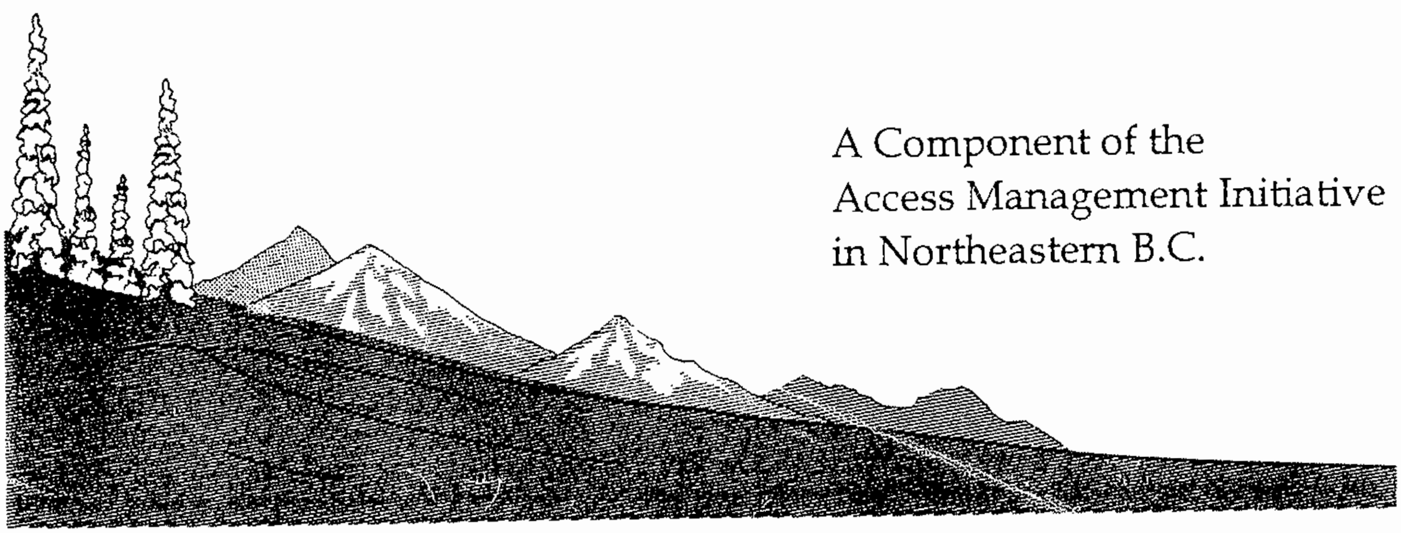
Cit as Anys 1995

A Compendium of Physical Access Control Measures for Roads and Other Rights-of-Way

March 1995



A Component of the
Access Management Initiative
in Northeastern B.C.

ACCESS MANAGEMENT INITIATIVE

In northeastern British Columbia, the cumulative affects of access development and subsequent uses have become an increasing concern to both government and non-government interests. The creation of motorized access has the greatest impact of any activity on the type, pattern and amount of use of public lands and resources Problems associated with the development and management of roads and other forms of access, such as cut lines, trails, and utility rights-of-way, are increasing.

Since June 1994, an initiative to improve understanding about the management and control of access on public lands has been underway in northeastern British Columbia. This process, called the *Access Management Initiative*, involves the Ministry of Environment, Lands and Parks, Ministry of Forests, Ministry of Energy, Mines and Petroleum Resources, local government, the forest industry, Westcoast Energy Inc , oil and gas producers, and a range of public interest groups.

Following a multi-party workshop held in Fort St John in June 1994, a volunteer steering group for the *Access Management Initiative* has worked cooperatively to develop a more active approach on a number of components of access management. The primary focus of these projects has been to provide information that can help to facilitate operational access decisions, thus avoiding duplication with the work of subregional land use planning teams (Land and Resource Management Plans). The results from the *Initiative*, however, are designed to complement land use planning processes.

The objectives of the Access Management Initiative are to:

- Provide a forum for the discussion of access management issues in northeastern B C.
- Provide an understanding of the current government procedures for making decisions about motorized vehicular access
- Identify gaps, duplication of effort and opportunities for improved efficiency in the procedures for making access development and deactivation decisions
- Create an acceptable compendium of physical access control measures for implementing access managing decisions.
- Explore the potential for an access planning process that could be applied to circumstances where closure or deactivation of existing access is being contemplated.
- Identify opportunities for improved intra-industry cooperation in developing and managing access
- Maintain the *Access Management Initiative* as a multi-party project that has the support of government agencies, licensed users and public interest groups.
- Promote public discussion and awareness of access management issues, and the means by which those issues can be addressed

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

1.1 THE ACCESS ISSUE

The effect of new and/or additional (incremental) access development on ecosystem integrity has become a central issue in current impact assessment, protection planning and natural area management in more remote regions throughout western and northern Canada This concern is commonly elicited in public media, and has become dominant as a topic of debate at major hearings on resource extraction or area development proposals Recommendations for access control measures to minimize increases in access potential are becoming increasingly common in impact assessment documents and regional land use plans.

Access control measures are most commonly recommended and/or implemented for the protection of wildlife and wildlife habitat. Wildlife can be impacted from access development by increased hunting pressures (both legal and illegal) and decreased habitat effectiveness in the vicinity of access corridors through disturbance and alienation from potentially suitable habitat. For some species, major transportation corridors or wide rights-of-way (RoW) can also act as deterrents or barriers to wildlife movements. As the relative significance of such impacts is dependent on an individual species' behaviour, habitat use and population biology, access closures are often focused on more vulnerable key species. Such species may be regionally significant game species and sensitive to disturbance such as grizzly bear or caribou, or may exhibit highly localized habitat use both temporally and spatially Hence, physical means to close or minimize access to protect wildlife and wildlife habitat can vary in their nature and timing of use

Access controls are also implemented where resource road deterioration (i e , rutting) is resulting from uncontrolled public use, particularly during wet conditions or spring break-up They have also been used as a means of controlling chronic erosion and run-off problems on facility RoWs, where surface disturbance from off-road traffic prevents a stabilizing mat of vegetation from developing on steeper slopes Such measures are of particular importance in the vicinity of stream crossings, where sediment-laden run-off can be introduced from RoWs into watercourses to the detriment of aquatic habitats

Social issues have also prompted access control measures For example, controls on resource roads are implemented where public safety is in question More recently, the public's demand for non-motorized activities to ensure a wilderness setting in wildland recreation areas has also resulted in the development of access control policies.

1.2 PROJECT BACKGROUND

In the Hart Mountains and Foothills of northeastern B.C., the relatively recent exploration for and development of major natural gas reserves has brought the access issue into focus. In discussing the development of effective environmental protection measures for this development area, Antoniuk (1994) stated that "the key environmental concern associated with continued natural gas exploration and development is the amount of temporary and permanent access which this creates". O'Neill (1993) estimated that, for the Sukunka and Bullmoose /Wolverine catchments and the eastern third of the Burnt/Brazion catchment, ATV and 4x4-accessible access trails/roads have doubled in availability (i.e., in km/km^2) from 1975 to 1992, and that the most important effect of this increase was the reduced use of habitats adjacent to roads by some species of wildlife. Expansion plans for exploration and development are being proposed by a number of operators in the area for the next five to 10 years, and new access potential will continue to increase in the area.

The use of existing corridors during the development of oil and gas facilities obviously reduces the amount of new access potential provided by the development, and is an approach which has largely been adopted within the petroleum industry (Bromley 1988, Antoniuk 1994). However, the ability to remain within an existing access infrastructure is highly site-dependent and, in most new developments, is limited in its application. Consequently, the incremental increase in access potential continues to occur from oil and gas activities, and is an issue of particular concern when potential industry-related cumulative effects in a given region are considered. It is becoming increasingly evident that the regulation of public travel along access corridors is of paramount importance for land use planning.

As a result of their proposed pipeline expansion plans in the Hart Mountains and adjacent area, Westcoast Energy Inc. (Westcoast) has become a leading participant in a joint industry/government Access Management Initiative for northeastern B.C. As part of this initiative, Westcoast retained Axys Environmental Consulting Ltd. (Axys) to undertake a review of physical access control measures which are employed on forested, public lands in British Columbia and Alberta. This report presents a compendium of physical access control measures available to industrial operators and government resource agencies.

1.3 STUDY SCOPE

This report documents the types of physical access control measures in use in B.C. and surrounding jurisdictions. It also discusses the relative frequency of their use and their relative effectiveness. The report does not speculate on the planning and legislative framework for making access management decisions, nor does the report make any judgements about the rights or privileges of the public to use Crown Lands.

It is recognized that the successful application of physical access controls requires supporting elements in the form of legislation, policy, land use strategies and planning procedures. It was not within the scope of this document to review legislative approaches (e.g., Acts, Land Use Plans, etc.) to access control, although agency personnel interviewed during the study sometimes volunteered information of a legislative nature. The reader is referred to the Shouldice *et al.* (1994) report prepared under separate cover for a more detailed description on access-related legislation and policy.

The preliminary findings of this study were presented to a multi-party workshop in Fort St. John in June 1994. Comments on the draft report were solicited from government, industry and public interests over the next six months as part of the broader Access Management Initiative that began with the June workshop. These comments have been incorporated into the report where appropriate.

