Bow Corridor
Regional Transportation Strategy

Best Practices for
Moving People and Animals with ease…

1 INTRODUCTION

Best Practices and Alternatives is the 3rd step in a four step study.

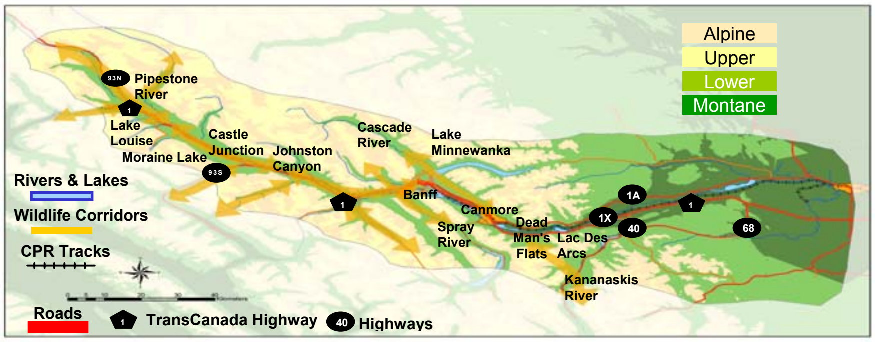
The Bow Corridor Regional Transportation Strategy is being developed in four steps – Issues Scan, Situation Analysis, Best Practices and Alternatives, and the Strategy itself. This technical memo summarizes results from the third step, Best Practices and Alternatives. The purpose of this step of the Study is to identify current 'best practices' and creative solutions being deployed when managing transportation issues in the US, Europe, Canada and elsewhere. It also presents a preliminary assessment of alternatives as they might be applied in the Bow Corridor, as the basis for discussion with stakeholders.

The objective of the Study is to create an overall framework to manage traffic in the Bow Corridor without negatively affecting ecological integrity.

The objective of the Strategy is to create an overall framework to absorb or manage the major types and modes of transportation traffic in the Bow Corridor without negatively affecting ecological integrity. The Strategy will develop a justified and reasoned list of transportation solutions for the region that can be practically implemented.

The Study Area extends 145 km westward along the TransCanada Highway from Highway 68 to the Alberta / BC border.

The Study Area extends 145 km westward from the TransCanada Highway / Highway 68 junction to the Alberta / BC border west of Lake Louise. It takes in the communities of Lake Louise, Banff and Canmore and includes lands up to the trailheads on either side of the TransCanada Highway (TCH). From Highway 68 to the Banff Park East Gate the TCH lies within Alberta Transportation (AT) jurisdiction, while it is within Federal Government jurisdiction from the East Gate to the west end of the Corridor.



The Bow Corridor is unique — no exact parallels exist in Canada, the US or elsewhere in the world.

No locations elsewhere offer exactly the same circumstances as the Bow Corridor. A transcontinental highway and railway are present throughout its entire length of 145 km. The highway and railway constitute Canada's principal east-west trade route as well as a primary east-west pathway for non-commercial travellers. Wildlife movement corridors are equally important pathways providing essential east-west and north-south connectivity for animals, including vital linkages between the Yellowstone and Yukon Territories.

The Bow Corridor also includes a national park. Unlike most US parks where developed communities are generally not permitted inside national parks, a sizable town (Banff) and a developed hamlet (Lake Louise) are both situated in the Banff National Park. Just outside the park boundary, however, is the town of Canmore, which is more typical of US parks where it would be referred to as a ‘gateway community'.

Despite the dissimilarities, several other locations around the world share similarities with the Bow Corridor situation. Passenger vehicles typically represent 80% or more of the traffic, for example.

Highways are the scene of much wildlife mortality. Within destination locations, peak traffic conditions cause congestion, and the major causes of vehicle congestion are inadequate roads, stop-and-go traffic and a shortage of parking capacity. Consequently, most strategies involve measures to reduce, eliminate or better manage the flow of vehicles and to minimize human / wildlife encounters. Therefore, it is instructive to review the experience at these other locations since practices that have been tried successfully elsewhere may have application to specific situations in the Bow Corridor.

An extensive review of experience around the world was undertaken, primarily focusing on the US and Europe.

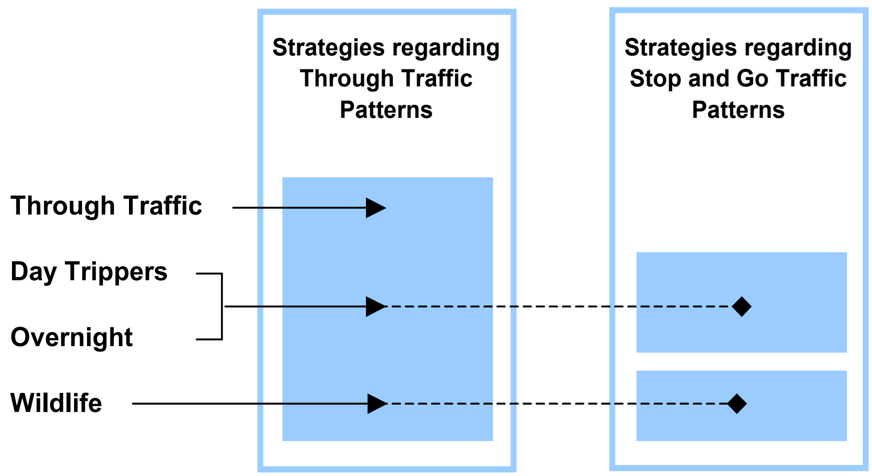
In conducting our review of best practices, we investigated experience in managing traffic in national parks and tourist destinations elsewhere. Our inquiries involved an extensive search on the Internet as well as a series of telephone interviews, which mainly focused on a number of national parks in the US. We also examined corridor design factors, systems that have supplanted private vehicle use in locations such as Zermatt, Switzerland, and a selection of 'intelligent transportation systems' technologies. Finally, we examined best practices that have been identified under the Alternative Transportation Program of the US National Park Service.

Our reasons for focusing so much on the US experience are threefold. First, best practices are well coordinated at the national level through the National Park Service which has had extensive experience implementing alternative transportation systems at more than 90 of the 400 parks throughout the nation. Second, most of the US experience is well documented and is readily accessible on the Internet or through direct contact with park officials. Finally, we assumed that human behaviours and public attitudes toward traffic mitigation measures are generally similar between Canada and the US, thus providing an indication of the expected level of acceptance of similar measures that might be applied in the Bow Corridor.

Various traffic management options are mixed and matched to suit the particular circumstances being addressed. A series of vignettes have been gathered to illustrate how the best practices work together.

It is clear from recorded experiences with traffic management in the US and elsewhere that no single response resolves all traffic challenges. A bundle of traffic management elements is usually deployed, applying a mix of options best suited for each particular location. For this reason, best practices have been presented as a series of vignettes which briefly illustrate how the situation is addressed in each case.

Because the Bow Corridor serves people and animals as both a major throughway and a series of destination points, best practices have been gathered to address two broad categories of traffic patterns as shown in the following diagram:



Best Practices and Alternatives have been organized in three sections, beginning with the Introduction. The next two sections address the following topics:

Section 2 Moving People and Animals Through the Corridor

Section 3 Managing Congestion Within the Corridor

The ideas in sections 2 and 3 provide the basis for consultation with stakeholders as to the feasibility and practicality of adopting selected best practices in the Bow Corridor Regional Transportation Strategy.

Overall, whatever mix of strategies is adopted must suit the needs and fit the circumstances of those who live and work in the Corridor. A series of open houses, focus groups and discussions will be held in the coming weeks to gather input and feedback from stakeholders before a Strategy is recommended. Thereafter, of course, the recommendations will be subject to further public debate and consideration by officials representing the MD of Bighorn, the Towns of Canmore and Banff, the community of Lake Louise, Alberta Transportation and Parks Canada.

It should be noted that expanding the TransCanada Highway (other than twinning the section between Castle Junction and the Alberta / BC border) has not been included as an option.

2 MOVING PEOPLE THROUGH THE CORRIDOR

One third of westbound traffic at Banff National Park East Gate is "through traffic".

Roughly one third of the vehicles driving along the Bow Corridor use it as a connector route. Their primary objective is to arrive at destinations either east or west of the Corridor, and their main criteria are safety and uninterrupted traffic flow. Similarly, wildlife use the Bow Valley as a conduit between habitat ranges and require safe, barrier-free routes across the TransCanada Highway and CPR rail tracks. The principal aim of most transportation strategies regarding through traffic is therefore to ensure efficient movement patterns with a minimum of delay and traffic accidents.

