



**Millar Western Forest Products Ltd.**

# **Compartment Road Network Access Plan**

**2007-2016 Detailed Forest Management Plan**

June 19, 2007





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# 1. Introduction

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## 1.1 Background

The compartment road network access plan is intended to show the main access corridors to all compartments within Millar Western Forest Products Ltd.'s FMA9700034. The road corridors included have been categorized as either proposed (the road has only been planned and not yet laid out or completely verified), active (the road has been constructed to some type of grade), or erosion controlled (the road has been temporarily reclaimed). The following plan describes only the proposed road corridors, as they have not been previously approved.

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## 1.2 Stakeholder Consultation

Oil and gas companies that operate on the FMA were sent a map of the compartment road network access plan in late July, 2006. There have been limited comments received. Further communication is planned with the Oil and Gas companies to facilitate potential collaborating on road access.

Contact with Forest Company representatives are planned for those companies that have overlapping tenures on Millar Western Forest Products Ltd.'s FMA9700034.

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## 1.3 Standard Construction Practices

Millar Western Forest Products Ltd.'s Road Construction, Road Reclamation and Stream Crossing Guidelines are included as appendices to this document.



The following Company documents, describing road construction, maintenance and reclamation, are included within the Appendices of this document as follows:

- Appendix II – Road Construction and Reclamation – Stream Crossing Guidelines (WOG-ROA-0012)
- Appendix III – Road Construction and Water Crossings (WOI-ROA-001)
- Appendix IV – Road Maintenance (WOI-ROA-003)
- Appendix V – Road Reclamation (WOI-ROA-004)
- Appendix VI – Sediment and Erosion Control (WOG-ROA-005)
- Appendix VII – Culvert Sizing Table (WOG-PLA-001)



## 2. Proposed Road Corridors

Table 1 identifies each proposed road's season of use and the compartments to which it will provide access to. The remainder of this section provides further details for each road, including its length, duration, major watercourse crossings, wildlife or other disposition considerations and any measures that may be required to mitigate impacts from the road. Appendix I contains the accompanying map to this plan, illustrating the location and status of these roads.

**Table 1. Table 1 – Proposed Road Corridors**

Road Name	Season of Use	Access to Compartment
AKU100	Winter	AKUINU
AKUINU MAIN	Winter	AKUINU & MUD CREEK
ATHABASCA FLATS	Winter	GOODWIN LAKE
BRLSH360	Summer	COUTTS & DORIS
CLEARWATER MAIN	Summer	CLEARWATER LAKE
COU100	Winter	COUTTS
COU300	Summer	COUTTS
COUTTS MAIN	Winter	COUTTS & FOLEY LAKE
DOR200	Summer	DORIS
DORIS MAIN	Winter	DORIS & ERICKSON LAKE
ELK1000	Summer	ERICKSON LAKE
ERICKSONLAKE ROAD	Summer	NORTH FREEMAN, CLEARWATER & ERICKSON LAKE
FOLEY CREEK MAIN	Winter	FOLEY CREEK
LONGEND LAKE MAIN	Winter	LONG END LAKE & MUD CREEK
MUD200	Winter	MUD CREEK
NGMAIN	Summer	NORTH GOOSE
OCELOT CONNECTOR	All Season	GOODWIN LAKE & BESSIE CREEK
OK500	Winter	FOLEY CREEK
PADDLE RIVER ROAD	Winter	PADDLE RIVER
SAKWATAMAU ML	Winter	SAKWATAMAU
SCCUT ACROSS 2	Winter	BESSIE CREEK
SCCUT ACROSS 3	Winter	BESSIE CREEK
SOUTH FREEMAN MAIN	Summer	SOUTH FREEMAN
THOCE CONNECTOR	All Season	TOM HILL & OCELOT
TIVERTON 1	Summer	MEEKWAP

## 2.1 AKU100 Road

### *Compartments Accessed*

Akuinu

### *Season of Use*

Winter

### *Length Of Road*

Approximately 6.6km – 5.4km is existing road under LOC by Apache Canada, Nexen Inc. and Conoco-Phillips

### *Duration of Use*

20 years





***Major Crossings (ie Bridges)***

None planned

***Wildlife Zones***

Entire road is in Zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1812 (Edward Graham)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.2 Akuinu Main Road**

***Compartments Accessed***

Mud Creek, Akuinu

***Season of Use***

Winter

***Length Of Road***

Approximately 23km – 20.5km is existing road under LOC by Apache Canada, Canadian Natural Resources Ltd.

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

All major crossings are associated with existing LOC portion and will have to be re-established.

### ***Wildlife Zones***

Approximately 16.4 km of Akuinu Main falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplins***

1812(Edward Graham) and 1738(Ike Ramsey)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.3 Athabasca Flats Road**

### ***Compartments Accessed***

Goodwin Lake

### ***Season of Use***

Winter

### ***Length Of Road***

Approximately 1.9km

### ***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Entire road is in Zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1697 (Glenn Standish)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.4 BRLSH360**

***Compartments Accessed***

Coutts and Doris

***Season of Use***

Summer

***Length Of Road***

Approximately 13.4km – 12.7km is existing summer grade under LOC 990889, 2629 and 1846 and 675m is proposed winter road under LOC 2629.

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

One major crossing is proposed with this road. If conditions permit, it will be snow filled or a bridge will be installed.

### ***Wildlife Zones***

Approximately 2.6km of Akuinu Main falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

1580 (Bailey Franklin)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.5 Clearwater Main Road**

### ***Compartments Accessed***

Clearwater

### ***Season of Use***

Summer

### ***Length Of Road***

Approximately 12.2km – 2.9km is under LOC by Millar Western Forest Products Ltd. and OK Lumber Ltd.

### ***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Approximately 6 km of the road falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1306 (Allan Pedersen), 1565 (Lynn Fleming) and 1330 (Brian Ruffiange).

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

Road comes within 1 km of a protected area listed for The Center of Alberta. No alternative plans for the road as a result of the protective area.

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.6 COU100 Road**

***Compartments Accessed***

Coutts

***Season of Use***

Winter

***Length Of Road***

Approximately 9.4km.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Approximately 1.2km of the road falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1705 (Joseph Burnstick) and 1286 (Stuart Voight).

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.7 COU300 Road**

***Compartments Accessed***

Coutts

***Season of Use***

Summer

***Length Of Road***

Approximately 9.2km.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Approximately 1.8km of the road falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1705 (Joseph Burnstick) and 1580 (Bailey Franklin).

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.8 COUTTS MAIN Road**

***Compartments Accessed***

Coutts

***Season of Use***

Winter

***Length Of Road***

Approximately 11.1km - 9.8km is existing road under LOC by Prairie Schooner, Spruceland Millworks, and Alberta Plywood.

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

One major crossing over the Coult's River, which is already constructed

### ***Wildlife Zones***

Approximately 2.3km of the road falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

1286 (Stuart Voight)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

Snowmobile Crossing Signage will need to be established with local club.

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.9 DOR200 Road**

### ***Compartments Accessed***

Doris

### ***Season of Use***

Summer

### ***Length Of Road***

Approximately 4.7km

### ***Duration of Use***

20 years





***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

N/A

***Traplines***

1580 (Bailey Franklin), 1705 (Joseph Burnstick) and 1565 (Lynn Fleming).

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.10 Doris Main Road**

***Compartments Accessed***

Erickson Lake and Doris

***Season of Use***

Winter

***Length Of Road***

Approximately 10.5km - 8.3km is existing road under LOC by Spruceland Millworks and OK Lumber.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

One existing major crossing.

***Wildlife Zones***

N/A

***Traplines***

1306 (Allan Pedersen) and 1565 (Lynn Fleming).

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.11 ELK1000 Road**

***Compartments Accessed***

Erickson Lake

***Season of Use***

Summer

***Length Of Road***

Approximately 14.5km – 12.6km is existing road under LOC by Prairie Schooner and Alberta Independent Loggers.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

689m of existing road is within wildlife zone B. No measures are planned for this section.

***Traplines***

1306 (Allan Pedersen), 1565 (Lynn Flemming) and 1705 (Joseph Burnstick)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.12 Erickson Lake Road**

***Compartments Accessed***

North Freeman, Clearwater, Erickson Lake

***Season of Use***

Summer

***Length Of Road***

Approximately 16.9km

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

Two major crossings are associated with this road. If conditions permit, they will be snow filled or a bridge will be installed.

### ***Wildlife Zones***

Approximately 7.4km of the road falls within Wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

2471 (Larry Olsen), 1330 (Brian Ruffange), 1565 (Lynn Flemming) and 1306 (Allan Pedersen)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.13 Foley Creek Main Road**

### ***Compartments Accessed***

Foley Creek

### ***Season of Use***

Winter

### ***Length Of Road***

Approximately 7km

### ***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

One major crossing is associated with this road. If conditions permit, it will be snow filled or a bridge will be installed.

***Wildlife Zones***

N/A

***Traplines***

1812 (Edward Graham) and 1687 (David Ehl)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.14 LongEnd Lake Main Road**

***Compartments Accessed***

Long End Lake

***Season of Use***

Winter

***Length Of Road***

Approximately 24km – 19.9km is existing road under LOC by Apache Canada and Canadian Natural Resources Ltd.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

There is one existing crossing.

***Wildlife Zones***

Approximately 14.2km falls within wildlife zone E with the remainder is in wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1738 (Ike Ramsey), 1438 (Barry Properzi), 2018 (Richard Aarsen) and 2410 (Lloyd Coles)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.15 MUD200 Road**

***Compartments Accessed***

Mud Creek

***Season of Use***

Winter

***Length Of Road***

Approximately 2km – 1.6km is existing road under LOC by Apache Canada and Canadian Natural Resources Ltd.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Entire road falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplins***

1738 (Ike Ramsey)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.16 NGMAIN Road**

***Compartments Accessed***

North Goose

***Season of Use***

Summer

***Length Of Road***

Approximately 12.6km – 2.0km is existing road under LOC by Connoco Phillips Canada.

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

There is one existing crossing established on the Connoco Phillips Canada LOC.

### ***Wildlife Zones***

Approximately 2.2 km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

2002 (Rodney Crawford) and 335 (John Chester)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.17 Ocelot Connector Road**

### ***Compartments Accessed***

Goodwin Lake, Bessie Creek

### ***Season of Use***

All season

### ***Length Of Road***

Approximately 16km – 6.1km is existing road under LOC by Millar Western Forest Products Ltd. and Penn West Petroleum Ltd.

### ***Duration of Use***

20 years





***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Approximately 4.4km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1697 (Glenn Standish) and 1688 (David Werner)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

Snowmobile Crossing Signage will need to be established with local club.

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.18 OK500**

***Compartments Accessed***

Foley Creek

***Season of Use***

Winter

***Length Of Road***

Approximately 4.1km – 600m is existing road held under LOC by Apache Canada Ltd.

***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

Approximately 1.7km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

***Traplines***

1687 (David Ehl)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.19 Paddle River Road**

***Compartments Accessed***

Paddle River

***Season of Use***

Winter

***Length Of Road***

Approximately 13km of existing road held under LOC by Weyerhaeuser Company Ltd and Shiningbank Energy Ltd.

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

Five major crossings are associated with this road. If conditions permit, they will be snow filled or a bridge will be installed.

### ***Wildlife Zones***

The entire road falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

2369 (John Davis) and 1844 (Dave Wilson)

### ***Grazing Dispositions***

GRL39887 (Teodore Commandeur) and FGL940013 (Geoff Strydhorst)

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.20 Sakwatamau ML Road**

### ***Compartments Accessed***

Baseline Lake and Sakwatamau

### ***Season of Use***

Winter

### ***Length Of Road***

Approximately 15.0km – 11.4km is existing road under LOC by Millar Western Forest Products Ltd. with the remaining 3.6 km as proposed road.

### ***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

N/A

***Traplines***

378 (Keith Mitchell)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.21 SCCut Across 2 Road**

***Compartments Accessed***

Would act as a link to Windfall, North half of Tom Hill, Athabasca, West Windfall, Pine Creek and Bessie Creek

***Season of Use***

Winter

***Length Of Road***

Approximately 8.5km

***Duration of Use***

20 years



### ***Major Crossings (ie Bridges)***

One major crossing is associated with this road. If conditions permit, it will be snow filled or a bridge will be installed.

### ***Wildlife Zones***

Approximately 3.8km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplins***

1697 (Glenn Standish)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.22 SCCut Across 3 Road**

### ***Compartments Accessed***

This section of road is a realignment in conjunction with SCCutacross2 and would act as a link to Windfall, North half of Tom Hill, Athabasca, West Windfall, Pine Creek and Bessie Creek.

### ***Season of Use***

Winter

### ***Length Of Road***

Approximately 0.5km

### ***Duration of Use***

20 years



***Major Crossings (ie Bridges)***

N/A

***Wildlife Zones***

N/A

***Traplines***

1697 (Glenn Standish)

***Grazing Dispositions***

N/A

***Protected/Recreation Areas***

N/A

***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.23 South Freeman Main Road**

***Compartments Accessed***

South Freeman

***Season of Use***

Summer

***Length Of Road***

Approximately 6.7km

***Duration of Use***

20 years

***Major Crossings (ie Bridges)***

N/A



### ***Wildlife Zones***

Approximately 2.7km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

2471 (Larry Olsen) and 1709 (Gordon Cross)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

N/A

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## **2.24 THOCE Connector Road**

### ***Compartments Accessed***

South half of West Windfall and South half of Tom Hill

### ***Season of Use***

All Season

### ***Length Of Road***

3.7km

### ***Duration of Use***

20 years

### ***Major Crossings (ie Bridges)***

One major crossing is planned



### ***Wildlife Zones***

Approximately 1.1km falls within wildlife zone B. With permission from the LOC holder(s) all crossings not associated with an all season LOC will be temporarily deactivated after operations are complete and the road will be seasonally erosion controlled.

### ***Traplines***

1407 (Ronald Hellekson)

### ***Grazing Dispositions***

N/A

### ***Protected/Recreation Areas***

N/A

### ***Mitigative Measures (ie timing constraints, access control)***

Access control gate installed on the bridge over the Old Man River

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## **2.25 TIVERTON1 Road**

### ***Compartments Accessed***

Meekwap

### ***Season of Use***

Summer

### ***Length Of Road***

4km

### ***Duration of Use***

20 years

### ***Major Crossings (ie Bridges)***

N/A





*Wildlife Zones*

N/A

*Traplines*

832 (Russell Willier)

*Grazing Dispositions*

N/A

*Protected/Recreation Areas*

N/A

*Mitigative Measures (ie timing constraints, access control)*

N/A





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## Appendix I – Road Corridor Plan Map





## **Appendix II – Road Construction and Reclamation – Stream Crossing Guidelines (WOG-ROA-0012)**







## Road Construction, Road Reclamation and Stream Crossing Guidelines





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**BRIDGE INSPECTION FORM 57**

**BRIDGE INSPECTION FORM 58**

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# ROAD CONSTRUCTION, ROAD RECLAMATION AND STREAM CROSSING GUIDELINES

## Purpose

To ensure our road construction, reclamation and stream crossing activities are performed in such a way that the protection of other resources is maintained and compliance with legislation is achieved.

## Scope

Provide our staff and contractors with a guideline that is specific enough to address most day to day situations. Keeping in mind however that every road and every stream crossing is different and site specific guidelines are not feasible. The intent of this document is to provide general direction and not a step by step prescription.



**OPERATIONAL GUIDELINES FOR MAINTAINING ACCESS FOR COMMERCIAL & NON-COMMERCIAL STAKEHOLDERS**

It is important to maintain access for other users of the forest and to maintain erosion control while still providing access to areas of heavy usage.

Millar Western and contractor supervisors must instruct operators in their area of any additional work that must be done to ensure that access is maintained. Maps must be provided to operators that clearly indicate the locations of seismic lines, power lines and pipelines. Existing trails and snowmobile crossings must also be shown on these maps. Machine travel is restricted to the approved routes indicated on the maps.

It is the responsibility of road building equipment operators to keep maintained access intact. While constructing roads do not pile strippings where any existing lines intersect the logging road. During reclamation activities ensure that existing lines remain accessible. ATV access must be maintained when reclaiming any road that uses part of an existing line.

Equipment operators must keep slash and log decks from obstructing existing lines. It will be the responsibility of the contractor to move any obstructions to access even if the operations have left the area. When parking your equipment, vehicles, shop trailers and camps do not block access. Your Supervisor must approve the location of stationary equipment.



ROAD CONSTRUCTION GUIDELINES

**Class I Roads**

- Primary permanent all weather road with a life of 20 plus years.
- R.O.W. will be a variable width 30-50m (100-150').
- Running surface shall be 8-12m (25-33') and must be level.
- Ditches have to be 1.0m plus with a flat bottom.
- Watercourse crossings will be permanent.

**Class II Roads**

- Secondary permanent all weather or dry weather road with a life of 5 – 20 plus years.
- R.O.W. will be a variable width 20-30m (66-100').
- Running surface shall be 5-10m (16-33') and must be level.
- Ditches have to be 0.6m plus with a round bottom.
- Watercourse crossings will be permanent.

**Class III Roads**

- Class III roads are tertiary winter or dry weather roads with a life up to 20 years.
- R.O.W. will be a variable width with a maximum of 20m (66') with the road on the north side where possible to optimise drying of the road surface.
- Running surface shall not exceed 10m (33') and must be level.
- R.O.W decks must be placed to one side of the R.O.W to ensure the road alignment is maintained.

**Class IV Roads**

- Class IV roads are temporary winter or dry conditions with a life span up to 5 years.
- R.O.W. will be a variable width with a maximum of 20m (66') with the road on the north side where possible to optimise drying of the road surface.
- Running surface shall not exceed 10m (33') and must be level.
- R.O.W decks must be placed to one side of the R.O.W to ensure the road alignment is maintained.
- Road surfaces shall not be cleared to bare mineral soil where possible; however, stumps or large woody debris must be cleared away to minimize damage to maintenance equipment.
- Finished log decks should be no more than 8m (26') apart.



### General Guidelines for Road Construction

- On those parts of the right of way not used for grade construction, disturbance to the duff and organic soil shall be minimized to reduce damage to the roots of bordering trees and to provide a protective soil cover.
- Trees with root systems damaged by road construction shall be removed from the edge of a road cut.
- Roads must be properly drained to disperse water.
- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses. Vegetated buffers shall be left or a system of obstructions installed to dissipate the force of water, where buffers alone do not retard water and soil movement effectively.
- If ditches are required they shall be deep enough to drain the subgrade. Ditch backslopes shall have a regular profile from the top of the cut to the bottom with no hanging banks or sharply cut ditches. Ditch backslopes should match the soil types natural angle of repose, unless other measures are taken to stabilize the slope. For Class IV winter roads ditches should be constructed as required.
- Cross drains shall be installed to mitigate erosion on barred surfaces
- To maintain safe traffic flow pullouts will be constructed every 250 metres where necessary (half way between turn around areas). Construction dimensions shall be 40 metres (130') long and 5 metres (16') wide excluding the travelled road surface.
- Stumps and other debris will be feathered back to the sides and walked down in cut-to-length blocks and if the road is to be left open for more than one year.
- The mill side of each deck shall be cleared of any debris to facilitate safe log loading.
- Soil or fine granular material is to be left after road construction and the opening of inventory blocks for proper grading. This material is to be left in a windrow approximately 30 cm (1') high no closer than 60 cm (2') to the road edge.
- Watercourse crossings will vary between operating seasons and will be pre-determined by Millar Western staff, depending on access strategies.
- Lesser vegetation shall be maintained approximately 30m (100') back from a crossing within the riparian area.