2.0 METHODOLOGY

2.1 TELEPHONE INTERVIEWS

Telephone interviews were used as the primary source of information for this study. A questionnaire composed of nine questions was developed and tested on several respondents before being standardized (see Appendix 1). Questions were open-ended, close-ended, or utilized Likert items (a subjective, 5-point scale) (Table 1) (Babbie 1982). The Likert items were used to allow respondents to rank the effectiveness of various access control measures that they were familiar with (Appendix 1, question 7). Respondents were encouraged to provide anecdotal information to support their responses to the questions posed, and were guaranteed anonymity in the final report at their request to encourage more open discussion.

All interviews were conducted by the primary authors of this report. The interviewers discussed the interview/questionnaire format thoroughly prior to interviews to standardize interview methodologies, and conversed regularly with each other during the course of the study to ensure that the questionnaire continued to be used in a standardized fashion. At the beginning of each telephone conversation, the background of the project and the nature of the interview was described. Respondents were then given the chance to decline the interview process. As noted below only one respondent declined. At the end of the interview, the respondents were provided with the name and telephone number of the interviewer so that they could provide additional information at a later time, if required.

Telephone interviews were primarily conducted with selected government and industry personnel in Alberta, British Columbia, Yukon, Alaska, Montana, and Idaho. These contacts were supplemented with additional contacts recommended by respondents. Interviews were conducted between 30 March 1994 and 29 July 1994, with the majority of interviews taking place during the month of April 1994.

Table 1. Likert items utilized to rank the effectiveness of physical access control measures.

Likert Item	Definition	Rank
Very High	Prevents ATV travel and possibly discourages predator travel	5
High	Discourages some ATV travel and prevents 4x4 travel.	4
Moderate	Unlikely to stop ATV travel, but prevents 4x4 travel.	3
Low	Navigable by 4x4s but not 2-wheel drive vehicles.	2
Negligible	Navigable to most vehicles.	1

2.2 SUMMARY OF RESPONSE RATE AND TYPE

A total of 46 government and industry personnel were contacted, with 45 interviews being completed (one respondent stated that their department had little experience with access control measures and they therefore felt that they had little to add to the interview process.) The length of the interview ranged from 12-56 minutes, the mean interview length was 23 minutes. Anonymous records of interviews are presented in Appendix 2.

Of the 45 persons interviewed, 23 were from British Columbia, 17 from Alberta, 3 from Montana, 1 from Alaska, and 1 from the Yukon. Eight of the respondents were from private industry (six from British Columbia and two from Alberta) and two were federal personnel from the United States. The remainder of the interviews, 35 in total, were conducted with provincial/state staff in British Columbia (17), Alberta (15) the Yukon (1) and Montana (2)

2.3 DATA ANALYSIS

For the purposes of analysis, open-ended questions were categorized, and tallied, and close-ended questions were tallied Likert items used in the access control effectiveness question were converted to numerical scores, ranging from 5 (Very High) to 1 (Negligible) (see Table 1). If a respondent gave a range instead of an absolute score the mean of the range was recorded. For example, a rating of "Low to Moderate" was scored as 2.5, and "Negligible to Moderate" was scored as 2.

2.4 OTHER INFORMATION

Axys staff have been involved in the development and mitigation planning of more than 10,000 km of linear facilities in western Canada and have been exposed to a variety of access control measures (either implemented or proposed) during the course of project work. Consequently, where appropriate, information from the actual interviews has been supplemented with our in-house experience, particularly pertaining to design specifications for access control measures.

2.5 SURVEY RESULTS

Appendix 2 presents an overview of survey results, including an analysis of access control objectives and responsibilities The section below focuses on actual measures available for use as access control, and provides a relatively detailed description of each. An assessment of frequency of use and relative effectiveness for each measure is also provided.

3.0 ACCESS CONTROL MEASURES

3.1 LEGISLATION/POLICY

As previously discussed, it was not within the scope of this study to review provincial legislation and policy pertaining to public access control. However, during the course of interviews, a number of contacts volunteered information of this nature, and their comments have been summarized below. The reader is referred to Shouldice *et al.* (1994) for a more comprehensive discussion of this issue.

Respondents who were familiar with the use of legislative or policy measures for controlling access ranked their effectiveness from "Negligible" (1) to "High" (4). The mean rank for legislative or policy measures suggests that they are slightly better than "Moderately" effective. It is important to note that fewer than 50% of the respondents who stated they used legislative or policy measures felt that they could suitably rank their effectiveness. This was in part due to the fact that some respondents felt that the ranking scale to be used was not relevant for non-physical access closure measures (Appendix 1, question 7).

Some government personnel feel that there is adequate legislation in place to limit access to all types of vehicles, but that there is insufficient enforcement power to ensure that any existing legislation is followed. This is especially true for sparsely populated northern areas, where enforcement officers are required to cover large areas and receive little public support in reporting violators. Other respondents felt that existing legislation is not powerful enough to limit access, particularly for off-road vehicles such as all-terrain vehicles (ATVs) and snowmobiles.

3.2 PHYSICAL ACCESS CONTROLS

The majority of respondents to the survey were familiar with a wide variety of physical access control measures (Table 2, Column 2), thereby providing a suitable selection of responses for analysis. In some cases, respondents felt that they did not have enough experience to rank the access control measures which they reported using To avoid biasing the data, the interviewer only recorded the ranks for access control measures that the respondent felt confident in ranking (Table 2, Column 3). For most of the access control measures reported, there was a large range of reported effectiveness (Table 2, Column 4). However, based on a mean rank, most access control measures were rated "moderately" effective (a score of 3) or better (Table 2, Column 5). For the purposes of this study, "Moderate" effectiveness was defined as "unlikely to stop All Terrain Vehicle (ATV) travel, but prevents 4x4 travel" (Table 1)

Table 2. Frequency of use and effectiveness of different access control measures as determined by telephone interviews with government and industry staff.

Method of Access Control	Freq. of Reported Use (n=45)	No. who Ranked*	Range of Rank	Mean Rank**
Legislation/Policy	30 (67%)	14	1-4	3.2
Manned Gates	27 (60%)	23	1.5-4	3.7
Unmanned Gates	41 (92%)	37	1-4	3.2
Berms	40 (89%)	37	1.5-4	2.9
Excavation	27 (60%)	20	2.5-4	3.3
Slash Rollback	24 (53%)	19	2.5-5	4.1
Stream Crossings	34 (76%)	28	2-5	3.5
Visual Screening	18 (40%)	12	1-5	2.7
RoW Recontouring	33 (73%)	22	2-5	3.7
Special Construction	10 (22%)	3	3-4	3.6
Other	3 (29%)	-	-	-

* In some cases respondents felt that they lacked enough experience to accurately rank the methods which they reported using. Ranks were only recorded for those who felt confident enough to rank the access control measure.
**Mean rank was calculated using only the total number of ranked responses, e.g., rank for legislation/policy was calculated using 14 ranked responses

It is important to note that almost all respondents qualified their rankings of access control measures by stating that access control was effective in stopping people who respected the intent of access control, but was ineffective in stopping persons who wished to proceed beyond the access control point. This perception amongst respondents is illustrated in the following quotes from the interviews conducted:

- "Physical closure- anyone who is determined will get around it",
- "abide, 10% do not";
- "Effective for honest people, ineffective for the 15% of people who are dishonest",
- "All (physical access control measures) can be circumvented by a person with a chainsaw who wants to cut their own access road. All can be circumvented by a snowmobile once it snows";
- Physical access control measures are "not 100% effective, with new ATVs that can go almost anywhere… (physical access control measures) also present a challenge to people",

Further details on the frequency of use and effectiveness of specific access control measures are provided below.

3.2.1 Manned Gates

3.2.1.1 Description. Manned gates, as implied, are gate structures placed across a RoW which are attended either continuously or during work hours only by a project employee. They are frequently temporary measures used during a defined construction period or, in the case of a permanent facility in a sensitive area (e.g., Primrose Weapons Range, Alberta), can be maintained through the life of the project.

Gates can be constructed from a variety of materials and in a variety of structural designs, and can be as simple as lengths of chain, cable or pipe between support posts spanning the access route at an above ground height capable of impeding the passage of all motorized vehicles. Gates may be marked with a sign indicating the purpose of the access closure or with simple visual markers to ensure that they are highly visible to vehicles, snowmobiles and ATVs. Posts for permanent gates are usually set in concrete. The positioning of a manned gate is important to ensure its effectiveness for access control. It is advantageous to position a manned gate in a location where natural off-RoW obstructions (e.g., steep terrain, dense timber) and the lack of alternative access corridors (e.g., intersecting seismic lines) will limit opportunities for travelers to detour around the gate.

Manned gates will be opened and closed (either manually or automatically) by an attendant assigned with the responsibility of screening people who wish to enter the gated area. Attendants working at permanent gates are usually provided with a shelter from which they can monitor the gate. In many situations (particularly in Alberta) where gates are installed for a temporary period only, the attendant may not have the legal authority to prevent the public from passing through the access control point. However, he can stop them on an informative basis to discuss the intent of the gate, and can record license numbers to discourage unlawful activity, should the individuals wish to proceed.

3.2.1.2 Specifications. None of the respondents to the questionnaire provided examples of specific design specifications used for the installation of gates.