Examples of best practices have been gathered under four headings:

2.1 Highway Design
2.2 Wildlife Corridors Design
2.3 Managing Safety
2.4 Minimising Delay

In addressing Highway Design, we have focused on wildlife crossing structures rather than on engineering practices since considerations related to 'road permeability' from an ecological perspective are generally less well known to transportation planners. Six options are described, including under- and over-passes. Road configurations such as elevated highways and tunnels are also addressed under this topic.

With the exception of the Castle Junction-Lake Louise stretch of the TransCanada Highway, which is assumed to occur over the short and medium term, adding lanes to the main highway has not been included as an option.

Wildlife Corridors Design is treated as a separate topic — guidelines prepared by the Bow Corridor Ecosystem Advisory Group (BCEAG) are presented as best practice in this field. Managing Safety highlights both technological and operational best practices, while Minimising Delay describes applications of intelligent transportation systems that enable motorists to choose travel on tolled express lanes.

2.1 Highway Design

A growing body of literature exists with respect to wildlife crossing structure design, location and function. From elevated highways to the smallest culverts, crossing structures incorporated into transportation infrastructure play into wildlife ecology. In the Bow Corridor, crossing structures were incorporated into the TransCanada Highway beginning with twinning efforts within Banff National Park reaching from the East Gate to Castle Junction.

Wildlife crossing structures are now considered standard fare in mountain ecosystem highway design.

Several studies have tracked the movement of wildlife across these structures as well as some newer ones outside of the Park, notably near the Three Sisters Interchange. Researchers now know that it takes several years for some species to become familiar with crossing structures, while others can incorporate crossing structures into their normal patterns of use in relatively short order. Ecologists have also discovered that some animals prefer to use culverts or underpasses, (i.e., cougars, wolverine, wolves and others), while some use only above-ground crossings (especially moose). Some animals are more adaptable, and use both (especially black bears). Thus, in the absence of a natural landscape for unencumbered crossings, a combination of overpasses and underpasses placed strategically and in close proximity to each other, seems to represent the most effective landscape design for wildlife crossing. The remaining unanswered question, however, is whether all of the successful crossings yield a functioning and sustainable ecosystem overall.

In Europe, extensive study into the effects of transportation systems on wildlife were conducted through the COST funding framework (*Cooperation in the Field of Scientific and Technical Research*, under Action 341 (COST 341)), as undertaken via the Infra-Eco Network Europe (IENE). This Action was completed in November of 2003 and included state of the art reports from the Czech Republic, Denmark, Hungary, Ireland, the Netherlands, Norway, Russia, Spain, Sweden, Switzerland and the UK.

Wildlife Habitat Connectivity Across European Highways (US Department of Transportation, 2002), a major review of European practice, concluded that a standard 50 metre wide green bridge, or wildlife overpass, is most frequently installed for large animals, together with fencing designed to exclude wildlife from the transportation right of way and guide them to the overpass. These structures are often found on national highway systems across the European continent, including toll roads.

Small culverts:

Culverts have long been part of highway design to allow passage for water — they also function as crossing structures for wildlife.

Corrugated aluminium culverts in a range of sizes allow water to pass across linear features such as roadbeds and railways. Despite having diameters as small as 30 centimetres, these culverts are used as crossing structures by a variety of terrestrial and aquatic animals especially rodents, amphibians and even small carnivores such as coyotes.

All controlled water crossings create the possibilities for aquatic system improvements or aquatic impacts. Where culverts link water bodies or watercourses, aquatic habitat connectivity can be maintained simply by ensuring that water does not cascade. Even without cascading water, culverts can cause watercourses to gain velocity, causing channelization and increased sediment loading, potentially causing water to warm, leading to algal bloom and/or eutrophication (lack of dissolved oxygen). However, properly constructed culverts provide valuable habitat linkage for a variety of small animals and represent critical linkages across linear disturbances such as transportation infrastructure. The cost of installing a small metal culvert is $8,000 to $10,000 per two-lane crossing in 2002 dollars (McGuire, 2002).

Planners can emulate natural patterns in culvert design.

Large-diameter metal culverts:

Where spring runoff is high, large-diameter metal culverts ranging in size up to about 3 metres in diameter serve as crossing structures for a wide variety of creatures, including ungulates, large and small carnivores, fish and reptiles. As with smaller culverts, large-diameter culverts have the potential to increase water velocity, thereby causing channelization and other aquatic changes downstream. Planners can mitigate aquatic impacts by maintaining natural flow patterns including velocity, sinuosity (degree of 'bendiness') and natural riverbed/shoreline materials and conditions. Similarly, fish habitat can be maintained by eliminating cascades from culvert ends and by simulating normal shoreline conditions along waterways with materials and design features that serve human needs (e.g., erosion control) while maintaining irregularity. Large-diameter steel culverts typically cost $250,000 to $290,000 per two-lane crossing (McGuire, 2002).

Box culverts allow safe crossing for a wide variety of large animals.

Cement box culverts:

Box culverts are underpasses for wildlife to cross beneath roads. They are pre-cast rectangular cement passages 2.4 m by 3.0 m that span the width of the road being crossed. Because of their structural integrity and ease of installation, box culverts are often used where grade is a concern. Cement box culverts can provide crossing opportunities for large and small animals, and have been important in maintaining habitat connectivity in a variety of places including Banff National Park. These structures have been used extensively in Phases 1, 2 and 3A of Trans-Canada Highway twinning efforts within the park, for example. Typical two-lane crossing structures cost between $190,000 and $250,000 (McGuire, 2002).

Wide-span underpasses (open-span bridges):

Where linear developments pass perpendicularly over small valleys, wide-span underpasses, or open-span bridges, allow small sections of road or rail to be raised above the valley floor to create gentle grades for transportation infrastructure and minimize the ground-level footprint of the infrastructure.

Open-span structures are generally considered the most favourable type of crossing for wildlife, as natural vegetation can be maintained underneath, thereby retaining some of the area's hydrological processes (runoff control) and habitat quality. Anthony Clevenger's studies from within Banff National Park show that the open-span crossings are among the most attractive and most successfully crossed structures in the Park (e.g., Healy Underpass and Five Mile Bridge). These structures cost in the neighbourhood of $2.5 million for a typical two-lane, 50 m long structure (McGuire, 2002).

Open-span structures are most favourable for wildlife, but are more expensive to build.

Many notable examples of wide-span structures exist in North America, including the I-10 highway crossing the Atchafalaya Swamp in Louisiana. This roadway is an extreme example of an elevated roadway. In Louisiana, the award-winning Interstate-10 incorporates at 60-km stretch of viaduct passing above the Atchafalaya Swamp, and represents an important link in the pan-US Dwight D. Eisenhower System of Interstate and Defence Highways. According to the US Federal Highway Administration, "the elevated roadway was constructed from precast segments, which were cast at a plant on Lake Pontchartrain and then floated by barge through a network of streams and canals to the Atchafalaya River Basin. There, large cranes placed the roadway portions on top of the supporting columns." The Interstate-10 stretches from California to Florida, passing through Louisiana.

Overpasses (green bridges):

The standard type of wildlife overpass is a raised structure, generally about 50 metres in width that passes above the highway or railway, incorporating vegetation along its surface to maintain attractiveness to animals wishing to cross. Throughout Europe, where the target species consist of deer and other ungulates and bears, this type of crossing structure is the preferred option. Elevated crossings are particularly important in areas where the landscape is flat and uniform, providing few natural valleys to be crossed with elevated roadways (open-span bridges). A two-lane, 16 m wide green overpass comes at a cost of about $1.6 million based on 1991 numbers (McGuire, 2002).

Green bridges are standard fare in Europe as well as North American national parks.

Fencing is the easiest and cheapest form of mitigation, but it creates a permanent barrier for wildlife.

Wildlife Exclusion Fencing:

Across the world, the simplest, cheapest and most immediate method of reducing wildlife mortality along transportation infrastructure is fencing. A variety of fencing options are available, including barbed wire, high-tensile (smooth wire), electrified wire, and a range of wooden, cement or stone structures.

Across Europe and North America, the standard fence for wildlife exclusion along highways is a tall high-tensile page wire fence (usually between 2 and 2.5 metres), using pressure-treated wooden posts. Wildlife exclusion fencing is used wherever a barrier is needed to exclude large mammals (especially ungulates, wolves, bears or large cats) from or guide them toward crossing structures, and to keep them out of the rights of way of transportation infrastructure. Standard 15 cm by 15 cm page wire (mesh) fencing with treated wooden posts comes at a cost of about $77,000 per km (each side) based on 1997 costs, and rises substantially if built with steel posts or ground apron (McGuire, 2002).

