

## **1.0 WINTER MAINTENANCE**

### **1.1 PREPARATION FOR WINTER**

The department will estimate the next winter's requirement of calcium chloride, sodium chloride (salt) and sand in the spring of each year, including amounts necessary for freeze proofing winter sand stockpiles.

Freeze proofed winter sand must be stockpiled at appropriate locations before winter. Inventories of salt, calcium chloride and sand must be monitored throughout the winter season to ensure adequate supplies are available.

All equipment must be in place before the onset of winter with sufficient number of trained staff. All sanding units must be calibrated to ensure that sand and deicing chemicals can be applied at the proper rates.

### **1.2 GUIDELINES**

Snow removal and ice control operations differ throughout the province due to influences of terrain, precipitation, temperature, wind and chinooks, etc. Regardless of these influences, the department and the contractor shall ensure that the minimum level of service is maintained.

The information provided in Table 1, Winter Level of Service illustrate the minimum acceptable levels of service for snow clearing within rural and urban locations.

Appropriate equipment and manpower should be available to provide the level of service as indicated in Table 1 for each highway classification.

**Table 1 - Winter Level of Service (Rural Highways)**

Class of Highway	Traffic Volume (AADT)	MAXIMUM Recreation Time * (hrs)	Maximum Time to Good Winter Driving Conditions ** (hrs)	Typical Recreation Time (hrs)
A	> 15,000	2	6	1
B	7,000-15,000	4	6	1
C	5,000-7,000	4	8	2
D	2,000-5,000	4	8	2
E	1,000-2,000	6	12	3
F	500-1,000	8	12	3
G	100-500	12	18	4
H	<100	16	24	5

- ⇒ Maximum time allowable for equipment to have commenced work from the time of a 3cm accumulation. This value represents the maximum time that will be required to respond after an average winter storm. Normally, equipment will begin work during most storm events and as a result most roads are cleared faster than the maximum time indicated.
- ⇒⇒ Good winter driving conditions exist when snow and ice have been removed from the driving lanes and excessive loose snow has been removed from the shoulders and centre line of highway. Short sections of ice and packed snow are acceptable and can be expected within the driving lanes between the wheel paths, as well as on centreline.

An average winter snowstorm is defined as one in which snowfall amounts range between 3 and 8 centimetres, the air temperature is lower than -10°C, the wind velocity is less than 15 kilometres per hour and the road surface is frozen.

The impact of salt on the environment is a growing concern on a global scale. The First Nation's operations should be scrutinized to ensure the use of salt is minimized and contamination is eliminated. The importance of eliminating salt contamination of the environment is critical to the operation and adequate preventative measures should be followed. The TAC Salt Management Guide has more information about proper salt use and storage.

## **1.3 STRATEGIES**

### **1.3.1 SNOW CLEARING - PAVED ROADS**

Snowplowing of paved highways should commence before snow becomes packed by traffic, or when snow accumulations exceed 3 centimetres.

To assist in providing timely response during changing winter conditions, maintenance staff must keep informed of weather forecasts. News of advancing storms should be communicated to neighboring maintenance areas.

The basic strategy for snow removal and ice control is: first - remove as much snow or ice as possible with suitable plowing equipment and second - treat any remaining snow or ice with sand, salt, or a salt/sand combination to achieve good winter driving conditions within the required time frames. Plowing and deicing activities will continue, as weather and operational conditions permit, with the aim of eventually achieving bare pavement.

Steep hills, curves, important intersections, and other areas known to create difficulties for traffic, should be attended to first.

Priority should be given to higher volume highways to provide the best service to the greatest number of motorists.

When roadway surface temperatures are too low for the use of salt, calcium chloride, other deicing chemicals and sand should be applied to maintain the best possible winter driving conditions. After the surface temperature of the roadway rises, applications of deicing chemical will remove snow and ice accumulations more quickly. Road surface temperature is often different from air temperatures, and application rates should be chosen based on road temperature, not air temperature.

Once good winter driving conditions have been achieved along all routes, "cleanup" activities, including the plowing of shoulders, cross-overs, approaches, etc., can be started if snow and ice deposits are significant enough to be considered a hazard to traffic.

If visibility is reduced to below 75 metres, or when, in the opinion of the equipment operator and area foreman, it is too hazardous to continue snowplowing, the equipment should be removed from the roadway to a safe location. Snowplowing should be resumed as soon as visibility improves sufficiently to allow operation at an acceptable level of safety.

### 1.3.2 ICE CONTROL OPERATIONS - PAVED ROADS

Under many conditions, the application of proper amounts of deicing chemicals onto the roadway will help to remove packed snow, ice or frost, thereby improving traction and driving conditions. Salt (sodium chloride) and calcium chloride are the primary deicing agents used.

Deicing chemicals should only be used on ice, frost or snow, which cannot be removed by snowplowing.

The application rate of salt varies considerably, depending on the surface condition being treated and the current and forecasted weather conditions. Experience and judgement must be used when determining application rates. Only the amount of salt necessary to do the job must be used. The proper use of deicing chemicals represents a cost efficient and effective use of resources.

Timing of the application of salt is critical, especially when conditions for its use are marginal. There is little heat available from the sun in December and January and, ideally, salt is applied just as the surface begins to warm. This will help ensure that the salt is on the roadway surface during the warmest part of the day. Following these practices will maximize the effectiveness of salt in removing snow and ice.