3.2.1.3 Relative Frequency of Use and Effectiveness. The majority of respondents were familiar with the use of manned gates and rated their effectiveness from slightly greater than "Negligible" to "High", with the mean rank being "Highly" effective (Table 2)

Although the costs of manned gates may seem high to some proponents required to implement them, they are an easily established and mobile form of access control and, hence, can be quickly relocated to adapt to changing conditions during a construction period. The presence of an attendant at the gate is a particularly effective deterrent to those individuals who may wish to use the road for illegal (e.g., poaching) or mischievous (e.g., vandalism) purposes, as vehicle identification and/or personal descriptions can be registered by the attendant. They become even more effective where the attendant has the legal authority to prevent people from using the road within the access closure area.

If the gate is not continuously manned, its effectiveness is reduced as soon as the guardian leaves, even if the gate is locked. Effectiveness can also be eroded if the attendant is less than diligent in discouraging travelers from passing beyond the gate. It is one respondent's opinion that once one person has been let in, or has forced their way in, the effectiveness of the manned gate will rapidly erode.

3.2.2 Unmanned Gates

3.2.2.1 Description. Unmanned gates are usually constructed in a more permanent and durable fashion than manned gates as they do not have the additional benefits of an attendant. Gates and support posts are generally constructed of steel to reduce damage from vandalism, and the gates are usually locked with a padlock or other device with keys being distributed to authorized users of the road. Although not indicated by interview respondents, unmanned gates should be accompanied by a sign stating the purpose of the gate.

Gates must be properly placed if they are to deter access. In particular, such gates must be constructed in conjunction with natural biophysical features which will prevent trails from being developed around the actual gate structure. Steep terrain and rock faces adjacent to the RoW in question pose effective barriers, as do mature timber stands which are difficult to cut and remove with typical recreational equipment. Gates on bridges across streams or ravines are also effective where adjacent fording areas are not available to vehicles. Gates must also be located in such a fashion that other alternative access corridors (e.g., intersecting seismic lines) do not provide a route around the gated area.

The importance of a strategic location for the gate is emphasized in the questionnaire responses. Respondents indicated that people who are determined to get around a gate (or any other physical control) will not hesitate to damage their vehicles or spend substantial amounts of time removing obstacles on the sides of the gates to allow access.

3.2.2.2 Specifications. None of the respondents to the questionnaire provided examples of design specifications used for the installation of gates. However, it is advisable for gates (and associated locks) to be constructed with hardened steel material to discourage cutting and dismantling, and to be supported with well fortified support posts (e.g., posts with recessed concrete bases, surrounded by protective boulders) to prevent damage and removal by vandals. To provide protection for locks against pry bars and firearms, the locks can be housed in steel covers open only at the bottom. In addition, where gates are bordered by only treed or shrubland areas, gates should extend sufficiently into the adjacent tree/shrub cover to increase the difficulty of developing detours around the gates.

3.2.2.3 Relative Frequency of Use and Effectiveness. Based on the response to the telephone survey, unmanned gates are the most frequently used access control measure (Table 2). Respondents ranked their effectiveness from "Negligible" to "High", with a mean ranking slightly above "Moderate" (Table 2). Although gates can limit access to most truck traffic, it was generally felt that unmanned gates are not effective in stopping ATVs unless they are ideally situated in conjunction with adjacent impassable terrain.

Unmanned gates are relatively inexpensive to install and are not prone to physical alteration by natural forces (e.g., erosion) as are berms and excavations. However, gates are often vandalized, and maintaining gates can be a long-term operational problem. People have been known to use winches, cutting torches and high powered rifles to dismantle the gate or to remove locks. At least one respondent indicated that public acceptance of such an access control measure will increase only after the gate has been replaced several times. One respondent also indicated that the effectiveness of unmanned gates could be improved in conjunction with signs explaining the reasons for road restrictions. The respondents indicated that locks present problems in themselves, including:

- numerous copies of keys become available;
- legitimate users neglect to close the gate after them because they intend to return shortly. Once the gate is open, unauthorized users enter. Unauthorized entry may present a safety problem or simply an administrative problem when the unauthorized user gets locked in; and
- if the lock is vandalized and needs replacement, there can be logistical problems in distributing new keys to authorized users.

3.2.3 Berms

3.2.3.1 Description. Berms are barriers constructed of slash, spoil, rock or other locally available materials (or a combination of materials) which span the width of the access corridor. It is not uncommon for several berms to be constructed in sequence along the RoW to improve their effectiveness, or for berms to be built in conjunction with excavations. Berm height and width varies but most berms are generally 2 m high and 3 to 5 m wide at their base. The size of material (e.g., rocks or slash) placed in the berm will depend on the type of material locally available.

As noted in the above discussion for gates, berms must be strategically located to prevent people from simply developing detours around the ends of these structures.

3.2.3.2 Specifications. Although none of the respondents to the questionnaire provided examples of design specifications used for the installation of berms, the authors have been involved in three projects where size and configuration of berms were specified to the contractor by the proponent. On a NOVA and Shell pipeline project in Alberta, berms were required to be approximately 1.5 to 2 m in height and 5 to 7 m wide at the base and were to be constructed of both slash (on top) and spoil material (at the base) to increase their longevity and reduce fire hazards (NOVA 1991; Shell 1992).

In these projects, berm configuration depended on the primary purpose of the berm. In response to trappers' concerns that cleared RoWs were acting as a barrier to certain furbearers, the berms described above were required to span the RoW width to provide possible movement corridors for such animals. However, at specified locations, the cross-RoW portion of the berm was to be supplemented with berm "wings" extending 10 m in both directions along both edges of the RoW from the berm in an "H" configuration (see Figure 1; Appendix 3). These wings, constructed in the same fashion as the berms and incorporated into undisturbed forested areas at the edge of the RoW, were designed to make detouring around the berms more difficult for ATV travelers.

3.2.3.3 Relative Frequency of Use and Effectiveness. Berms are one of the most frequently used methods to deter access, but a mean ranking by respondents indicates that they are slightly less than "Moderately" effective. Respondents varied widely in their estimate of berms effectiveness ranking them from "Negligible-Low" to "High" (Table 2). However, the mean rating reflects the general opinion of the respondents that berms are easily negotiated by ATVs and some 4x4s.

Berms are relatively inexpensive to build because they utilize local materials and can be easily incorporated into a project as part of final clean-up. However, berms are prone to erosion and physical alteration and their longevity may be shortened as a result. Berms are often viewed as challenges by off-road drivers, and can become physically altered when 4x4 and ATV drivers test their vehicle's climbing ability. The drivers often make repeated attempts to climb a berm, gradually reducing its effectiveness in the process. Because berms are frequently abused in this manner frequent monitoring and repair are needed to maintain berms which will effectively deter people. Even berms which are constructed of large rocks or logs can be altered or dismantled. One respondent reported that several large rocks had been placed across a roadway to deter access, but that the rocks were removed by off-road recreationists using a truck mounted winch. Berms may also present a safety hazard to ATV user's and snowmobilers if they are not visually obvious to the traveler.

In spite of the above, berms can be an effective means of stopping at least 4x4 travelers and a portion of the ATV traffic if properly constructed. It is recommended that the berms be constructed of a spoil/rock material base, with large diameter slash being used to cap the berm base in an uncompacted criss-crossed fashion. Such a combination obviously removes the attractiveness of the berm as a challenging ATV obstacle. In addition, a spoil base comprised of local surface mineral soil provides a medium for shrub encroachment through natural colonization, a feature which would further enhance the effectiveness of the berm as an access control measure. It is also recommended that the "H" configuration be adopted for berms to make detouring around such structure a more difficult undertaking. There is also the potential that large berms provide additional security and movement corridors for wildlife residing in the vicinity of the RoW and, hence, may be a habitat enhancement as well as an access control structure. One respondent added that berms and excavations located at the junction of an unrestricted road are likely to be more effective due to the visibility of the road closure, as opposed to berm location at a point down the closed access road which may invite attempts to traverse the berm. Educational signage may also improve the effectiveness of berms.

The operational division of some pipeline companies wish to have access options along RoWs for maintenance or emergency work, and may stipulate that a gate be incorporated into the berm structure. However, such a design introduces a weak point in the berm vulnerable to the vandalism issues raised for gates above, and operators should be discouraged from such a requirement wherever possible.

3.2.4 Excavations

3.2.4.1 Description. A variety of excavations have been used to discourage travel along linear corridors. Waterbars with associated ditches are normally constructed as erosion control features on abandoned roads, designed to direct surface run-off from the road bed into stable vegetated off-road sites. However, these structures can be effective access control measures for conventional trucks and 4x4s if constructed with sufficient combined berm/ditch relief. Tank traps are more pronounced excavations with steep edges designed specifically for access control, and are normally excavated with a hoe. Like waterbars, they must extend across the entire width of the access route to be a deterrent to vehicles, and are often placed one after another or in combination with berms to increase their effectiveness. "Kelly Humping", which refers to the alternate raising and lowering a bulldozer blade to create a series of large mounds and channels, is another example of an excavation/berm combination used for access control. While such measures may be appropriate for seismic lines, powerline RoWs or abandoned roads, they are not generally used on pipeline RoWs where high pressure hotlines are generally only 1 m below the surface.

As with other techniques noted above, excavations need to be properly placed to eliminate the possibility of people detouring around the access control point.

3.2.4.2 Specifications. None of the respondents to the questionnaire provided examples of design specifications for excavations for access control.