Salamanders have seasonal movement patterns. They too need to cross the highway.

Amphibian crossings:

In addition to fish and mammals, amphibians have seasonal movement patterns that can take them across transportation infrastructure such as highways. Between adjacent wetland areas in the Bow Valley, for example, researchers have tracked seasonal movements of hundreds of salamanders across the Trans-Canada Highway. While only a few days in duration, this natural movement pattern previously led to significant mortality of the relatively rare salamanders. To facilitate amphibian crossing of roadways, a number of crossing structures have been developed in Europe and North America.

Amphibian crossings consist of a trough that runs parallel to the roadway, into which the herptiles fall. The trough then guides them to a culvert or similar crossing structure. These structures require some maintenance to make sure the trough does not become obstructed with debris. Preliminary research has been conducted on these crossing structures in Europe via the Infra-Ecological Network Europe (IENE) funding framework and also by Parks Canada.

Elevated Roads:

Elevated roads, or viaducts, provide gentler grades and wildlife crossings — but they come at a price.

Sections of elevated roads, or long viaducts, have been used extensively throughout the world, to minimize impacts on sensitive areas. Notable US examples are the 60 km section of I-10 across the Atchafalaya Swamp in Louisiana, the Glenwood Canyon section of I-70, and I-90 in the Seattle area.

The Glenwood Canyon section of I-70 in Colorado is particularly comparable to the Bow Corridor, as it passes through similar terrain of mountains and steep canyon valleys and has similar needs in terms of moving traffic through ecologically sensitive areas. In order to maintain gentle grades on the road, retain wildlife movement in the region and blend the Interstate into the surrounding landscape, sections of the I-70 have been elevated above ground level on viaducts. The speed limit was lowered to 50 mph to allow the road to bend more sharply to match the contours of the surrounding landscape. The I-70 incorporates several sections of twin viaduct (raised highway), passing above the Shoshone Power Plant on the Colorado River, and creating smooth transitions to the No Name and Hanging Lake Tunnels, through which the freeway also passes.

Elevated roadways in sensitive park environments are typically expensive – the 1999 review for Parks Canada provided a $12.5 million estimate for a 200 metre twinned elevated structure with the necessary approach embankments, or about $62,500 per metre of elevated structure (Reid Crowther & Partners, 1999).

Tunnels:

Tunnels may be constructed either by boring into the ground (or hill/mountain) or by digging a ‘cut’ and then covering the cut area to form a tunnel ('cut and cover' construction). Tunnels in mountain parks have typically been used to create a shorter route or to get through a physical obstacle that could not be circumvented. Tunnels have also been constructed to minimize impacts on human housing areas (e.g., McGill Tunnel on Highway 1 in Vancouver), and this type of application could be extended to avoid wildlife corridors or sensitive wild areas.

To overcome physical obstacles, tunnels may provide the best alignment for highways.

Tunnels have been used for major rural highways in sensitive areas of the US. A notable example is I-70 through the Glenwood Canyon, where a tunnel (and numerous elevated sections) was used to minimize damage to the sensitive setting and achieve suitable grades for the Interstate. The H-3 Interstate tunnel on the Oahu Island in Hawaii is another example. In this case, an extended double freestanding viaduct over 2 km long was constructed to carry traffic around a small mountain, leading up to the Haiku Portal of the 1.5 km Trans-Koolau tunnel bored through an adjacent mountain with a minimum of terrestrial disturbance. The viaduct cost $140 million USD and took three years to build, as it incorporated an unprecedented foundation supported by five foot-wide (1.6 m) shafts drilled (not pile-driven) over 100 feet (30 m) into the bedrock.

The Trans-Koolau tunnel incorporates a state-of-the-art Traffic Operations Centre, which monitors the size and speed of each vehicle entering the tunnel. If a vehicle changes speed, stops or changes lanes, an alarm is sent to the Traffic Operator to be monitored over closed-circuit television, and responded to accordingly. It also includes variable illuminated signage to direct and inform traffic within the tunnel. The whole H-3 Interstate project, including the extensive Trans-Koolau tunnel, was the largest public works project in the history of Hawaii and cost $1.3 billion USD to complete.

In June 1999, Parks Canada commissioned a review of the financial impact of alternative wildlife crossings (tunnel or elevated structure) in Banff National Park. A number of assumptions were made including the requirement for extensive blasting and related earthworks, and extensive utilities work. The resulting cost estimate for a 200-metre tunnel, with extensive approach cutting at both ends, was $23.9M (Reid Crowther & Partners, 1999).

Note on cost estimates:

Various cost estimates for construction have been cited for crossing structures and other highway design elements as described above. To put these estimates into perspective, they can be compared with standard infrastructure designed for motor vehicles. Interchanges cost in the range of $15 million each, and bridges tend to vary between $2 million and $20 million depending on variables such as length, width, engineering and construction issues.

2.2 Wildlife Corridors Design

The Bow Corridor has generated world-class guidelines for wildlife corridors.

The Bow Corridor Ecosystem Advisory Group, or BCEAG, was a working group made up of scientists and representatives from federal, provincial and municipal governments in the Bow Corridor. BCEAG released a groundbreaking set of guidelines for recognizing and delineating wildlife movement corridors in mountainous areas in 1999 (*Wildlife Corridors and Habitat Patch Guidelines*). The guidelines were groundbreaking in that no one had ever defined wildlife movement corridors in such a comprehensive way. The BCEAG guidelines were created for vegetation and wildlife types found in the Canadian Rocky Mountains and are applicable throughout the Bow Corridor.

Since 1999, the BCEAG guidelines have been incorporated into the MD of Bighorn's Municipal Development Plan and were used as reference in the BMG development proposal in Dead Man's Flats. They are included here as a best practice for two reasons: First, wildlife corridors are as critical to the safe and uninterrupted movement of animals as the TransCanada Highway and CPR mainline are to the safe movement of goods and people.

Second, to be effective, wildlife corridors must form a network of linkages that enable animals to traverse their natural ranges. In the case of some animals, this can be extensive (male bears typically range an area as large as 1,200 square kilometres). Transportation planners must therefore take the pattern of wildlife corridors into account when placing built infrastructure such as highways, interchanges and intercept parking lots along the Corridor.

The BCEAG guidelines provide an extensive set of parameters for wildlife movement corridors relating to width, length, slope, hiding cover and proximity to built-up areas and human influence. According to *Wildlife Corridors and Habitat Patch Guidelines*, the stipulated variables "interact together to produce an acceptable wildlife corridor. However, an increase in corridor length will necessitate an increase in width. Similarly, less vegetative hiding cover will need to be balanced by a wider corridor or larger local habitat patch." Thus, the BCEAG guidelines consider dynamic interactions among elements to create meaningful minimum parameters rather than setting a static set of dimensions that could be applied out of context.

BCEAG parameters include hiding cover, slope, proximity to human development, length and width.

In general, the minimum dimensions of a primary corridor maintain a stretch of terrain at least 350 metres in width and 1 kilometre in length in areas of flat topography having at least 40% vegetation cover *and no human use within the area*. Where human development exists adjacent to the corridor, a minimum setback is required, preferably including a berm, bench or offset elevation to provide additional separation between conflicting land uses. The guidelines also set an 8 kilometre maximum length for a corridor, meaning that adjacent habitat patches must be within 8 kilometres of each other.

2.3 Managing Safety

Safety is a major concern on mountain highways — for both humans and wildlife.

Traffic safety can be enhanced through a variety of engineering and behavioural strategies. No one response serves to assure overall safety; as with other aspects of transportation management, a combination of factors help to address the issue. Safer vehicles and safer roads are examples of engineering factors contributing to traffic safety, while modal shifts (to mass transit, for instance), driver training and lower speeds are examples of behavioural factors that enhance overall safety. Five best practices are illustrated below, highlighting smart cars, signage, speed zones and wildlife safety practices (aversive conditioning and carcass removal).

Smart Cars: Japan

Intelligent Transportation Systems technologies can aid in navigation, safety and driver information.

Japan is championing advances in adaptive cruise control, lane keeping, intersection collision avoidance, obstacle/pedestrian detection and headway-keeping technologies, and is hoping for nationwide implementation in 2015. Some Japanese satellite-based navigation systems are capable of guiding users around even minor roads, using global positioning systems (GPS) and a network of satellites operated by the US Defence Department.