Use of salt when the temperature of the road surface is below -10 degrees Celsius is not justifiable. Salt loses its effectiveness rapidly under this temperature, and excessive amounts are necessary to achieve melting action. Under such conditions, straight sand or sand pre-wetted with a liquid deicing chemical should be applied to maintain the best possible driving conditions.

When conditions are favorable, salt or a liquid deicer applied early in the storm will prevent the bond from forming between the pavement and packed snow. Much less salt is required to prevent the bond from forming than to melt packed snow after the snowfall has ended.

Time is of the essence when chemical applications are involved. Often snow, sleet and freezing rain are created by rapidly advancing cold air. Temperatures can drop dramatically in a matter of hours. Any necessary chemicals must be applied quickly to allow as much time as possible for them to work. If timing of snow plowing and chemical applications are right, the highway will "freeze dry". At low temperatures too much diluted brine on the roadway will freeze to ice.

Table 2 provides guidelines for adjusting salt application rates under varying conditions.

**Table 2 - Salt Application Guidelines**

Rates kg of Salt per 2 Lane km	Conditions (Road and Weather)	Factors Affecting Salt Application Rate
50	* temperature near 0° Celsius * light amounts of snow/ice/frost	INCREASE RATE WHEN <ul style="list-style-type: none"> <li>• temperatures are lower or falling</li> <li>• road surface is cold</li> <li>• increased amounts of snow/ice/frost</li> <li>• traffic flow is light and won't help break up ice</li> </ul>
125	* temperature near -6° Celsius * moderate amounts of snow/ice/frost	
225	* Temperature near -10° Celsius * Thicker ice/snow * For temperatures below -10° salt has limited effectiveness and straight sand should be used.	Decrease Rate When: <ul style="list-style-type: none"> <li>• temperature surface is rising</li> <li>• road surface is warm</li> <li>• the sun is warming the road surface</li> <li>• there are lesser amounts of snow/ice</li> <li>• traffic volume is higher and will help break up ice</li> </ul>

**Note:** This table refers to the amounts of salt in a sand/salt mixture. At near-freezing temperatures, brine from the salt will be tracked by traffic several hundred metres beyond the area treated, so that intermittent applications of salt may give the same effect as a lighter, continuous application.

**For example:** If spreading a 50-50 mix of sand and salt at the suggested salt application of 50kg per 2 lane kilometre, the total amount of 50-50 material being spread on the road would be 100 kg per 2 lane kilometre.

Sanding will improve traction and provide better winter driving conditions when temperatures are too low for the effective application of ice control chemicals. Typical sand application rates for providing traction are 1000 kg/2 lane km for heavy sanding, 500 - 700 kg/2 lane km for normal sanding, and 300 - 500 kg/2 lane km for reapplication of sand or light sanding.

When temperatures are near -20 degrees Celsius, calcium chloride or other pre-wetting agents may be added to help imbed the sand particles into the ice surface. Adding 0.5 to 1.5 percent by weight of calcium chloride will promote this effect. The addition of too much calcium chloride will cause tracking and create icing.

If snow is blowing across the highway without sticking, sand should not be applied unless the highway is dangerously slippery, as the sand will cause the snow to stick, aggravating drifting and icing problems.

Ice Blading can be carried out when deicing chemicals are not effective and involve removal or roughening of ice and packed snow from the paved roadway surface with the aim of achieving good winter driving conditions. Under no circumstances will carbide tipped removable tooth blades (i.e. System 2000 ice blades) be used on paved surfaces. Ice blading on seal coated roads is not recommended, and should only be done with extreme caution.

When snow accumulations at the edge of the paved surface exceed 30 centimetres, or when snow at the side of the road causes drifting, winging should be considered.

### **1.3.3 SNOW AND ICE CONTROL - GRAVEL ROADS**

Plowing of gravel surface roadways should be commenced before snow accumulations reach 10-15 cm on the roadway. However, if drifting conditions prevail, plowing operations may be commenced sooner. In general, winter maintenance schedules are determined by weather conditions.

Priority should be given to school bus routes and high traffic volume routes. Overall, priorities should be determined using local information.

During the first snow fall, it is desirable to mix snow into the loose gravel to stabilize the surface material when it freezes. This minimizes future gravel loss from snow plowing.

Ice blading may become necessary if the roadway becomes slippery due to compacted snow or ice. Ice blading roughens the surface for improved traction. Care must be taken to minimize gravel loss.

Winging of snow into the ditch will be necessary before plowed snow accumulates to a depth of 30 cm along the shoulder edge.

## **1.4 SNOWFENCE**

Snowfence should be placed in areas where snow drifting is prevalent to reduce Snow accumulation on the roadway and to improve visibility. The location of the snowfence will be determined by local conditions and past experience.

Fences should be checked and repaired periodically throughout the winter.

Snowfencing should be installed after farming operations have been completed and prior to winter. Snowfence should be located 25-40 metres from the centerline of the roadway. Typically, the drift formed by the snowfence will extend for a distance of approximately 10 times its height. The snowfence should be removed early in the spring to avoid conflicts with the landowner's operations. All debris must be removed from the property and properly disposed of (wire, lath, etc.).

## **2.0 SURFACE MAINTENANCE - PAVEMENT**

### **2.1 PAVEMENT REPAIR - GUIDELINES**

All highway surfaces must be kept in a condition suitable for safe travel at the posted speed limit. Keeping the surface of all roads in a safe condition is the number one priority maintenance item.