## Truck Turning Areas

### Construction

- Turn around areas are needed at least every 500 metres on spur roads with no exit.
- The entrance to each turn around area must be flared sufficiently to easily allow all types of truck and trailer combinations to back into and pull out of the turn around. The flared entrance should be a minimum of 15 metres (50') wide. Approximately three dozer blade widths.
- Each turn around must be a minimum of 30 metres (100') in length to allow sufficient room for the truck and trailer to back into the turn around.
- Turn around areas must be constructed on level ground or the up hill side of the road. The up hill slope of a turn around should not be sloped too much that it will cause difficulty for a truck and trailer to enter.

## Borrow Pits

### Construction

(All Borrow Pits will have previous approval from Millar Western Staff)

- Borrow pits are to be kept to a minimum.
- Borrow pits are to be kept within the actual ROW, unless otherwise instructed.
- They should be located approximately 30m (100') from any watercourse.
- They should be no greater than 40m by 50m (131' x 164').
- Borrow pits that fall outside of the road right of way will require prior approval from the LFD.
- Borrow pits will be backsloped and reclaimed concurrent with construction activities.
- 

### Reclamation

- Fill the borrow pit with strippings from the road construction.
- Make sure the borrow pit is self-draining wherever possible.
- Borrow pits should be backsloped at 2:1 depending on the soil types.



## ROAD RECLAMATION GUIDELINES

### Temporary Roads

#### Erosion Control (Seasonal):

Refers to the construction of cross-ditches in order to prevent erosion of road running surface and keep access to a minimum.

- All temporary and permanent crossings will be removed unless instructed otherwise.
- Crossings will be reclaimed as per the Standardized Stream Crossing Guidelines.
- The road will be cross-ditched to disperse water flow and seeded to grass to prevent erosion.
- Ensure cross-ditches are deep enough to divert water and achieve access control. Refer to the tables below for the spacing of the cross-ditches based on soil types and slope gradient.
- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses.
- Steeper slopes will be cross-ditched and some slash may be scattered on the road surface.
- Ensure all seismic lines and trails are clear of slash for ATV travel.
- Access control measures may be required; MWFP personnel will identify these locations.

#### Deactivation (Total):

Refers to the total rolling back of the road surface; returning it to productive ground within the block.

- All crossings will be removed.
- Crossings will be reclaimed as per the Standardized Stream Crossing Guidelines.
- Slash, stumps, and topsoil will be pulled back onto the road surface.
- Deep ripping of the road surface may be required.
- The road surface will be contoured to ensure drainage and stabilization is re-established.
- The road will be cross-ditched where required dispersing water flow away from watercourses. Refer to the tables below for the spacing of the cross-ditches based on soil types and slope gradient.
- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses.
- Crossing locations and other erodible surfaces should be seeded to grass.
- Ensure all seismic lines and trails are clear of slash for ATV travel.
- Helipad locations are to be maintained in all blocks not adjacent to a permanent all-weather road.

#### Cross Ditch & Waterbar Spacing Guidelines

Road Gradient %	Soil Type		
	Silts & Sands	Cohesive Clays	Gravels
0 – 5	100 meters	160 meters	210 meters
6 – 10	80 meters	110 meters	160 meters
11 – 15	50 meters	90 meters	130 meters
16 +	Site Specific		

Spacing in the above Table should be modified for slope position and steepness as follows:



### Correction Factors

Slope Position	Side Slope %			
	0 - 20	21 - 40	41 - 60	>61%
Upper Slope	1.0	0.8	0.7	Site Specific
Middle Slope	0.8	0.7	0.6	
Lower Slope	0.7	0.6	0.5	

\* Tables adapted from Deactivation and Safety Manual, Eric L. Kay.

### To Use the Tables

1. Divide the road into sections of similar grades, soil types and slope.
2. Measure the average road gradient in percent.
3. Visually estimate the soil type in the ditches and on the road surface. Choose the spacing require for the most erodible soil. Erodibility generally decreases:

Silt → Fine Sand → Sand → Clay → Gravel

4. Choose the slope position
5. Measure the average side slope for the road section.
6. Choose the basic spacing from the road gradient and soil type, and multiply it by the appropriate correction factor.

Example:

Silt soil, road gradient-15%, side slope-15%, middle slope.

Water bar spacing should be: 50m. \* 0.8 = 40m.

Note: On flat ground (swamps) and black spruce areas away from slopes, water bars and cross ditches are generally not required. Cross ditches in low lying areas will pool water and create a greater hazard than leaving the vegetation intact and maintaining the original drainage patterns.

### Helipads

- Helipads must be maintained in blocks that are not adjacent to permanent all weather roads.
- Helipads will be constructed on level ground, clear of slash, and not have any standing trees within 30m (100').
- The dimensions of the pad shall be approximately 20m x 20m (66'x 66')in size.
- The slash around the perimeter of the helipad shall be walked down to prevent debris coming in contact with the rotor of the helicopter.
- Ensure there is no risk of erosion on the helipad site.
- Road intersections and haul truck pullouts may be utilized for helipads.
- Approximately one pad per 20 hectares shall be constructed.



**STREAM CROSSING GUIDELINES**

**Snow Fill (Appendix I)**

**Construction:**

- Stream channel is to be filled with clean snow to a minimum of 60cm (24"), or to the top of the stream banks. Clean snow will be obtained from road right of ways that have not been plowed, or cut blocks, etc.
- The snowfill should be a minimum of 7m (22') wide extending 1m (3') past the road running surface on each side.
- If snow is being hauled to the site, ensure the box of the dump truck is clean prior to loading the snow.
- The snow is pushed into the stream channel and compacted with a small cat (i.e. D3 or D5).
- A snow berm will be built up approximately 30cm - 60cm (12" - 24") parallel with the road on both sides of the snow fill, to prevent the soil from leaving the running surface of the snow fill and impacting the stream.
- Over the surface of the snow fill and between the snow berms, approximately 15cm (6") of soil or wet snow will be placed to provide structural integrity to the running surface. Soil is available from the construction of the road or from a borrow pit.

**Reclamation:**

- Rip up the soil cap on the snow fill.
- The ripped soil cap and dirty snow will be removed away from the creek bank and spread evenly on the disturbed road running surface.
- Soil caps should be disposed in a manner that will not allow siltation back into the watercourse.
- The clean snow will be notched without disturbing the vegetation or gully sides. This will allow the stream flow in the spring to naturally remove the remainder of the snow fill.
- Any disturbed areas shall be seeded to grass.



### Log Fills (Appendix II)

#### Installation:

- Fill bottom of stream channel 25 – 30% with logs and a minimum of 2m (6') from the centre of the channel or to the top of the breaks (Black Poplar if it is available).
- The diameter of the logs should be as large as possible and should be topped before being placed in the channel. The lengths must be a minimum of 10m (32') to ensure the logs extend a minimum of 1.5m (5') past the grade fill.
- Cover logs with 60 - 90cm (24 - 36") of conifer boughs or geo-jute.
- Guard logs should be used if there is a risk of soil entering the watercourse.
- Cover conifer boughs or burlap with a soil cap, the soil cap shall not exceed 30cm (12"). The soil cap must only be applied when there is a proper separation layer to contain the soil on top of the crossing. Only mineral soil is to be used as a cap, no slash (stumps or limbs) are to be mixed in.

#### Reclamation:

- Use an excavator as the first choice of equipment
- Rip up the soil cap on the log fill.
- The ripped soil cap and the separation layer will be removed to the log layer.
- Limbs and boughs will be used for road reclamation,
- Remove logs, not disturbing the stream channel vegetation.
- Logs should be removed 9m (30 ft) from the crossing itself (mill side of logging operations).
- The ripped soil cap and dirty snow will be removed away from the creek bank and spread evenly on the disturbed road running surface.
- Soil caps should be disposed in a manner that will not allow siltation back into the watercourse.
- Any disturbed areas shall be seeded to grass.

### Culverts (Appendix III) (300mm up to 1500mm diameter)

#### Installation

- Conduct a pre-work meeting.
- Installations on fish bearing streams require DFO approval.
- Where Federal permits are obtained the plan attached to the approval must be followed.
- Assemble culvert where appropriate, preferably on dry ground prior to installation.
- Excavate base to follow the natural grade and ensure the base is solid enough to maintain the natural grade of the watercourse.
- Place the culvert in position ready to be backfilled, culvert should then be checked to ensure the proper grade has been obtained for drainage.
- Culverts must be embedded in the stream bed 10% of the culvert's diameter.
- Place fill over upstream end of the culvert first then the downstream end, this will isolate stream flow into the culvert, thereby protecting the stream from backfilling activities.
- Place fill over centre of the culvert to stabilize it.
- Complete the backfilling procedure ensuring adequate compaction is achieved while bringing the fill level up to the finished road surface.
- It is extremely important to have the same amount of fill as the culvert's diameter before crossing over with equipment. (1m diameter culvert then 1m of fill over top)
- Rip-rap should be placed where required (**NOT IN THE CHANNEL**).



### **Removal and Reclamation**

- Remove as much of the fill over the culvert as possible but leave some fill at each end of the culvert to maintain flow direction into the culvert.
- Remove remainder of the fill starting at the downstream end and working towards the upstream end.
- Proceed with the removal of the culvert.
- Remove the remainder of the fill from within the gully to an approximate distance of 9m from the stream and/or out of the active channel in which the stream flows.
- Fill slope must be stabilized and all disturbed areas shall be seeded to grass.

### **Culverts (>1.5m)**

#### **Installation**

- Detailed information such as silt fences and diversion ditches on each permanent (fish bearing or non-fish bearing) creek crossing will be provided by the Area Supervisor at the time of installation.
- Plans must be on site and followed.
- Installations on fish bearing streams require DFO approval.
- Where Federal approvals are obtained, the plan attached to the approval must be followed.
- Culverts > 1.5m require a provincial approval under the Water Act.

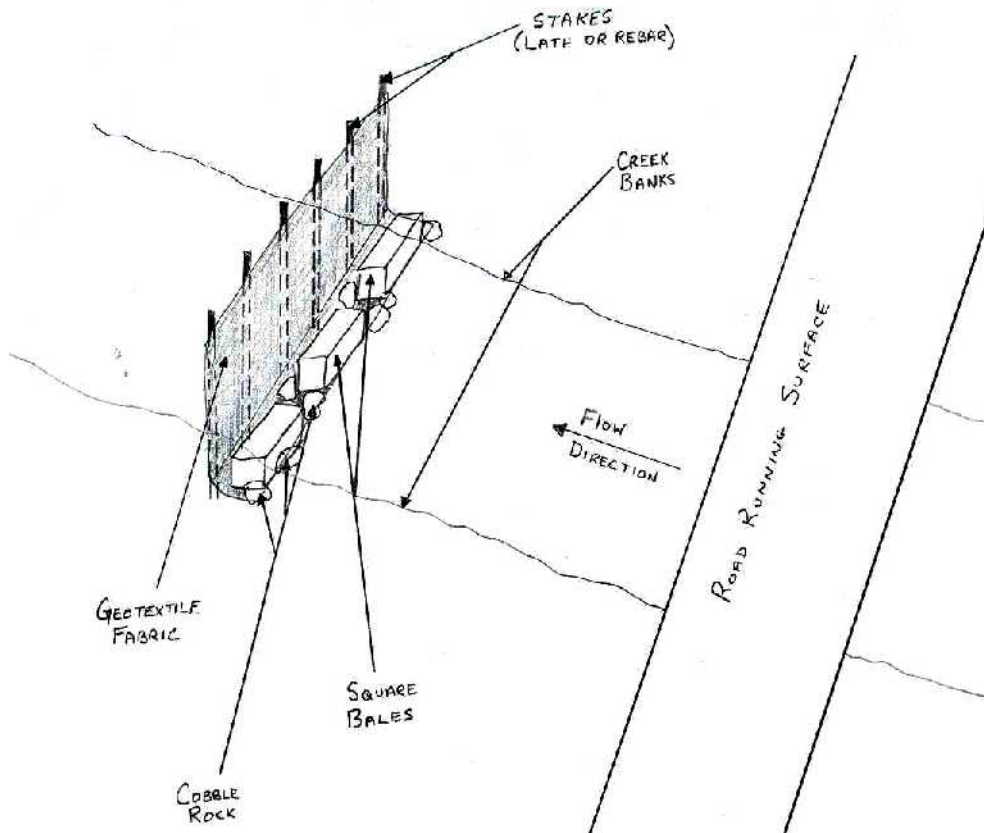
### **Mitigative Measures for Fish Creek Culvert Crossings**

#### **SILT FENCES**

1. 3 silt fences must be installed below watercourse crossing at least 20m (60') apart.
2. Each silt fence will have an extra 30cm of textile positioned on the ground in front of stakes. (Figure 1)
3. Rocks will be placed on the extra material and straw bales will be placed over top of this extra textile.
4. Once the silt fences are installed correctly, the construction supervisor will inspect them before any works will proceed.
5. An Aqua Dam or diversion ditch must be installed to allow diversion of water from the installation site. (See Aqua Dam or Diversion Ditch)
6. The creek channel will then be prepared for installation of the culvert at the proper slope.
7. The culvert will be placed into the channel and embedded approximately 10% of the culverts diameter into the creek channel.
8. Back filling will occur once culvert is placed and has proper alignment.
9. Once culvert is fully installed the silt fences will then be cleaned of all silt material by hand shovel.
10. The silt fences will be removed after culvert installation is complete.



Figure 1: Silt Fences



### AQUA DAM

Aqua Dam is used to stop water flow through crossing. The backed up water is then pumped around the site and allowed to re-enter the creek channel above the first silt fence.

1. Aqua dam is to be installed in a confined section of the creek channel where ground seepage is a minimum.
2. Large cobbles may have to be moved by hand to allow a smooth creek bottom for proper seal underneath the Aqua Dam.
3. Water is then pumped for the creek channel into the Aqua Dam bags on both sides. The water levels in each bag have to be equal to prevent any creep of the Aqua Dam downstream. As the water levels come up the Aqua Dam seals off the water from proceeding downstream.
4. The water that begins to back-up behind the Aqua Dam is then pumped around the installation site and is released back into the creek channel above the first silt fence.
5. Once culvert installation is complete, the water is slowly emptied out of the Aqua Dam by pulling on the open end of the bags.
6. Normal water flow is allowed to proceed once the dam is removed.



Placement of Aqua Dam



Bag Fills Across Stream

Filling up Bags Equally



Checking for Proper Seal





Channel is Totally Sealed Off

### **Diversion Ditch**

A diversion ditch is installed if an Aqua Dam will not seal off water flow.

1. A diversion ditch is dug from above the first silt fence to above the installation site.
2. Banks in the diversion ditch must be backsloped and armoured with non-erodible material.
3. Once the ditch is protected from erosion possibility, the ditch can then be opened up to the creek to allow water flow through the ditch.
4. Installation of the culvert proceeds once the water is totally removed from the installation site.
5. Once culvert is in place and has been back-filled, the ditch is blocked off with non-erodible material, to allow the water to return to the natural channel.
6. Once water has emptied out of the diversion ditch, it can be back-filled with appropriate subgrade materials.



### Permanent Steel Bridge (Single Span) (Appendix IV)

#### Installation

- Install portable crossing as per instructions to cross the watercourse.
- Install appropriate abutment and retaining wall configuration.
- Assemble retaining wall if required and line with soil separator.
- Fill retaining wall with appropriate material and ensure adequate compaction.
- Move equipment to the other side of the stream utilizing a portable crossing.
- Repeat steps for the installation of abutments and retaining walls on bush side.
- Move bridge to the abutment.
- While equipment is on the other side of the stream attach a cable line from the equipment to the bridge.
- Sometimes it will be necessary to winch the steel bridge from a winch-truck
- Maintain pressure and tension from both sides of the crossing with equipment to ensure that the bridge is installed with no impact to the stream.
- Lift bridge up onto the abutment.
- Set bridge on the appropriate sills.
- Build road grade up to level of bridge deck.
- Provide appropriate erosion control measures and grass seed exposed areas.
- Remove portable bridge.

#### Removal and Reclamation

- Remove road grade up to the edge of bridge in preparation for removal on the "mill side."
- Walk machinery over to the "bush side" of the bridge.
- Remove road grade down to the level of the retaining wall.
- Back low-bed in with winch tractor & hook up slings.
- Hook up line from the equipment to the bridge (bush side).
- Winch bridge onto lowbed while maintaining tension with equipment.
- Remove fill from retaining wall and replace it to the original ground line with equipment unless otherwise instructed.
- Build ditch block along the road and approach to the bridge.
- Cross the stream in a approved manner.
- Remove fill from remaining retaining wall and replace it to the original ground line with equipment.
- Build ditch block along the road and approach to the bridge.
- Seed exposed areas to grass.



### Native Timber Bridge (Appendix V)

#### **Installation:**

- Corduroy the approach to the crossing site if required to protect the immediate banks of the watercourse for approximately 2.5m (8").
- Drive four piles, one on each corner, a minimum of 1m (3") from the creek and a minimum of 7.0 m (22') apart.
- Lay a minimum of 2 sill logs on the outside of each set of piles a minimum of 7.5m (24') long so that you have a foot extending past each pile.
- Lay stringers with butts alternating between piles and on top of the sill logs
- Lay deck logs between piles and perpendicular to stringers.
- Corduroy the bush side of the crossing if required to protect the immediate banks of the watercourse, for approximately 2.5m (8").
- Lay strips of geo-jute (separation layer) parallel with deck and long enough to wrap back over guard logs with a minimum overlap of 30cm (12").
- Lay a large log as a guard rail on the inside of each set of piles parallel with the road surface and wrap the geo-jute back over the top of the guard logs. Guard logs must be a minimum of 5.5m (18') apart.
- Lay a minimum of 24-36 cm (2') of conifer boughs over the geo-jute if available, and cap with approximately 15-30cm (6-12") of dirt.
- Soil cap must not exceed height of the guard logs. The soil cap must only be applied when there is a proper separation layer to contain the soil on top of the crossing. Only mineral soil is to be used as a cap, no slash (stumps or limbs) are to be mixed in.
- Refer to the FERIC log bridge design criteria for species and dimensions based on span.

#### **Reclamation:**

- Remove road grade up to the edge of bridge in preparation for removal on the "bush side".
- Walk equipment over to the "mill side" of the bridge.
- Rip the dirt cap just enough to enable the machinery to remove the dirt cap, limbs and geo-jute.
- Remove road grade down to the corduroy (if it exists) on the mill side of the bridge.
- With the excavator remove the guard logs, deck logs, stringers and corduroy.
- Bridge material not used in the reclamation process should be moved approximately 30 meters (90') away from the active channel.
- Provide appropriate erosion control measures and grass seed exposed areas.



