

Roads

More than lines on a map



Acknowledgements

The Roads Project is a project of the CPAWS Wildlands League. It is comprised of three products: a Canada-wide roads map, five case studies and this public information document on the problem of roads. The Roads Project Team responsible for overall design and vision are Anna Baggio and Janet Sumner of CPAWS Wildlands League and Tim Gray of CPAWS.

Roads: more than lines on a map was written and compiled by Brad Cundiff based on research compiled by Rosie Page and Laura Pitkanen. It was also based in part on the Yukon Fish and Wildlife Management Board's *Down the Road: The Effects of Roads and Trails on Wildlife*. CPAWS Wildlands League would like to thank Christine Cleghorn and the Yukon Fish and Wildlife Management Board for allowing us to use their publication on the impacts of roads in the Yukon as a model and resource for our nation-wide product.

The following people reviewed and provided valuable insights and comments into *Roads: more than lines on a map*: David Pearce, Chris Hogan, Leslie Wakelyn, Peter Zimmerman, Theresa Gulliver, Justina Ray, Gillian McEachern, Wendy Francis, Helene Walsh, Gaile Whelan Enns, Julee Boan, Christine Cleghorn, Chris Henschel, Janet Sumner and Tim Gray. CPAWS Wildlands wishes to thank all of the reviewers for their contributions. We alone are responsible for content and any errors that may appear in this document.

The amalgamated map on the back cover was generated by Julee Boan of CPAWS Wildlands League.

We gratefully acknowledge ESRI for supporting our map production through their Conservation Grant program.

CPAWS Wildlands League gratefully acknowledges the generous contribution and support of the *George Cedric Metcalf Charitable Foundation* in the production of the Roads Project.



George Cedric
Metcalf Charitable
Foundation

Foreword

Roads are one of the least understood sources of impacts on wild places and wild species. While many people understand the potential effects of logging, mining or other resource developments on natural areas, few people appreciate the dramatic impact of roads. But despite their low profile, roads – particularly poorly planned roads – are a real and growing threat (as the map at the back of this report makes clear) to wild places .

Roads obviously serve many useful purposes, from allowing access to resources to reducing the isolation of remote communities – including the social and economic costs associated with such isolation. But too often **we don't take the time to look at how we can reduce the many impacts of roads** – from breaking apart large areas of intact forest to directly destroying wildlife habitat and spreading pollution – before construction begins.

Worse yet, we have rarely made a comprehensive and proactive effort to balance the need for roads with **the need to maintain our shrinking areas of intact forest habitat.** As a result, we have rarely put in place proper safeguards for large roadless areas outside of parks and protected areas – places that are becoming increasingly scarce in almost every province.

We only have to look at species such as woodland caribou to see the mark left by roads on our natural areas. **Woodland caribou have disappeared from close to half of their traditional habitat range** over the past decade in the face of a rapidly spreading network of roads and development.

We can – and must – do better. This report ends with a series of recommendations for decreasing the impacts of roads and preventing the further loss of our immensely important wild areas. We hope this document will be useful in sparking a broader discussion of a responsible approach to roads and the preservation of roadless areas in Canada.

Published by CPAWS Wildlands League, Toronto Ontario
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Canada's boreal forest region includes some of the largest areas of undisturbed wild forest left in the world. But other parts of this vast sweep of forest, lakes and wetlands running across the centre of Canada from Labrador to Yukon have been divided up by extensive networks of logging roads, mine and hydro access roads, pipelines, transmission corridors and seismic lines. In the southern boreal forests of Ontario, for example, there are now approximately 62,000 kilometres of logging roads. In Alberta, logging roads are often paralleled by oil and gas access roads and seismic lines – corridors cut through the forest as part of oil and gas exploration, dividing much of the province's forest into a patchwork.

What happens when forests are divided up by roads and other corridors?

“Even when only a small percentage of the land’s surface is directly occupied by roads, few corners of the landscape remain untouched by their off-site ecological effects”

Trombulak, S. C., and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14: 18-30.



Tim Gray

Roads have both direct and indirect impacts and change the character of wild areas.