Breaks or distortions that occur on the pavement's surface can pose a hazard to traffic; these areas must be identified and attended to immediately. Until the necessary repair work is done, warning signs must be placed on each side of break or distortion area. The hazard must be monitored until repaired. The permanent repair of all serious pavement break areas and distortions must be completed as quickly as possible.

In addition to the daily/weekly routine inspections, all pavements on First Nations should be subjected to a detailed Surface Condition Rating (SCR) every two years. As part of this process, all types and severity of pavement distresses will be identified for the purpose of programming proactive and in some cases reactive treatments.

Transverse cracking, surface oxidization, general hairline cracking, pavement joint separation and roller cracks, are examples of distresses which if left unattended, will eventually develop into more serious pavement failures.

Pavement Distresses that would require treatment would include:

- Pot Holes
- Alligator Cracking
- Wheelpath Cracking
- Depressed Transverse Cracking
- Subgrade Failures
- Settlements/Distortions (i.e. culvert dips)
- Spalling and Raveling
- Rutting

## **2.2 PAVEMENT REPAIR - STRATEGIES**

Examples of pavement repair strategies include:

- Selective and full surface seals (i.e. chip seals and sand slurry seals); These are useful methods for repairing aggregate loss which may have occurred as the result of the progressive deterioration of segregated areas. While it will not fix underlying failures in the asphalt structure, sealing the surface may prolong the life of the pavement.
- Deep patching is used when base and pavement repair is required (i.e. structural failures). Skin patching can be used to address raveling, rutting, and depressions or distortions.
- Rout and seal, spray patch, mill and fill, treatments can be used to repair various types of cracking and transverse cracking.

A repair strategy will be selected based on the final result desired. For example, if a road segment is scheduled for major rehabilitation in the following year, the department may opt to select a lower cost repair as opposed to a higher cost repair that would have better long-term performance. In this example long term performance of the repair would not be a factor due to the fact that the segment will receive an overlay in the following year.

There are also different methods of completing the same type of repair. For example, there are two methods of providing skin patching, with a grader or with a paver. Both of these repair methods have advantages and disadvantages.

## **2.3 CRACKSEALING**

### **2.3.1 GUIDELINES**

Cracksealing is a pavement preservation activity that is to be carried out on an "as required" basis. The First Nation will determine which roadways within their network are to be crack-sealed each year.

The purpose of cracksealing is to prevent moisture from penetrating the base and subgrade thereby weakening the roadway structure. It also prevents material spalling from the edges of the cracks.

Cracks, that are wide enough to accept crackfiller (usually wider than 5mm), should be sealed as early as possible once the frost is out of the base layer. Under certain conditions some sections of highways may not require annual crackfilling (e.g. well drained subgrades). The earlier this function can be completed, the more successful it will be in minimizing moisture penetration from spring rainfalls.

### 2.3.2 STRATEGIES

The intent of the cracksealing is to ensure that the crack is sealed. A crack does not need to be completely full to be considered sealed. It is not uncommon for the material to sag or settle in the crack and not look filled after a period of time.

Various asphaltic materials are acceptable for cracksealing. The usual materials used in Alberta are cold pour, catalytic cracksealer, hot pour and various types of hot pour rubberized cracksealers.

In order to provide for proper accommodation of traffic, cracksealing must be carried out on one lane at a time with signs and properly attired flagpersons directing traffic.

A blotting agent may be required where traffic cannot be kept out of the work zone (i.e. intersections) before the crackfilling material dries.

## 3.0 SURFACE MAINTENANCE - GRAVEL

### 3.1 GUIDELINES

The purpose of gravel surface maintenance is to provide a reasonably smooth and safe roadway for the motoring public, taking into consideration weather and traffic conditions.

Regularly scheduled road inspections should be carried out to ensure the required level of service is maintained. Inspections may occur more frequently if required due to changing traffic volumes or excessively wet conditions.

The rate of blading shall be sufficient enough to maintain the required level of service. Traffic volumes, traffic type, weather, and general road conditions shall all be considered. The minimum frequency of blading operations will be once per week or as required based on the road inspections. Table 3 illustrates the maximum kilometers of roadway allowable per grader based on traffic volume (AADT).

**Table 3 - Motor Grader Allocation Guidelines**

Guidelines for Motor Graders per km of Graveled Roadway			
AADT	Subgrade Width 7-10 m	Subgrade Width 10-12 m	Subgrade Width Over 12 m
Under 1	100-200 km per grader	80-150 km per grader	60-120 km per grader
100-500	60-100 km per grader	60-100 km per grader	40-80 km per grader
Over 50	50-80 km per grader	40-70 km per grader	30-50 km per grader

### **3.2 ROADWAY SURFACE MAINTENANCE**

Roadway surfaces should be bladed to remove all potholes, washboards and ruts. All gravel roadways should be maintained to have a uniform crown of 3 - 5 % and all curves must be bladed in such a manner as to maintain the designed super elevation. The crown of the main roadway should be maintained through the intersection, while the crown on the intersecting roadways should be feathered back. Gravel road surfaces should be kept free and clear of all large rocks that may appear after normal blading. All approaches to bridge decks and railway crossings will be bladed in such a manner as to ensure that the bridge deck and railway crossing surface is kept clear of all excess material. All crossings will be regularly inspected and monitored to ensure that blading operations have not damaged the crossing. The First Nation will immediately inform the railway operator of any damage that has occurred to the crossing.