### Ice Bridges (Appendix VI)

#### Installation:

- Measure depth of ice and depth of water from the bottom of the ice; a minimum of 0.3m or (1') of water under the ice is required.
- Always retrieve water from the down stream side of the bridge.
- Build two snow berms across the creek a minimum of 7.6m (25') apart.
- Flood the entire area between the berms in layers based on the initial thickness of the ice, (ie:1.5cm of water for <5cm ice). **MAXIMUM OF 5cm (2") AT ANY ONE TIME.**
- Repeat the flooding until ice thickness reaches a minimum of 0.6m (2').
- With a small cat push 0.3m (1') of clean snow over the ice, at the same time building up the existing snow berm to 0.6m (2').
- Place markers in the snow berm to indicate ice bridge location.
- Repeat flooding steps until an additional 0.3m (1') of ice is made or appropriate standards **(Appendix VII).**
- If the watercourse is utilized by recreational vehicles during the winter months (ie: snowmachines or quads) place signs up and down stream of the watercourse indicating its presence.
- **For large crossings refer to the U.S. Army Corps of Engineers Ice Crossing Guidelines.**

#### Reclamation:

- With a ripper break up the ice and clean it off in 15cm (6") increments until below snow layer.
- Clean all snow and ice off river bed and spread on high ground.
- If possible dig to natural ice or main stream flow without impeding water flow.
- Place barriers after ice bridge is reclaimed.



**Winter Temporary Bridges (Appendix VIII)**

**Installation:**

- Freeze down road to crossing until it is safe to haul the bridge.
- If enough snow exists, fill the watercourse with clean snow for temporary access to move equipment across for the bridge installation.
- If there is not sufficient snow to fill the watercourse then approval must be given to place logs in the watercourse for temporary access, remove logs and place to the side for reclamation.
- Cross the temporary crossing with machinery and then back the bridge into place.
- Prepare area for bridge to be placed and lay sills for the bridge to sit on.
- Maintain pressure and tension from both sides of the crossing with machinery to ensure that the bridge is installed with no impact to the stream.
- Place abutment logs or planks against end of bridge, cover with a soil separator and begin pushing material (preferably clean snow) to build approaches to the bridge.
- While pushing material (preferably clean snow) to build the approaches also build up a berm (snow or logs) on both sides of the approach.
- Cap the running surface with approximately 15cm (6") of dirt.

**Reclamation:**

- Rip the dirt cap on the loaded side and remove the dirt and snow.
- Cross the watercourse on the snow fill or by replacing the log fill in the watercourse and remove the approach on the empty side in the same manner as the loaded side.
- Remove the bridge while maintaining pressure and tension from both sides of the crossing with equipment to ensure there is no impact to the stream.
- Cross the creek with equipment and remove log fill or notch the snow fill to the ice level on the creek.
- Provide appropriate erosion control measures and grass seed exposed areas.

**Note: All crossings that require Federal approval for construction also require approval for reclamation.**

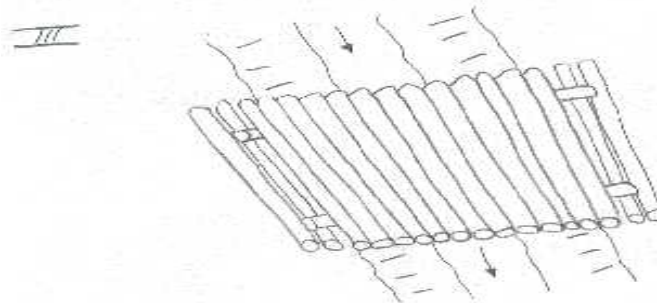
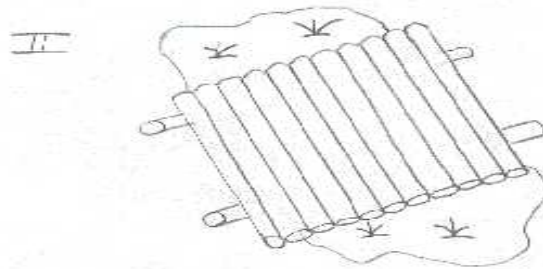
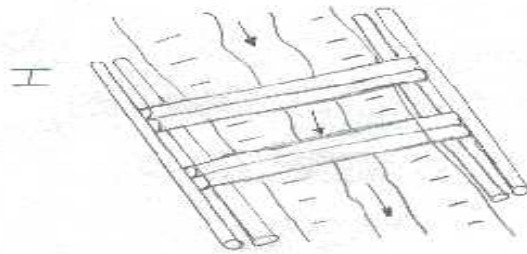


### ATV Creek Crossings

The following crossings must be installed prior to crossing permanent streams.

- I. This is Millar Western's minimum standard for creek crossings with ATV's. It is designed for one pass per day and may be modified to not include the bottom sill logs.
- II. When crossing soft ground this type works extremely well. If multiple passes per day are required the crossing must be corduroy (as drawn). For one pass you can simply use just the span logs as shown in I.
- III. Creeks with a defined channel and needing to be crossed multiple times per day.

Keep in mind the weight of the vehicles that will be passing over the structure. The span logs support all of the weight and distribute it into the sill logs, therefore appropriate size and number of span logs should be used to facilitate safe crossing. Corduroy should be placed on the approaches to all structure to protect the creek banks. All crossings should be left in place when finished work in the area, to provide other users (hunters, etc) proper creek crossings.





## ROAD & WATERCOURSE CROSSING INSPECTION GUIDELINES

### General Guidelines

- All crossings will be inspected and the information stored in the GIS database.
- Each fall before there is any snow the crossings from the previous year's harvesting operations will be inspected and the data recorded in the GIS database. From those inspections each crossing will be given a follow-up inspection date (i.e. 3 months, 6 months, 1 year, 2 years etc.) until the crossing is considered stable.
- Where travel by vehicle or ATV is limited due to reclamation activities, observations will be made by helicopter; those crossings that require a closer look can be identified and an on site inspection completed.
- Any crossings identified as needing follow up work will have a Road & Crossing inspection form (Appendix VIII) completed.
- Photos of all crossings on large and small permanent creeks will be required; all other crossings will be photographed if there is follow-up work required.
- All woodland's staff will be given a Road & Crossing inspection booklet that will be used to record observations on a day to day basis. These observations will be passed on to the Production Supervisor and the appropriate Area Supervisor for follow-up as well as filed in the applicable block or road file.
- Additional inspections will be conducted if a significant rain event comes through the area. Those areas or crossings identified as high risk will be inspected immediately following the storm and observations recorded using the Road & Crossing inspection form.
- At the beginning of each month the Production Supervisor will run a report to identify those crossings that need to be re-inspected for that month and notify the person or persons responsible.

### **Inspection Data (Not including Bridges)**

1. Inspection Dates
  - Record the date of the current inspection, the previous inspection will automatically move to the Last Inspection Date row.
  - Based on the observations made and any consultation with the person responsible for the crossing a Next Inspection Date or Crossing Stabilized Date will be indicated.
2. Inspector
  - The inspector's name will be identified for each inspection.
3. Person Responsible
  - The person responsible for the crossing (Area Supervisor, Construction Supervisor or Silviculture Technician) will be identified for each crossing.
4. Observations
  - The database has a pick list to indicate the status of each crossing, which is as follows.
    - Crushed
    - Hanging
    - Plugged
    - Too Short
    - Culvert marker missing
    - Not Vegetated
    - Slumping
    - Stable
    - Other
5. Inspection Comments



- Any general comments that the inspector feels should be made.
6. Photo Data
- If photos are taken for a crossing the photo number and date will be recorded.
  - Photos will be linked to the crossing in the database.
  - If the crossing is re-inspected the old photos will be hard copied and filed, then replaced with the new photos in the database.

### **Bridges**

- Bridges will be inspected separately on an annual basis or more frequently if required.
- A bridge inventory will be maintained with photos, dimensions and inspection data.
- Bridges will be inspected based on the Bridge Inspection form in Appendix X.





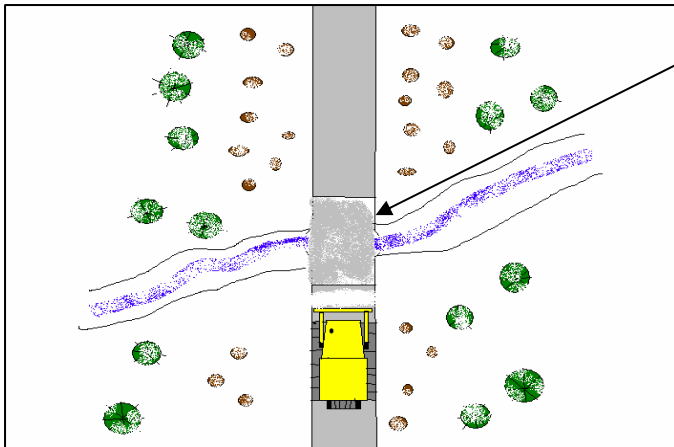
**APPENDICES  
DETAILED DRAWINGS**



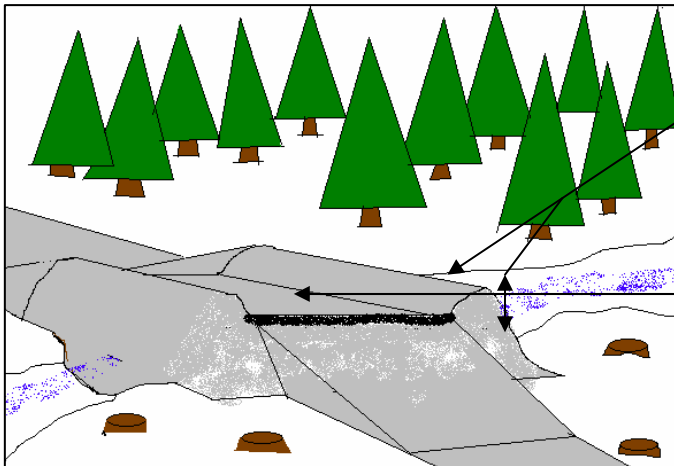
**SNOWFILLS  
APPENDIX I**



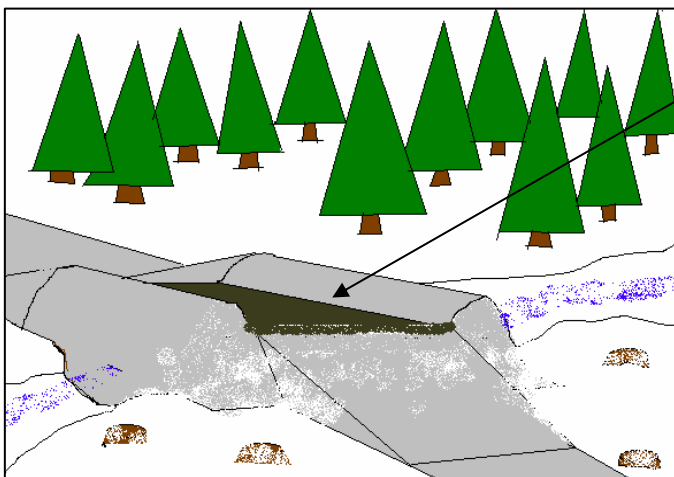
Snow Fill Construction Guidelines



- Gully is filled with 24cm (2') of clean snow.
- Snow is obtained from road right-of way, cut-blocks or trucked in from another site.
- A cat is used to push the snow into the gully and will also do some of the compacting.



- A snow berm 30 - 60cm (12 - 24") will be built up parallel with the road on both sides to ensure the soil does not leave the running surface of the snow fill and impact the stream.
- Snowfill must be a minimum of 7m (32ft) wide ensuring a minimum of 1m extends past the road running surface.



- Over the surface of the snowfill and between the two snow berms, approximately 15cm (6") of soil will be placed to provide structural integrity to the running surface. Soil is available from the construction of the road or a borrow pit.

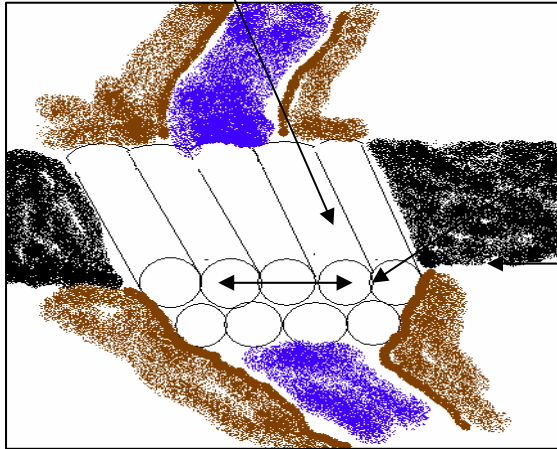


**LOGFILLS  
APPENDIX II**



**LOGFILL CONSTRUCTION GUIDELINES**

Log diameters must be as large as possible and should be a minimum length of 10m (32'). Cover logs with 60 - 90 cm (24 - 36") of conifer bows. There must be a minimum of 1.5 m (5') of visible log left on each side of the crossing, when road grade is established over logfill.

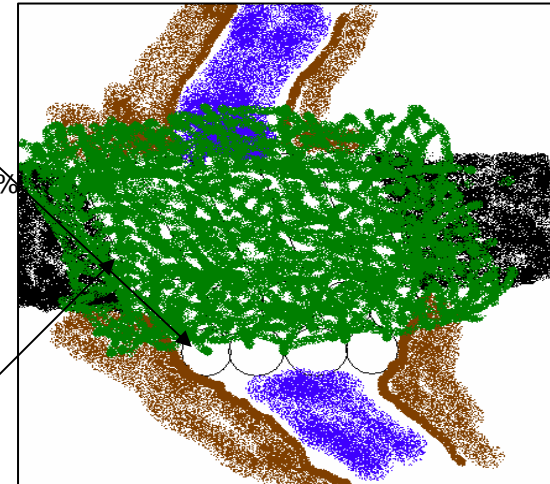


The bows should extend no less than 1m past the logs.

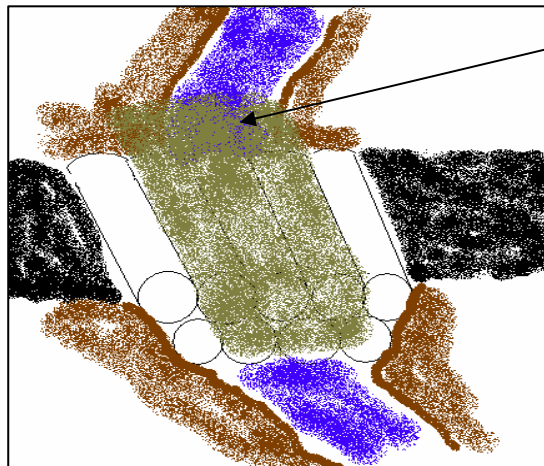
Fill the bottom of the gully with 25 - 30% full of logs and a minimum of 2m (6') from the centre of the channel or to the top of the breaks.

**NO DISTURBANCE WITHIN 9m (30 FEET) OF CROSSING**  
**NO DITCHING**

Cover bows with a minimum of 15cm (6") of soil.

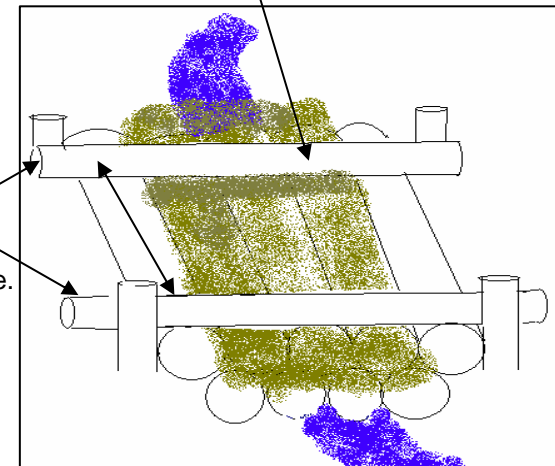


Guard logs should be used when there is a risk of soil entering the watercourse.



In situations where conifer bows are unavailable cover the logs with geo-jute (burlap) making sure the geo-jute extends well past the logs on either side.

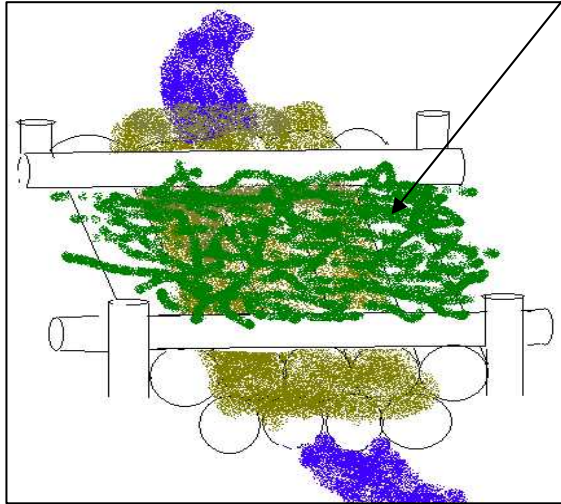
Guard logs must be a minimum of 5.5m (18') apart and over the geo-jute. The geo-jute should then be wrapped back over the guard logs.



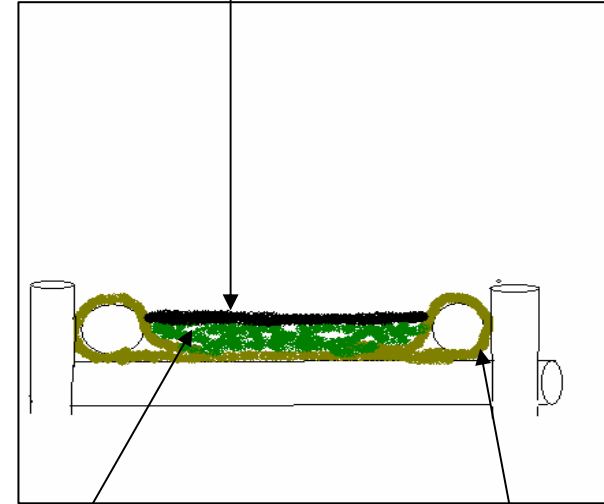


**LOGFILL CONSTRUCTION GUIDELINES**

Again Lay 60 – 90 cm (24"-35")  
Of conifer bows over the  
Geo-jute and cap with 15cm  
(6") of dirt.



minimum 15cm (6") dirt cap



60 – 90 cm (24-36") of conifer bows

Geo-jute wrapped back around guard  
logs.