The primary thrust of Smart Car technology is improved road safety (reduction in collisions), particularly in urbanized areas, by taking over most of the functions in which the human driver is liable to make errors – steering, braking, maintaining appropriate distance from the vehicle in front, and so on.

Overall, Smart Car technology falls into three main categories: collision warning and avoidance, driver assistance and traveler information devices. The various technologies provide features such as automated low speed operation (for more efficient start / stop driving on congested roadways), lane changing collision avoidance warnings, graphical navigation assistance and onboard travel information systems.

Real-time warning signs:

A specific example of traveler information devices is real-time warning signs that alert drivers to the presence of wildlife in the area. Although still under development, real-time wildlife warning signs are being used in a variety of places around the world, most notably Switzerland. According to the USDOT Field Report of European wildlife connectivity initiatives, "the Swiss are using a series of solar-powered heat sensors to determine animal presence, which then triggers a fibre-optic wildlife warning sign to reduce speed to 40 km/h. The installation has reduced wildlife mortality on a two-lane regional road." Similar systems are under development around the world, each with varying degrees of accuracy and effectiveness.

Though hard to fine-tune, wildlife-triggered warning signs can save lives.

Lower Speed Zones:

According to the US Department of Transportation, speeding (exceeding the posted speed limit or driving too fast for conditions) was a contributing factor in 29% of all fatal crashes in 2000. Speeding reduces a driver's ability to steer safely around curves or objects in the roadway, increases the distance in which a vehicle can be stopped and increases the distance traveled while the driver reacts to a dangerous situation. Lower speeds contribute to safety by helping to prevent collisions.

Speed and volume of traffic also affect levels of wildlife mortality. The presence of seasonal speed reduction zones in wildlife areas draws attention to the fact that wildlife may be encountered on the road. According to a pan-European USDOT Field Report, "Europeans recognize a relationship among traffic volume, speed, and wildlife mortality. Results indicate that traffic volumes of 10,000 average daily traffic (ADT) represent a complete barrier to animal movement for some species, and that many species suffer 50 per cent mortality when crossing highways with volumes as low as 2,000 ADT. Therefore, measures to reduce mortality are indicated for highways with elevated traffic levels."

Lower speed in specific areas may reduce collisions, especially when wildlife abound.

Aversive Conditioning:

Aversive conditioning focuses on specific 'problem' behaviour among wildlife.

Apart from the physical barriers of fencing and traffic, wildlife can be 'conditioned' or trained to avoid certain areas by associating nuisance animal behaviour with a negative stimulus. This aversive conditioning may be done with noise, by scaring the animal away or with more physical deterrents such as rubber bullets. Such conditioning helps to reduce the prevalence of 'problem behaviour' among wildlife and causes less physical impacts to habitat connectivity. However, it is labour-intensive and requires Park Wardens or other custodians to arrive at the place and time the offending animal is present. As a result, this kind of response is suited to reducing instances of problem wildlife behaviour in relatively small areas, including communities or other concentrations of vulnerable human developments.

Carrie Hunt of the Wind River Bear Institute in Montana has taken the concept of aversive conditioning to a new level in her employment of Karelian Bear Dogs. These specially trained dogs are bred for their fearlessness in the face of bears and are used to associate a negative stimulus (harassment) with problem bear activity, thus training the curious creatures to be wary of human contact and to resume natural patterns of activity in the wild.

Similar approaches are being used in the Bow Corridor already, as Park Wardens use dogs to chase elk, bears and other problem wildlife from undesirable locations, especially the Town of Banff, the Hamlet of Lake Louise and roadsides within the park, where visitors create 'bear jams' when congregating around wild animals by the roadside. These aversive conditioning exercises work to educate both wildlife and humans in an effort to reduce conflict and, ultimately, mortality.

Elimination of attractants:

One of the most fundamental mitigation strategies to reduce the number of wildlife present along roads and railways in particular, and areas of human use within wilderness ecosystems in general, is to remove the attractants that draw animals from the surrounding areas. Depending on the context, this could involve mowing lush vegetation from roadsides; reducing plant species that attract wildlife along road and rail rights of way; vacuuming grain from rail beds and minimizing grain spillage along the rail right of way; installing bear-proof garbage containers; enforcing safe storage of campers' food in sealed, secured areas away from the actual camp site; or a variety of other means.

Removing attractants reduces conflict.

Whatever the context, elimination of attractants involves identifying the root of human-wildlife conflict and removing the human-caused draw for that encounter. Eliminating attractants represents one part of a comprehensive wildlife awareness program.

Carcass removal:

Carcasses attract scavengers, leading to conflict and increased mortality near roads and railways.

A specific application of the strategy to eliminate attractants is carcass removal. One of the worst effects of wildlife mortality is the compounding effect of scavengers or carnivores being killed on transportation rights of way while preying upon another recently killed animal. To alleviate this concern, all carcases must be removed from transportation rights of way as soon as possible, thus removing the very potent attractant. The carcasses can be disposed of in a variety of ways, including hauling them deep into the forest, where they are consumed naturally by scavengers and natural processes. Within Banff National Park, carcass removal has been an effective component of a comprehensive wildlife mortality reduction effort.

2.4 Minimising Delay

It is critical to move people and goods through transportation corridors with minimum delay.

One transportation strategy that is sometimes introduced to minimize delay is differential road pricing. This approach is designed to encourage off-peak travel or use of express lanes, although its main purpose is often to raise funds to pay for construction and maintenance of highway infrastructure. It is included here as a longer-term option for facilitating through traffic in the Bow Corridor.

Imposing tolls is one way to effect differential road pricing, but traditional toll booths interrupt traffic flows and create delays. New technologies to avoid this problem are now available. Two examples of Electronic Toll Collection Systems (ETCS) are illustrated below. ETCS technology assists in the collection of tolls, or charges for travel along a particular piece of road or road network with a limited number of entry and exit points. The roadway has toll reading points at all entrances and exits. This allows for a completely open road system with no toll plazas or lane restrictions, and with entry / exit at full highway speeds. An ETCS system requires special legislation and strong initial enforcement.

<u>Toronto, Ontario:</u>

Electronic Toll Collection Systems eliminate delays on congested public freeways, making other management strategies more effective.

Highway 407 in Ontario is a toll-operated freeway reaching from Oakville to Markham that parallels existing free public roads but offers higher speed limits and therefore faster through traffic. In order to manage traffic across periods of varying demand, the freeway incorporates a sophisticated vehicle identification and billing system incorporating options for drivers to use prepaid cards or visual recognition of license plates with automated cameras for time-sensitive billing.

On Highway 407, toll rates are highest during the morning and afternoon peak periods. They drop in the off peak periods, midday and evenings, and the lowest rate is at night. Weekends and holidays are charged a lower toll rate than weekdays. There are three toll rates depending on the class of vehicles. Passenger vehicles are charged the lowest rate. The rate doubles for single-unit trucks and triples for trucks with trailers.

Roadside data capture is accomplished through the use of two toll gantry structures. The gantries are spaced 10 metres apart, with the upstream gantry containing the video cameras, lights, light sensors and test transponders. The downstream gantry contains the reader antenna and the vehicle detection and classification system. When a vehicle enters the toll gantries they are identified by photo and/or transponder and the speed and time is recorded.

In all, peak pricing and efficient billing create a fast and hassle-free travel experience coupled with incentives linked to time of day and speed of travel.

State Route 91 Express Toll Lanes, Orange County, California:

Drivers can choose to use express lanes depending on variable pricing calculated depending on the time of day or the day of the week.

State Route 91 Express is a toll road in California that connects the residential areas of Riverside and San Bernardino with major employment centres in Orange County and southern L.A. County. State Route 91X (SR 91X) refers to several lanes that were built in the median between the existing lanes of State Route 91. The new lanes each accommodate 1,400 to 1,600 vehicles per day and operate on a toll basis, with prices varying by time and day of the week. Discounts are available for high-occupancy vehicles (at least three persons).

Travellers have the option of using the toll lanes (SR 91X) or the free lanes of State Road 91. The pricing scheme is designed to manage peak level traffic and is adjusted according to road congestion trends and policy decisions. The incentives provided in the toll structure have had success in managing congestion. However, with traffic levels increasing on all regional roads, even the toll system is straining to keep pace with local traffic growth.

3 MANAGING CONGESTION WITHIN THE CORRIDOR

Two thirds of westbound traffic at Banff National Park East Gate is either day trippers (including residents, commuters and visitors) or overnight visitor traffic.