### **3.3 SHOULDER MAINTENANCE**

Shoulder maintenance (pulling of shoulders) will be done on all gravel roadways on an as required basis. Roadways should be inspected regularly to determine whether pulling shoulders is required.

Shoulder maintenance will be required when, the shoulders of the roadway push out, the crown rate of the roadway becomes flatter than 1%, or the cross-section is wider than designed and not properly draining. Typically, shoulder maintenance will be required prior to the commencement of regravelling operations.

### **3.4 SURFACE REGRAVELLING**

The excessive loss of gravel from a roadway results in loss of traction, a reduction in strength, rutting, and deterioration of the roadway surface and side slopes. Gravelled roadways require regravelling, on average, once every three years. In the late fall of each year the department will inspect all gravel roads for the purpose of condition rating. Part of the condition rating process will be to determine which roadways will require regravelling in the following year. A roadway will be considered for regravelling when it exhibits any of the following characteristics:

- Excessive loss of surface gravel
- Numerous bald or shiny spots
- Clay balls on the shoulders after blading
- Excessive rutting

Ultimately, the condition, type, width, and traffic volume of a roadway will dictate the application rate of gravel. The department staff will work closely with the maintenance contractor to determine the optimal application rate for each roadway. The recommended rates of application are shown in Table 4.

**Table 4 - Regravelling Application Rates**

AADT	Tonnes/km
>500	400-800
<500	400-500

Prior to regravelling operations, the roadway should be reshaped to the proper crown rate and width. If required, it may be necessary to "pull shoulders" (refer to sections 3.2 and 3.3).

On roadways with an Average Annual Daily Traffic (AADT) higher than 50, the gravel should be spread all the way out to the shoulders, on roadways with an AADT less than 50, the gravel should be spread out to within one metre from the shoulders.

Windrowed, or unspread gravel, will not be left on the roadway overnight. In an emergency, windrowed or unspread material may be left overnight with adequate warning devices.

Where applicable, the maintenance contractor will consult the First Nation prior to the commencement of hauling on roads under their jurisdiction. The contractor will be required to regularly maintain haul roads to keep them in a reasonably smooth and safe condition for the general motoring public. If required, dust control materials will be provided in front of residences, at intersections, hills and curves. Haul roads will be inspected/checked at least twice per day to ensure that maintenance and dust control operations are effective.

### **3.5 DUST CONTROL**

First Nation staff should identify all roadway segments that will require dust control. Dust abatement material may be applied to selected roadways, intersections, on curves, hills, in hamlets, and other public places. The application of dust control materials is usually initiated late in the spring. Prior to the application of dust abatement material, the First Nation will identify the sections of roadway that need to be bladed and/or regravelled

Materials used for dust abatement can include:

- Flake Calcium Chloride
- Liquid Chemical Products
- Petroleum Products

Recommended application rates shown in Table 5. Local conditions may justify pre-approval of other applications rates.

**Table 5 — Dust Abatement Application Rates**

Type	Kg/m <sup>2</sup>
Flake calcium Chloride	.75
Liquid calcium chloride	.75-1.25
Kignosulphates	.75-1.25 (50% dilution)
Petroleum based products	Supplies recommend rates
Water	As required

## 4.0 RIGHT-OF-WAY MAINTENANCE

### 4.1 RAILWAY CROSSING MAINTENANCE

Crossing maintenance is required to ensure a safe crossing for the motoring public and the railway operator. All railway crossings should be inspected weekly and immediately following the completion of any maintenance activity that has been carried out in close proximity to the crossing. Visual checks should be performed more frequently on those crossings that are known to be problematic.

All crossings will be kept clear of all debris, gravel, snow and ice, resulting from roadway maintenance activities. When roadway maintenance affects the operation of the railway, the railway operator must be notified prior to the commencement of the work.

All crossings should be signed in accordance with Alberta Infrastructure standards. The railway operator should be immediately notified of conditions which may interfere with the safe operation of the crossing. Loose planking or rail damage should be reported to the railway operator as soon as possible.

### 4.2 DELINEATORS

Delineators, sometimes referred to as guide posts, are installed to assist the motorists during periods of limited visibility. Delineators are used;

- at changes in road alignment,
- at changes in roadway width,
- for marking roadside hazards,
- as a guide for turning movements,
- in advance of a guardrail end treatment that is turned away from the highway.

Delineators are not warning devices, and appropriate warning signs must be used to advise motorists of hazards.

### **4.3 GUARDRAIL**

Guardrail is a longitudinal roadside barrier that is intended to contain or redirect a vehicle that may inadvertently attempt to leave the roadway. Typically guardrail is used to protect vehicles from three major hazards: roadside obstacles, permanent bodies of water, and steep slopes or high embankments.

Proper maintenance of guardrail is critical to safe operations. Improperly installed/maintained guardrail can actually be more of a hazard than the feature they guard.

The First Nation will inspect all guardrails annually to ensure proper and effective operations; guardrail that is prone to damage should be inspected more frequently. The department will identify all substandard guardrail and will work closely with the maintenance contractor each year to develop a guardrail replacement/repair/maintenance program based on the needs of the network. If guardrail causes a snow drifting hazard that is more severe than the original hazard the guardrail was intended to protect against, the installation should be reevaluated.