**CULVERTS  
APPENDIX III**

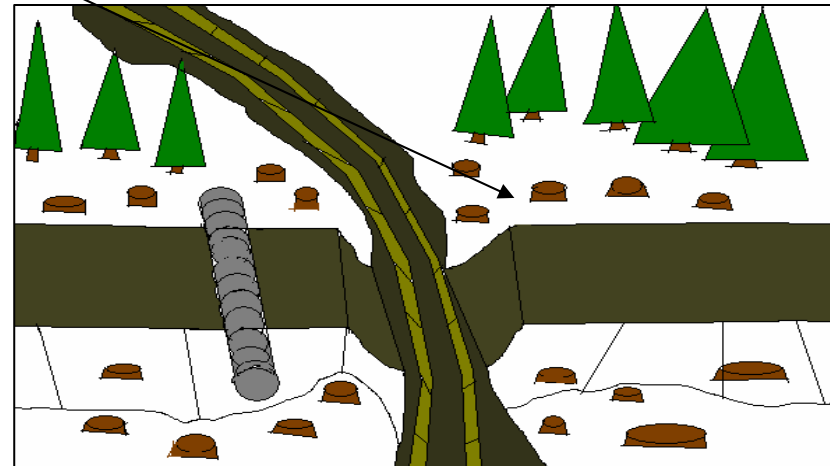
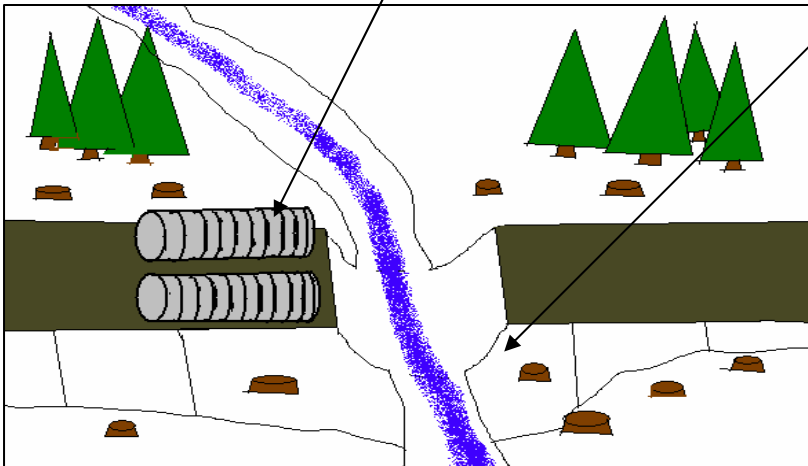




CULVERT INSTALLATION GUIDELINES

**REMEMBER NO DITCHING AND OTHER DISTURBANCES WITHIN 9m (30 FEET) OF THE CROSSING**

Assemble culvert on dry ground



Excavate base to follow natural grade and ensure base is solid enough to maintain the natural grade of the watercourse.

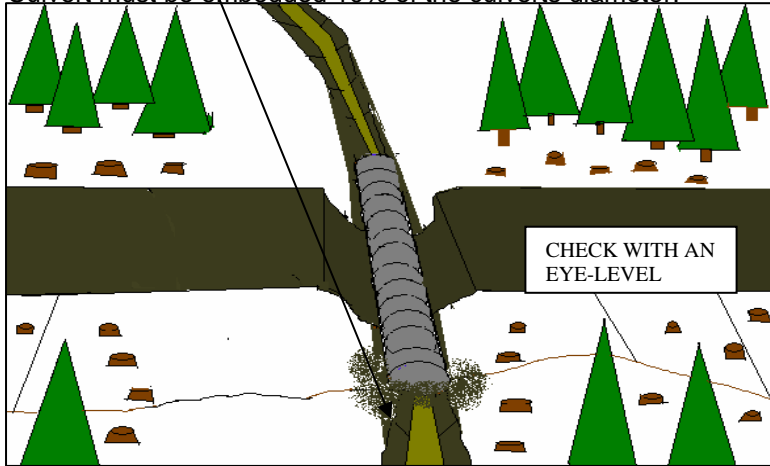
Place culvert into position ready to be backfilled.





**CULVERT INSTALLATION GUIDELINES**

Culvert must be embedded 10% of the culverts diameter.



Next place fill on the downstream side of the culvert  
culvert



Place fill over upstream side of culvert first.



Place fill over the center of the culvert to stabilize the



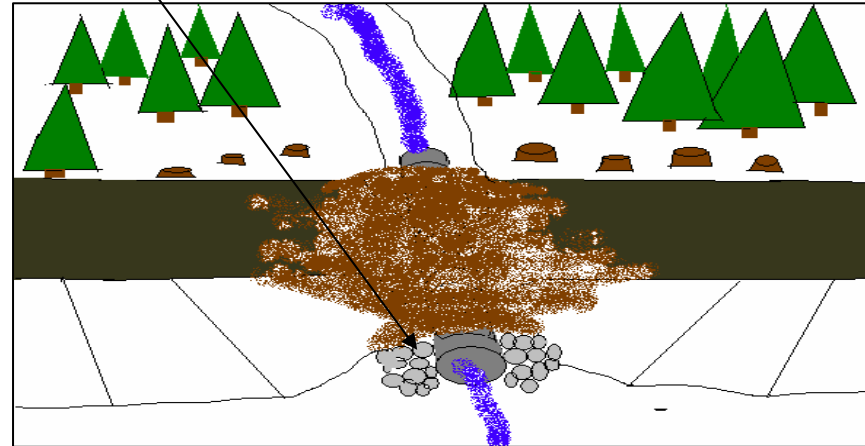


**CULVERT INSTALLATION GUIDELINES con't**

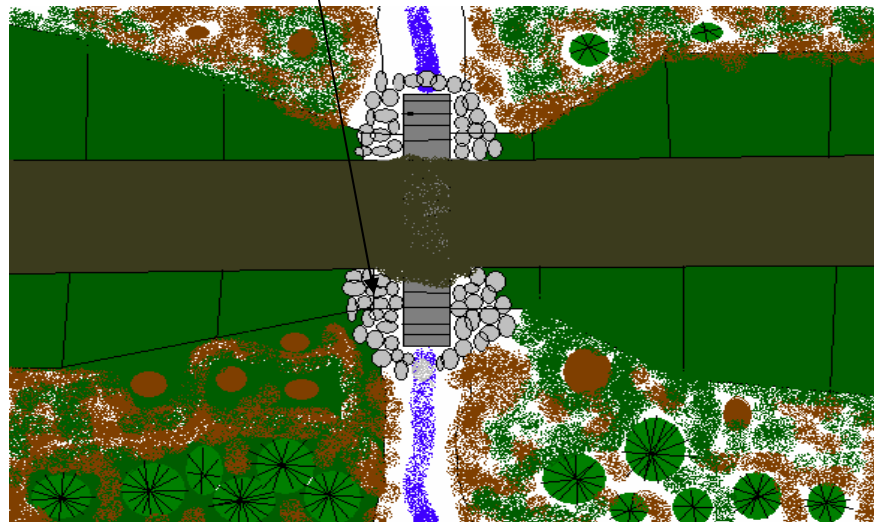
Complete backfilling procedure ensuring adequate compaction while bringing the fill up to the finished road surface.



Rip Rap and other erosion control measures should be placed where Required.



Finished product should have rip-rap and other erosion control measures.





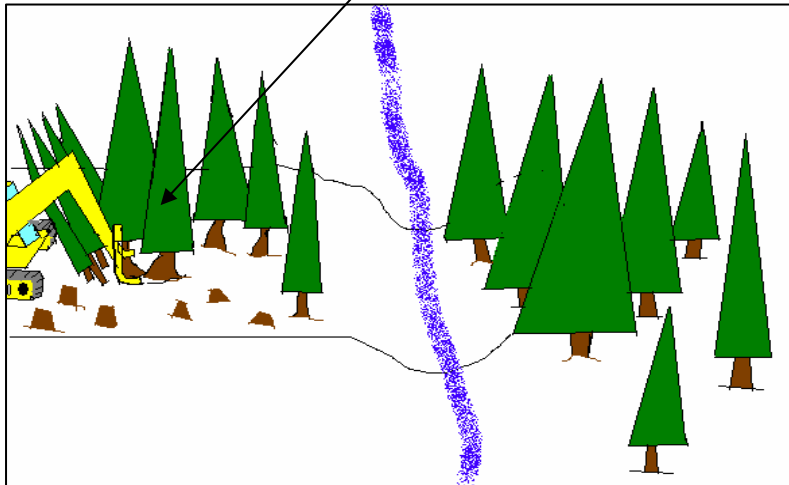
**PERMANENT STEEL BRIDGE  
APPENDIX IV**



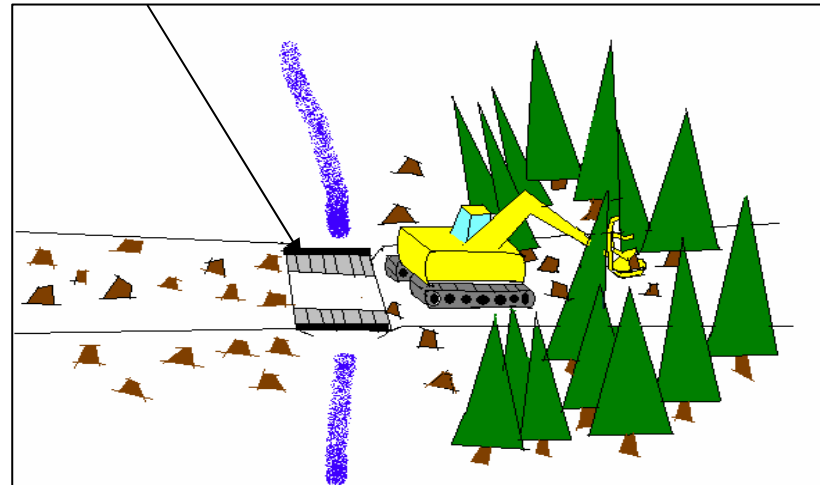


**Permanent Steel Bridge Construction Guidelines**

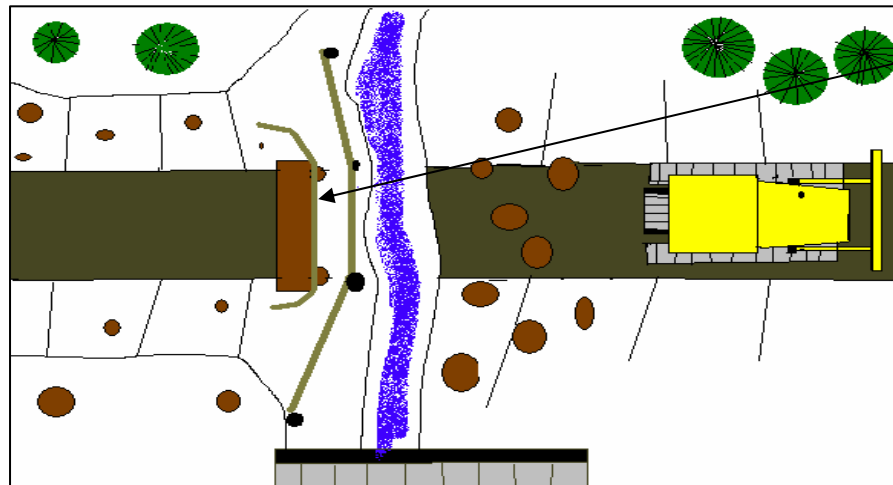
Log the road right-of-way right up to the desired crossing.



Install a temporary crossing (Portable Bridge) to cross the water course and continue cutting the road right-of-way.



**REMEMBER NO DISTURBANCE WITHIN 9m (30 FEET) OF CROSSING (NO DITCHING)**

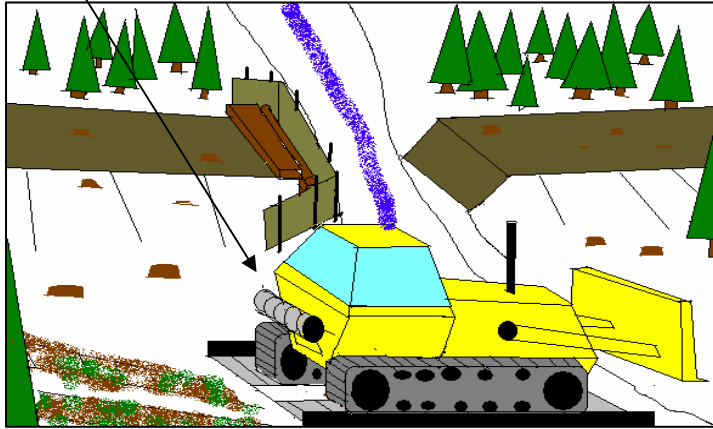


Assemble appropriate retaining wall and install soil separator if required.

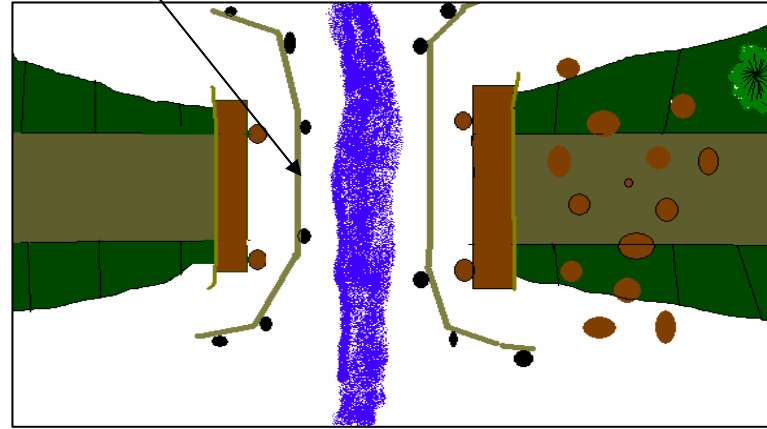


Permanent Steel Bridge Construction Guidelines con't

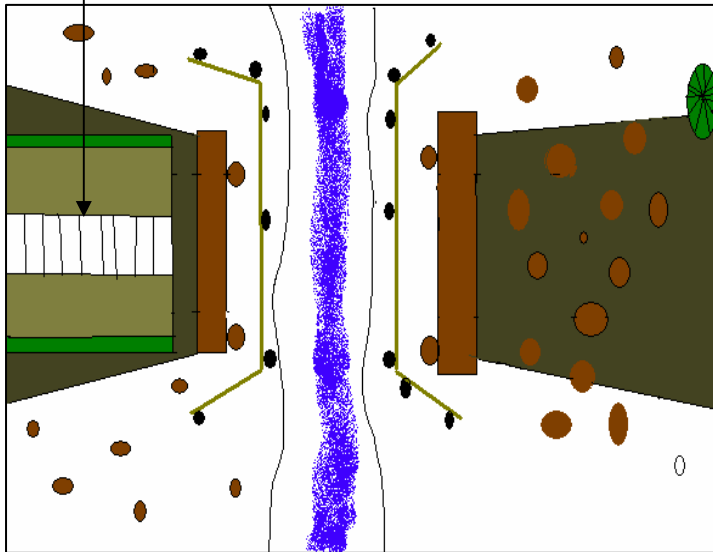
Move equipment across creek using a portable crossing



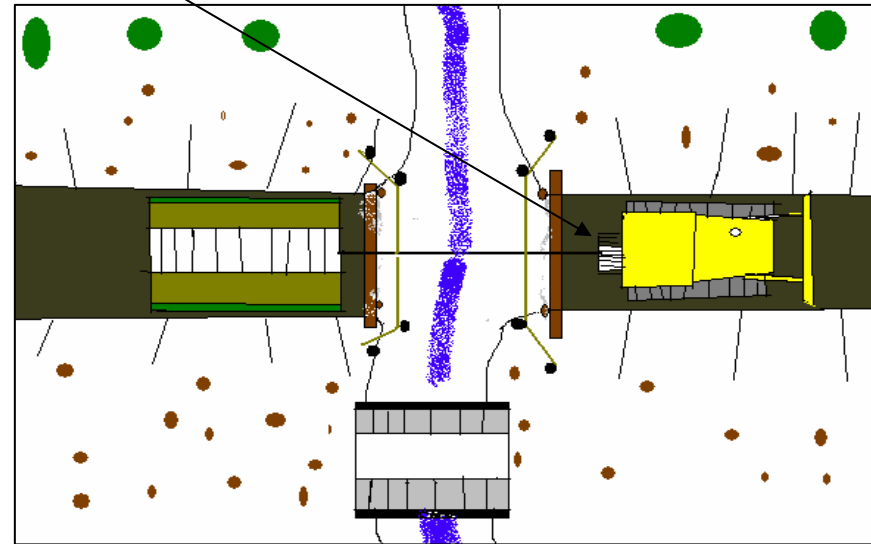
install appropriate retaining wall and bridge abutments on otherside of crossing. Install soil separator if required.



Move bridge to the abutments.



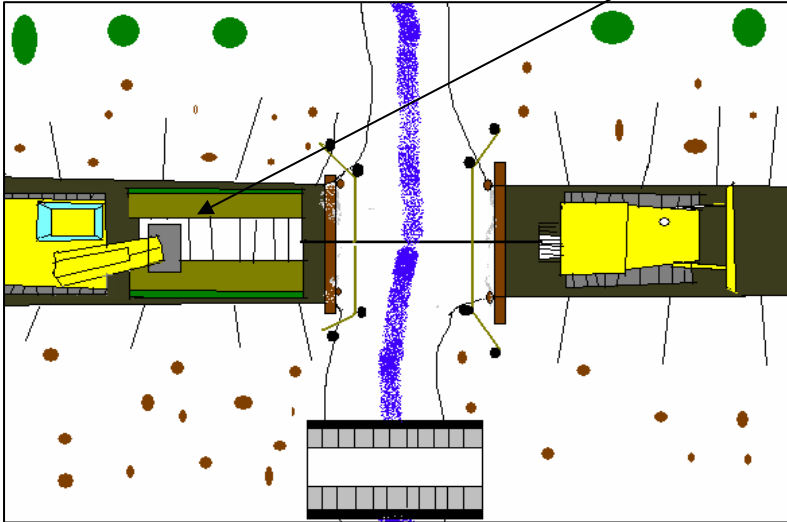
While Cat is on the other side attach a winch line from the cat to the Bridge.