About two thirds of the vehicles driving along the Bow Corridor do so because they intend to arrive at destinations along the Corridor. Approximately half are day trippers (including commuters, residents and visitors) while the other half are visitors who stay overnight. Accordingly they exhibit 'stop and go' traffic patterns and, at peak periods, cause traffic congestion within the Corridor.

Much of the congestion occurs in communities or at scenic points along the Corridor that are not, strictly speaking, part of the Study Area (which is defined to extend either side of the TransCanada Highway up to the trailheads). Nevertheless, congestion in areas adjacent to the Bow Corridor can cause repercussions for the main highway, and many traffic management strategies include elements that would be implemented within the Study Area itself (intercept parking lots or intelligent transportation systems, for example).

Traffic management strategies typically combine a mix of options best suited for a particular location. Best practices have therefore been presented as a series of vignettes to illustrate how the elements are bundled together. The vignettes have been grouped under seven headings to highlight various broad categories of strategies, although the examples often include additional traffic management elements that could as easily be presented under one or more of the other headings. Best practices identified by the US National Park Service (NPS) are summarized under an eighth heading. The eight headings are as follows:

3.1 Intelligent Transportation Systems
3.2 Advanced Reservation Systems
3.3 Regional / Facilities Cooperation
3.4 Restricted Access
3.5 Partial Restricted Access
3.6 Encouraging Mass Transit
3.7 Pricing Options
3.8 Overview: NPS Alternative Transportation Program

The major causes of vehicle congestion are inadequate roads, stop-and-go traffic and a shortage of parking capacity. Consequently, most

The Bow Corridor experiences a range of transportation-related pressures strategies involve measures to better manage, eliminate or reduce the flow of vehicles. The overriding aim of most transportation strategies is to ensure efficient movement patterns with a minimum of delay and, in resort and ecologically significant areas, to enhance visitor experience and protect wildlife and vegetation.

Intelligent Transportation Systems and Advanced Reservation Systems provide examples of strategies that seek to provide better management of traffic volumes and flow. Intelligent Transportation Systems and improved communications may be installed as a means of monitoring traffic and conveying information to prospective visitors. These include electronic message boards, Internet messaging and traffic detectors embedded in the roadway. A reservations system for overnight accommodation (i.e., hotels, campsites) and transit services may also be introduced.

Traffic management often requires coordination among a large number of private and public sector entities to be effective. Examples are included under the heading Regional / Facilities Cooperation.

Analogous areas have adopted alternatives to the car-centered model.

One of the more popular strategies for controlling vehicle congestion is the introduction of alternative transportation systems. This approach might involve shuttle buses, like in a number of US national parks, or trains and automated people movers, as is the case in Zermatt or is being proposed for Grand Canyon National Park. Such strategies might also involve improved facilities to encourage bicycling and pedestrian modes of transportation.

Alternative systems may incorporate different features. The service may be mandatory and exclude cars (discussed under Restricted Access and Partial Restricted Access), or it may be voluntary and operate in parallel with reduced volumes of vehicle traffic (addressed under Encouraging Mass Transit). It may be free or user-pay, and financial incentives (e.g., time of day pricing) may be offered to encourage travellers to use a particular service or facility (examples are given under Pricing Options).

All in all, the variety of options available is fairly broad. The following review of best practices around the world provides an extensive inventory of transportation strategies from which to draw when addressing traffic issues in the Bow Corridor.

3.1 Intelligent Transportation Systems

Acadia National Park:

Automated technologyies can facilitate congestion management.

Acadia National Park is located on the east coast of Maine and currently handles about 2.7 million visitors a year, 90 percent during the summer season. The park is located near four gateway communities, most notably Bar Harbour. Most of the overnight accommodation and support services for visitors to the park are located outside the park boundary and in these communities.

The large number of visitors to the park cause significant congestion in the adjacent communities in terms of sheer volumes and oversized vehicles. Parking is also a problem in both the communities and the park, where parked vehicles can spill over onto the roadway.

Acadia National Park is using parking enforcement to manage traffic inside the park. High technology solutions include traffic detectors embedded in the roadway that record the number and size of vehicles entering the park, information that can be accessed in advance by visitors over the phone. Similar technology is installed in parking lots to provide visitors with advance information on parking availability.
The parking information has impacted the decisions visitors make about travel in the park. Of visitors using the parking information, 43% changed the time they visited a destination and 38% changed

destinations based on the information. Acadia also uses real-time bus departure signs and on-board bus announcements. These technologies enhance the visitors' experience while at the same time encouraging them to use the bus service rather than their private vehicles.

Bristol, UK:

The key to alternative transportation is early interception.

Bristol is one of four European cities (the others are Barcelona, Bremen and Alkmaar) that is demonstrating the concept of intermodal door-to-door transport solutions designed to "intercept car usage as close as possible to its source". The program is being developed under INTERCEPT, an acronym for Intermodal Concepts In European Passenger Transport, and builds on previous innovations such as the introduction of a mobility centre that provides individuals with mass transit or intermodal trip planning services.

INTERCEPT combines four strategies to promote reduced car usage:

- Increasing availability of alternatives to the private car (parking management, car sharing and taxi dispatching);
- Increasing the cost of travel by car (electronic road pricing, zone access control and automated enforcement) and
- Reducing the cost of travel by public transport (electronic ticketing); and
- Providing Intelligent Transportation Systems in the form of high quality door-to-door travel information (web-based public transport and intermodal trip planners, linked to park'n'ride sites)

3.2 Advanced Reservation Systems

Denali National Park:

Denali National Park is located in Alaska, about 240 miles north of Anchorage. It is the location of Mount McKinley, North America's tallest peak. Denali covers an area of 6 million acres and experiences about 300,000 visitors a year. The 90-mile Denali Park Road has limited access and private vehicles are not allowed to go beyond the first 14 miles. To travel beyond this point, visitors must use tour buses or the park shuttle services. Bus transportation was introduced into the park in 1972 to limit wildlife impacts.

Buses and trains are the only way to travel through Denali National Park, and prior reservations are required.

Advanced reservations are required and tickets must be purchased to access the visitor transportation system, which operates from May to September and visits various destinations throughout the park and goes to the far end of Denali Park Road. Buses depart from the park entrance every half-hour and visitors can get off one bus and board another at different points of interest along the way. In addition, free area shuttle buses are available at the park entrance and operate over three different routes. Camper buses provide transportation for visitors staying overnight and there are also bus tours that provide interpretative programs.

It is noteworthy that freight trains operate through Denali National Park (not unlike the situation in the Bow Corridor). Petroleum products are moved along this route from a refinery near Fairbanks; coal is hauled from Healy to Seward for ultimate delivery to South Korea. Trains also provide transportation for people. Between May and September, the park enjoys daily passenger service from both Anchorage and Fairbanks, with park visitors accounting for a significant share of ridership.

Fort Clatsop National Historic Park:

Fort Clatsop National Historic Park is located in northwestern Oregon, near the mouth of the Columbia River. It covers an area of only 125 acres and experiences about 250,000 visitors a year.

Shuttle buses are gaining widespread use in North American parks.

In June 2004, the park will be introducing the Lewis & Clark Explorer Shuttle in order to cope with growing volumes of visitors, particularly those associated with the bicentennial of the Lewis & Clark Expedition. Visitors will be required to purchase tickets in advance for timed entry to the park. The shuttle will operate from June to September for three years and will be integrated with existing transit routes in the area. The parking lot at the Fort Clatsop visitor centre will be shut down from June 14^{th} to September 6^{th} and visitors will be encouraged to leave their cars at their hotel or designated parking facilities and board the shuttle to the park. It is apparently the first time in the US national park system that a timed entry ticket will be offered in combination with a shuttle bus service.

The adult entry fee for the park will be $5, which will include travel on the shuttle and access to regional transit services. The shuttle will serve most hotels and campground facilities in the area.

3.3 Regional / Facilities Cooperation

Acadia National Park:

Regional cooperation and coordination are one hallmark of success.

As mentioned earlier, Acadia National Park is located on the east coast of Maine. Since the park and neighbouring communities are so closely intertwined, all the parties entered into a regional partnership that in 1999 caused the creation of the Island Explorer, a fleet of propane-powered buses that operate on eight routes that tie in adjacent towns with travel within the park. The service operates from June to mid-October and connects hotels, motels and campgrounds inside and outside the park as well as the Bar Harbour Airport. It caters to overnight visitors and bus routes and stops have been designed accordingly.