### **4.4 MOWING**

Vegetation along the right-of-way will be mowed for the following reasons:

- eliminate obstructions to sight distance on curves.
- control weed and brush growth.
- reduce snow drifting on the roadway.
- provide for unobstructed drainage.
- reduce the fire hazard in some areas.
- improve road aesthetics.
- eliminate obstruction to signs.
- increase the visibility of large animals on the right-of-way.

By maintaining close communications, all parties will be able to ensure that new weed issues are being dealt with quickly and that overall weed control is being provided in a timely and effective manner.

### **4.7 BRUSH CONTROL**

First Nation's should remove brush where necessary in order to;

- improve sight distance at intersections and curves,
- restore proper drainage in ditches,
- reduce snow drifting problems,
- and allow for dissipation of dust clouds, created by traffic on gravel roads.

Brush control is best performed before the vegetation reaches 2m in height or before sight distance becomes impaired.

Brush control requirements should be reviewed and prioritized on an annual basis. A brush control program should be developed by early fall of each year.

After brush control operations have been completed, all cuttings larger than 10cm in diameter or longer than 50cm should be removed and properly disposed of. Mechanical brushing may produce debris small enough to leave in the right-of-way.

#### **4.8 LITTER CLEAN UP**

Good housekeeping and, consequently, neat appearance of our roads, can create a favorable impression of our community to our own citizens, as well as, travellers and tourists from other areas. Therefore, it is important to keep a clean right-of-way. A clean right-of-way is also important in preventing damage to equipment and tires during mowing operations.

#### **4.9 DRAINAGE SYSTEMS**

As flowing water can be one of the greatest natural destructive forces affecting a road, it is very important that all structures and other features of the drainage system are well designed and properly maintained. In order to maintain a roadway in optimum condition, water must be kept from saturating the subgrade and also from eroding the roadway.

Drainage systems include the following components:

- Ditches
- Ditch Blocks
- Down Drains
- Bridges
- Culverts
- Curbs/Gutters
- Subsurface Drains

Each spring, the First Nation should update and prioritize the culvert maintenance program. This program will describe any drainage system deficiencies and identify what corrective action needs to be taken.

##### **4.9.1 CULVERTS**

The First Nation should maintain an accurate inventory database of all culverts, which exist in the community. Inventory information will contain detailed item descriptions as well as installation and condition information. All culverts should be inspected regularly to ensure proper and effective operations.

Culvert installations provide relief for natural drainage and also prevent the undue accumulation and retention of water on and adjacent to the roadway.

Properly installed and maintained culverts will protect the roadway against storm and subsurface water drainage. The capacity of culverts can be reduced dramatically when

damaged. The capacity of culverts can be reduced dramatically when damaged by silt, debris, or ice.

Culverts prone to freezing, should be inspected in the early spring. Culverts that become plugged with ice during spring runoff should be steamed open as soon as is practical.

Maintenance of culverts should include silt removal and spring steaming on an as required basis.

#### **4.9.2. DITCHES**

Ditches that become “silted in” or blocked can alter the natural drainage patterns thus causing flooding. Periodic maintenance of ditches may be required to ensure that drainage ditches are functional and that they are capable of carrying their design flows.

All ditches, especially those with heavy flows and those subject to flooding or erosion, should be inspected each spring or during peak flow periods to ensure proper operation.

## **5.0 TRAFFIC CONTROL DEVICES**

### **5.1 SIGNING**

#### **5.1.1 STANDARDS**

Signs are used to inform motorists of traffic regulations, warn of changes in the roadway characteristics or hazards, and to provide directional/distance information that is necessary to motorists.

The Alberta Highway Signing Manual, Traffic Control Standards Manual and the Uniform Traffic Control Devices for Canada Manual, provide standards and guidelines for the application of signing along Alberta's highways.

- The department's Traffic Control Standards Manual contains the Alberta standards for sign positioning and layout, including height and setback.
- The Uniform Traffic Control Devices for Canada Manual deals with sign characteristics and application.
- The Alberta Highway Signing Manual contains standards and policies relate to the installation of business signing on Alberta's highways.

#### **5.1.2 INVENTORY INFORMATION**

The department will maintain an accurate database of all signs currently installed along Alberta's provincial highways. The department and the Maintenance Contractor will work together to ensure that all sign information contained in the department's Infrastructure Management System (IMS) is kept current and up-to-date.

### **5.1.3 MAINTENANCE**

All highways should be checked on a regular basis to ensure that all signs are properly in place, functional and conform to established standards. In addition to daytime inspections, night inspections should be carried out regularly to ensure that signs are reflective and legible during hours of darkness. Lighting which has been installed on overhead sign structures should be inspected regularly to ensure that all fixtures are operational.

Signs larger than 3m<sup>2</sup> should be placed on breakaway bases to minimize the potential for injury and vehicle damage if struck by vehicles leaving the roadway. Shear bolts should be checked periodically for proper torque so that the breakaway feature will function as intended.

### **5.1.4 RESPONSIBILITY**

#### Regulatory and Warning Signs

- All regulatory and warning signs within the right-of-way will be maintained by First Nation's, unless other arrangements have been made.

## **5.2 TRAFFIC SIGNALS**

The function of a traffic control signal is to safely assign the right-of-way between the conflicting flows of traffic at an intersection. Standards related to the installations and operation of traffic control signals can be found in the Manual of Uniform Traffic Control Devices for Canada.