3.2.4.3 Relative Frequency of Use and Effectiveness. Excavations have been used by the majority of the respondents (Table 2). All respondents tended to rank the effectiveness of excavations in a similar manner, with the range of effectiveness being ranked as "Low-Moderate" to "High" (Table 2). The mean rank of slightly more than "Moderately" effective (Table 2) agrees with the general view of respondents that excavations can deter 4x4s and, if severely designed, some ATVs

Like berms, excavations are relatively inexpensive to construct but are prone to long term degradation from weathering and modifications by vandals. Although few respondents had observed attempts by off-road users to modify excavations to improve access, the authors have personally observed the use of log bundles as infill material in such excavations to facilitate vehicle passage. In addition, the vertical walls of the excavations can, under many soil conditions, be broken down sufficiently with shovels to provide access to ATVs. Once such structures have been successfully navigated by one or more of these vehicles, their effectiveness quickly decreases. Excavations can be more effective long-term structures where they are) developed in surficial materials which will hold a vertical bank structure for a long period of time (e.g., clay-rich till), ii) where they are developed in high water table areas and, hence, will fill with

water, and iii) where they can be developed in conjunction with off-RoW features which will prevent detour trails from being cut around them

Like berms excavations pose a safety hazard to snowmobilers and ATV drivers as they may not be readily visible to such off-road users. Therefore, stretches of RoW with such structures should be appropriately signed to ensure public safety.

3.2.5 Slash Rollback

3.2.5.1 Description. Slash rollback refers to the re-distribution of vegetative slash generated during clearing onto a linear corridor during clean-up or abandonment. Slash rollback differs from berms in that the material is not piled but rather distributed evenly along portions of the linear corridor of interest. Rollback is generally used on projects where active RoW use by construction vehicles is only required during the construction period, and where clean-up can be undertaken within 1 to 2 years of initial corridor development. Slash rollback was reported to be used in lengths ranging from 100 m to 400 m or more.

3.2.5.2 Specifications. A number or respondents provided some design specifications for rollback. Respondents indicated that rollback spread over a distance of 100 m is regularly circumvented by ATV users and sufficient lengths of rollback (e.g., 400 m or greater) are needed to discourage detours. Several respondents stated that placing rollback at intervals every several hundred meters also improved the efficiency of this technique as access control as would-be user's of the access route quickly tire of driving over repeated lengths of rollback. It was recommended that slash should be of a sufficient size to increase the difficulty of removing such material with winches, and should be kept dirty to reduce the temptation for off-road users to cut it with a chainsaw to facilitate travel. It was also noted that some northern regions which support small tree growth only may not provide adequate slash supplies for effective rollback

The authors are familiar with several NOVA documents which provide specifications for rollback. NOVA has produced a typical drawing for rollback implementation (see Figure 2, Appendix 3), which discusses extra workspace requirements for the storage of rollback and specifies that such material should be distributed in an uncompacted, overlapping fashion during installation. In several Development and Reclamation plans prepared for pipeline approvals, rollback was specified on either side of the intersection of the new RoW and existing corridors for a distance of 200 m (e.g., NOVA 1990).

3.2.5.3 Relative Frequency of Use and Effectiveness. Slash rollback had been used by slightly more than half of the respondents (Table 2). Respondents ranked its effectiveness from "Low-Moderate" to "Very High", and it scored the highest mean ranking for effectiveness in this review (Table 2). It was the only method which respondents consistently suggested could deter 4x4, ATV, as well as predator travel along RoWs.

Slash rollback is a relatively inexpensive, flexible access control measure that can be implemented in a variety of situations wherever slash material is generated during corridor development. If large diameter material (i.e., > 30 cm) can be spread in an uncompacted overlapping fashion over adequate stretches of RoW, it presents, as discussed above, a formidable obstacle to vehicle as well as predator travel. It also reduces the amount of burning associated with RoW development and slash disposal and, hence, reduces local degradation of air quality. Provided that large diameter material is used, its natural decay rate will be long enough to provide effective access control until natural shrub recolonization can occur.

The implementation of rollback does poses some potential land management problems, as follows:

- to obtain sufficient quantities of large diameter material for rollback, timber salvage may have to waived by local Forestry authorities over specified stretches of the RoW;
- some Forestry personnel are concerned that rollback may increase fire hazard and the risk of insect infestation, while adversely affecting local aesthetics. One respondent indicated that the susceptibility to increased fire hazard may be reduced by removing fine fuels from the rollback;
- the salvage and storage of slash for rollback generally requires increased quantities of extra workspace requirements during RoW development and, hence, more land disturbance;
- although some organic rollback during RoW clean-up can enhance reclamation efforts, the quantities of rollback needed to effectively block access can actually inhibit revegetation. Therefore, rollback may not be advisable on steeper slopes where a stabilizing vegetative cover is required to control long-term erosion;
- government agencies frequently encourage operators to use existing corridors to reduce new access development. Removal of rollback to facilitate corridor re-use will cause breakage of the rollback material, and reduce its long-term effectiveness after it is replaced.
- rollback makes aerial surveillance of RoWs difficult, and precludes ground-based monitoring work by the operator.

It was noted by several respondents that slash rollback may not be effective in deterring snowmobile travel in deep snow areas, where rollback is completely covered by the snowpack.

3.2.6 Stream Crossings

3.2.6.1 Description. Temporary road construction for all facets of industrial activity invariably involves the installation of vehicle crossing structures at water crossings. These structures can vary from bridge spans to culverts to log bundles to corduroy (logs placed across the traveling surface of the RoW to stabilize surface conditions in muskeg crossings). Removal of such structures during a temporary suspension of activities or during clean-up/abandonment can be an effective access control device, depending on the location of the crossings within the new RoW development.

3.2.6.2 Specifications. None of the respondents to the questionnaire provided examples of design specifications for crossing structure removal. However, specifications for crossing restoration are regularly provided to proponents in B.C. by Ministry of Environment, Lands and Parks and Department of Fisheries and Oceans, and by Alberta Environmental Protection in Alberta in regulatory or land disposition agreements. These specifications can be relatively site-specific but generally pertain to the restoration of bed and banks to stable pre-construction conditions. In muskeg areas, the total removal of corduroy is generally not required, as such a procedure would entail needless surface disturbance to the organic layer. However, most agencies require the removal of designated sections of the corduroy to maintain natural subsurface flows across the RoW and to prevent vehicle travel along the RoW during thawed ground conditions.

Although not discussed by the respondents, stream bank restoration undertaken for fisheries reasons can also provide an additional means of controlling access. RoW grading for pipe installation frequently removes the vertical bank structure of streams, facilitating the development of long-term vehicle fords across smaller streams. Under the "no net habitat loss" policy of the Federal Fisheries Act, a comparable bank structure should be replaced during clean-up if it represents an important habitat component for resident fish, and log cribbing, blocky rock rip rap and even gabion baskets can be used to replace such structure. If extended across the full width of the graded RoW, these structures can present a vertical drop at the crossings which will stop all forms of motorized RoW travel. Schematic drawings for such structures are found in a number of government and industry documents, including Watercourse Crossing Guidelines for Pipeline Systems (TERA and Beak 1993) and Pipeline Agreements (PLA) issued for pipelines in Alberta (see Figures 3 and 4, Appendix 3).

3.2.6.3 Relative Frequency of Use and Effectiveness. The removal of vehicle crossing structures for access control was the third most cited method in this review (Table 2). Respondents ranked this methods as being "Low" to "Very Highly" effective, with the mean rank being midway between "Moderate" and "Highly" effective. In general, the effectiveness of this method is very dependent on the location of watercourses in relation to corridor development, as bridge, culvert, corduroy, etc. removal cannot always take place in an ideal location for access control. Effectiveness also depends on the size of the waterbody in question and its natural effectiveness in controlling vehicle travel. One respondent cited an example of unauthorized individuals who constructed their own bridge across an impassable creek, after the original bridge had been removed to protect sensitive wildlife habitat.

The use of artificial vertical bank structures (e.g., cribwalls) may be required to adequately stop vehicle access across watercourses, particularly on pipeline RoWs. Although relatively expensive to install, these structures can serve a dual function of controlling access and complying with required fisheries restoration standards, if properly designed.

3.2.7 Visual Screening

3.2.7.1 Description. Visual screens refer to several physical measures used to limit line-of-sight down RoWs. They are commonly used in pipelining and seismic operations, and utilize such methods as tree plantings or doglegging (i.e., installation of jogs or corners) in the RoW alignment. Such measures generally do not physically block access but instead are designed to mask the presence of the RoW to the public. Several respondents suggested that such techniques could be used in combination with other access control measures (e.g., slash rollback) to increase the overall effectiveness of the measures.

3.2.7.2 Specifications. Although none of the respondents offered design specifications for these techniques, there are a number of provincial field guides for industrial operations in remote areas which provide guidelines for the use of such line-of-sight controls. For example, in Alberta, seismic operations are requested to install doglegs every 360 m in important wildlife areas where natural terrain features do not limit line-of-site, and similar requirements have, on occasion, been applied to pipeline RoWs through the PLA process. The need for doglegs is also specified at the intersections of new RoW with existing corridors to reduce the visibility of new lines to the traveling public (Alberta Forestry, Lands and Wildlife 1990).