The Island Explorer is available to both visitors and residents and is offered free-of-charge. The service is not mandatory and cars are still allowed inside the park.

It is estimated that during its first season, the Island Explorer replaced 43,000 vehicles on local roads.

Sintra, Portugal:

Sintra, with a resident population of 25,000, is a popular tourist destination located in the mountains 30 km from Lisbon. Approximately 1.5 million people visit the area each year, 100,000 of them staying in hotels. The town and its surroundings suffer from traffic congestion because 85% of local resident travel relies on passenger vehicles, and 89% of the tourists also travel by car. Few alternate transportation services were available for tourists prior to the implementation of measures undertaken by MobilSintra, a pilot project conducted as part of Europe's MOST (Mobility Management Strategies for the Next Decades) initiative.

'Travel cards' and 'mobility centres' provide efficient alternative transportation options for visitors to a hilltop town in Portugal.

The pilot project issued one day travel cards for regional bus and train services; issued a multi-modal transport guide and established two 'mobility centres' to provide personal tourist and mobility advice to visiting customers, including a free telephone line providing tourist and mobility information in Portuguese, English, French and Spanish. In addition, car sharing and transfer services were provided by hotel operators, as well as collective taxis for tourists from hotel to airport.

One of the lessons learned, according to the MOST initiative, is that information needs to be supplied to tourists through a multitude of channels, since it is difficult to reach them before they arrive at their destination. The involvement of tourist offices and hotels and using specific smart cards for public transport were said to hold a high potential for decreasing reliance on passenger vehicles, as was evident in Sintra which experienced a 10% increase in the usage of shuttle buses.

Parking facilities for bicycles were also added at public transit intermodal points. Because cycling in the mountainous region had not been popular, facilities to carry bicycles on horse-drawn carriages were made available.

A network of cycling and walking paths provides access to the public transit sites.

Rotterdam, Netherlands:

The City of Rotterdam hosts a number of festivals and special events throughout the year. Examples include the Rotterdam Marathon and the World Port Days, each of which attracts thousands of people.

Planning for periodic special events and transportation as a single mobility management program can facilitate effective long-standing relationships among a large number of players.

Mobility management strategies are used to promote orderly and sustainable transportation for visitors. The City determined that it should not conceive of its festivals as single events, but rather as a series of events spread over time. This approach helped to coordinate an ongoing mobility management program.

Elements of the program include tickets that combine special event entrance fees together with transportation fees and/or overnight stays at hotels, and coordination between City officials, transit operators, event organizers and hotel operators. A pilot information centre ('mobility centre') was introduced on a temporary basis to provide program and event information as well as personalized advice on travel and accommodations.

Additional services were also implemented for the European Championship: extra manpower, special time schedules, special types of transport (shuttles, group taxis), special ticketing, dynamic route guidance, dedicated routes for public transit and taxis, detour routes for normal transport, clear and safe walking routes including good signage, special embarking facilities, real time information via the web site, information brochures for the public and staff, and 200 city ambassadors at strategic locations like stations or airport and infotainment centres.

Rotterdam participated in the MOST initiative and reported four prerequisites for success of its mobility management program:

- Ticket integration,
- Accessibility restriction combined with good alternatives (shuttle services),
- Good parking facilities (i.e., on the outskirts or outer rings of the city), and
- A cooperative co-ordination group consisting of all responsible players.

Rotterdam identified four prerequisites for success.

Puget Sound, Washington:

Seven public transportation agencies in the Puget Sound region created a 'transportation system without boundaries' when they introduced a new fare system that will allow passengers to move more easily between buses, trains and ferries across four counties.

Smart card technology was used to create a single fare card embedded with a microchip that automatically calculates any fare due. The cards can be reloaded and used indefinitely, and by 2006 will eliminate the current system of more than 300 types of tickets, passes and tokens issued by the area's bus, ferry and train systems. The cards are read at the farebox, terminal or station with the fare automatically deducted. The smart card technology also improves the authorities' financial accounting systems by facilitating daily intermodal reconciliations. The project is expandable to other transit systems within a three-state radius.

Smart cards make inter-regional cooperation possible, and are a boon for travellers.

3.4 Restricted Access

Zion National Park:

Zion National Park is located in Southwest Utah and currently experiences about 2.5 million visitors a year. The town of Springdale, with a permanent population of 350, is located just outside the park boundary.

The route into the Park follows a box canyon for six miles and ends at a number of trailheads. Cars are only allowed as far as the hotel, about two miles along, and only if they have hotel reservations. Beyond this point park patrons must use the bus service. There are 400 parking stalls at the visitor centre and smaller parking areas further inside the park.

In Zion, cars are allowed only so far — bus service takes over from there, stopping every five minutes in peak season.

Zion offers a bus service in partnership with the town of Springdale. The service is viewed as a model and is now entering its fifth year of operation. It was introduced because of air and noise pollution, traffic congestion, overflow parking and 'social trailing', which causes erosion and destruction of vegetation. Since the service was introduced, wildlife sightings have increased.

The service consists of 32 propane-powered buses that operate from April 1st to October 31st and can be boarded free of charge. The bus system has two parts, one in the town and one in the park, which are fully integrated and have a starting point in the town. Visitors take an in-town bus to the edge of the park, cross a bridge, pay a $20 entry park fee at a visitor centre and then board an in-park bus. The bus service is not mandatory and motorists pay the same $20 entry fee. The creation of the bus service meant that certain park areas had to be disturbed in order to accommodate the visitor centre and a maintenance garage.

Zermatt, Switzerland:

The village of Zermatt is a mountain resort located in the southern part of Switzerland near the foot of the Matterhorn. It has a population of 5,600 and is situated at an elevation of 5,315 feet. It attracts over 1.7 million overnight visitors a year. Zermatt is a mountain climbing venue and is located adjacent to a number of major ski areas. It has 116 hotels (6,800 rooms) and hosts a number of cultural and sporting events throughout the year.

Zermatt, Switzerland has become a car-free mountain resort.

In an obvious effort to control traffic congestion and reduce air pollution, Zermatt has become a car-free community. Cars approaching Zermatt can only go as far as Tasch, which is 5 km away. In Tasch, visitors to Zermatt must leave their cars in public and private parking facilities which offer capacity for over 3,000 vehicles. They then board shuttle trains to Zermatt that operate every 20 minutes.

Although Zermatt is manageable on foot, electrically-powered buses and taxis are available for travel within the village. In the winter, bus travel is included in the price of a ski pass.

Bad Hofgastein, Austria:

Bad Hofgastein has 6,000 inhabitants and is situated in the Gastein valley, a mountainous region of Austria. As a tourist destination, Bad Hofgastein experiences roughly 1 million overnight stays per year. The community is situated on the Tauern railway, the main connection between Munich and southern districts of Austria. The railway station lies 2 km away from the city centre, and a private bus service therefore connects the railway station with the city centre.

The mountainous town of Bad Hofgastein in Austria has a pedestrian-only town centre.

The city centre was recently redesigned to create a pedestrian zone — vehicles are restricted to public transportation and delivery services (delivery of goods is restricted to the hours between 7:30 and 10:30 am). Each point in Bad Hofgastein can be reached only from one of the three entrances to the city.

The number of parking spaces in the streets is very low, since parking is provided at the edge of the city and in an underground car park. Two free bus lines serve the city centre. In winter, ski-buses connect the city with the ski lifts.

<u>Groningen, Netherlands:</u>

Self-propelled transportation becomes popular when a whole adopts it as a 'badge of honour'.

Groningen (population 170,000) boasts that it has the highest proportion of bike riders in Europe (57% of its residents, compared to 4% in the UK). Groningen has formally adopted a strategy to promote bicycle traffic throughout the city by narrowing roads or closing them to vehicular traffic, building a 'fine mesh' system of cycleways, and developing new housing to which the only direct access is by bicycle. Out-of-town shopping centres are banned. Thousands of parking places are made available for bicycles, including cycle garages and secure 'guarded cycle parks'.

Nuremburg, Germany:

Nuremburg features residential districts designed to eliminate the need for vehicles. Although its circumstances are not directly parallel to the Bow Corridor, experience with such developments has identified certain best practices that are pertinent to the general topic of restricted access strategies:

Communities can be designed around the pedestrian.

- Walking distance between housing units and transportation outlets (car parks or transit stops) is kept to a maximum of 150 to 200 metres;
- The walkway between housing units and car parks is given some protection from the weather;
- Fewer spaces are provided for parking cars, and the parking lots are located on the periphery of the development or underground;
- Daily shopping needs (groceries, drugstores, medical clinics etc.) are located within the development; and
- Facilities for moving heavy objects such as suitcases and groceries are provided (e.g., by equipping each unit with a luggage trolley).