## **5.3 PEDESTRIAN SIGNALS**

If warranted, Alberta Infrastructure will install and maintain all pedestrian signals located on the provincial highway network.

In some very unique situations, the department may have allowed local municipalities to install pedestrian signals and cross walks that did not meet the current warrants. In these cases the installing municipality will be responsible for the ongoing operations and maintenance.

In situations where the department became the road authority after the signal installation had occurred (i.e. as per the secondary highway transfer), the department will assume the responsibility for all costs related to the operations and maintenance of the signal.

The MCI should work closely with local municipalities to ensure that all signals, regardless of ownership, function properly. The MCI will ensure that repair and routine maintenance for all department owned signals are promptly completed.

#### **5.4 EMERGENCY VEHICLE ACCESS SIGNALS**

These are special traffic control signals that are installed to aid emergency vehicles to obtain right of way and gain access on to a roadway. Due to the varied nature and purpose of these devices, they have been deemed a municipal responsibility. Typically, these devices are operated by other parties such as fire departments or ambulance/hospital authorities.

### **7.0 SPRING CLEANUP**

#### **7.1 WASHING BRIDGES**

Carried out on an annual basis, this process involves the removal, containment and disposal of all dirt, debris and deleterious material and washing of the bridge structure to remove all ice control (salt) materials.

All bridge surfaces shall be swept prior to washing to minimize the amount of material washed into the watercourse. Deck surfaces, sidewalks, gutters, drainage structures, expansion and deck joints, are to be cleaned of all dirt and debris and flushed with water to remove any remaining chemicals and winter abrasives. This includes railing and truss members to a height of three metres above the deck surface and bridge approaches and all bridge elements for a distance often metres.

#### **7.2 SWEEPING**

In rural areas, scheduled sweeping is undertaken once in spring normally at intersections where there is accumulation of winter sanding material. Sweeping is usually carried out at intersections with turning bays, bridge decks, or along raised median. At other times of the year, sweeping is done as required to remove debris from the road surface (i.e. trucks turning onto the road from a muddy field).

Sweeping and cleaning paved surfaced is undertaken to:

- Remove sand and debris from the pavement surface to avoid damage to vehicles.
- Remove sand and debris from areas scheduled for line and message painting.
- Prevent debris from entering drainage inlets.
- Reduce potential for skidding by increasing traction.
- Remove sand and debris from the pavement surface prior to crack filling or tacking.
- Clean up spills and vehicle accident debris.
- Remove loose chips from pavement surface.

In urban cross-section, if required. The First Nation will sweep from curb to curb once, generally in the spring. Sweeping is usually done with a "pick up broom". This will remove residual sand remaining from winter sanding operations.

## **8.0 LIVESTOCK GUARDS**

Livestock guards are used to prevent domestic and wild animals from entering the roadway. Most livestock guards are installed on approaches to highways; however, there are a small number located on the main highway.

The First Nation shall inspect the guards to ensure that the guard is carrying out its intended function of preventing domestic and wild animals from entering roadway. Accumulated debris must be removed before it causes water drainage problems or builds to a height that it renders the guard ineffective. Repairs to guard and associated fencing are done as required.

# **BRIDGE MAINTENANCE GUIDELINES**

## **INTRODUCTION**

### **BACKGROUND**

Given that the required average life of standard bridges is about 40 years and about 50 years for major bridges and culverts, it is important that these structures be properly maintained to ensure that they reach their full design life.

This section describes maintenance activities that may be required based on the periodic inspection of bridges and culverts, as defined by the Alberta Infrastructure's (AI) Bridge Inspection and Maintenance system (BIM). It specifically deals with bridge maintenance activities that First Nation's can reasonably be expected to undertake.

This section provides a performance standard for each maintenance activity to be undertaken. It should be recognized that modifications to these suggestions might be necessary to accommodate site specific concerns and events.

This section provides general, common sense repair techniques for commonly found defects in bridge materials. The areas covered include timber, repair, signing, guardrail/bridge rail repair, small area concrete patching, culvert strutting and repair of washouts at bridge abutments.

The purpose of the Manual is to provide guidelines for:

- Planning and scheduling bridge maintenance, arising from deficiencies identified during bridge inspection.
- Planning the performance standards to provide information on typical manpower and equipment requirements.
- Performance standards also provide descriptions of general procedures for undertaking the work.

## **1.0 TIMBER STRIPDECK MAINTENANCE**

Timber stripdeck is used as the wearing surface for most timber stringer bridges and steel truss, as well as some steel girder bridges. The stripdeck may be either untreated or CCA treated 3 x 10 or 3 x 12 timbers. The stripdeck may be damaged due to rot penetration, particularly at the cut ends, or wear due to vehicular traffic. The average life of untreated timber stripdeck is dependent on the type and volume of traffic, grade and finish of the lumber, weather conditions, subdeck condition, and type of fastener, but is usually in the order of seven years.

In cases where damage is limited to small areas, it is economical to repair these areas and extend the time before total replacement of the stripdeck is necessary. The wheel lines are often the areas of most wear and may become a safety concern if the deterioration is severe. Any damage should be reported to the AI Regional Bridge Group as soon as possible. Hazard markers may be required if repairs cannot be completed within a day or two.

It is preferable to carry out stripdeck patching or replacement when the surface is dry and free of gravel, snow and ice. Fall is generally the preferred season for stripdeck replacement, however, traffic safety may dictate when maintenance should be done. In some cases, it is less disruptive to the road users and safer to do one side of the bridge at a time.

