeezed and backfilled, and the oil-contaminated soil piles were consolidated into one. This pile was sloped and smoothed, and the whole area seeded with an appropriate grass/legume mixture.

RECLAMATION COST

Following is a breakdown of the costs of the Herald reclamation project, not including Government Personnel and travel expenses, as of July 31, 1990.

Oil Clean Up and Trucking		$16,595
Oil Cleaning Charges (N.O.S.)		30,470
Heavy Equipment		18,525
Steam and Pressure Washing		2,210
Metal Salvage		6,500
Sample Analyses		2,130
	Total	$76,430

FUTURE RECLAMATION

A number of alternatives have been considered for the reclamation of the stockpiled oil-contaminated soil. These included:

1. Landfarming. This would involve spreading the soil, homogenizing it, fertilizing heavily with N and P, regular cultivation and possibly manure or other amendments. Once the oil content was below about 1%, the site could be seeded with an appropriate grass/legume mix.

2. Taciuk Process. This would involve transporting the contaminated soil to Calgary or Grande Prairie to be incinerated. The "clean" soil could then be used locally as fill material.

3. Bioremediation. This would involve adding specific quantities of certain microorganisms to the soil, either in-situ or in holding tanks. The microorganisms would decompose the oil and the "clean" soil could then be spread and seeded with an appropriate grass/legume mixture.

4. Experimental Site. The site could be used as an experimental location and reclaimed as part of a scientific study.

5. Hold. The soil stockpiles could be left as they are, the site seeded with an appropriate grass/legume mixture, and final treatment delayed until better technologies are developed.

It is obvious there are problems associated with each alternative. At this point, however, the situation is under control, so time is available to carefully consider the alternatives.

A combination of #3 and #5 above was initiated during the summer of 1990. Samples of the oil-contaminated soil are presently being used in an enzyme degradation study conducted at the Alberta Environmental Centre in Vegreville. The soil stockpiles have been consolidated and smoothed, and the entire site has been seeded and fertilized.

CONCLUSION

The Herald Oilfield Service Reclamation Project, which began over one year ago, has contained and cleaned up a 2 acre oil spill at a defunct oil cleaning business in NW Alberta. During a 14 day operation, all liquid oil was picked up and transported to another oil cleaning plant; all metal was washed, piled, and salvaged; and roughly 5 acres were graded to provide drainage. Total cost of the clean up was over $76,000.00.

A number of alternatives for future reclamation have been considered. At present, the site, including the oil-contaminated soil stockpile, has been graded, seeded and fertilized, and a study of enzyme degradation is underway. When the reclamation is satisfactorily complete the site should have a low oil content soil; good, positive drainage; and a well established, self-sustaining vegetative cover composed mainly of local species. To achieve this condition the Reclamation Branch will, realistically speaking, need to monitor and work on the site for a minimum of four more years.

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Front Cover: 1986 airphoto of the Suncor facility, north of Fort McMurray, Alberta.

TABLE OF CONTENTS

An Overview of Land Reclamation at Suncor 1
Stephen Tuttle

An Overview of Syncrude's Current Land Reclamation Programs 25
Tony S. Dai

Hybrid Poplars: The New Addition to Syncrude's Land Reclamation Species 29
Martin Y.P. Fung

Avian Colonization of Reclaimed Areas on the Suncor Lease 33
John R. Gulley

Oil Sands Clay Fines: Can they be Reclaimed as Productive, Self-Sustaining Wetlands? 43
Hans Boerger, Mike Mackinnon and Bill Hunter

Wet Pond Reclamation at Suncor 55
Robert Martin

Herald Oilfield Service Reclamation Project 61
Michael A. Mensforth

Design of an Oil Waste Land Treatment Facility for the Cold Lake Production Project 71
Bruce Runge, Alan Kennedy and Margaret Mears

Erosion Control Projects on the Alberta Oil Sands Pipeline 81
Glenn MacIntosh and David Walker

Panel Discussion - Public Participation in Development and Reclamation . 83

Government Perspective 85
Larry Brocke (Alberta Environment)

Industry Perspective 91
Garry Mann (OSLO)

Public Perspective 107
Newell Pickerl (Genesee Power Project Advisory Committee)

List of Attendees 109

List of References for Oil Sands Reclamation 113

DEDICATION

These proceedings are dedicated to the memory of Bruce Runge and Michael Mensforth. These two reclamationists passed away in the fall of 1990 while on the job.

Bruce Runge worked for Western Oilfield Environmental Services Ltd. as Operations Manager and was on his way to conduct a pipeline inspection in the Primrose Lake area when the helicopter he was in crashed on the outskirts of Edmonton. Bruce was 45 years old.

Michael Mensforth worked as a reclamation technologist for Alberta Environment, Land Reclamation Division and was on his way to a site in northern Alberta when he was killed in a freak vehicle accident. Micheal was 35 years old.

The loss of these two specialists is a blow to the small reclamation community of our province. It also points out to the rest of us that ours can be a dangerous profession and that safety is critical in our business.

SPONSORS

The Alberta Chapter of the Canadian Land Reclamation Association would like to thank the following sponsors for making the conference and tour a success:

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