From a reclamation perspective, the authors have been involved in the development and implementation of visual screens at specified locations along new pipeline RoWs for both Shell and Westcoast. These features involved transplants of local stock as well as the planting of nursery stock in blocks extending across the majority of the RoW. The screens were designed more to limit line-of-sight and to provide wildlife cover than to block access as, in both cases, the planting design allowed for a doglegged, travel corridor to be maintained through the blocks for operational vehicles (see Figure 3, Appendix 3). Plantings over the hotline were limited to shrubs (as opposed to trees) because of the perceived threat of pipeline damage from tree roots. On the Westcoast project, the blocks were fenced off with log rail fences to discourage vehicle travel through the plots, and were equipped with signs identifying the plots as an experimental reclamation project jointly implemented by Westcoast and a local Indian band to hopefully discourage vandalism. Most of the blocks were established at the intersection of the new RoW with existing roads.

3.2.7.3 Relative Frequency of Use and Effectiveness. Less than 50% of the respondents were familiar with the use of visual screens and those that did respond were only familiar with the use of doglegs (Table 2). Almost all responses regarding this type of access control came from people working in areas with relatively flat terrain. The use of visual screenings in mountainous or rolling areas is limited because an abundance of natural topographic screens is already provided. Although this method received the greatest range of ratings in its effectiveness (ranks ranged from "Negligible" to "Very High" effectiveness [Table 2]), it also received the lowest mean rank of the techniques listed on the questionnaire, with a slightly below "Moderately" effective rating.

Visual screens are effective in masking the presence of a RoW to the casual observer and they limit the aesthetic impact of new RoW from vantage points along a main road. Visual screens also limit the ability of hunters and predators to easily sight game on RoWs at long distances, although others have suggested that such screens provide hunters/predators with stalking cover at intervals along RoWs. In the case of doglegs, they can easily be installed at little cost to the project. However, doglegs are of little value in controlling access once the public becomes aware of the RoW alignment, unless rollback, berms or other measures are also implemented on the RoW. In addition, it has been suggested by pipeline operational staff that masking the presence of a pipeline RoW, particularly at road crossings, can increase the potential for third party damage to the line.

Tree/shrub plantings can be used to both screen RoWs and provide access control if they extend across the entire RoW in a mature growth phase. However, the establishment period for such plantings to reach a maturity which provides good screening and access control is relatively long under most forested conditions (i.e., 7-10 years), and plantings can be damaged from on-going vehicle travel or wildlife browsing pressure in the interim period. Survival rates of transplant stock can also be low if the RoW bed is not adequately prepared and if moisture is lacking during the initial growth phase after transplanting. Although little can be done to prevent wildlife browsing pressure on the planting blocks, fencing and interpretive signage is recommended to discourage vandalism or inadvertent damage to the blocks.

3.2.8 RoW Recontouring

3.2.8.1 Description. In more mountainous terrain, RoW development for roads, pipelines, seismic lines, etc. generally involves cut and fill techniques on side slopes, where material removed from the high side of the slope (i.e., cut area) to create a flat driving surface is spilled onto the lower side of the slope (i.e., fill area). During RoW clean-up or road abandonment, the operator may be required to reslope the RoW to stable contours, with fill material being brought up-slope to recontour the RoW area and with cut areas being smoothed and/or rounded to an acceptable steepness. On flatter areas, the RoW surface may also be scarified with a ripper cat to mix surface organics into mineral soil and produce a rough, uncompacted surface ideal for seeding.

Both recontouring and scarification can make an abandoned RoW surface unsuitable for truck and 4x4 travel, although ATVs will be able to negotiate these RoWs in most situations. Therefore, bed abandonment may have to be combined with other access control techniques to reach a satisfactory level of effectiveness. The authors have observed several Shell RoWs in the Ram-Clearwater district of Alberta where steep slope recontouring coupled with the distribution of large scattered rollback material (primarily large aspen), surface diversion berms for erosion control and vigorous regrowth (i.e., tall reclamation grasses which screened the rollback) made even ATV travel extremely difficult.

3.2.8.2 Specifications. During the course of the interviews, several respondents identified provincial reference documents which provide broad guidelines for road bed/RoW abandonment. In British Columbia, three levels of road deactivation are recognized, including permanent, semi-permanent, and temporary (Ministry of Forests, 1993), while Alberta generally recognizes two levels (i.e., temporary and permanent) (Fisher 1989). In both cases, temporary abandonment generally involves the installation of erosion control devices (e.g., water bars, surface diversion berms) and possible gates or blockages at the start of the road, all features which offer some access control properties. On permanent closures, bridge/culvert removal, slope recontouring, erosion control features, rollback and revegetation are all discussed as reclamation requirements (Alberta Energy and Natural Resources 1984, Fisher 1989, B.C. Ministry of Forests 1993), and jointly represent effective access control measures.

3.2.8.3 Relative Frequency of Use and Effectiveness. Road bed/RoW deactivation was the third most commonly cited measure for access control (Table 2), although its widespread use appears to be relatively recent. Respondents ranked its effectiveness from "Low" to "Very High", with a mean ranking just below "Highly" effective (Table 2). This mean ranking was second only to that for slash rollback.

Road bed/RoW deactivation not only provides effective access control but returns the land base back to near-original topographic conditions and capability. However, it is expensive relative to other access control measures, particularly where extensive recontouring is required. It also causes some operational inconveniences for both industrial and government resource agencies, and may increase costs for:

- future forest fire fighting;
- future maintenance, reclamation, or remedial work along facility RoWs.

3.2.9 Specialized Construction Techniques

During interviews, participants were asked to comment on any specialized construction techniques that, to their knowledge, had been suggested or actually utilized as an access control measure. Several examples of possible techniques were provided to the respondents by the interviewers to assist them with their responses (e.g., horizontal boring, directional drilling).

Few respondents were aware of situations where specialized techniques had been used for access control, and only three felt that they could comfortably rank their effectiveness. One respondent suggested that limiting road/RoW construction through muskeg areas to winter road standards (i.e., no all-weather fill) would be an effective construction technique for controlling summer access.

The authors are familiar with two construction techniques which have been used on pipeline projects for reasons unrelated to access control but which have access control potential. A third technique was utilized for the preparation of seismic RoWs specifically for access control purposes. These are discussed below.

3.2.9.1 Stream Bores. Boring refers to a horizontal drilling technique (as opposed to directional drilling which is technologically more complex) which has been traditionally used for pipeline installations under roads, railroads and even shelterbelts. With the technique, bellholes 2 to 3 m deep are generally excavated on either side of the linear facility to be crossed. A boring machine, situated in one of the bellholes, is used to drill a hole under the linear facility to the opposite bellhole. Once this hole is reamed to a sufficient diameter to accommodate the pipe, the pipe is attached to the drill stem and pulled through the hole.

This same technique can be used to install pipe under smaller water crossings and adjacent riparian fringes, thus eliminating the removal of natural vegetation and bank structure for RoW development. An access shoo-fly equipped with a bridge can be used to facilitate RoW traffic during the actual construction period, but can be readily closed to post-construction traffic by removing the bridge and installing rollback. The crossing is therefore left as an effective access control point.

There is the general perception that such a technique is costly, relative to open cut crossing techniques. However, on a recent small diameter NOVA pipeline project, boring proved to be more cost effective than open cut crossings (based on contractor estimates for open cut construction procedures) in three out of four small streams (i.e., bores of less than 50 m), particularly when the reclamation costs associated with conventional techniques were factored into the comparisons (Houser and Eccles 1993). The only bore which was more costly than open cut estimates had its bellholes located in silty-sand fluvial material, where shoring-up of the bellholes resulted in increased costs The other bellholes were situated in competent till material or sandstone bedrock.

Boring is not limited to horizontal operations. On a NOVA project in central Alberta, slant boring was used to install pipe below unstable and erosion-prone "badlands" terrain from the Red Deer River floodplain to the top of the valley breaks. This technique not only avoided reclamation costs for slope restoration, but also eliminated the potential for off-road access trails from developing on the slope.

3.2.9.2 Directional Drilling. This relatively new technique is generally used for installing pipelines under major water crossings or unstable terrain features (e.g., steep, slumping slopes). Although similar in concept to boring operations, directional drilling has, as the name implies, the capability for directional down-hole control, enabling curved as well as straight line holes to be drilled.

Most large streams crossed by pipelines are natural access impediments, regardless of whether they are drilled or open cut for pipeline installation. However, steep, unstable terrain normally impassable to off-road vehicles frequently becomes passable once the RoW has been graded to construction standards, and effective post construction access control may not always be possible. If directional drilling can be used to install pipe under short sections of such terrain (300-400 m), then natural access impediments can be maintained. Construction traffic can either be routed to the drilled area from either direction along the RoW, or can be accommodated by a carefully designed shoofly (access road around the drilled area) which can later be recontoured and rehabilitated.

Directional drilling costs may discourage operators from considering such an option, particularly for large diameter pipe. From a logistical perspective, drilling becomes a difficult option where unsuitable overburden (e.g., gravels) or unstable rock strata encountered by the drilling rig result in frequent hole failures. An adequate staging area is also required at either end of the operation.

3.2.9.3 Clearing/Grading Restriction. On winter seismic programs, conventional lines can provide considerable new access potential for both off-road vehicles and predators. To reduce such access potential, seismic contractors on a Saskoil (now Wascana) geophysical program in northeastern Alberta were required to construct seismic lines through relatively flat muskeg terrain without disturbance to the moss layer (i.e., no grading). Cutter blades (or simply raised blades in some areas) were used to shear-off trees and shrubs above ground level, leaving protruding stumps and broken debris on the RoW to discourage travel by unauthorized vehicles. Workers on the project were transported along the lines by tracked vehicles which could negotiate the stumps and debris with minimal damage. In more heavily treed areas, some of the slash was windrowed to the sides of the line to accommodate tracked vehicle travel, and then re-distributed over the lines during clean-up.