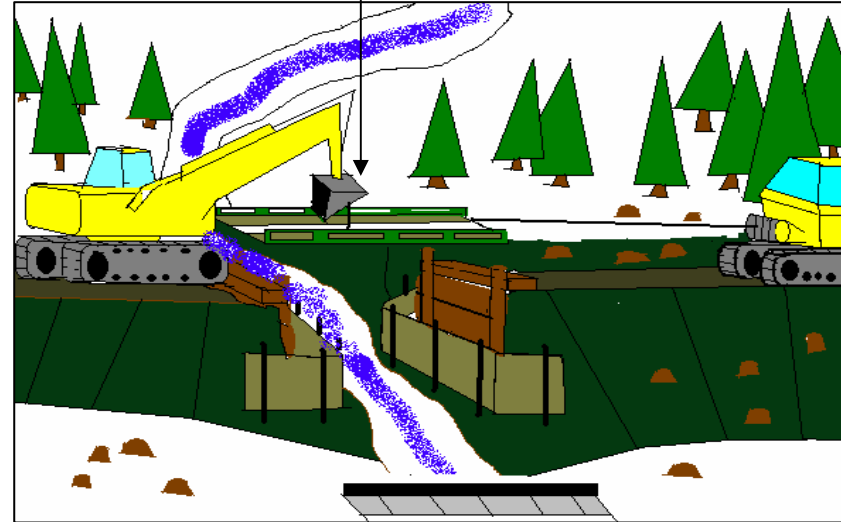


**Permanent Steel Bridge Construction Guidelines con't**

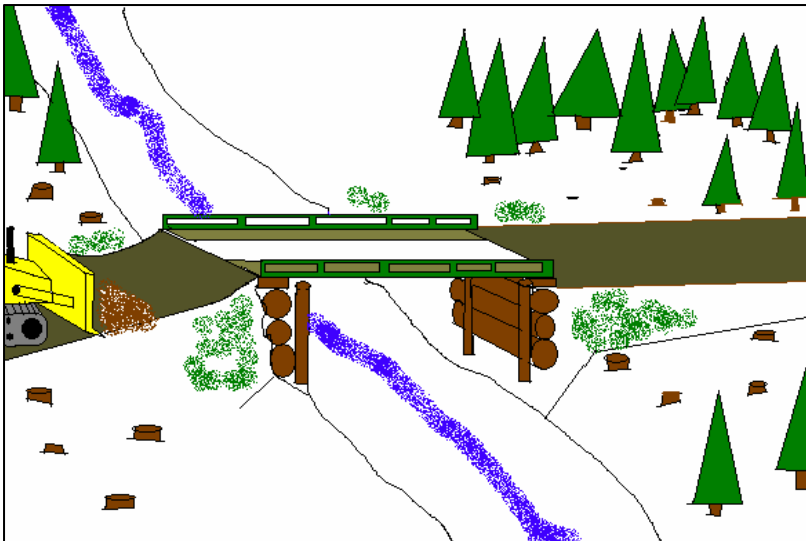
Maintain pressure and tension from both sides of crossing with machinery to ensure no adverse effects to stream



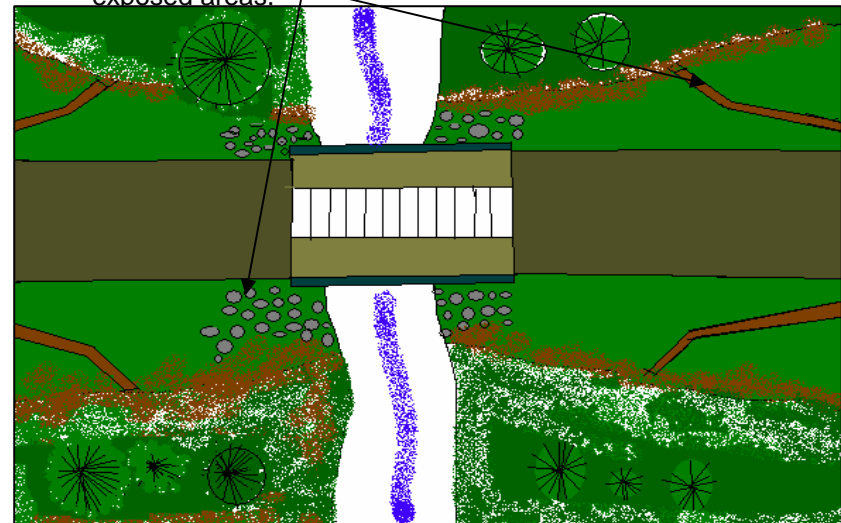
Lift bridge up on to the abutments.



Set bridge on sill and build road grade to level of bridge.



Provide appropriate erosion control measures and grass seed exposed areas.





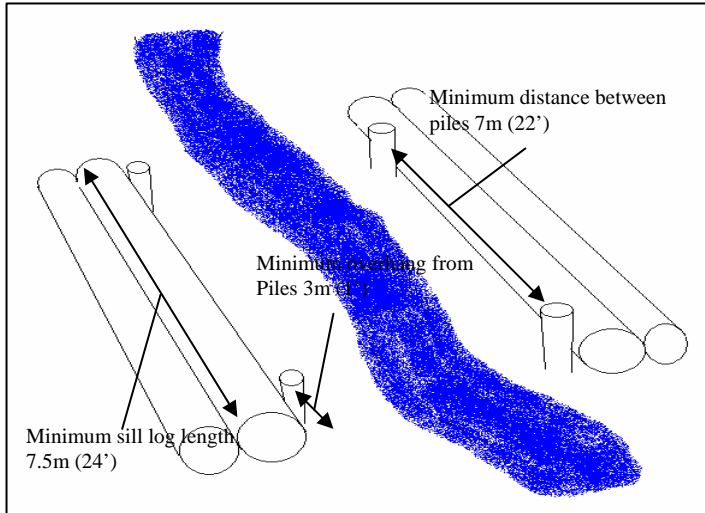


**NATIVE TIMBER BRIDGE  
APPENDIX V**

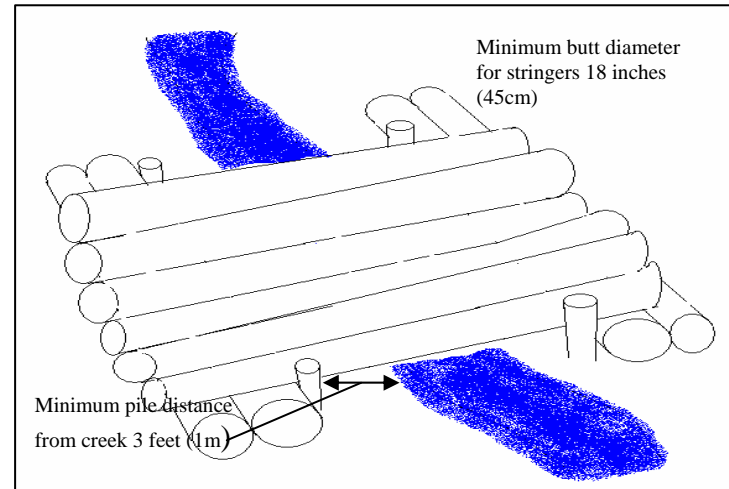


Native Timber Bridge Guideline

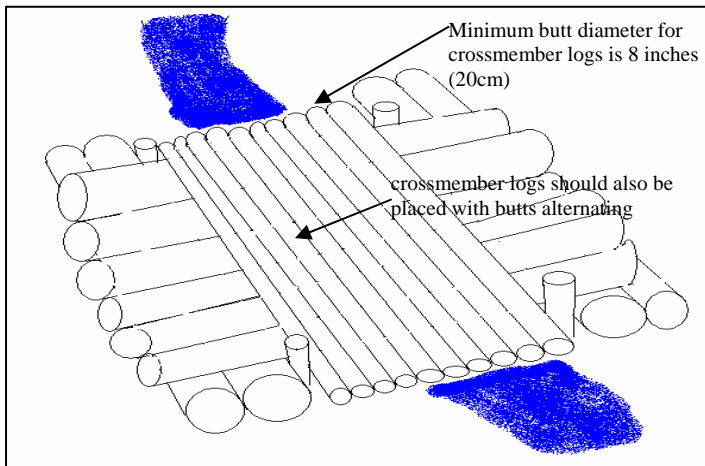
**Stage 1: Lay down sill logs and drive piles.**



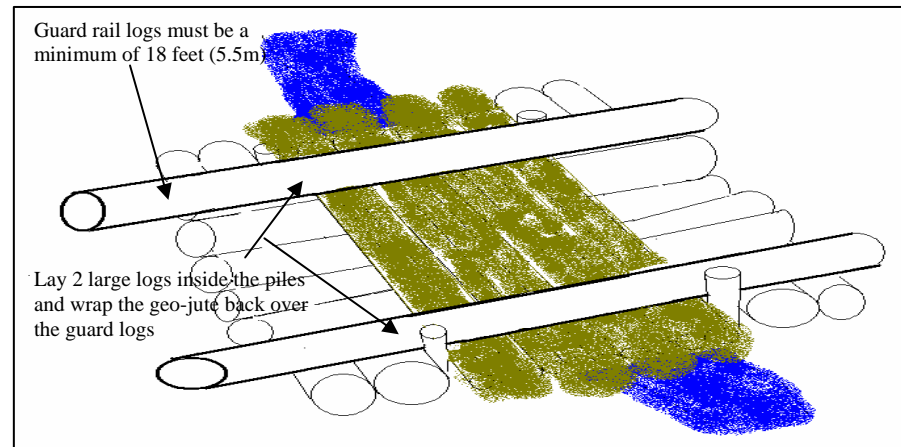
**Stage 2: Lay stringers with butts alternating between piles and on top of sill logs.**



**Stage 3: Lay crossmember deck logs between piles and perpendicular to stringers.**



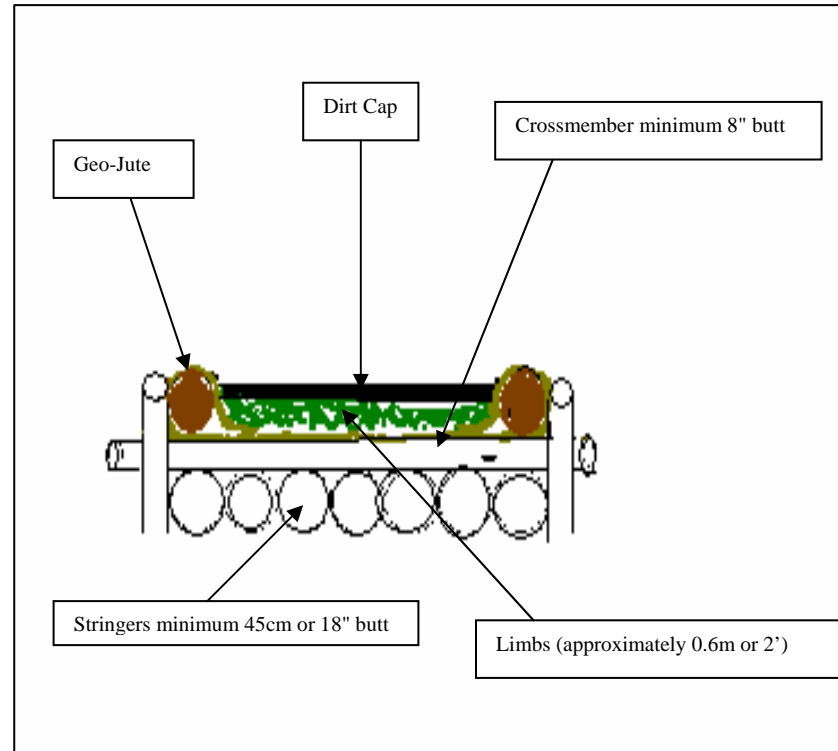
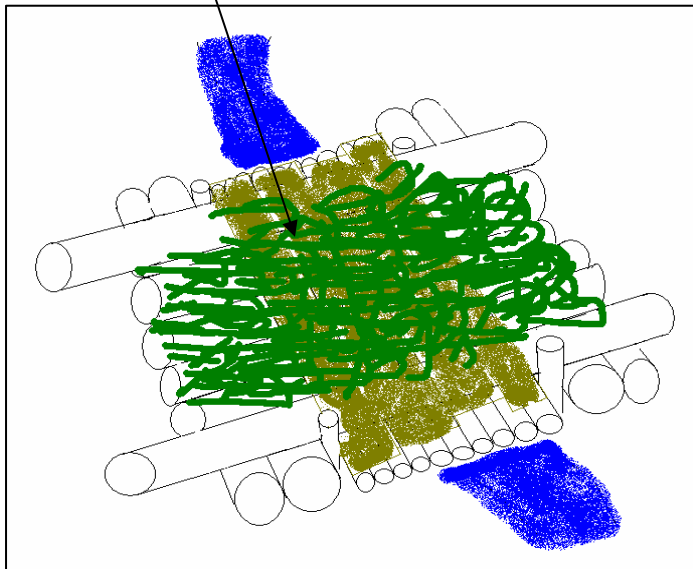
**Stage 4: Lay strips of geo jute (separation layer) parallel with crossmember logs and long enough to wrap back over guard logs.**





Native Timber Bridge Guideline con't

Stage 5: Lay 2 feet of conifer bows over the geo-jute, and cap with 10-15 cm (4"-6") of dirt.





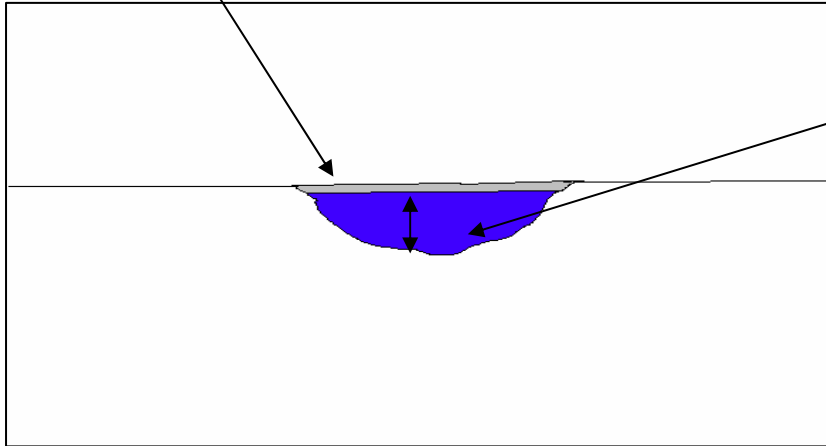
**ICE BRIDGE  
APPENDIX VI**



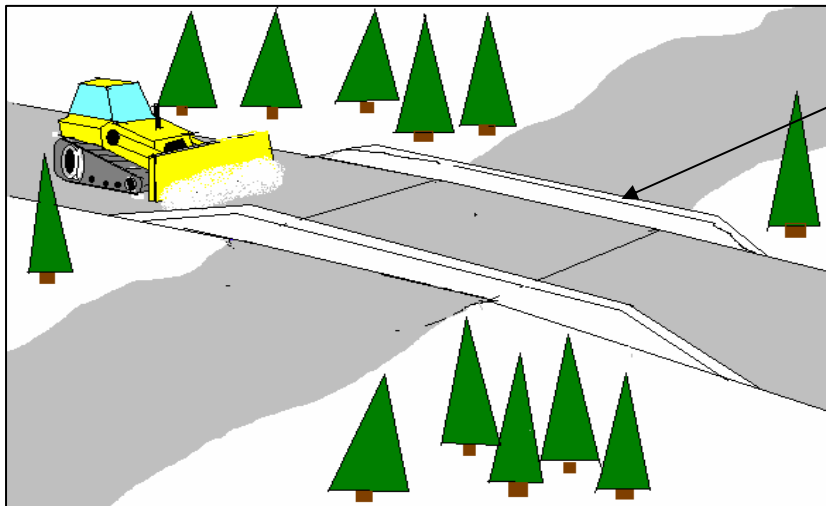


Ice Bridge Construction Guidelines

Measure the depth of the ice.



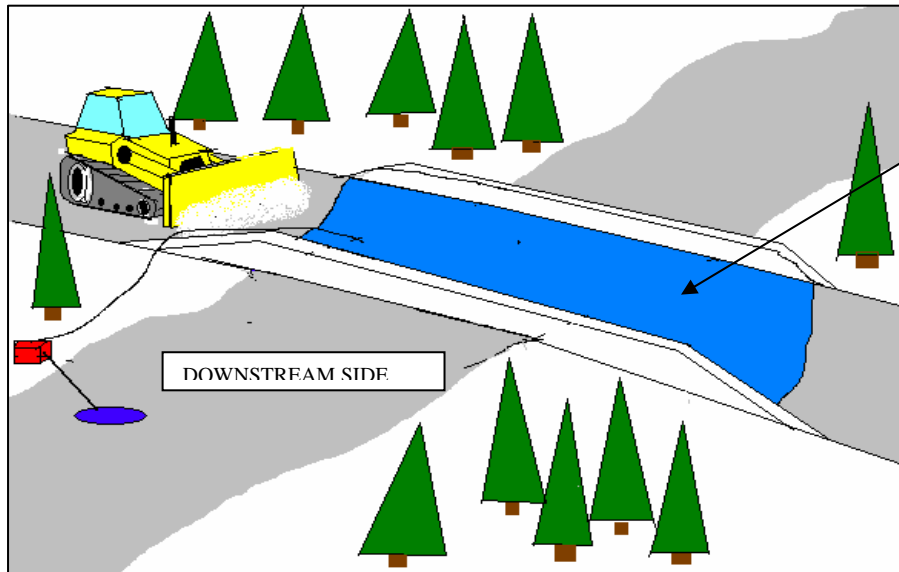
Measure the depth of water under the ice. A Minimum of 0.3m or 1' of water under the ice is required.



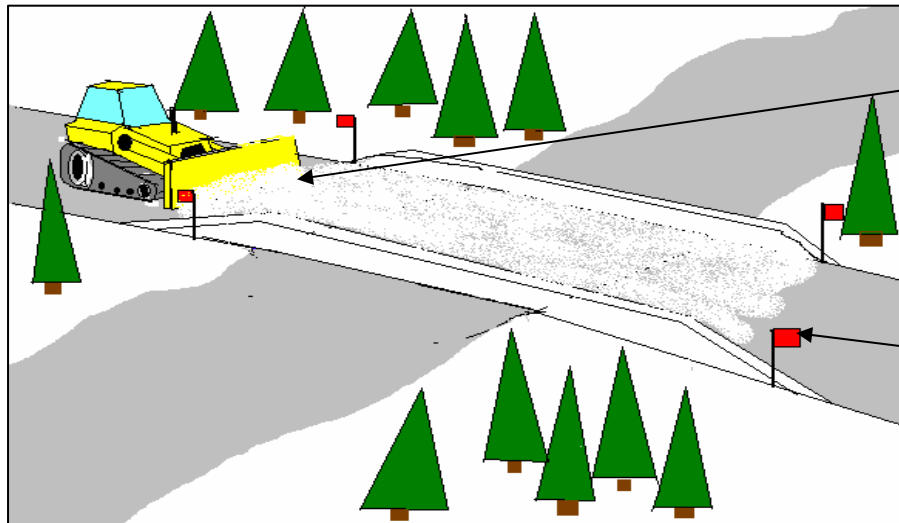
Build two snow berms across the creek a minimum of 7m (25') apart.



Ice Bridge Construction Guidelines con't



Flood the entire area between the berms in layers based on the initial thickness of the ice. Repeat the flooding until the ice reaches a minimum thickness of 0.6m (2').  
**MAXIMUM OF 5cm (2") AT ANY ONE TIME.**

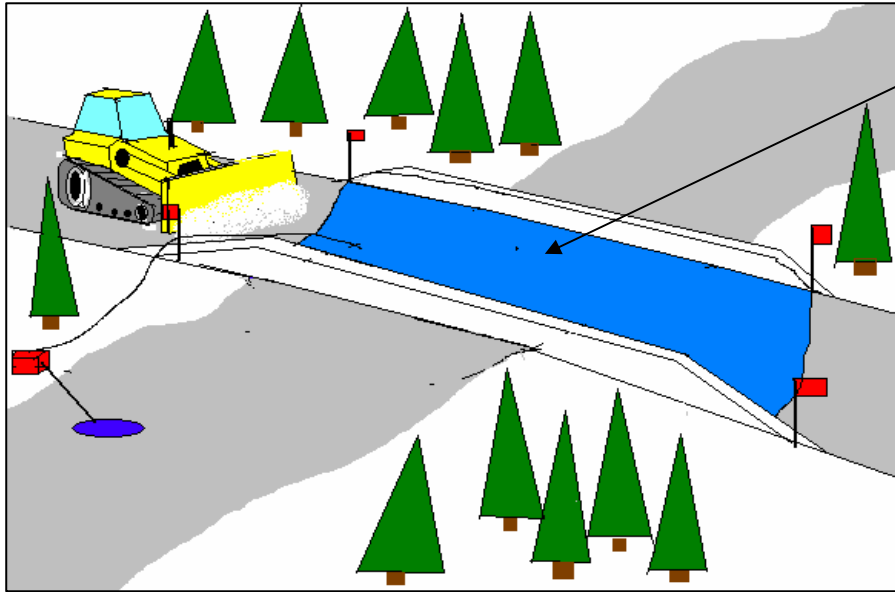


With a cat push 0.3m (1') of clean snow over the ice, at the same time building the existing snow berm up to 0.6m (2').