3.5 Partial Restricted Access

Best Practices: Managing Congestion Within the Corridor

Rocky Mountain National Park:

Rocky Mountain National Park is located about 80 miles northwest of Denver, Colorado. Just outside the park boundary is the gateway community of Estes Park, which has a permanent population of 6,000 and a peak summer population of about 20,000. Thus, in terms of its physical location in relation to a gateway community and a major city, Rocky Mountain bears some similarity to Banff National Park.

Mandatory shuttle service is central to the Rocky Mountain National Park in Colorado.

The park currently experiences about 3.2 million visitors a year, which is down slightly since 9/11.

Rocky Mountain has had a shuttle system in place since 1978, which operates from June to September. The system was up-graded with newer buses in 2001 and the improvements were funded through an increase in the park entry fee. The system moves about 250,000 visitors a year on a nine-mile route that originates inside the park boundary and dead-ends in the park.

The shuttle service is mandatory later in the day when all the parking lots inside the park are full. Once the lots are full, private vehicles are not allowed to proceed beyond a certain point and are directed toward the shuttle bus loading point.

Transit studies were conducted between 2000 and 2002. Parking is considered the major problem and more ambitious traffic mitigation measures are anticipated. These might include Intelligent Transportation Systems (e.g., electronic message boards) and a shuttle system that originates in the town of Estes Park.

Grand Canyon National Park:

Grand Canyon National Park is located in Northwest Arizona, covers an area of 1.2 million acres and handles over 4 million visitors a year. The town of Tusayan is located just outside the park boundaries and serves as a gateway community.

To preserve the Grand Canyon, parking is being phased out of the park, making room for a light rail system.

In an effort to control congestion, the National Park Service has developed a plan that would phase out parking along the canyon rim and encourage visitors to either walk or use shuttles. Under the plan cars would still be allowed inside the park but with no opportunity to stop.

A major part of the proposed transportation system is a $200 million light rail transit system that would originate in Tusayan and transport visitors to a visitor centre on the canyon rim. Although the visitor centre has been built, funding has been held up for construction of the rail line, presumably because of slowing visitor growth and the inalienable right of motorists to use their cars. Planners have been asked to review other transportation alternatives.

Katmai National Park, Alaska:

Electrified fences keep wildlife out of select areas.

A type of restricted access strategy that applies to wildlife is electrified fencing. From Africa to Alaska, electric fences are effective in deterring a wide range of wildlife. The Katmai National Park used an electric fence to deter bears from a campground near Brooks Camp. Whereas bears previously wandered through the campground on their route from denning areas on the facing mountain to the river below, the campground saw only one bear entry since installing the electrified fence. This sub-adult bear was running to escape a pursuing adult bear and crashed through the electrified strands, later to be escorted out by campground staff.

Electric fences are ideally suited for small, enclosed areas, where the fence is extremely effective in deterring bears, deer and other large mammals. The principle behind electrified fences is that wild animals approach unknown objects with their noses, which are very sensitive to electric shock. Unlike cattle fences, which must deliver an effective shock through hair and hide, electrified wildlife exclusion fencing may be effective at lower shock levels. In general, the fences use high voltage with low amperage and a pulsating or alternating current. Together, these attributes create a fence that delivers a stern shock but does not cause involuntary muscle contraction; animals are shocked and left to jump away.

Vendors suggest that electrified fencing will deter bears from almost any attractant inside the fence, with the possible exception of honey.

3.6 Encouraging Mass Transit

Bryce Canyon National Park:

Bryce Canyon National Park is located in Southwest Utah and currently experiences about 1.4 million visitors a year. It was emphasized that, unlike other national parks, Bryce does not have to deal with any gateway communities, which is considered an advantage in terms of not having to deal with local businesses on traffic management measures.

Shuttle service is the main traffic management strategy employed at Bryce Canyon.

The main traffic management measure at Bryce is a voluntary shuttle bus service. The service was introduced four years ago in response to traffic and parking congestion inside the park. It is run by a private operator under a five-year contract.

The service originates outside the park at a large leased parking lot and at a resort called Ruby's Inn, with whom the park administration works very closely. There is only one way to enter and exit the park and there are a number of stops along a single route (e.g. overlooks). Travel on the bus is included in the $20 park entry fee.

There are no financial incentives such as differential entry fees to encourage visitors to use the service. The service is voluntary because a mandatory service would require a greater number of buses and there are no optional attractions that would enable visitors to enjoy the park without using the service.

Operationally, the service has been successful in reducing congestion inside the park.

Financially, the service has been a failure. The park administration was too optimistic in their visitor and revenue projections when setting the terms for the service contract. Annual visitors to the park have declined from 1.7 million to 1.4 million over the last four years. Accordingly, the service has since been cut back in terms of service frequency, route length and operating season.

Yosemite National Park:

Yosemite has plans to introduce hybrid-electric shuttle buses.

Yosemite National Park is located in east-central California, near the Nevada border. It consists of a narrow valley, similar to Zion National Park. There is a town located near the main entrance called El Portal, which is both a gateway community and a domicile for park employees. The town of Wawona is situated farther south near the park boundary. Yosemite currently handles about 3 million visitors a year. There may be as many as 5,000 vehicles a day on a busy summer weekend. The general Yosemite region is served by the Yosemite Area Regional Transit System (YARTS). It links three counties in the region with destinations in Yosemite Valley.

A flood in 1997 provided an opportunity for the park administration to begin planning for a number of changes to improve the visitor experience. The park is currently tied up in litigation over some of these proposed changes and there is a sense that things are generally 'under construction'.

Inside the park, a shuttle service (13 buses) travels in a loop and operates from a parking lot that is reasonably close to a visitor centre. The parking lot can currently accommodate 400 cars and there are plans to increase its capacity to as many as 600 vehicles. There are also plans to replace the current bus fleet with 14 hybrid-electric buses in 2005. The shuttle serves only a portion of the park, that part containing all the hotels and Yosemite Falls. The park entry fee for visitors is $20, which includes travel on the shuttle.

No reservations are required for cars or day-use, although reservations are required for all lodging operated by the concessionaire, and for campgrounds in the 'Valley' but not the rest of the park.

There are efforts afoot to improve the visitor experience by reducing traffic congestion and restoring habitat, including reductions in the number of campsites and parking capacity inside the park. However, this has met with resistance from merchants in nearby communities.

<u>Laon, France:</u>

A gondola, or automated people mover (APM) lifts people up the steep hillside in Laon, France in 3 minutes, instead of the 15 minutes it takes a bus.

Laon, a town of 30,000 situated northeast of Paris, is situated on an isolated ridge forming two sides of a triangle, which rises some 330 feet above the surrounding plain and river of Ardon. From the railway station, a straight staircase of several hundred steps leads to the gate of the town, and all roads connecting Laon with the surrounding district are cut in zigzags on the steep slopes. Diesel buses typically take 15 minutes to ascend from the valley floor to the hill top town.

The town attracts thousands of visitors each year because of its cathedrals, historic sites and the International Film Festival for Young People.

The town built an automated people mover (APM) in 1989 to facilitate visitor traffic. Travel time from the valley floor has been reduced to about 3 minutes as a result of the APM which has three stations and operates 13 hours per day, six days per week (seven in summer, because of the tourist season). Three cars are always on-line and each vehicle carries 12 seated and 28 standing passengers. Normal waiting time is 2-1/2 minutes; the maximum wait is six minutes. A parking garage and APM control and maintenance facility are located at the lower terminal.

Whistler, BC:

Whistler's gondola is a high-speed APM connecting resort villages with ski areas—there's no need for a car.

The resort town of Whistler was designed around a non-vehicle, pedestrian-oriented street formed by commercial, retail and residential buildings. Elevated, covered walkway systems and convenient APMs were included as central features of the design.

A high-speed two-stage APM serves both the Whistler and Blackomb resorts. A series of 8-passenger cabins carry up to 2,600 people per hour to ski areas, climbing over 440 m (combined upper and lower sections) up an incline over 2.2 km long. By serving the ski areas directly from the towns of Whistler and Blackomb, visitors do not require cars, but can step on to the gondola from town and ski out along the gentle runs that terminate at their original starting place. Alternatively, skiers can drive to the mid station and park there, loading onto the gondola from a point about one third of the way along its total ascent.