In addition to providing access control during the active seismic period, such "no grading" procedures produced a radically different end product than conventional graded lines. During a site visit conducted to the program area in the June following seismic operations, it was evident that much of the natural low shrub, seedling and herbaceous growth common to the area was still intact on the new lines. This was in marked contrast to conventional lines which supported a wetter graminoid/moss community even several years after seismic operations (Delta 1991). The potential for natural regeneration on the "no grading" lines to provide even more of an access deterrent in the short term was high.

3.2.10 Other Measures

Respondents provided a variety of other techniques related to access control, these included:

- Signage
- Custodians or Patrols
- Access Management Plans
- Public Education
- Leave Natural Washouts

3.2.10.1 Signage. Signage was the most frequently reported method in the "Other" category. Respondents generally indicated that the use of signs alone was "Negligible" in deterring access. Only very honest people appear to obey signs, unless their own safety is at risk. Signs are commonly used in association with other access control methods, especially gates, to provide the public with important information on the reasons for access closure.

3.2.10.2 Custodians or Patrols. Information from the interviews referred to the use of custodians or patrols at campground and cross-country ski areas. The custodians role was simply to report access violations to the owners or police if possible

More recently, field patrols have been employed during the winter construction season by oil and gas operators in winter caribou range in northeastern Alberta to discourage hunting activities along winter roads (C. Edey [NGTL], pers. comm.) These patrols were responsible for disseminating information on caribou issues and concerns in the area to construction personnel, and for monitoring unauthorized vehicle traffic using the winter roads.

3.2.10.3 Access Management Plans/Public Education. Although not widely recorded in the "Other" category, these methods were often recommended as mechanisms for improving access control through public participation in access management decision making

3.2.10.4 Natural Washouts. One respondent indicated that although natural washouts pose a variety of environmental and safety hazards, they can be very effective in reducing access.

4.0 SUMMARY

Results of the interviews indicated that most respondents felt that slash rollback, manned gates and certain specialized reclamation techniques were the most effective measures for controlling access. However, while such physical access control measures have been widely implemented in western Canada in an attempt to manage access-related impacts, there was a general consensus among those interviewed that most physical barricades on linear corridors can be circumvented by persistent individuals who wish to access an area. This is a particular problem in more heavily developed areas, where a large number of alternative access routes are frequently available to off-road users who are confronted by an access control point.

Measures to improve the effectiveness of access control measures were voiced by most respondents. Within government, there was a general agreement that greater inter-agency cooperation and consistency was required when implementing access control plans. In addition, government agencies saw a need for additional funding and manpower to monitor the effectiveness of access control measures and enforce access closures, as well as to educate the public on the importance of access control for resource management. Within industry, several respondents voiced the need for greater cooperative planning among various operators in an area to maximize the use of common corridors. Some respondents indicated that both government and industry must understand that the public is more likely to accept closures of new access roads, prior to the development of "traditional use" along these roads. Consequently, closures of such temporary corridors as abandoned wellsite roads should be undertaken as soon as possible.

The effectiveness of physical access controls will depend on the extent of user acceptance of the need for active management, as well as on the clarity of the objectives for access closure or deactivation. Approximately 40% of respondents mentioned the need for increased public education and/or coordinated access management planning (which involves public input) during the course of their interview. In general access control is instituted to control public activities in sensitive areas (e.g., limiting use of ATVs in wilderness areas). However, in most jurisdictions, the general public has had little opportunity to play a role in access planning and closures. The allowance for adequate "designated ATV areas" in any coordinated land use plan was also raised as a requirement to reduce access impacts in other more sensitive areas.

None of the respondents were able to provide examples of systematic monitoring conducted to assess the effectiveness of physical access control measures. Monitoring was usually done as part of other duties (e.g., conservation officers patrolling backcountry areas) and on an *ad hoc* basis. One Alberta respondent indicated that on roads with manned gates, no caribou were killed during a construction season while, on adjacent roads with no gates, two caribou were known to be poached. However, without further information on the size of the area covered by the respective roads, as well as a number of other factors, it is dangerous to speculate on the significance of this information. One Montana respondent indicated that they are in the process of writing a report on the effectiveness of access control in elk winter range.

5.0 REFERENCES

Alberta Energy and Natural Resources, Forest Service. 1984. The Resource Handbook Operational, Guidelines for Industry. Prepared by Forest Land Use Branch.

Alberta Forestry, Lands and Wildlife. 1990. Provincial Geophysical Guidelines.

Antoniuk, T.M. 1994. Environmental Protection Strategies for Development of the Monkman/Grizzly Valley Gas Fields. Prepared for Amoco Canada Petroleum Company Ltd., Norcen Energy Resources Ltd., Ocelot Energy Inc., Petro-Canada Resources, Sceptre Resources Ltd., Shell Canada Ltd., Talisman Energy Inc by Salmo Consulting Inc., Calgary.

Babbie, Earl R. 1982. Social Research for Consumers. Wadsworth Publishing Company, Belmont, California.

British Columbia Ministry of Forests. 1989. Forest Planning: A Guide to Coordinated Access Management Planning.

British Columbia Ministry of Forests. 1993. Forest Road and Logging Trail Engineering Practices (Interim): and instructions for its implementation.

David Bromley Engineering (1983) Ltd. 1988. Environmental Operating Guidelines for the Alberta Petroleum Industry. Prepared for the Canadian Petroleum Association.

Edey, C. Personal Communication. Nova Gas Transmission Limited, Calgary, AB.

Houser, M. and R. Eccles. 1993. Effectiveness of Horizontal Boring Operations for Stream Crossings in West Central Alberta. Nova Corporation of Alberta *and* The Delta Environmental Management Group Ltd., Calgary. 9pp.

Fisher, G.L. 1989. Resource Road Planning Guidelines for the Green Area of Alberta. Prepared for Alberta Forestry, Lands and Wildlife, Forest Service.

NOVA. 1990. Application for Development and Reclamation Approval for Wembley Lateral Loop #2 and Valhalla Lateral Loop. Prepared for Environment & Quality Management Department of NOVA Corporation of Alberta by R. Eccles, The Delta Environmental Management Group Ltd., Calgary.

NOVA 1991 Application for Development and Reclamation Approval for the Edson Mainline Loop #2 (Wolf Lake Section) Prepared for Environment & Quality Management Department of NOVA Corporation of Alberta by R. Eccles, The Delta Environmental Management Group Ltd , Calgary .

O'Neill, G 1993 Access Development in the Peace-Liard Sub-Region from 1975 to 1992 and its potential impacts on wildlife. Unpublished manuscript prepared for Ministry of Environment, Fort St. John in partial fulfillment of the requirements of the University of Victoria Biology Co-op Education Program

Schouldice, R.R., M.A. Skenke and A.B. Cormick. 1994. Access Management in British Columbia A Legislative and Administrative Overview. Draft No. 1. Prepared by Ladner Downs Barristers and Solicitors. 79pp.

Shell 1992. Ram/North Clearwater Pipeline Project Development and Reclamation Plan. Prepared for Shell Canada Ltd. by HBT Agra Limited and The Delta Environmental Management Group Ltd , Calgary.

TERA Environmental Consultants (Alta.) Ltd. and Beak Consultants Limited. 1993. Watercourse Crossing Guidelines for the Pipeline Industry Prepared for Canadian Associatiou of Petroleum Producers.

6.0 APPENDICES

APPENDIX 1: Questionnaire Structure

Date: ____________________ Time (Start): ____________________

Time (End): ____________________

Interviewer: ____________________

Informant: ____________________ Position: ____________________

Ministry: ____________________ Dept.: ____________________

Address: ____________________

____

____

____

____

Tel: ____________________ Fax: ____________________

1. Have you employed access control measures or are you aware of access control measures which your department employed for resource protection? (physical or legislation or policy).

2. What were the specific objectives of the access control (e.g., wildlife protection, erosion control, road surface protection, public safety, etc?)

3. Who was responsible for implementing the access control measures (government agency, industrial operator)?

4. What specific measures were employed as access control (circle the appropriate categories):

   i) legislated/policy, ii) manned gates,

   iii) unmanned gates, iv) berm constructed of slash, spoil, rock or other materials,

   v) excavation, vi) slash rollback,

vii) clean-up measures to make use of natural obstructions (e.g., removal of bridges and culverts at stream crossings, removal of corduroy in muskeg),

viii) visual screenings (e.g., doglegs, tree planting),

ix) specialized construction techniques (creek bore, slant drilling through a hillside to keep physical barrier intact,

x) specialized reclamation techniques, (e.g., vertical crib walls at creek crossing to prevent crossing, put road to bed)

xi) Other (Describe).

5. Were design specifications developed for the access control measures? If so, what were they? (e.g., size of slash material for rollback, berm configuration, etc.)

6. Was any monitoring done to assess the effectiveness of the access control measures? What were the results? (Keep separate notes for each method)

7. Please provide a subjective rating of the effectiveness of the access control measures, using the following categories (Keep separate notes for each method):

- **Very High** (prevents ATV travel and possibly discourages prodator travel);
- **High** (discourages some ATV travel and prevents 4x4 travel)
- **Moderate** (unlikely to stop ATV travel, but prevents 4x4 travel)
- **Low** (navigable by 4x4's but not 2-wheel drive vehicles)
- **Negligible** (navigable to most vehicles)

8. What are the major short-comings of the access control measures (e.g., short life span, unsightly, fire hazard, etc.). Can you suggest any improvements?