Many wild species tend to fare better in large

intact, healthy areas of habitat. Barriers such as roads, trails or other human-made corridors divide large areas of habitat into smaller fragments. Scientists call this effect fragmentation and today a common measure of forest health is the degree of fragmentation of the forest. A Global Forest Watch Canada survey of Canada’s boreal region found that only 62% of this region could still be called “intact” – that is, having few enough roads or other human disturbances to be considered still fully ecologically functional.

Roads are often built on valley floors, floodplains, eskers and south-facing slopes. In fact, many roads are placed in areas with high habitat value for wildlife because conditions in these places often make it easier and cheaper to build here. Roads can alter animal behaviour by causing them to shift their home range, avoid roads or begin using roads for travel.

Why are roads a problem?

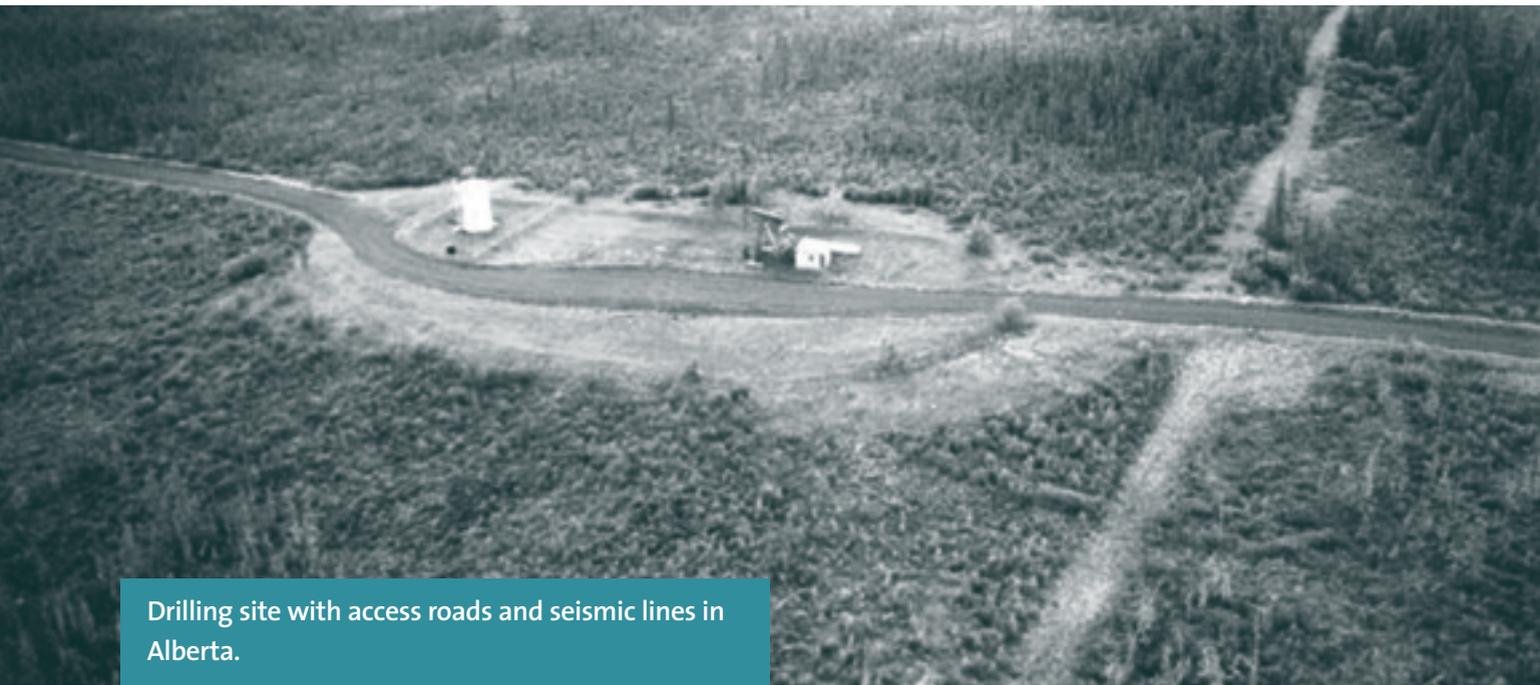


John Mitchell, Earth Images

Some species of animals simply refuse to cross barriers as wide as a road. When this happens, individuals or groups may become cut off from the main population or the population as a whole may be divided into smaller groups that are less likely to survive. These sub-populations are at higher risk of problems such as reduced genetic diversity (due to factors like inbreeding), which makes them less likely to survive sudden environmental catastrophes

(such as a windstorm or major fire) or unexpected changes in habitat conditions (such as those caused by climate change).