For low traffic volume roads and smaller bridges, it may be acceptable to allow traffic to travel on the subdeck during stripdeck replacement. For two lane bridges, traffic can be accommodated by replacing half the stripdeck at a time and permitting one lane traffic to continue over the bridge.

## **2.0 REPAIR TIMBER BRIDGERAILS, POSTS AND FLEXBEAM RAILS**

Bridgerails are a safety feature required to protect the public from the hazards associated with falling from the bridge deck. There are a wide variety of bridgerails, dependent primarily on the type of structure and the standards at the time of construction. Typical bridgerails include timber plank, w-beam, steel lattice, vertical bar rail, tube rail and concrete parapet. Damage or deterioration may present a hazard to traffic that warrants signing, repair or replacement of the bridgerails. All repairs associated with steel tube and concrete railing and posts shall be referred to the Regional Bridge office.

Repairs to rail should be scheduled for high visibility hours and times where disruption to the travelling public is projected to be minimal. Work should be performed on one side of the bridge at a time.

## **3.0 INSTALL/REPAIR FLEXBEAM ON BRIDGE APPROACHES**

Flexbeam guardrail on bridge approaches is a required safety feature which protects the travelling public from the hazard associated with a vehicle leaving the road adjacent to bridge structures. The approach flexbeam is generally attached to the bridgerail, which may require one of several types of transition sections. The end of the flexbeam that is away from the bridge is normally a turned down section. Flexbeam should be installed and/or repaired in accordance with current departmental standards.

Installation or repair of bridge approach flexbeam should be done as soon as possible in order to maximize the safety of the travelling public. When repairs cannot be done immediately, appropriate hazard warning must be installed.

#### **4.0 INSTALLATION OF LOAD POSTING SIGNS**

By analysis of the design capacity of the bridge and its elements, a bridge may not be capable of carrying legal loads. Bridges in poor condition may require reduction of the loads that can safely cross the bridge. All bridges that cannot operate at legal highway loading shall be posted to their appropriate capacity in order to protect the users and the bridge. In most installations with new signing, a total of six signs will be required.

#### **5.0 INSTALLATION/REPLACEMENT OF HAZARD MARKERS**

Hazard markers are alternating diagonal striped signs, installed to advise motorists of potentially dangerous roadside obstacles, such as the ends and edges of bridges and the protruding ends of culverts. Hazard markers are generally installed immediately in advance of the hazard, and the diagonal stripes point downward towards the roadway. In the case of standard bridges, the hazard markers are attached to the bridge ends. In some cases, special post brackets are used to allow easy removal and replacement, where necessary, to accommodate wide loads. Missing or damaged hazard markers should be repaired or replaced as soon as possible, in order to maintain safety for the travelling public.

#### **6.0 ROAD CLOSURE ASSOCIATED WITH BRIDGES**

Closure of a bridge to public traffic may be required in emergency situations or during extensive repairs and/or bridge replacement. In general, emergency closure is associated with high risk of collapse or extreme danger to the public.

Structures that are in imminent danger of collapse, or that are dangerous to the user, should be closed immediately. In most cases, this type of closure is not pre-planned and the Local Road Authority maintenance personnel will likely be the first to identify this requirement. It is important that all staff be trained to decisively respond to this type of safety situation and that a plan of action including designated response teams be organized.

In cases where road closure is forecast on the basis of major repairs and/or replacement of the bridge, it is appropriate that such closures be properly planned and coordinated with staff from the Regional Bridge Office and the Bridge Engineering Branch. It is desirable to schedule closures such that inconvenience to the public is minimized. Notice of closure should be published in local newspapers or aired on local radio stations.

#### **7.0 SMALL AREA CONCRETE PATCHING**

Minor patching repair of concrete girders and concrete bridge elements is an economical way to effectively delay rapid deterioration of the element. In general, this type of repair can be used for surface type damages and non-structural repairs.

The nature of the patching required will dictate when the repair should be done. Most patching materials are sensitive to moisture and temperature. Cold weather is generally the poorest time to attempt a repair in an unprotected environment. Hot weather can also be a problem for some patching materials. Timing of the repair will depend on location, volume of traffic, etc.

## **8.0 BANDING SPLIT PILES**

The backfill behind the abutments exerts horizontal pressure against the backwall. If there is not a structural member to resist this force, then the backwall will migrate inwards, pushing the piles. The result will be either the pile splitting at the drift and/or the cap rolling inwards. Both produce an unstable structure. Banding a split pile is a means of preventing the pile from getting worse. Notify the office if over half of the pile is pushed past the cap. An effective long-term solution to movement of the pile or cap is the use of struts, backwall clamps, or spill through abutments.

This job is best performed where access under the bridge is available, during low flows or in winter. Performing the work after a dry spell will increase the likelihood that the timber is not wet prior to working on the bridge.

## **9.0 REPAIR OF BRIDGE ABUTMENT WASHOUTS**

Incases of high flow conditions in a stream, or instances where there is poor alignment of the stream with respect to a bridge crossing, either the headslope or the approach road itself may be washed out or damaged due to overtopping or undermining. In the event of such an occurrence, the first consideration and action to be undertaken is to preserve the safety of the travelling public. Temporary road closures, as well as other precautionary measures, may be required.