9. Request for further information.
** Please send any available copies of legislation, reports, articles
** Can you recommend anyone else to speak with?
** My number is XXX-XXXX if you have any further comments please do not hesitate to contact me.

APPENDIX 2: SURVEY RESULTS

RESPONSE OVERVIEW

All respondents indicated that they were familiar with physical access control measures. Slightly more than half of the respondents (n=21, 51%) indicated that they were familiar with legislative measures for access controls, while 23 (51%) indicated that they were familiar with less formal "policy" measures of limiting access. Of the respondents indicating that they were familiar with legislative controls, nine stated that physical controls could not be put in place without legislation allowing such limitation of access. These respondents also indicated that several Acts can be utilized to limit access (see Shouldice *et al.* [1994] report).

The 100% response rate regarding the use of physical access control measures indicates that such measures are commonly used or recommended for use by various government agencies. However, as noted below, this does not indicate that all agencies are familiar with all techniques for physical access control, nor does it indicate that all access control measures can be used in any environment.

The relatively low response rate to the use of legislative and policy measures may be explained in several ways:

1. Legislated access closures (e.g., access restrictions in certain B.C. Wildlife Management Units) may be commonly implemented in some jurisdictions but not well known in others. This was particularly true regarding the use of Coordinated Access Management Planning (C.A.M.P.) in B.C. Forest Regions. Some Forest Regions use C.A.M.P. extensively, while others do not.

2. Several respondents indicated that physical access control measures cannot be put in place without legislated backing. It is possible that other respondents may have referred to the physical measures only, although they were aware of the associated legislated backing.

OBJECTIVES OF ACCESS CONTROL

A total of 7 different objectives for access control were identified through the interview process (Table A-1). As alluded to in the introductory discussion and reflected in the summary of interview responses in Table A-1, the most frequently cited purpose for implementing access control is to help ensure the protection of fish and wildlife and their habitat. Minimizing erosion-related problems was cited a major concern as well. The remaining objectives included: public safety, the protection of wildland aesthetics and recreation opportunities, the protection of private property, minimizing fire hazard, and minimizing damage to vegetation.

The predominant concern over biophysical issues reflects the governmental focus on the protection of public lands and natural resources within those lands. The protection of private property was a more notable concern from the industry personnel interviewed, accounting for 4 of the 6 responses in this category (Table A-1).

Table A-1. **Main objectives for implementation of access control, as determined from government and industry interviews.**

Objective	No. of citations*	Citations as a % of interviews (45)
Protection of fish & wildlife and habitat	36	80%
Minimizing erosion & water quality problems	18	40%
Public safety concerns	11	24%
Protect wildland aesthetics/recreation opportunities	9	20%
Protect private property	9	20%
Minimize forest fire hazard	5	11%
Minimize damage to vegetation	5	11%

* Number of citations is greater than 45 because most respondents provided several objectives of access control.

Of the access control programs in place for fish and wildlife protection, it is likely that most are set up to protect big game species. Nearly one third of respondents (n=13, 29%) spontaneously provided target species for their access control programs. Ungulates were cited most frequently as being targets for access control programs, while grizzly bears, fish and Trumpeter Swans were also spontaneously cited as targets of access control programs (Table A-2). With the exception of the Trumpeter Swan, all species listed in Table A-2 are known to be susceptible to hunting pressures and/or poaching, and access is usually limited in an attempt to reduce these pressures. Access control may also be established to protect special habitat areas, such as key winter habitat for elk, or to prevent harassment of species which are known to be especially sensitive to human disturbances (e.g., mountain goats).

Most respondents (n=34, 76%) provided multiple reasons for establishing access control programs, and several indicated that the reasons for access control were highly site and situation specific.

RESPONSIBILITY FOR IMPLEMENTATION OF ACCESS CONTROL

The majority of respondents (n=29, 64%) indicated that both government and industry are responsible for implementing access control measures. It appears that, in most cases, a government agency recommends access control after reviewing the project, and the proponent is subsequently responsible for actually constructing the access control measure. However, in other cases, the proponent may request to install access control measures and the government agency will approve or deny the privilege. At least 1 respondent indicated that responsibility for implementation was site and situation dependent.

In some situations, a government agency will act on behalf of another government agency to implement the access control measure. For example, in both British Columbia and Alberta, the Fish and Wildlife Branch will recommend access control to Forestry. Forestry will then request the proponent to install access control devices.

Of the remaining respondents, 10 (22%) indicated that government was solely responsible for implementing access control, 4 (9%) indicated that industry was responsible, 1 (2%) indicated that in some cases private land owners (water users) have

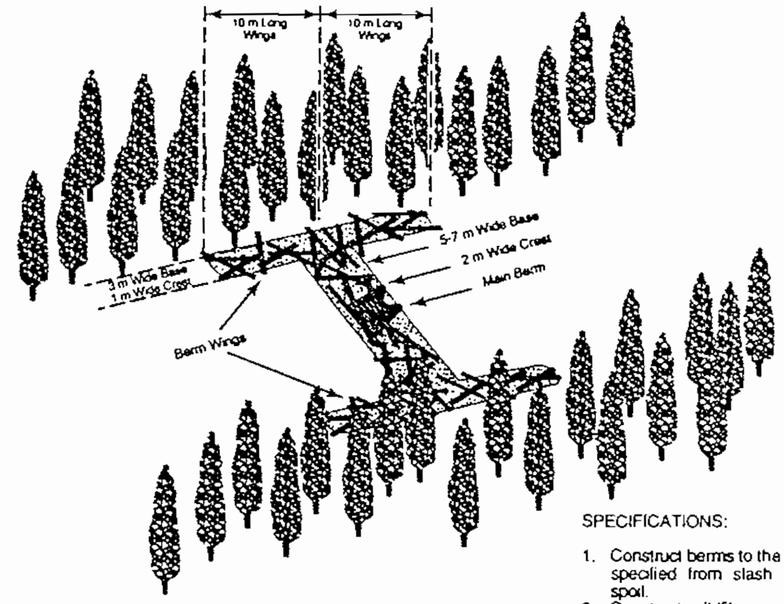
Table A-2. Species spontaneously indicated by respondents to be targets of access control programs, as determined from government and industry interviews.

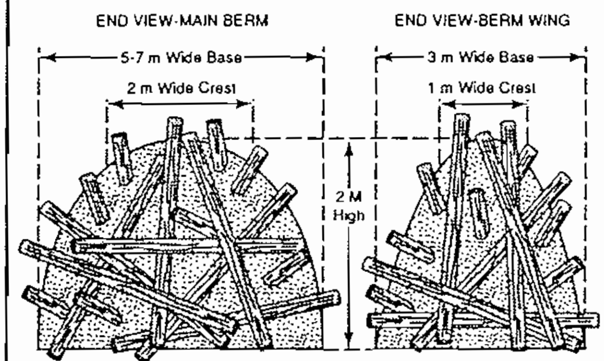
Species	No. of citations*	Citations as a % of interviews (45)
Ungulates		
Bighorn sheep	2	4%
Caribou	7	16%
Deer	2	4%
Elk	4	9%
Moose	6	13%
Mountain goat	1	2%
Other		
Grizzly bear	5	11%
Fish	4	9%
Trumpeter Swans	1	2%

* Number of citations is greater than 13 because most respondents provided several species which were the targets of access control.

the right to request access control, and 1 (2%) indicated that responsibility lay with multiple stakeholders in the region in question. Some industry personnel indicated that government was solely responsible, while some government personnel indicated that industry was solely responsible.

APPENDIX 3: DIAGRAMS OF PHYSICAL CONTROL MEASURES





SPECIFICATIONS:

1. Construct berms to the dimensions specified from slash mixed with spoil.
2. Construct wildlife crossing berms to the same specifications but without wings.
3. Leave berms in uncompacted fashion, with overlapping and protruding slash.
4. Incorporate end of main berm and berm wings into undisturbed forest at edge of ROW.
5. Do not construct on steep slopes.
6. Seed berms to grass-legume mix.

<u>Access Control Berm</u>

H - Construct as shown above.

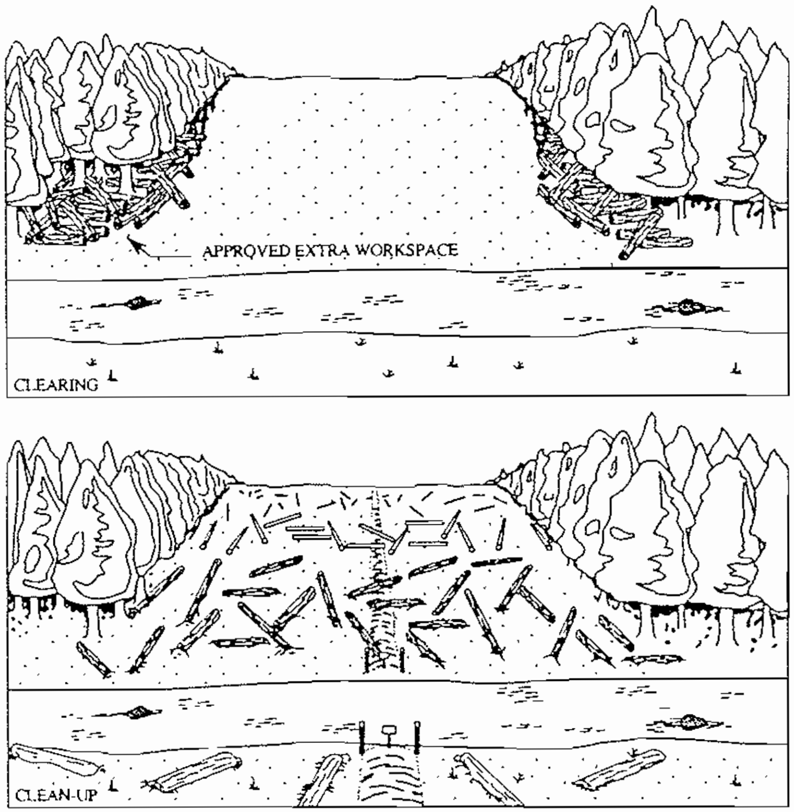
<u>Access Control Tree Screen</u>

T - Construct as shown above but delete berm wings.