Species known to change their movements due to roads include mountain lion, black bear, wolf, elk, caribou, wolverine and some small mammals. Roads have been shown to cause shifts in natural home ranges of species, including both black bears and grizzlies.



Drilling site with access roads and seismic lines in Alberta.

Species such as wolves may be less abundant in areas with many roads, while other species, such as woodland caribou, will actively avoid habitat close to roads (staying out of suitable habitat areas as much as one kilometre from a road in some cases). Barren ground caribou may avoid roads because they are more vulnerable to hunting during their migration. If they cannot avoid roads, they may face a sudden surge in hunting pressure.

Fragmented habitat is also degraded habitat. The presence of a road instantly reduces the amount of available undisturbed habitat

known as “interior habitat,” which is required by many species, such as forest songbirds. Areas of habitat alongside roads will have greater proportions of “edge” habitat, which is often sunnier, hotter, dustier and drier. Some forest areas may become so fragmented that they contain virtually no interior habitat. This is bad news for species such as marten that are known to avoid edge habitat – ecologists find it difficult to detect martens in places where cleared areas are less than 100 m apart.

See the illustrations on pages 11-14 for an example of what happens when roads are built in previously intact forest areas.

Woodland Caribou – On the road to extinction?

David Dodge



The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated the woodland caribou as a *threatened* species, which means that it is “likely to become an *endangered species* if nothing is done to reverse the factors leading to its

extinction.” It is an animal known to be particularly sensitive to human disturbance. These forest caribou are almost completely gone from the large areas of their boreal forest home that now have extensive logging road networks or other human developments.

There are thought to be a number of reasons for the ongoing decline in woodland caribou populations, but most come back to one main issue – roads and access. Woodland caribou rely on their highly dispersed populations and dense forest cover to avoid predators like wolves. Logging road networks dramatically change this balance by providing wolves and other predators (including humans) with easier access to caribou habitat.

As well, the logging that roads are often built to accommodate changes the forest, making it younger with less suitable habitat and fewer food sources for caribou. Meanwhile, this younger forest attracts deer and moose, which can lead to further increases in wolf populations and caribou exposure to deer-borne disease.

In most parts of Canada, woodland caribou have already disappeared from close to half of their historical range. Recent research in Alberta shows that caribou actively avoid roads – a practice that is becoming increasingly difficult in the industrially managed forest.

Roads increase pressure on wildlife

It's a simple fact that the harder a place is to get to, the fewer people you are likely to find there. That's why the construction of a road into a previously inaccessible area can have such a big impact. When roads and trails are punched into previously intact areas, there is often a surge in activities like hunting, fishing, camping or even poaching. Hunters are attracted by rich game populations that are suddenly easy to reach while fishers head for lakes that, unlike many "drive-in" lakes, are unlikely to have been heavily fished. Poachers may use roads to go after species that are protected, such as caribou, or to take more than the legal limit of non-protected species.

Snowmobile and ATV use of roads and trails may also increase the pressure on wild species. For example, compacting of snow