The urgency and scope of repairs will be determined by the extent of damage and the importance of the road, based on consideration of factors such as type and volume of traffic, emergency access requirements and Local Road Authority priorities.

## **10.0 HIGH BACKWALL ABUTMENT - REPAIR OF BACKWALL SCOUR**

If left unattended, scour behind a backwall can result in holes appearing in the approach road and/or failure of the bridge. The failure will likely occur with little or no warning during high stream flow.

Factors that can contribute to backwall scour are:

- Poor alignment of the bridge abutment and the stream bed
- High localized stream velocities
- Erodeable stream bed and/or backwall material
- Initial backwall planks set too high

In the event of backwall scour occurring, the first consideration and action to be undertaken is to preserve the safety of the travelling public. Temporary road closures, as well as other precautionary measures, may be required.

The urgency and scope of repairs will be determined by the extent of damage and the importance of the road, based on consideration of factors such as type and volume of traffic, emergency access requirements and A.C.R.S.

### **11.0 PLACING STRUTS ON STANDARDS BRIDGES**

The backfill behind the abutments exerts horizontal pressure against the backwall. If there is not a structural member to resist this force, then the backwall will migrate inwards, pushing the piles. The result will be either the pile splitting at the drift or the caprolling inwards. Both produce an unstable structure. Standard bridges have three means of handling this force: backwall U-clamps around each pile, spill through abutments where the backwall height (or pressure) is not significant, or as describe here, timber struts between piles.

This job is best performed during periods where access under the bridge is available. This occurs either during low flows, or in winter when the ice is thick.

### **12.0 RESTORATION OF BRIDGE HEADSLOPES**

Many bridge crossings are located in river valleys having wide floodplains relative to the width of the main watercourse channel. It is generally impractical and uneconomical to span the entire width of the valley or, in some cases, the total main channel with bridge superstructure. In such cases, fill embankments are used on the bridge approaches to shorten the length of structure required. The portion of fill spilling towards the channel beneath the ends of the bridge is known as a headslope. The slope of the headslope is generally in the range of 2 horizontal to 1 vertical. Since these headslopes are exposed to the concentrated flow of the channel, as well as from drainage of the road approaches and the bridgedeck, they are vulnerable to erosion and scour damage. In some cases, the headslopes will be armored with systems such as riprap and concrete, which are also subject to damage. The extent of repair required will vary depending on site conditions.

Restoration of headslopes and their protective systems is best done when low flow conditions prevail in the watercourse. In general, it is difficult to use motorized equipment when the ground and headslopes are in a wet condition. In emergency situations, it may be possible to end dump heavy rock riprap as a temporary deflector to protect a failing headslope or protection system.

In some cases, concerns about disturbances to the stream bed may affect scheduling the repair. The maintenance contractor is responsible to contact the appropriate provincial or federal environmental agency to obtain all permits and clearances.

### **13.0 BRIDGE WASHING**

Salt accumulation on bridge decks is the leading cause of rapid deterioration of concrete bridge elements. Once salt is transported internally through the concrete, it causes corrosion of the reinforcing structural steel encased in the concrete and, ultimately, leads to spalling of the concrete. Gravel and sand accumulations tend to contain salt and moisture, which provide another source of contaminants, as well as potential abrasion damage to concrete surfaces. Washing concrete decks and other surfaces at least once a year is a cost-effective way to reduce this type of damage.

It is advantageous to wash the bridge decks in the spring, after the danger of freezing temperatures has passed. Removal of gravel and sand, as well as opening of clogged drains, can be done from spring to fall, but is best coordinated with washing, (also see Section 7.1)

### **14.0 SITE CLEANUP**

Most maintenance activities will result in site disturbance and/or waste products. It is environmentally and aesthetically unacceptable to leave sites in a disturbed condition, or to improperly dispose of waste, after maintenance activities are completed.

Site cleanup and waste disposal must be considered in the scheduling of any maintenance projects; weather and traffic conditions are the prime considerations.

### **15.0 REMOVE BEAVER DAM**

The presence of a beaver dam in close proximity to a bridge or culvert opening can significantly reduce the hydraulic capacity of the structure. The resulting damage can range from washout of the crossing to flooding of upstream properties. Removal of the beaver dam can also damage the structure, if improperly done.

Beaver dams are more easily removed in low water conditions. Water depth upstream of the beaver dam should be determined for safety purposes before attempting removal, (also see Section 4.9.3)

### **16.0 TIMBER STRUTTING OF METAL CULVERTS**

Metal culverts are prone to problems associated with improper installation and movement or deterioration of the structural backfill surrounding the pipe. In many cases, the pipe geometry will deform and/or cracking of the seams or plate may occur. In order to prevent collapse of culverts that are severely deformed, struts are used as a temporary repair. The use of timber struts is generally limited to immediate type repairs, where adequacy of opening is not severely

impacted, and drift is not a problem. Strutting is generally used for structures with equivalent diameters between 1500mm and 4000mm.

Strutting is more easily achieved in low or no flow conditions and, therefore, fall and winter conditions generally make for easier installation. In some cases, where risk of collapse is great, dewatering, cleaning out, and water control may be necessary. In situations where the amount of fill over the culvert is less than 1800mm, consideration should be given to limiting traffic over the structure while it is under repair. In no case should a repair be attempted on a severely deformed culvert under low fill without the supervision of qualified bridge staff.

# HIGHWAY MAINTENANCE GUIDELINES AND LEVEL OF SERVICE MANUAL

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