Place markers in the snow berms to indicate ice bridge location.



Ice Bridge Construction Guidelines con't



Repeat flooding steps until an additional 0.3m (1') of ice is made or appropriate standards.





**ICE BRIDGE SPECIFICATIONS  
APPENDIX VII**



**GUIDELINES FOR ICE BRIDGE THICKNESS**

<b>VEHICLE WEIGHT (kg)</b>	<b>MINIMUM ICE THICKNESS (cm)</b>	<b>MINIMUM DISTANCE BETWEEN VEHICLES (m)</b>
90.9	5.1	5.2
909.1	10.2	10.4
1818.2	15.2	14.6
2727.3	17.8	17.7
3636.4	20.3	20.4
4545.5	22.9	22.9
9090.9	33	32.3
18181.8	45.7	45.4
27272.7	55.9	55.8
36363.6	66	64.3
45454.5	76.2	73
54545.5	86.4	82
63636.4	96.5	91
72727.3	96.5	100
81818.2	106.7	109



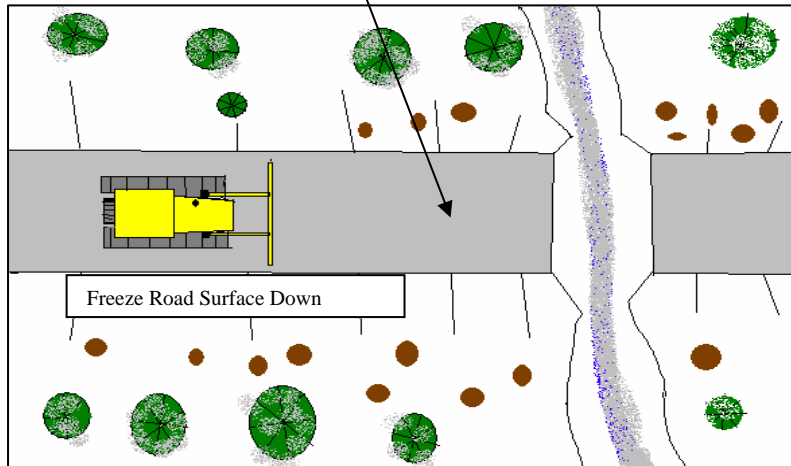
**WINTER TEMPORARY BRIDGES  
APPENDIX VIII**



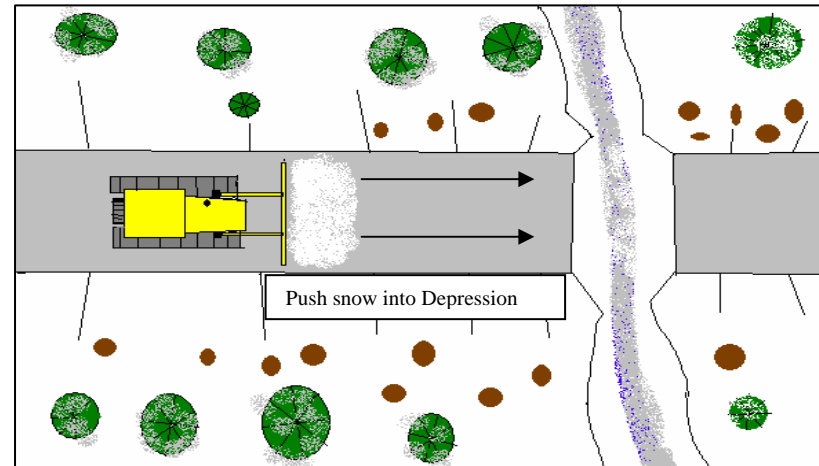
Winter Bridge Construction Guidelines

**NO DITCHING AND OTHER DISTURBANCES WITHIN 9m (30 FEET) OF CROSSING**

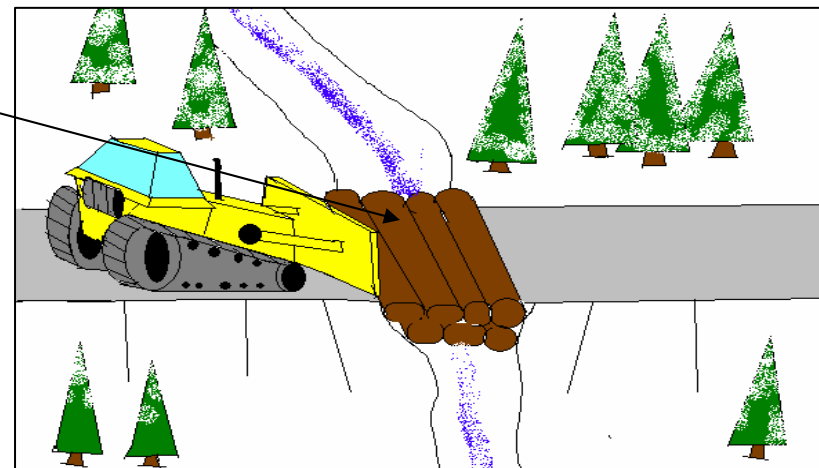
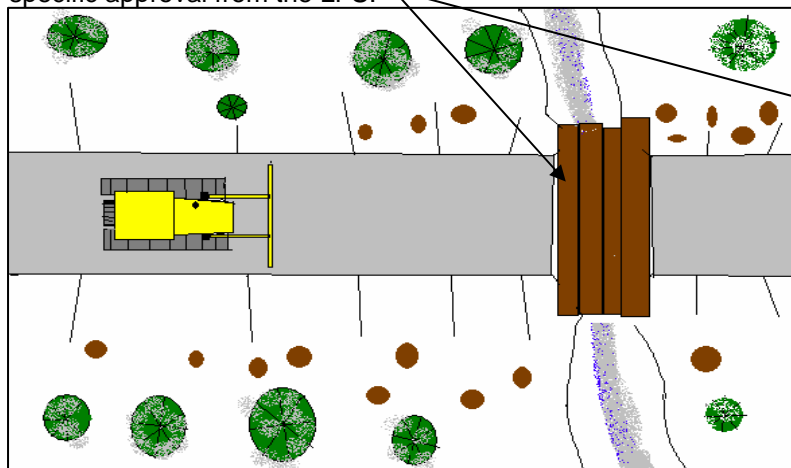
Begin by freezing down approach to temporary bridge location.



If snow is available push snow into depression to allow machinery to cross.



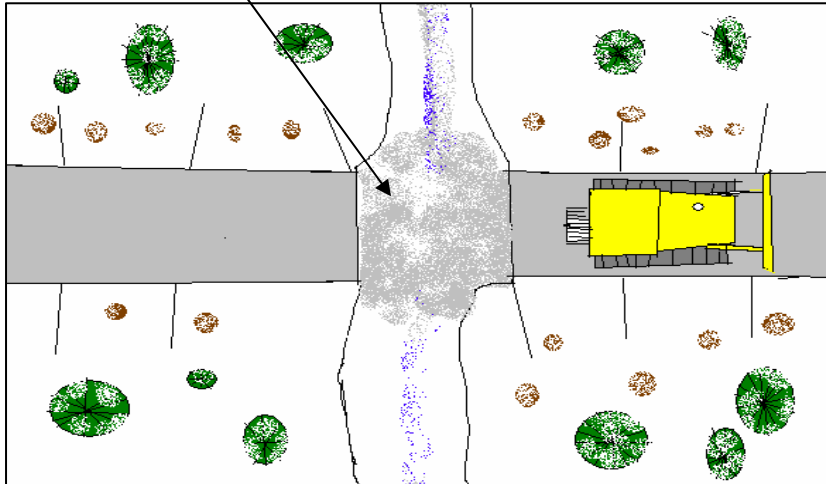
During years of lean snow logs may be used; However, this requires specific approval from the LFS.



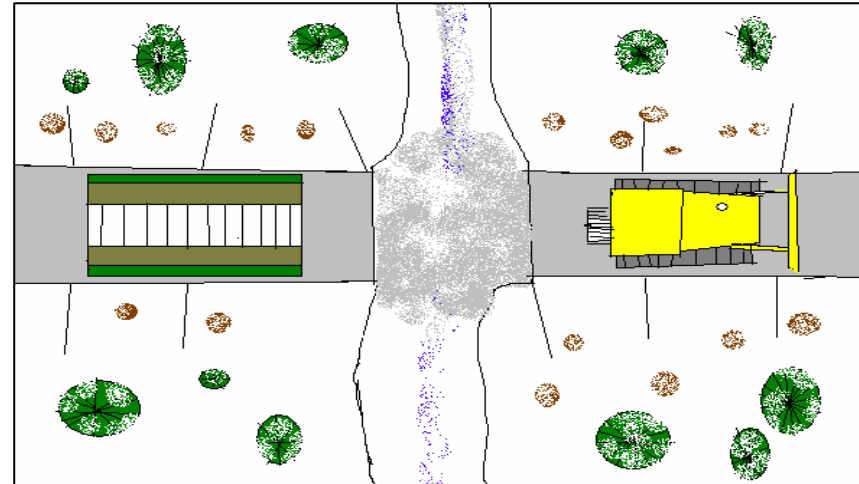


Winter Bridge Construction Guidelines con't

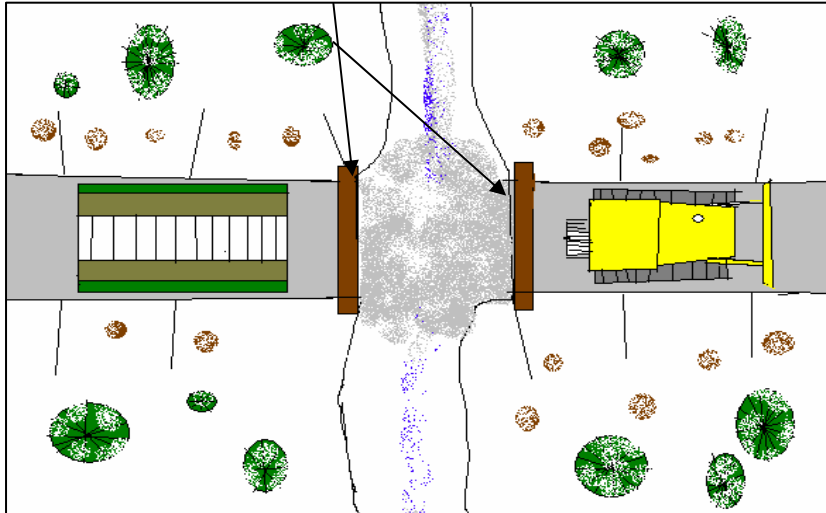
Cross the temporary crossing when enough snow is pushed into the depression.



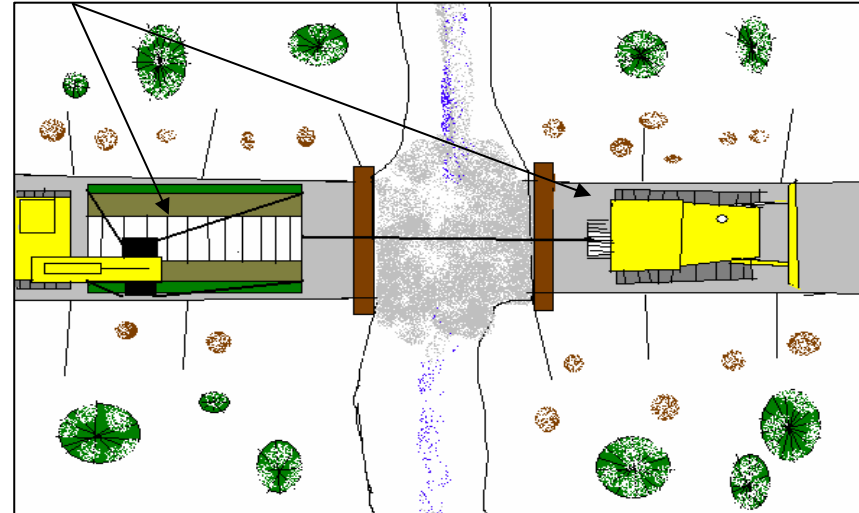
Back the bridge into place.



Place logs or planks for the bridge to sit on.



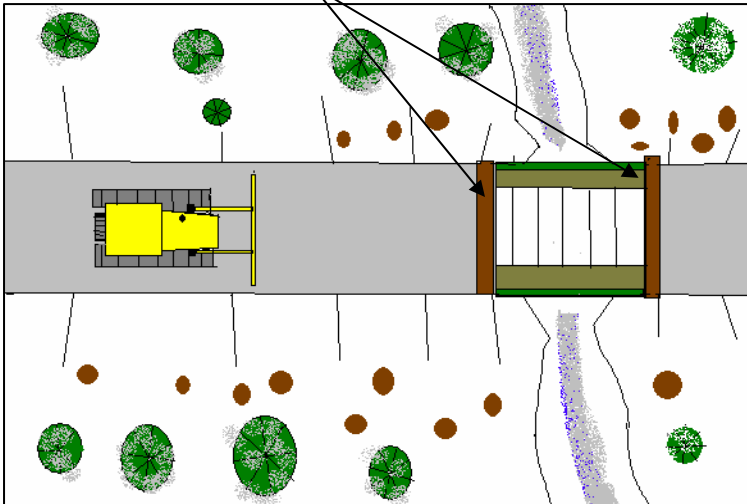
Maintain pressure and tension from both sides of crossing with machinery.



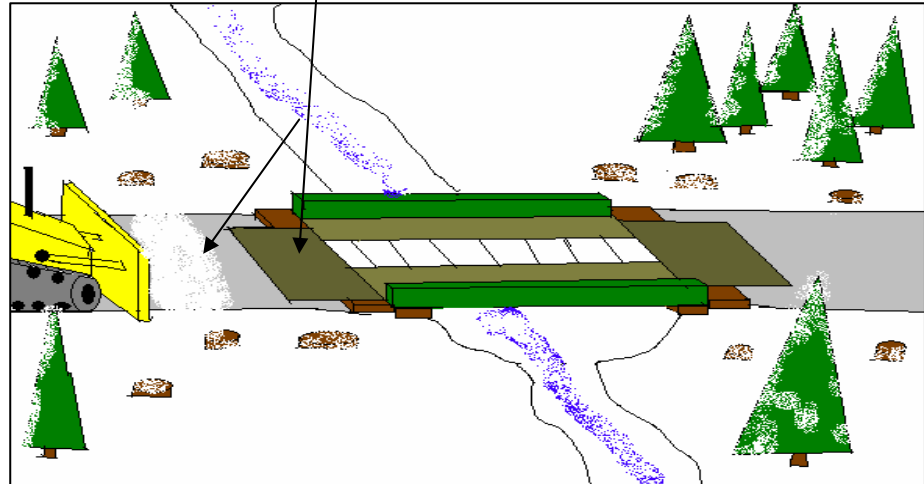


Winter Bridge Construction Guidelines con't

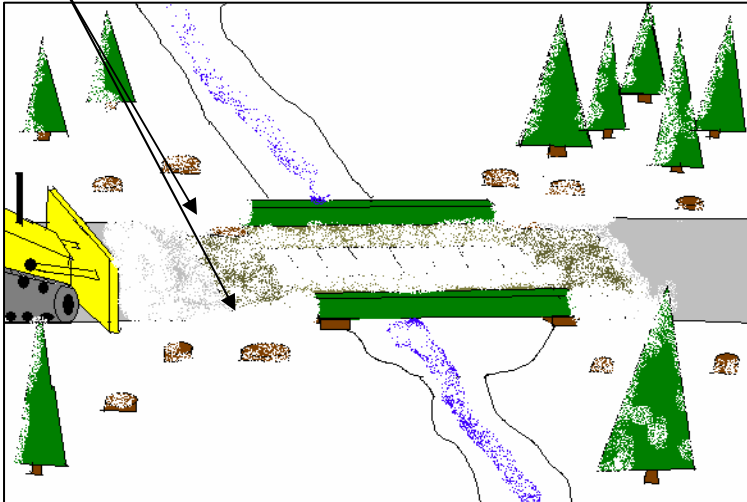
Place abutment logs or planks against end of bridge.



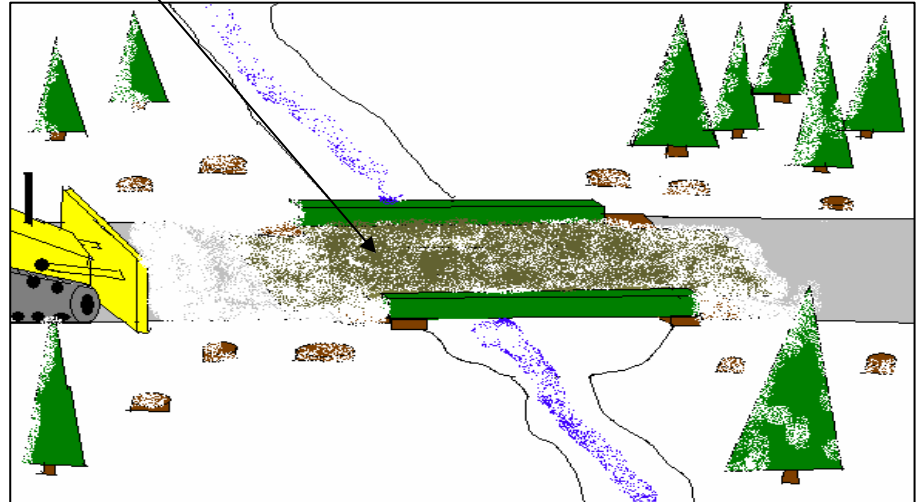
Cover with soil separator and begin pushing material preferably snow to build approaches to the bridge.



Build up approaches and a snow berm on both sides of approach.



Cap the running surface with 15cm of dirt.