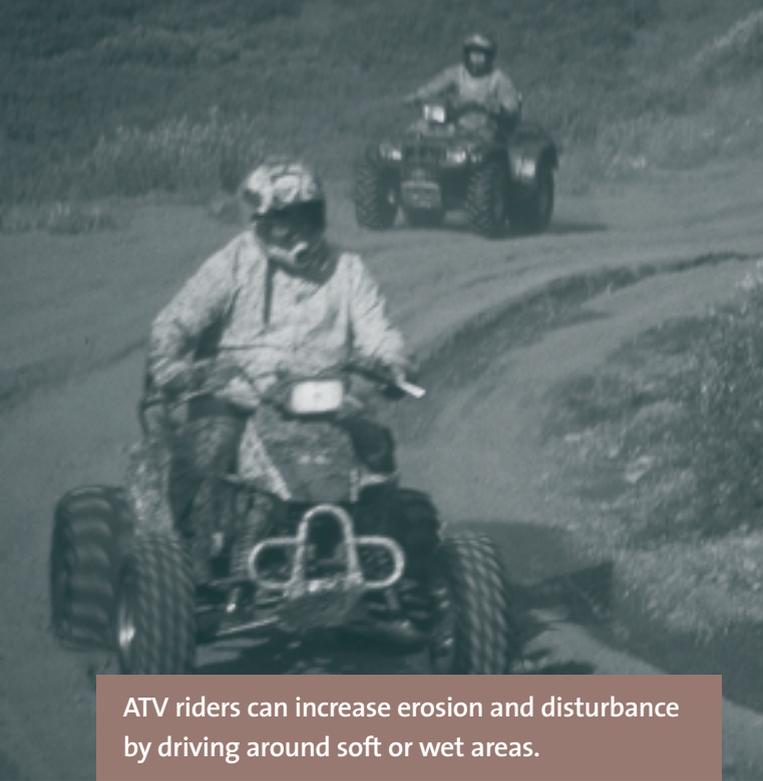
by snowmobiles lowers the temperature beneath the snow and reduces the over-winter survival of plants, soil microbes and even small mammals. ATV drivers may increase the impact of existing trails by trying to bypass

wet spots or other obstacles and thereby "braiding" one trail into many different paths.

Disturbance by motorized vehicles and other human intrusions causes stress for animals, leading them to use up critical energy reserves by running away or moving around more than usual. Stress and exertion

can threaten an animal's survival and mean the difference between the birth of healthy or unhealthy young in the spring. Species that are repeatedly disturbed, particularly at sensitive times of year such as during calving or just after emerging from hibernation, may abandon their best habitat areas to avoid

Compacting of snow by snowmobiles lowers the temperature beneath the snow and reduces the over-winter survival of plants, soil microbes and even small mammals.



ATV riders can increase erosion and disturbance by driving around soft or wet areas.

Sam Gunch

further disturbance.

Populations of small creatures, particularly amphibians and reptiles, can be severely impacted when their members are killed by motor vehicles. But even for larger species, such as moose, vehicle collisions can be a significant cause of death. A study of roads in southwestern Quebec found more than 380 mammals killed over 116 days, along with 150 amphibians, 228 reptiles and 217 birds. Similarly, during a two-year study, more than 32,000 vertebrates (mostly amphibians) were killed along a 3.6-km stretch of road near a nature reserve at Long Point, Ontario.

A study done in British Columbia's Rocky Mountains found that between 1971 and 1998, all the grizzly bears killed by humans (96 bears) were killed within 500 metres of a road or trail.

In Ontario's boreal region, a population of lake trout in Michaud Lake showed "rapid and severe" decline due to intense fishing pressure following the construction of a 12-km forest access road. Once anglers were able to access the lake in both summer and winter (by snowmobile and all-terrain vehicle), average catch rates of lake trout declined by 72% within five months.

Roads open forests to increasing industrial use



Garth Lenz

Roads built for one purpose, whether it is to create access to a remote community or for logging, may later be used for other industrial purposes. New roads may make it more cost effective, for example, to prospect for minerals in an area or explore for oil and gas in a once-inaccessible area. As a result, roads may trigger cascading developments and expanding road networks in a region and result in significant combined impacts.

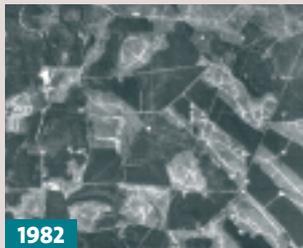
Time-lapse sequence of four aerial photographs (1949, 1964, 1982, 1991) documenting the transformation of an area in the Swan Hills, Alberta by the cumulative effects of the petroleum and forest industries.

Energy industry leaves its mark

Seismic lines are the source of a significant amount of disturbance across boreal regions, and yet are not as well-understood as logging roads. The term refers to wide (generally 6-8m) corridors created to identify areas containing valuable oil and gas deposits. The energy industry uses reflections of soundwaves to create a cross-sectional diagram of subsurface geological structures, which, in turn, is used to identify areas likely to have oil or gas. Until recently, conducting a complete seismic survey typically involved bulldozing vegetation to form a number of parallel linear corridors some 400m apart, followed by drilling and dynamite explosions (to create sound waves) at regular intervals along the lines.