Transplant trees on berm

FIGURE 1 H BERM SPECIFICATION FOR ACCESS CONTROL

(Adapted from Shell 1992) R. LAUZON



Windrow slash against standing timber on both sides of the right-of-way.

Portion of trees 15 cm in diameter or greater are not suitable for erosion control and will be salvaged or burned as required.

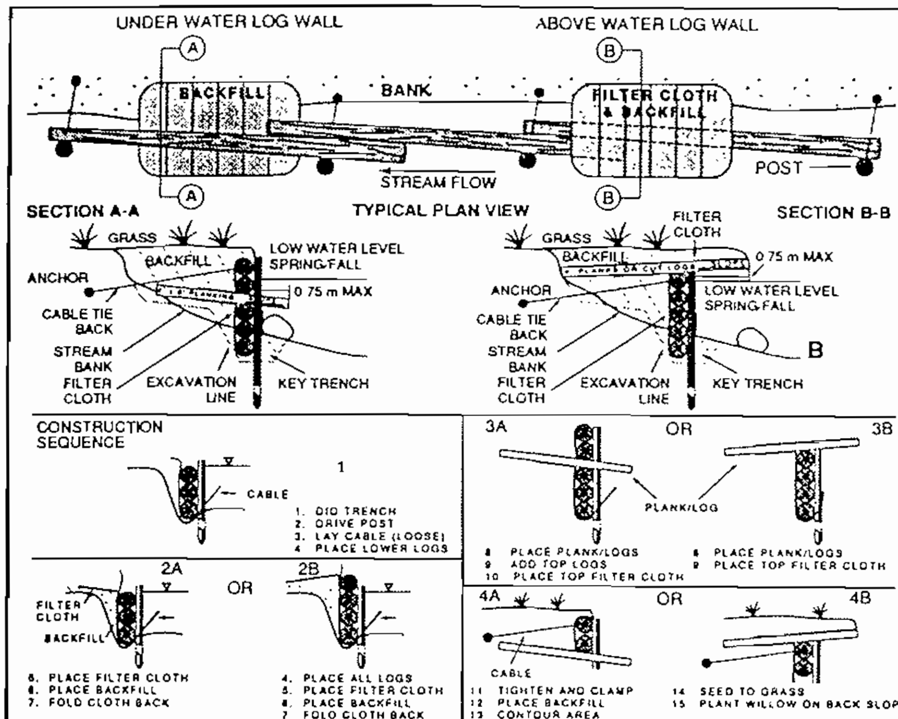
Temporary workspace off right-of-way for storage of rollback will require approval from a Public Lands Officer.

Maintain existing access right-of-ways through rollback (i.e., trails, seismic lines).

Rollback should be evenly distributed over right-of-way and compacted flush with a dozer. Avoid overlap of

FIGURE 2 TYPICAL ROLLBACK FOR EROSION CONTROL

(Adapted from Nova 1991) R. LAUZON



Purpose - to provide a low temporary bank stabilization structure in combination with overhead cover. This will provide shelter and safety in addition to feeding and resting opportunities for small streams. This type of structure does not work in streams with strong ice movement. This structure should be limited to streams no wider than 5 m and with a relatively firm channel bed.

Construction Notes:

1. Select sound, straight coniferous trees, (30-35 cm butt diameter) with a mean diameter of about 20 cm and very similar lengths. Trim all branches and debark all logs prior to installation. Select 8" trees (butt diameter) for the vertical posts used to hold the log wall together. Obtain 4" thick planks from a local sawmill, with a width of 30 cm or more if possible. An alternative is to use short delimbered coniferous logs cut from an abundant tree supply.
2. Dig a level trench (key way) along the stream bank, to accept the bottom log. This trench should be below or at the level of the adjacent channel. Place bottom log loosely in trench for fit.
3. Pound posts deep into the channel bed at appropriate distances to allow for the horizontal wall log overlap.
4. Place the bottom logs against the driven posts with the butts in the same direction and place tieback cable under the log and around the post, leaving the cable
5. loose in the trench.
   Place second layer of horizontal wall logs in the opposite direction to the bottom layer to compensate for diameter reduction and reduce voids in the log layers.
6. Continue for additional layers, alternating the direction of the log placement.
7. Cut and place filter cloth against the logs, leaving 1 m overlap to cover backfill material. Place backfill against filter cloth and logs and compact. Fold filter cloth back over backfill.
8. Lay perpendicular planking across backfill, logs and out into the stream, with a projection of not more than 0.75 m past the log wall. To ensure a close fit, jam the
9. planks against the top layers of logs and 1/2 across top log.
10. Tighten cable around logs, place clamp and take cable back into bank and attach to a strong anchor in the bank.
11. Place backfill and topsoil on the filter cloth and seed to grass.

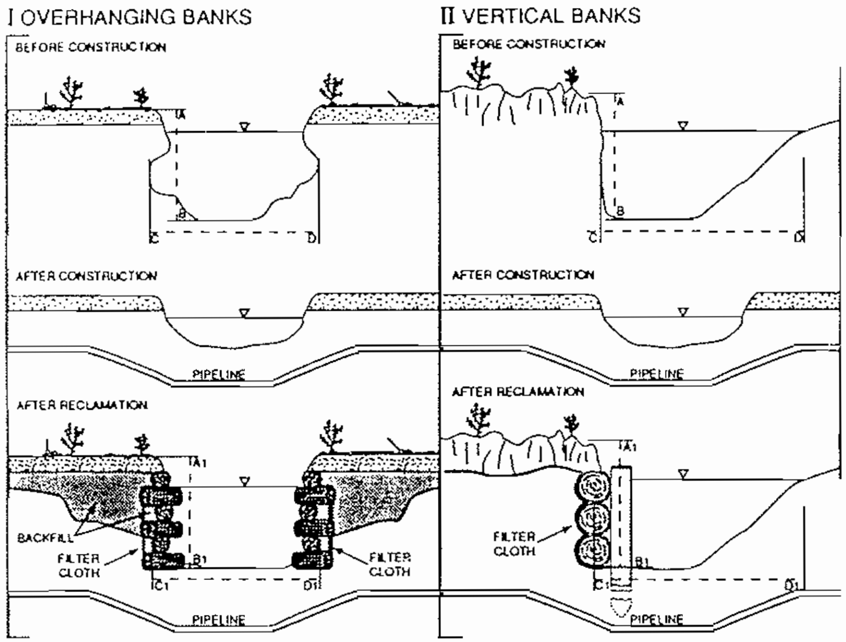
Lifespan may be limited to 10 years, more or less, depending on submergence (longer life) or channel ice movement (less life) or many alternative wet and dry cycles of timber (short life).

Perpendicular deck planking is more costly than horizontal logs, but recommended as the failure of several planks does not significantly threaten the integrity of the structure, in contrast to overhanging trees placed parallel to the direction of flow. If one fails, a significant amount of habitat is lost.

LIMITATION - For small stream channels 1-6 m wide, low velocities and nonsignificant ice movement during spring break up.

FIGURE 3 LOG WALL (Small Streams, Width < 5 m)

(Adapted from Alberta Environment 1988) R. LAUZON



PROFILE B
N.T.S.

NOTES

1. Install where original stream banks overhang and provide fish habitat.
2. Install log overhang greater than 30 cm.
3. Install native timber (coniferous where possible).
4. Ensure $A_1 - B_1$ is not less than A-B.
5. Ensure $C_1 - D_1$ is not greater than C-D.
6. Backfill with coarse, non-erodible material.
7. Replace subsoil and topsoil.
8. Transplant native vegetation. Sow appropriate seed mix.
9. Live willows may be layed perpendicular to stream flow within and projecting from the crib wall above the water line. This will create a live crib wall.

NOTES

1. Install where original stream banks were vertical to provide erosion control and fish habitat.
2. Install pressure treated vertical posts 3 times the length of the exposed height.
3. Utilize native timber or lumber for horizontal structure.
4. Ensure $A_1 - B_1$ is not less than A-B.
5. Ensure $C_1 - D_1$ is not greater than C-D.
6. Anchor posts as required.
7. Backfill with coarse, non-erodible material.
8. Replace subsoil and topsoil.
9. Transplant native vegetation. Sow appropriate seed mix.
10. Live willows may be layed perpendicular to stream flow within and projecting from the crib wall above the water line. This will create a live crib wall.

FIGURE 4 STREAMBANK PROTECTION-CRIB WALL

(Adapted from CAPP 1993) R. LAUZON