**ROAD & CROSSING INSPECTION FORM  
APPENDIX IX**



**Millar Western Forest Products Ltd.  
Road & Crossing Inspection Form**

<b>Name:</b> _____		<b>Date:</b> _____	
<b>Location:</b>			
Licence	_____	GPS co-ord.	_____
Road	_____	Crossing #	_____
LOC	_____	Crossing Size	_____
Other	_____	Block (Source)	_____
GIS status correct: <b>Yes No</b>			
If no, correct status is: <b>Active</b>		<b>Reclaimed</b>	

<b>Observations:</b> (e.g. erosion, hanging culvert, plugged, needs more grass cover)	
_____	
_____	
_____	
<b>Urgency Rating:</b> _____	<b>1 = Urgent 2 = 2-4 Weeks 3 = 1-3 Months</b>
<b>Equipment Needed:</b>	
_____	
_____	
<b>Comments:</b>	
_____	
_____	
_____	

<b>Follow-up</b>	
Date Repaired: _____	Supervisor: _____
Inspection Date: _____	Inspector: _____

- Copies:
1. Production Supervisor
  2. Area Supervisor or Construction Supervisor
  3. Road or Block file





**BRIDGE INSPECTION FORM  
APPENDIX X**



**Millar Western Forest Products Ltd.  
Bridge Inspection Form**

<b>Name:</b> _____	<b>Date:</b> _____
<b>Location:</b>	
Legal _____	Bridge # _____
GPS co-ord.'s _____	Dimensions _____
Road ID _____	Location (km) _____
Watercourse _____	Block (Source) _____

**Observations:**

	<b>Condition</b>		
	Good	Fair	Poor
<b>1. Decking</b> <input type="checkbox"/> <ul style="list-style-type: none"> <li>- running boards</li> <li>- cross members</li> </ul> Comments: _____ _____ _____	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>2. Main Beams</b> <input type="checkbox"/> <ul style="list-style-type: none"> <li>- cracks</li> <li>- rust</li> <li>- attachment to pilings</li> </ul> Comments: _____ _____ _____	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>3. Bridge Support</b> <input type="checkbox"/> <ul style="list-style-type: none"> <li>- pilings</li> <li>- sill logs</li> </ul> Comments: _____ _____ _____	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>Condition</b>			
	Good	Fair	Poor
<b>4. Retaining Walls</b> <input type="checkbox"/> <ul style="list-style-type: none"> <li>- materials contained</li> <li>- any sinking or slumping</li> <li>- tie backs (still tight, clamps, cables)</li> <li>- leaning or straight</li> </ul>	<input type="text"/>	<input type="text"/>	<input type="text"/>



Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. Rip Rap

- condition if present  
Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. Vegetation

- condition  
Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. River Alignment

- unchanged  
- debris  
Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. Road Surface

- (30m either side of bridge)  
Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

9. Signage

- speed  
- bridge warning  
- restricted widthloaded trucks have ROW  
- maximum weight  
Comments: \_\_\_\_\_  
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**Recommendations:** \_\_\_\_\_  
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<p><b>Completion Date:</b> _____      <b>Supervisor:</b> _____</p> <p><b>Next Inspection Date:</b> _____</p>
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Copies:      1. LOC file      2. Bridge binder      3. Production Supervisor



## **Appendix III – Road Construction and Water Crossings (WOI-ROA-001)**





## Work Instruction Road Construction and Watercourse Crossings

### Purpose:

To ensure Millar Western employees and contactors are aware and familiar with the expectations for road construction and watercourse crossings.

### Scope:

All road construction and watercourse crossings within Millar Western's FMAs and various licence areas.

### Roles:

Millar Western employees  
Millar Western contractors

### Procedure:

#### Millar Western Supervisor:

- Ensure all required approvals are in place before work commences. (LOC's, AOP, Navigable Waters, Water Act)
- Ensure all agreements are in place for pipeline crossings, powerline crossings, and highway approaches.
- Conduct a pre-work meeting and complete the Road pre-work checklist (FOR-ROA-001).

#### Contractor:

- Attend pre-work meeting and sign off the road pre-work checklist prior to starting operations. (FOR-ROA-001)
- Construct road and watercourse crossings based on the following standards:

#### Class I Roads

- Primary permanent all weather road with a life of 20 plus years.
- R.O.W. will be a variable width 30-50m (100-150').
- Running surface shall be 8-12m (25-33') and must be level.
- Ditches have to be 1.0m plus with a flat bottom.
- Watercourse crossings will be permanent.

#### Class II Roads

- Secondary permanent all weather or dry weather road with a life of 5 – 20 plus years.
- R.O.W. will be a variable width 20-30m (66-100').
- Running surface shall be 5-10m (16-33') and must be level.
- Ditches have to be 0.6m plus with a round bottom.
- Watercourse crossings will be permanent.



### Class III Roads

- Class III roads are tertiary winter or dry weather roads with a life up to 20 years.
- R.O.W. will be a variable width with a maximum of 20m (66') with the road on the north side where possible to optimise drying of the road surface.
- Running surface shall not exceed 10m (33') and must be level.
- R.O.W decks must be placed to one side of the R.O.W to ensure the road alignment is maintained.

### Class IV Roads

- Class IV roads are temporary winter or dry conditions with a life span up to 5 years.
- R.O.W. will be a variable width with a maximum of 20m (66') with the road on the north side where possible to optimise drying of the road surface.
- Running surface shall not exceed 10m (33') and must be level.
- R.O.W decks must be placed to one side of the R.O.W to ensure the road alignment is maintained.
- Road surfaces shall not be cleared to bare mineral soil where possible; however, stumps or large woody debris must be cleared away to minimize damage to maintenance equipment.
- Finished log decks should be no more than 8m (26') apart.

### General Road Construction Guidelines

- On those parts of the right of way not used for grade construction, disturbance to the duff and organic soil shall be minimized to reduce damage to the roots of bordering trees and to provide a protective soil cover.
- Trees with root systems damaged by road construction shall be removed from the edge of a road cut.
- Roads must be properly drained to disperse water.
- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses. Vegetated buffers shall be left or a system of obstructions installed to dissipate the force of water, where buffers alone do not retard water and soil movement effectively.
- If ditches are required they shall be deep enough to drain the subgrade. Ditch backslopes shall have a regular profile from the top of the cut to the bottom with no hanging banks or sharply cut ditches. Ditch backslopes should match the soil types natural angle of repose, unless other measures are taken to stabilize the slope. For Class IV winter roads ditches should be constructed as required.
- Cross drains shall be installed to mitigate erosion on barred surfaces.
- To maintain safe traffic flow pullouts will be constructed every 250 metres where necessary (half way between turn around areas). Construction dimensions shall be 40 metres (130') long and 5 metres (16') wide excluding the travelled road surface.
- Stumps and other debris will be feathered back to the sides and walked down in cut-to-length blocks and if the road is to be left open for more than one year.
- The mill side of each deck shall be cleared of any debris to facilitate safe log loading.
- Watercourse crossings will vary between operating seasons and will be pre-determined by Millar Western staff, depending on access strategies.
- Lesser vegetation shall be maintained approximately 30m (100') back from a crossing within the riparian area.





## Borrow Pits

### Construction

*(All Borrow Pits will have previous approval from Millar Western Staff)*

- Borrow pits are to be kept to a minimum.
- Borrow pits are to be kept within the actual ROW, unless otherwise instructed.
- They should be located approximately 30m (100') from any watercourse.
- They should be no greater than 40m by 50m (131' x 164').
- Borrow pits that fall outside of the road right of way will require prior approval from the LFD.
- Borrow pits will be backsloped and reclaimed concurrent with construction activities.

### Reclamation

- Fill the borrow pit with strippings from the road construction.
- Make sure the borrow pit is self-draining wherever possible.
- Borrow pits should be backsloped at 2:1 depending on the soil types.

## WATERCOURSE CROSSING GUIDELINES

### Snow Fill

- Stream channel is to be filled with clean snow to a minimum of 60cm (24"), or to the top of the stream banks. Clean snow will be obtained from road right of ways that have not been plowed, or cut blocks, etc.
- The snowfill should be a minimum of 7m (22') wide extending 1m (3') past the road running surface on each side.
- If snow is being hauled to the site, ensure the box of the dump truck is clean prior to loading the snow.
- The snow is pushed into the stream channel and compacted with a small cat (i.e. D3 or D5).
- A snow berm will be built up approximately 30cm - 60cm (12" - 24") parallel with the road on both sides of the snow fill, to prevent the soil from leaving the running surface of the snow fill and impacting the stream.
- Over the surface of the snow fill and between the snow berms, approximately 15cm (6") of soil or wet snow will be placed to provide structural integrity to the running surface. Soil is available from the construction of the road or from a borrow pit.

### Log Fills

- Fill bottom of stream channel 25 – 30% with logs and a minimum of 2m (6') from the centre of the channel or to the top of the breaks (Black Poplar if it is available).
- The diameter of the logs should be as large as possible and should be topped before being placed in the channel. The lengths must be a minimum of 10m (32') to ensure the logs extend a minimum of 1.5m (5') past the grade fill.
- Cover logs with 60 - 90cm (24 - 36") of conifer boughs or geo-jute.
- Guard logs should be used if there is a risk of soil entering the watercourse.
- Cover conifer boughs or burlap with a soil cap, the soil cap shall not exceed 30cm (12"). The soil cap must only be applied when there is a proper separation layer to contain the soil on top of the crossing. Only mineral soil is to be used as a cap, no slash (stumps or limbs) are to be mixed in.



### Culverts (300mm up to 1500mm diameter)

- Installations on fish bearing streams require DFO approval.
- Where Federal permits are obtained the plan attached to the approval must be followed.
- Assemble culvert where appropriate, preferably on dry ground prior to installation.
- Excavate base to follow the natural grade and ensure the base is solid enough to maintain the natural grade of the watercourse.
- Place the culvert in position ready to be backfilled, culvert should then be checked to ensure the proper grade has been obtained for drainage.
- Culverts must be embedded in the stream bed 10% of the culvert's diameter.
- Place fill over upstream end of the culvert first then the downstream end, this will isolate stream flow into the culvert, thereby protecting the stream from backfilling activities.
- Place fill over centre of the culvert to stabilize it.
- Complete the backfilling procedure ensuring adequate compaction is achieved while bringing the fill level up to the finished road surface.
- It is extremely important to have the same amount of fill as the culvert's diameter before crossing over with equipment. (1m diameter culvert then 1m of fill over top)
- Rip-rap should be placed where required (**NOT IN THE CHANNEL**).

### Culverts (>1.5m)

- Detailed information such as silt fences and diversion ditches on each permanent (fish bearing or non-fish bearing) creek crossing will be provided by the Area Supervisor at the time of installation.
- Plans must be on site and followed.
- Installations on fish bearing streams require DFO approval.
- Where Federal approvals are obtained, the plan attached to the approval must be followed.
- Culverts > 1.5m require a provincial approval under the Water Act.

### Mitigative Measures for Fish Creek Culvert Crossings

#### SILT FENCES

- 3 silt fences must be installed below watercourse crossing at least 20m (60') apart.
- Each silt fence will have an extra 30cm of textile positioned on the ground in front of stakes. (Figure 1)
- Rocks will be placed on the extra material and straw bales will be placed over top of this extra textile.
- Once the silt fences are installed correctly, the construction supervisor will inspect them before any works will proceed.
- An Aqua Dam or diversion ditch must be installed to allow diversion of water from the installation site. (See Aqua Dam or Diversion Ditch)
- The creek channel will then be prepared for installation of the culvert at the proper slope.
- The culvert will be placed into the channel and embedded approximately 10% of the culverts diameter into the creek channel.
- Back filling will occur once culvert is placed and has proper alignment.
- Once culvert is fully installed the silt fences will then be cleaned of all silt material by hand shovel.
- The silt fences will be removed after culvert installation is complete.



## Diversions Ditch

A diversion ditch is installed if an Aqua Dam will not seal off water flow.

- A diversion ditch is dug from above the first silt fence to above the installation site.
- Banks in the diversion ditch must be backsloped and armoured with non-erodible material.
- Once the ditch is protected from erosion possibility, the ditch can then be opened up to the creek to allow water flow through the ditch.
- Installation of the culvert proceeds once the water is totally removed from the installation site.
- Once culvert is in place and has been back-filled, the ditch is blocked off with non-erodible material, to allow the water to return to the natural channel.
- Once water has emptied out of the diversion ditch, it can be back-filled with appropriate subgrade materials.

## AQUA DAM

Aqua Dam is used to stop water flow through crossing. The backed up water is then pumped around the site and allowed to re-enter the creek channel above the first silt fence.

- Aqua dam is to be installed in a confined section of the creek channel where ground seepage is a minimum.
- Large cobbles may have to be moved by hand to allow a smooth creek bottom for proper seal underneath the Aqua Dam.
- Water is then pumped for the creek channel into the Aqua Dam bags on both sides. The water levels in each bag have to be equal to prevent any creep of the Aqua Dam downstream. As the water levels come up the Aqua Dam seals off the water from proceeding downstream.
- The water that begins to back-up behind the Aqua Dam is then pumped around the installation site and is released back into the creek channel above the first silt fence.
- Once culvert installation is complete, the water is slowly emptied out of the Aqua Dam by pulling on the open end of the bags.
- Normal water flow is allowed to proceed once the dam is removed.

## Permanent Steel Bridge (Single Span)

- Install portable crossing as per instructions to cross the watercourse.
- Install appropriate abutment and retaining wall configuration.
- Assemble retaining wall if required and line with soil separator.
- Fill retaining wall with appropriate material and ensure adequate compaction.
- Move equipment to the other side of the stream utilizing a portable crossing.
- Repeat steps for the installation of abutments and retaining walls on bush side.
- Move bridge to the abutment.
- While equipment is on the other side of the stream attach a cable line from the equipment to the bridge.
- Sometimes it will be necessary to winch the steel bridge from a winch-truck
- Maintain pressure and tension from both sides of the crossing with equipment to ensure that the bridge is installed with no impact to the stream.
- Lift bridge up onto the abutment.



- Set bridge on the appropriate sills.
- Build road grade up to level of bridge deck.
- Provide appropriate erosion control measures and grass seed exposed areas.
- Remove portable bridge.

### Native Timber Bridge

- Corduroy the approach to the crossing site if required to protect the immediate banks of the watercourse for approximately 2.5m (8").
- Drive four piles, one on each corner, a minimum of 1m (3") from the creek and a minimum of 7.0 m (22') apart.
- Lay a minimum of 2 sill logs on the outside of each set of piles a minimum of 7.5m (24') long so that you have a foot extending past each pile.
- Lay stringers with butts alternating between piles and on top of the sill logs
- Lay deck logs between piles and perpendicular to stringers.
- Corduroy the bush side of the crossing if required to protect the immediate banks of the watercourse, for approximately 2.5m (8").
- Lay strips of geo-jute (separation layer) parallel with deck and long enough to wrap back over guard logs with a minimum overlap of 30cm (12").
- Lay a large log as a guard rail on the inside of each set of piles parallel with the road surface and wrap the geo-jute back over the top of the guard logs. Guard logs must be a minimum of 5.5m (18') apart.
- Lay a minimum of 24-36 cm (2') of conifer boughs over the geo-jute if available, and cap with approximately 15-30cm (6-12") of dirt.
- Soil cap must not exceed height of the guard logs. The soil cap must only be applied when there is a proper separation layer to contain the soil on top of the crossing. Only mineral soil is to be used as a cap, no slash (stumps or limbs) are to be mixed in.
- Refer to the FERIC log bridge design criteria for species and dimensions based on span.

### Ice Bridges

- Measure depth of ice and depth of water from the bottom of the ice; a minimum of 0.3m or (1') of water under the ice is required.
- Always retrieve water from the down stream side of the bridge.
- Build two snow berms across the creek a minimum of 7.6m (25') apart.
- Flood the entire area between the berms in layers based on the initial thickness of the ice, (ie: 1.5cm of water for <5cm ice). **MAXIMUM OF 5cm (2") AT ANY ONE TIME.**
- Repeat the flooding until ice thickness reaches a minimum of 0.6m (2').
- With a small cat push 0.3m (1') of clean snow over the ice, at the same time building up the existing snow berm to 0.6m (2').
- Place markers in the snow berm to indicate ice bridge location.
- Repeat flooding steps until an additional 0.3m (1') of ice is made or appropriate standards
- If the watercourse is utilized by recreational vehicles during the winter months (ie: snowmachines or quads) place signs up and down stream of the watercourse indicating its presence.
- For large crossings refer to the U.S. Army Corps of Engineers Ice Crossing Guidelines.



## Winter Temporary Bridges

- Freeze down road to crossing until it is safe to haul the bridge.
- If enough snow exists, fill the watercourse with clean snow for temporary access to move equipment across for the bridge installation.
- If there is not sufficient snow to fill the watercourse then approval must be given to place logs in the watercourse for temporary access, remove logs and place to the side for reclamation.
- Cross the temporary crossing with machinery and then back the bridge into place.
- Prepare area for bridge to be placed and lay sills for the bridge to sit on.
- Maintain pressure and tension from both sides of the crossing with machinery to ensure that the bridge is installed with no impact to the stream.
- Place abutment logs or planks against end of bridge, cover with a soil separator and begin pushing material (preferably clean snow) to build approaches to the bridge.
- While pushing material (preferably clean snow) to build the approaches also build up a berm (snow or logs) on both sides of the approach.
- Cap the running surface with approximately 15cm (6") of dirt.

## Records and Forms:

FOR-ROA-001 Road Pre-work Checklist  
FOR-ROA-002 Road Construction and Watercourse Crossing Checklist

## Related Documents:

SOP-ROA-001 Roads Pre-work SOP  
SOP-ROA-004 Access Control SOP  
WOG-ROA-001 Road Construction, Road Reclamation & Stream Crossing Guidelines

This document is not controlled when printed. Check electronic EMS manual for the current version.





## **Appendix IV – Road Maintenance (WOI-ROA-003)**







## Road Maintenance

### Purpose:

To ensure Millar Western staff and contactors are aware and familiar with the expectations for road maintenance.

### Scope:

All active roads and watercourse crossings owned or operated by MWFP .

### Roles:

MWFP employees  
MWFP contractors

### Procedure:

#### MWFP Supervisor:

- Ensure all required approvals are in place before work commences. (LOC's, AOP, Navigable Waters, Water Act, Fisheries Act)
- Conduct inspections based on the following guidelines:

#### General Guidelines

- All crossings will be inspected and the information stored in the GIS database.
- The previous year's harvesting operations will be inspected annually and the data recorded in the GIS database. From those inspections each crossing will be given a follow-up inspection date (i.e. 3 months, 6 months, 1 year, 2 years etc.) until the crossing is considered stable.
- Any crossings identified as needing follow up work will have a Harvest and Road Activities Inspection Form (FOR-HAR-002) completed.
- Photos of all crossings on large and small permanent creeks will be required; all other crossings will be photographed if there is follow-up work required.
- All woodland's staff will be given a Road & Crossing Inspection booklet for recording observations concerning the road integrity. These observations will be passed on to the appropriate Area Supervisor for follow-up as well as filed in the applicable block or road file.
- Additional inspections will be conducted if a significant rain event comes through the area. Those areas or crossings on mainline roads will be inspected immediately following the storm and observations recorded on a Harvest and Road Activities Inspection Form.

#### Contractor

- Attend pre-work meeting and sign off the Harvest and Road Activities Pre-Work Form prior to starting operations. (FOR-HAR-001)
- Follow detailed instructions from MWFP supervisor on the activity to be performed. Refer to the following activities listed below
  - Grading – Crown all roads to 2% to prevent water from pooling on the road surface and maintain rut-free running surface.



- Culverts – Clean inlet/outlet of deleterious material to allow free water flow. Ensure culvert is functioning and repair or replace if necessary.
- Ditches – Ensure adequate ditch depth, proper gradient, and unrestricted water flow.
- Cut/Fill Slopes – Ensure that both cut/fill slopes are stable and that the road grade is stable and erosion free.
- Bridges – Ensure the integrity of the structure and the abutments the bridge is placed on.
- Road Signage – Ensure road signage is properly placed and maintained.
- Road Side Vegetation – Adequate line of sight and adequate ditch flow.