In 1999, about 100,000 seismic lines crisscrossed northern Alberta, with a total length of over 1.5 million km. Low rates of regeneration have been reported in studies of vegetation in 20-year-old seismic lines. As well, seismic corridors provide further access into forested areas for all-terrain vehicles, snowmobiles and other vehicles, which may increase levels of illegal hunting and logging.

The good news is that in some regions, new seismic lines are becoming much narrower and large regular grid patterns are becoming less common thanks to new exploration technologies such as GPS locators and helicopter surveying.



Roads change the place

There are at least eight essential environmental characteristics that may be significantly altered by roads in their immediate environment: soil density, temperature, soil moisture content, light, dust levels, surface-water flow, runoff patterns, and sedimentation.

Environmental changes caused by roads include soil compaction long after construction is completed, increased temperature in adjacent soils and the functioning of roads as night-time “heat islands” that attract reptiles and some birds, increasing their risk of road collisions or predation. Soils alongside roads also suffer from depleted moisture levels. Increased light levels at forest edges allow light-adapted weedy species to invade. Elevated dust levels can settle on plants and block photosynthesis and respiration, while dust levels can also affect the clarity of streams.

Roads can act as pathways for the movement of exotic species into forests, waterways and wetlands – these non-native species often thrive in areas where there has been soil disturbance. Their introduction can have a significant impact on native species by altering habitats, increasing competition for nutrients and changing soil conditions. Public access is also known to play a large role in the introduction of nonnative fishes and other aquatic organisms into waterways (for example, as lost bait or through fish stocking). Similarly, people and vehicles can carry seeds or plant material into previously remote and undisturbed areas.

What happens when we don't plan carefully?

The following series of hypothetical images illustrates the common reality of road building in Canada's forests. **Resource roads are planned with little regard for their impact on other values, like wildlife habitat or remote tourism businesses, and there is often little coordination between different resource industries or operations. The result is the fragmentation of previously intact forests and, all too often, a legacy of environmental and economic harm.**

Remote forest with fly-in or winter road access only.

Woodland caribou calving area
(peninsula and island)

Large areas of intact, old forest



Trapper's cabin and trapline

Remote fly-in tourism lodge

First Nation community

Old burn

Tim Yearrington

Primary resource roads constructed.

Large areas of mature forest still intact

Primary road construction begins



Gravel pits for road material

Remote lake now accessible by road

Construction of water crossings like culverts and bridges can lead to erosion into waterways and can interrupt water flows

Roads – and impacts – spread.

Network of secondary and tertiary roads further fragments habitat

Caribou retreat from disturbance into remaining intact forest areas

More than 90% of logging in boreal forests is clearcutting



Mine staking and exploration is made easier by expanding road network

Drive-in access to lakes increases fishing pressure

Heavy haul roads create dust, noise and increase chances of collisions for wildlife

Tim Yea rington

Roads fundamentally change the forest.

Hunters and anglers use expanding road network to establish camps

Huge areas of old diverse forests are clearcut

Off-road vehicle use is increased by road access and logging trails



Tim Yearington

Waste increases with development

Utility lines follow roads and/or further fragment forest

Remote tourism business dwindles

Trapline impacted as wildlife populations decline or wildlife avoid roaded areas.

Mine drilling and exploration increases disturbance for wildlife

Logging operations prepare to spread into further uncut areas

Roads can be toxic



Volunteers clean up garbage along a northern Ontario logging road.

Roads are often sources of environmental pollutants that originate with vehicle emissions and/or leakage as well as from road salt. For example, heavy metal contamination may include lead, aluminum, iron, cadmium and copper. Depending on local wind patterns, heavy metal contamination can reach areas up to 200m from the road, although levels decrease substantially after 20m. Increased erosion near roadsides can also wash heavy metals lodged

in soils into the surrounding environment.

De-icing salts alter the acidity and chemical composition of soils, which changes plant communities by favouring species with a higher tolerance for these conditions. Salt along road edges or salty meltwater attracts certain animals, such as deer and moose, to roadsides putting them at risk of being hit by oncoming vehicles.