San Francisco Bay Area, California:

A case study examined the issue of commuter psychology in the Bay Area, focusing on ridership among "affluent technologists in the corridor" (including "soccer moms", who were said to have the most complex set of transportation needs of all user groups studied). Commuter objections to mass transit options were summarized as follows:

- Travel time on transit is greater than via car (wait times were characterized as being three times longer than real time);
- Transit does not provide sufficient convenience and flexibility for non-commute trips (lunch, workout at gym, dry cleaner, professional services, child care, etc.);

Experience in the San Francisco Bay Area reveals insights into 'commuter psychology' and the challenges for promoting alternative methods of transportation.

- Cars serve as 'security blankets', offering convenient storage for personal items and a cocoon-like setting for comfort and relaxation;
- Cars provide privacy for business and social cell phone calls; and
- The perceived cost of automobile travel is less than the perceived cost of mass transit fares.

Solutions identified in the case study included a reference to the Bay Area's RIDES service which provides free personal analysis of transit alternatives. It was also suggested that transit operators offer higher priced seating options to facilitate privacy for conversations on cell phones.

CPR Piggyback Operations:

Transportation modes may be complimentary as in containerized freight or truck / rail 'piggy back' arrangements.

One form of mass transit is piggybacking truck-trailers on flat bed railcars. CPR's piggyback operations are currently confined to its Expressway unit operating in the Montreal-Detroit corridor. This unique service allows truck trailers to be driven onto flatcars at convenient locations adjacent to the highway but remote from conventional container terminals for relatively short hauls over high-density routes.

While truck density does not yet offer a commercially attractive market for application of this service in the Bow Corridor, over a 20 year planning horizon it is an option which should not be discarded in conjunction with TransCanada Highway capacity and safety issues on the section of TCH extending to Kamloops, BC. (In Europe, piggyback operations move trucks as well as autos through trans-alpine rail tunnels pending the kind of highway improvements that are also required west of Banff.)

Passenger Rail Service:

Passenger rail could be a viable alternative under the right conditions.

In the matter of the potential for a rail passenger shuttle serving the Bow Corridor, CP has suggested that the service might be offered in the long term. The service is subject to some expensive upgrades which would enable a diversion of a certain number of freight trains to CP's southern route through the Crowsnest Pass between Medicine Hat and Golden.

3.7 Pricing Options

Arches National Park:

Arches National Park is located in Eastern Utah near the town of Moab. The park currently handles about 1 million visitors a year. The roadway at Arches consists of a 24-mile loop with one way in and out. There are a number of stop-and-go situations along the route (e.g., trailheads, viewing points) that tend to slow vehicle traffic. The demand for parking along the route exceeds the supply of stalls.

Differential pricing may reduce peak-time congestion.

Some alternative solutions are being considered. The park is thinking about spreading traffic more evenly throughout the day through the use of a differential entry fee structure. They are also considering a reservation system for the more popular destinations inside the park, which they feel may be difficult to manage. Finally, they are considering opening a second entry/exit point.

Arches is not considering shuttle buses as a solution. According to their Seattle-based consultant at least 2 million annual visitors are required in order to make shuttle bus service viable. The frequency of service would be too low and the time between buses too long, which would reduce the attractiveness of the service and result in unacceptable waiting times in the daytime summer heat.

London, UK:

On February 17, 2003, the City of London began charging a £5 daily fee for driving private automobiles in its central area during weekdays. The objective was to reduce traffic congestion and raise revenues to fund transport improvements.

Congestion charges deter peak-time use.

According to the latest figures, the congestion charge has triggered an 18% reduction in central London's traffic. The number of cars has fallen by 30% while buses, taxis and motorcycles have all become more common. Around 110,000 people are paying the charge each day, fewer than had been anticipated. However, a daily average of 13,500 penalty notices are sent to people who are caught on camera without paying, and London's congestion charging cameras have pinpointed 100 'cloned' cars with bogus number plates during the first year of the scheme's operation, as motorists use elaborate techniques to avoid paying the £5 - a-day fee.

Initially opposed by business interests, recent polls revealed that 72% of companies in central London believe the road charging experiment is working, with only 14% convinced it is a failure. Many also felt the congestion charging scheme had enhanced London's reputation worldwide. Only 26% said the charge has had a negative impact on the capital's economy, while 32% said it was neutral and a further 26% judged it to be positive. Independent experts at the London School of Economics say the impact has been insufficiently dramatic to cause significant damage to the capital's economy.

3.8 Overview: NPS Alternative Transportation Program

The Alternative Transportation Program (ATP) was created under the US National Park Service (NPS) in 1998. It is an outgrowth of the US *Transportation Efficiency Act for the 21st Century* (TEA-21) as it relates to the Federal Lands Highway Program.

Traffic issues plague many resorts — the US National Parks Service has outlined a range of challenges and possible solutions.

The purpose of the ATP is to coordinate activities related to the development and implementation of alternative transportation systems in US national parks and adjacent communities. In 1999, a Transportation Planning Guidebook was published under the program to provide guidance on planning, funding, local partnerships and best practices.

The National Park Service divides transportation issues or challenges into three broad categories in terms of their impact on visitor experience and the environment:

- Access: The inability of visitors to access a park because of vehicle congestion.
- Circulation: The inability of visitors to use non-motorized modes of travel (e.g., bicycling, walking, hiking) or alternative transportation systems.
- Parking: The inability of visitors to find convenient and well managed parking.

The guidebook then addresses each transportation challenge by identifying a number of broad objectives and suggesting strategies or best practices for managing traffic inside national parks. These are summarized as follows.

Vehicle Access:

Four objectives are identified in relation to improved vehicle access: Manage transportation demand; Reduce traffic congestion; Reduce vehicle travel; and Minimize impacts on park resources.

Access can be improved and vehicle congestion reduced by maximizing use of the existing road system, controlling demand and expanding roadway capacity through the following strategies.

There are many options to improve access.

- Roadway modifications:
- Create one-way roads
- Realign converging roads
- Post speed limits and direction signs
- Safety improvements
- Traffic restrictions:
- Reservations for campsites, transit services, etc.
- Restrict vehicle types (e.g. oversized vehicles)
- Encourage off-peak park use.
- Intelligent Transportation Systems (ITS):
- Advanced information to park visitors via the Internet, radio, telephone, etc.
- Changeable message boards on major roads.
- Maps and brochures on road systems, alternative travel routes, transit routes, bus schedules and prices and bike and pedestrian paths.
- Provide advanced trip planning information for park visitors.
- Differential entrance fees to encourage use of alternative transportation systems.
- Reservation requirement for access to the park.
- Link vehicle access to overnight accommodation, day-use permit, etc.
- Trip reduction programs for park staff and concessionaires (e.g. carpooling, vanpooling).
- Expand roadway capacity:
- Add roads
- Widen lanes and roads
- Add turning lanes
- Add or widen intersections

Vehicle Circulation:

Four objectives are identified in relation to improved vehicle circulation: Improve visitor access to park features; Improve bicycle and pedestrian access; Reduce vehicle congestion; and Minimize impacts on park resources.

The following strategies are suggested as a means of achieving these objectives.

Limited movement and transportation options curtail circulation.

- Reduce and redistribute visitor demand in congested or over-used park areas through improved information and reservations systems.
- Enhance transportation options through provision of bicycle and pedestrian alternatives.
- Remove transportation facilities from sensitive areas.
- Enforce laws and regulations governing traffic circulation.
- Encourage use of alternative modes.

Vehicle Parking:

Two objectives are identified in relation to improved parking: Eliminate parking overflow; Manage traffic demand.

The following strategies are suggested as a means of achieving these objectives.

Both parking and parking demand can be managed.

- Coordinate remote parking with adjacent communities or public lands. For example, visitors could be encouraged to use these lots and board shuttle buses through discounts on park entry fees.
- Coordinate alternative transportation systems and bike and pedestrian facilities with adjacent communities.
- Reduce and redistribute visitor demand using reservations systems.

- Enhance non-vehicular transportation systems to reduce parking demand.
- Provide separate parking for overnight and day visitors.
- Enforce parking laws and regulations.
- Channel visitors away from sensitive areas.
- Remove parking from sensitive areas.
- Add parking capacity, where necessary.

4 NEXT STEPS

A series of open houses, focus groups and discussions will be held over the coming weeks in Canmore, Banff and Lake Louise. Stakeholder input and feedback will be gathered from these events and used to inform recommendations put forward in the Bow Corridor Regional Transportation Strategy.