Water and roads: A bad mix

Waterways can be heavily impacted by roads and road construction. The removal of vegetation near streams during construction can cause an increase in stream sediment and temperature. An improperly installed culvert will stop fish from migrating upstream and may force them to spawn in unsuitable sites or not at all. Erosion from roads can affect water quality (clarity and oxygen levels, for example) in nearby streams or rivers. Badly constructed roads or poorly planned resource operations near roads can lead to mudslides or stream bank collapses that affect water quality and habitat for long distances downstream.



The 1 million hectare Whiskey Jack Forest Management Unit in northwestern Ontario is crisscrossed by 807 km of logging roads. A CPAWS Wildlands League study of the unit determined that it had only five intact areas remaining, covering just 49,000 ha or 4.6% of the unit.

If culverts are too high, fish will not be able to pass through them. **If culverts are too steep**, the water inside them will move too quickly for fish to swim against it.

An independent assessment of construction work on Phase II of the Trans Labrador Highway found that more than 50% of culverts were improperly installed. Improper culvert installation has also been a consistent problem identified in forestry operation audits conducted by CPAWS Wildlands League and Sierra Legal Defence Fund in northern Ontario.

Poorly built water crossings are a major source of sediments and erosion into waterbodies.

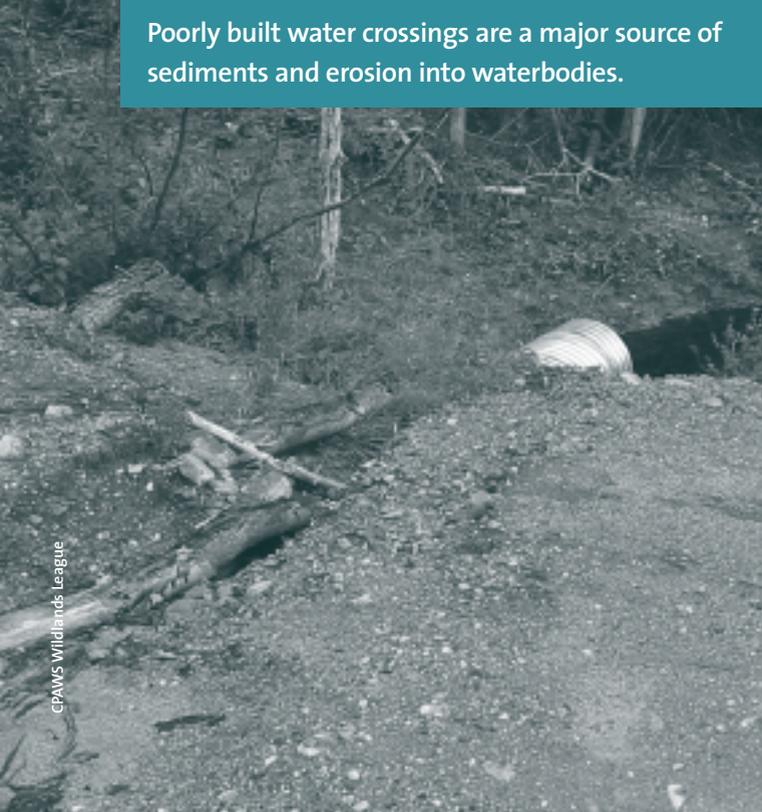


Improperly installed culverts can stop fish and other aquatic animals from moving between areas.

Increased sedimentation can affect the development of fish eggs and harm invertebrates that fish feed on.

Increased water temperature can cause migratory disruption, a decrease in reproductive success and an increased vulnerability to disease.

Riparian vegetation, the vegetation along the shores of streams, provides a food source for fish and keeps them cool. Debris from riparian vegetation provides important in-stream habitat.



It all adds up to a big impact



Garth Lenz

In the previous sections, we have outlined the many impacts that roads can have. But these individual impacts, whether it is pollution, habitat fragmentation, uncontrolled access or direct loss of habitat, are only part of a bigger story. The combined or cumulative impact of roads is what really makes it critical to consider their ecological impacts.

For example, certain roads may result in declining predator populations due to things like increased hunting pressure or roadkill. With fewer top predators, populations of smaller opportunistic species like racoons and foxes may sharply increase, leading to a decline in the songbird and small reptile and amphibian populations that are their prey. Similarly, deer populations may explode when large predators become scarce and the over-

grazing caused by these artificially large deer populations can encourage weedy exotic plants that thrive in ecosystems under stress.

Conversely, roads into previously inaccessible areas may lead to an increase in predator populations as access to new prey increases. This can put pressure on species such as woodland caribou that depend on it being difficult for predators to locate them. The result, however, is the same: The natural ecosystem balance is disturbed with impacts cascading through the entire system.

Just as importantly, forest roads are not built in isolation: they almost always serve an industrial purpose and therefore are often the trigger for a radical reshaping of the wild landscape and wildlife habitats. Where a road goes, change is sure to follow. And that change often represents bad news for wild species.

How can we reduce the impact of roads?



Bighorn sheep are sensitive to disturbance by off-road vehicles.

1. Designate areas that should remain roadless

In Ontario's southern boreal forest, there are only four roadless areas larger than 1,000 square kilometres remaining outside of parks. Like many other provinces, Ontario is rapidly running out of wild forest areas that are free from the significant impacts of roads.

Given what we are learning about the impacts of roads on sensitive wildlife like caribou and wolverine and even on more adaptable species like wolves and bears, taking steps to hold onto significant roadless

areas should be part of all land-use planning and resource management processes. These areas can be key assets for the development or expansion of remote-based tourism enterprises and are likely to attract keen interest from those interested in remote wilderness experiences. They can also supplement our often too-limited protected areas system in their role of helping to sustain ecosystems and wild species. Such areas can also be important safeguards for protecting water sources and at-risk species populations.



However, to be effective, the selection of roadless areas should be based primarily on their biological significance and not simply on the absence of economically valuable natural resources.

2. Curtail road building and motorized recreation in parks and protected areas

Too often our parks and protected areas are already islands of protection in a sea of development. Putting further pressure on parks by building resource access roads or snowmobile and ATV trails in parks and protected areas only adds to the problem and increases stress for park wildlife. Such roads can also make it difficult to ensure compliance with park rules for hunting,

fishing and general recreational access.

Road building in parks should be minimized, with only roads that are essential for park management allowed. Snowmobile and ATV recreation should be properly sited on the extensive public lands available outside of parks in areas where ecological damage and stress for wildlife can be minimized.

Planning for roads should also address the need to maintain connections between core protected areas and other large remote areas used by wildlife with large home ranges, such as woodland caribou. The ability of wide-ranging animals to use lands between protected areas can be preserved by minimizing the density of roads and other linear intrusions.

3. Make road planning an essential part of broader land-use planning

In order to avoid the many combined impacts of roads and other industrial land uses like logging and mining on wildlife, ecosystems and waterways, we have to look at all of these land uses as a package and find ways to limit the overall impacts of all of these related activities. By making road planning a part of broader conservation-first land-use planning, we can ensure that no unnecessary roads are built, that routing takes into account sensitive areas and key ecological and community values, and that problems caused by increased access are as limited as possible. Roads must be seen as much more than simply narrow corridors of disturbance – their much wider landscape effects must be fully considered in planning processes.

4. Use existing roads wherever possible

All too often, different industries or even different companies will develop parallel road networks to access resources. We need to develop policies that strongly encourage the sharing of road networks in order to minimize the duplication and expansion of existing road networks. An Alberta study, for example, found that increasing the sharing of road networks between forestry and oil and gas

companies from 10% to 50% dramatically reduced the overall fragmentation effect on the forest and markedly improved the survival chances of woodland caribou.

As part of these efforts, all resource planning should include comprehensive inventories of existing roads and set conservation-science based targets for the retention of intact forest areas within a region. The construction of roads through sensitive or important wildlife areas (such as denning or calving sites) should be avoided. New water crossings should be minimized wherever possible.

5. Plan routes to reduce impact

Efforts must be made to ensure that new roads do not cut through large intact habitat areas, isolate populations of species at risk or create long fragments of habitat with extensive edge habitat (as compared to compact areas with good core habitat). In other words, planners must consider the broad landscape impact of a road rather than just a one-dimensional road corridor.

Winter roads can be used to reduce some of the impact of roads, but these also need to be planned carefully to reduce stress on wildlife already coping with winter conditions. In particular, they should avoid steep slopes



and stream crossings as much as possible and avoid denning and calving areas.

In Labrador, the original route proposed for Phase III of the Trans Labrador Highway presented a significant threat to sensitive caribou habitat, important wetlands and a national park reserve. By shifting the route south, many of these problems were avoided or mitigated.

6. Limit access

Increased human access and disturbance of wildlife is one of the most significant impacts of new roads. Taking steps to properly control public recreational access must become a routine part of road system construction and

management. Such steps could include temporary closings during important calving, post-denning, or winter periods when wildlife may be more sensitive to disturbance, as well as bans on hunting within a certain distance of a road. Grasses that are not palatable to grazing animals can be planted along road edges to discourage species like moose and deer from coming up to the road. In other cases, it may be more appropriate to simply not allow recreational access in order to protect species, while actively planning for the removal of the road once its primary purpose is finished.

Access controls must be enforced and effective to truly offer protection to wildlife and sensitive habitats. A study in Ontario's

Temagami region found that access controls in the area (ranging from signs to gates and berms) had a violation rate of 55%. Access controls that used natural barriers, such as waterways or impassable terrain, were found to be much more effective. Another option is to plant trees densely around an access points. Staffed barriers can also be effective, especially where a road is in regular use by authorized personnel.

Companies seeking access to remote areas should be required to prove that they can effectively manage access on an ongoing basis. There should also be real deterrents (e.g., stringent fines or other penalties) for those found violating access controls.

7. Use best practices in construction

By scheduling road construction during the least disruptive periods for wildlife (e.g., avoiding work during late winter or early spring or during fish spawning periods) and by properly installing culverts and other water crossings and minimizing road or corridor width, the direct habitat impact of a road can be reduced. Even with these steps, however, it will be difficult to limit impacts on all species at all times.

For seismic lines, avoiding a rigid linear grid with wide lines is important. Lines should be

laid out in small segments with intact forest between them and/or to follow staggered routes by using GPS locators and helicopters to locate and access exploration points. Governments should also mandate the sharing of seismic information between companies to avoid redundant exploration efforts.

8. Remove roads

Few roads are truly decommissioned even after their original purpose has ended. Road removal will be most effective when it is planned for before construction of the road actually begins. Effective access controls will also prevent recreational users from becoming accustomed to using the road and, therefore, will help avoid conflict when the road is eventually decommissioned.

To be effective, road removal must involve active decommissioning and not just simply blocking and/or abandoning the road. Such decommissioning should involve removing all bridges, culverts and other water crossings, digging up or tilling roadbeds and initiating forest re-growth using seedlings. If roads are not properly decommissioned, more problems for both public safety and the environment will develop as water crossings and road beds deteriorate.

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Appendix A

The roads you know and the roads you don't know



Roads in Ontario's industrially allocated forest (as of 2003)

The top map shows the roads that most Ontarians are aware of, such as major highways and secondary routes. The bottom map shows the actual road network in the managed forest — a web of logging and resource roads that has left only a tiny handful of areas free of the impacts of roads.



Map key

- Roads
- Protected areas



The map illustrates the growing push by government and industry to open areas of one of the world's last large intact forests to further development through the construction of new road networks. However, the roads and potential new road corridors shown on this map are only the primary access routes: Each of these primary roads brings with it an extensive and often expanding network of secondary roads and trails that further fragment and degrade forest habitat. In some areas, the impact of these roads is compounded by the clearing of thousands of kilometres of seismic lines, pipeline and utility corridors.

Canada's boreal forest is one of the three largest remaining areas of intact wild forest remaining on the planet. If we want to protect the species, waters and ecosystems of this magnificent forest, we must quickly rethink the direction we are headed.

Data Source: forestry tenure, intact forests, Global Forest Watch (2004); Boreal forest ecozone, Stan Rowe (1972); Road proposals are for illustrative purposes only. Special thanks to CPAWS chapters who provided regional information and Manitoba Wildlands and Protected Areas Association. Map produced by CPAWS Wildlands League, 2005.