### **Records and Forms:**

FOR-HAR-001 Harvest and Road Activities Pre-work Form  
FOR-HAR 002 Harvest and Road Activities Inspection Form

### **Related Documents:**

SOP-ROA-001 Roads Pre-work SOP  
SOP-ROA-004 Access Control SOP  
SOP-ROA-002 Road Inspection SOP  
WOG-ROA-001 Road Construction, Road Reclamation & Stream Crossing Guidelines



## **Appendix V – Road Reclamation (WOI-ROA-004)**





## Road Reclamation

### Purpose:

To ensure Millar Western staff and contactors are aware and familiar with the expectations for road reclamation.

### Scope:

All temporary roads and watercourse crossings within MWFP's FMA and various licence areas.

### Roles:

MWFP employees  
MWFP contractors

### Procedure:

#### Millar Western Supervisor:

- Ensure all required approvals are in place before work commences. (LOC's, AOP, Navigable Waters, Water Act, Fisheries Act)
- Conduct a reclamation pre-work meeting and document on FOR-HAR-003.

#### Contractor

- Attend pre-work meeting and sign off the reclamation pre-work form prior to starting operations. (FOR-HAR-003)
- Utilize the following guidelines for road and crossing reclamation:

## ROAD RECLAMATION GUIDELINES

### Temporary Roads

#### Erosion Control (Seasonal):

Refers to the construction of cross-ditches in order to prevent erosion of road running surface and keep access to a minimum.

- Remove all temporary and permanent crossings unless instructed otherwise.
- Reclaim crossings as per the WOG-ROA-001 Road Construction, Road Reclamation & Stream Crossing Guidelines.
- Cross-ditch roads to disperse water flow and seed to grass to prevent erosion.
- Install cross-ditches deep enough to divert water and achieve access control. Refer to the tables below for the spacing of the cross-ditches based on soil types and slope gradient.
- Water from roads, ditches and bared soil surfaces shall not be permitted to drain directly into watercourses.
- Steeper slopes will be cross-ditched and slash may be scattered on the road surface.
- Ensure all seismic lines are reclaimed unless otherwise instructed
- Ensure all trails are clear of slash to allow ATV travel.



- Access control measures ( ie gates, berms ) may be required; MWFP personnel will identify these locations.

### Deactivation

Refers to the total roll back of the road surface and returning to productive ground.

- Remove all crossings. Slash, stumps, and topsoil will be pulled back onto the road surface.
- Deep ripping of the road surface may be required.
- Contour the road surface to ensure drainage and stabilization is re-established.
- The road will be cross-ditched where required dispersing water flow away from watercourses. Refer to the tables below for the spacing of the cross-ditches based on soil types and slope gradient.
- Water from roads, ditches and bare soil surfaces shall not be permitted to drain directly into watercourses.
- Crossing locations and other erodible surfaces should be seeded to grass.
- Ensure all seismic lines are reclaimed unless otherwise instructed
- Ensure trails are clear of slash to allow ATV travel.
- Helipad locations are to be maintained in all blocks not adjacent to a permanent all-weather road as directed by MWFP supervisor.

### Cross Ditch & Waterbar Spacing Guidelines

Road Gradient %	Soil Type		
	Silts & Sands	Cohesive Clays	Gravels
0 – 5	100 meters	160 meters	210 meters
6 – 10	80 meters	110 meters	160 meters
11 – 15	50 meters	90 meters	130 meters
16 +	Site Specific		

Spacing in the above table should be modified for slope position and steepness as follows:

### Correction Factors

Slope Position	Side Slope %			
	0 - 20	21 - 40	41 - 60	>61%
Upper Slope	1.0	0.8	0.7	Site specific
Middle Slope	0.8	0.7	0.6	
Lower Slope	0.7	0.6	0.5	

\* Tables adapted from *Deactivation and Safety Manual*, Eric L. Kay.

### To Use the Tables

1. Divide the road into sections of similar grades, soil types and slope.
2. Measure the average road gradient in percent.
3. Visually estimate the soil type in the ditches and on the road surface. Choose the spacing require for the most erodible soil. Erodibility generally decreases:



Silt → Fine Sand → Sand → Clay → Gravel

4. Choose the slope position
5. Measure the average side slope for the road section.
6. Choose the basic spacing from the road gradient and soil type, and multiply it by the appropriate correction factor.

Example:

Silt soil, road gradient-15%, side slope-15%, middle slope the water bar spacing should be:  $50m \cdot 0.8 = 40m$ .

Note: On flat ground (swamps) and black spruce areas away from slopes, water bars and cross ditches are generally not required. Cross ditches in low lying areas will pool water and create a greater hazard than leaving the vegetation intact and maintaining the original drainage patterns.

### Helipads

- Helipads must be maintained in blocks that are not adjacent to permanent all weather roads as directed by MWFP supervisors.
- Helipads will be constructed on level ground, no risk of erosion, clear of slash, and not have any standing trees within 30m (100').
- The dimensions of the pad shall be approximately 20m x 20m (66'x 66') in size.
- Walkdown the slash around the perimeter of the helipad to prevent the risk of debris coming in contact with the rotor of the helicopter.
- Road intersections and haul truck pullouts may be utilized for helipads.
- Construct approximately one pad per 20 hectares.

### Sediment and Erosion Control

- Sediment must be controlled from entering onto watercourse crossings or directly into watercourses.
- Silt fences can be used to filter out sediment from ditchlines on low gradient areas. They must be installed with excess geotextile buried below the ditchline to ensure that water flow is not allowed to pass under the fence. The silt fences must be maintained regularly by removing any excess sediment build up away from the fence with a hand shovel.
- Diversion ditches can be used to deflect water away from watercourses at least 20m before a watercourse crossing to allow vegetation to filter the water.
- Conveyor belt installed on the running surface can also be used to deflect water to a ditchline or diversion ditch along the running surface.
- Silt fences can be installed along the snow berm of a snow fill to prevent splash of sediment from traffic utilizing the snow fill during warm weather.
- Grass seed should be used shortly after construction or reclamation to control surface erosion.
- The most effective sediment control method is to minimize the amount of traffic utilizing a watercourse crossing during adverse conditions as well as the installation of temporary cross ditches.
- Refer to WOG-ROA-005 for detailed instructions on the above mentioned methods.

### Watercourse Crossing Reclamation Guidelines

#### SNOWFILL

- Breakup the soil cap on the snow fill.



- Remove the ripped soil cap and dirty snow away from the creek bank and spread evenly on the disturbed road running surface.
- Dispose of soil caps in a manner that will not allow siltation into the watercourse.
- The clean snow will be notched without disturbing the vegetation or gully sides. This will allow the stream flow in the spring to naturally remove the remainder of the snow fill.
- Any disturbed areas shall be seeded to grass.

## **LOGFILLS**

- Use an excavator as the first choice of equipment
- Breakup the soil cap on the log fill.
- The broken soil cap and the separation layer will be removed down to the log layer and spread evenly on the disturbed road running surface.
- Use limbs and boughs for road reclamation,
- Remove logs, not disturbing the stream channel vegetation.
- Logs should be removed and placed 9m (30 ft) from the crossing. (on the mill side of logging operations).
- Soil caps should be disposed in a manner that will not allow siltation into the watercourse.
- Disturbed areas shall be seeded to grass.

## **CULVERTS**

- Remove as much of the fill over the culvert as possible leaving some fill at each end of the culvert to maintain flow direction into the culvert.
- Remove remainder of the fill starting at the downstream end and working towards the upstream end.
- Proceed with the removal of the culvert.
- Remove the fill from within the gully to an approximate distance of 9m from the stream and/or out of the active stream channel.
- Fill slope must be stabilized and all disturbed areas shall be seeded to grass.

## **STEEL BRIDGES**

- Remove road grade up to the edge of bridge in preparation for removal on the “mill side.”
- Walk machinery over to the “bush side” of the bridge.
- Remove road grade down to the level of the retaining wall.
- Back low-bed in with winch tractor & hook up slings.
- Hook up line from the equipment to the bridge (bush side).
- Winch bridge onto lowbed while maintaining tension with equipment.
- Remove fill from retaining wall and replace it to the original ground line with equipment unless otherwise instructed.
- Build ditch block along the road and approach to the bridge.
- Cross the stream in an approved manner.
- Remove fill from remaining retaining wall and replace it to the original ground line with equipment.
- Build ditch block along the road and approach to the bridge.
- Seed exposed areas to grass.

## **NATIVE TIMBER BRIDGES**

- Remove road grade up to the edge of bridge in preparation for removal on the “bush side”.
- Walk equipment over to the “mill side” of the bridge.
- Break the dirt cap just enough to enable the machinery to remove the dirt cap, limbs and geo-jute.





- Remove road grade down to the corduroy (if it exists) on the “mill side” of the bridge.
- With the excavator remove the guard logs, deck logs, stringers and corduroy.
- Bridge material not used in the reclamation process should be moved approximately 9 meters (30') away from the active channel.
- Provide appropriate erosion control measures and grass seed exposed areas.

### **ICE BRIDGES**

- Break up the ice and clean it off in 15cm (6”) increments until below snow layer.
- Clean all snow and ice off river bed and spread on high ground.
- If possible dig to natural ice or main stream flow without impeding water flow.
- Place barriers after Ice Bridge is reclaimed.

### **Records and Forms:**

FOR-HAR-003 Reclamation and Piling Pre-work Form

### **Related Documents:**

SOP-ROA-004 Access Control SOP  
WOG-ROA-001 Road Construction, Road Reclamation & Stream Crossing Guidelines  
WOG-ROA-005 Sediment and Erosion Control Guidelines





## **Appendix VI – Sediment and Erosion Control (WOG-ROA-005)**





## Sediment and Erosion Control

Sediment must not be allowed to enter into a watercourse. The following are methods that can be used to control sediment and erosion on roads, ditches, and watercourse crossings.

### SILT FENCE

- Silt Fences are to be used on low gradient areas for controlling sediment transport.
- They must be installed with the excess geotextile buried below ground level to prevent water from passing underneath the fence.
- It is advisable to install at least 3 silt fences in a row 20 m apart to ensure that all carried sediment is filtered out.
- They must be maintained on a regular basis by removing all dropped sediment with a hand shovel. The sediment should be placed in an area that will not allow the sediment to erode back into a watercourse.
- Silt fence can also be placed along the snow berms of a snow fill to prevent sediment splash from the snow fill to enter into a watercourse.

### DIVERSION DITCHES

- Diversion ditches are used to divert water away from the ditchline or running surface and into a vegetated area.
- They should be installed on a 30 degree angle from the running surface and direct water into a vegetated area at least 20m from a watercourse.

### CONVEYOR BELT

- Can be used in place of a cross ditch where access must be maintained.
- They are installed by digging a small trench and placing the conveyor belt on its side in the trench. It is advisable to have 4 inches of conveyor belt above the road running surface.
- Once placed in the trench, backfill is placed against the belt to hold it in place.
- The conveyor belt allows the deflection of surface runoff without restricting access.

### GRASS SEED

- Grass seed is a good method to establish a root structure within the top surface of the soil.
- It must be placed soon after construction or reclamation to get established quickly. Once in place the root structure will prevent only minor surface runoff of soil.

**The most important preventative method to erosion and sedimentation is proper planning of activities around weather conditions. If weather conditions start to deteriorate a watercourse crossing or erosion is starting to happen, it is important to implement one of the above procedures to prevent any adverse effects to the environment.**





## **Appendix VII – Culvert Sizing Table (WOG-PLA-001)**







### Culvert Sizing Tables

Average Stream Width (m)	Q100 Cross-Sectional Area Calculation													
	Average Depth of Stream (m)													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1				
0.2	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60				
0.3	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90				
0.4	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.20				
0.5	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50				
0.6	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80				
0.7	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.10				
0.8	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.16	2.40				
0.9	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43					
1.0	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40						
1.1	0.33	0.66	0.99	1.32	1.65	1.98	2.31							
1.2	0.36	0.72	1.08	1.44	1.80	2.16	2.52							
1.3	0.39	0.78	1.17	1.56	1.95	2.34								
1.4	0.42	0.84	1.26	1.68	2.10	2.52								
1.5	0.45	0.90	1.35	1.80	2.25									
1.6	0.48	0.96	1.44	1.92	2.40			Pipe Dia.	Area (m2)	Legend				
1.7	0.51	1.02	1.53	2.04	2.55			400	0.126					
1.8	0.54	1.08	1.62	2.16				500	0.196					
1.9	0.57	1.14	1.71	2.28				600	0.283					
2.0	0.60	1.20	1.80	2.40				800	0.503					
2.1	0.63	1.26	1.89	2.52				900	0.636					
2.2	0.66	1.32	1.98					1000	0.785					
2.3	0.69	1.38	2.07					1100	0.950					
2.4	0.72	1.44	2.16					1200	1.131					
2.5	0.75	1.50	2.25					1300	1.327					
2.6	0.78	1.56	2.34					1400	1.539					
2.7	0.81	1.62	2.43					1500	1.767					
2.8	0.84	1.68	2.52					1600	2.011					
2.9	0.87	1.74						1700	2.270					
3.0	0.90	1.80						1800	2.545					

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### Culvert Sizing Tables

Average Stream Width (m)	Q50 Cross-Sectional Area Calculation												
	Average Depth of Stream (m)												
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1			
0.2	0.05	0.10	0.14	0.19	0.24	0.29	0.33	0.38	0.43	0.48			
0.3	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57	0.64	0.71			
0.4	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95			
0.5	0.12	0.24	0.36	0.48	0.59	0.71	0.83	0.95	1.07	1.19			
0.6	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.28	1.43			
0.7	0.17	0.33	0.50	0.67	0.83	1.00	1.16	1.33	1.50	1.66			
0.8	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.52	1.71	1.90			
0.9	0.21	0.43	0.64	0.86	1.07	1.28	1.50	1.71	1.92	2.14			
1.0	0.24	0.48	0.71	0.95	1.19	1.43	1.66	1.90	2.14	2.38			
1.1	0.26	0.52	0.78	1.05	1.31	1.57	1.83	2.09	2.35				
1.2	0.29	0.57	0.86	1.14	1.43	1.71	2.00	2.28					
1.3	0.31	0.62	0.93	1.24	1.54	1.85	2.16	2.47					
1.4	0.33	0.67	1.00	1.33	1.66	2.00	2.33						
1.5	0.36	0.71	1.07	1.43	1.78	2.14	2.49						
1.6	0.38	0.76	1.14	1.52	1.90	2.28		Pipe Dia.	Area (m2)	Legend			
1.7	0.40	0.81	1.21	1.62	2.02	2.42		400	0.126				
1.8	0.43	0.86	1.28	1.71	2.14			500	0.196				
1.9	0.45	0.90	1.35	1.81	2.26			600	0.283				
2.0	0.48	0.95	1.43	1.90	2.38			800	0.503				
2.1	0.50	1.00	1.50	2.00	2.49			900	0.636				
2.2	0.52	1.05	1.57	2.09				1000	0.785				
2.3	0.55	1.09	1.64	2.19				1100	0.950				
2.4	0.57	1.14	1.71	2.28				1200	1.131				
2.5	0.59	1.19	1.78	2.38				1300	1.327				
2.6	0.62	1.24	1.85	2.47				1400	1.539				
2.7	0.64	1.28	1.92					1500	1.767				
2.8	0.67	1.33	2.00					1600	2.011				
2.9	0.69	1.38	2.07					1700	2.270				
3.0	0.71	1.43	2.14					1800	2.545				

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### Culvert Sizing Tables

Average Stream Width (m)	Q25 Cross-Sectional Area Calculation									
	Average Depth of Stream (m)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
0.2	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29	0.32	0.36
0.3	0.05	0.11	0.16	0.22	0.27	0.32	0.38	0.43	0.49	0.54
0.4	0.07	0.14	0.22	0.29	0.36	0.43	0.50	0.58	0.65	0.72
0.5	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90
0.6	0.11	0.22	0.32	0.43	0.54	0.65	0.76	0.86	0.97	1.08
0.7	0.13	0.25	0.38	0.50	0.63	0.76	0.88	1.01	1.13	1.26
0.8	0.14	0.29	0.43	0.58	0.72	0.86	1.01	1.15	1.30	1.44
0.9	0.16	0.32	0.49	0.65	0.81	0.97	1.13	1.30	1.46	1.62
1.0	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80
1.1	0.20	0.40	0.59	0.79	0.99	1.19	1.39	1.58	1.78	1.98
1.2	0.22	0.43	0.65	0.86	1.08	1.30	1.51	1.73	1.94	2.16
1.3	0.23	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34
1.4	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.02	2.27	2.52
1.5	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	
1.6	0.29	0.58	0.86	1.15	1.44	1.73	2.02	2.30		
1.7	0.31	0.61	0.92	1.22	1.53	1.84	2.14	2.45		
1.8	0.32	0.65	0.97	1.30	1.62	1.94	2.27	Pipe Dia.	Area (m <sup>2</sup> )	Legend
1.9	0.34	0.68	1.03	1.37	1.71	2.05	2.39	400	0.126	
2.0	0.36	0.72	1.08	1.44	1.80	2.16	2.52	500	0.196	
2.1	0.38	0.76	1.13	1.51	1.89	2.27		600	0.283	
2.2	0.40	0.79	1.19	1.58	1.98	2.38		800	0.503	
2.3	0.41	0.83	1.24	1.66	2.07	2.48		900	0.636	
2.4	0.43	0.86	1.30	1.73	2.16			1000	0.785	
2.5	0.45	0.90	1.35	1.80	2.25			1100	0.950	
2.6	0.47	0.94	1.40	1.87	2.34			1200	1.131	
2.7	0.49	0.97	1.46	1.94	2.43			1300	1.327	
2.8	0.50	1.01	1.51	2.02	2.52			1400	1.539	
2.9	0.52	1.04	1.57	2.09				1500	1.767	
3.0	0.54	1.08	1.62	2.16				1600	2.011	
3.1	0.56	1.12	1.67	2.23				1700	2.270	
3.2	0.58	1.15	1.73	2.30				1800	2.545	

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### Culvert Sizing Tables

Average Stream Width (m)	Q10 Cross-Sectional Area Calculation									
	Average Depth of Stream (m)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
0.2	0.02	0.05	0.07	0.09	0.12	0.14	0.16	0.18	0.21	0.23
0.3	0.03	0.07	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.35
0.4	0.05	0.09	0.14	0.18	0.23	0.28	0.32	0.37	0.41	0.46
0.5	0.06	0.12	0.17	0.23	0.29	0.35	0.40	0.46	0.52	0.58
0.6	0.07	0.14	0.21	0.28	0.35	0.41	0.48	0.55	0.62	0.69
0.7	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.81
0.8	0.09	0.18	0.28	0.37	0.46	0.55	0.64	0.74	0.83	0.92
0.9	0.10	0.21	0.31	0.41	0.52	0.62	0.72	0.83	0.93	1.04
1.0	0.12	0.23	0.35	0.46	0.58	0.69	0.81	0.92	1.04	1.15
1.1	0.13	0.25	0.38	0.51	0.63	0.76	0.89	1.01	1.14	1.27
1.2	0.14	0.28	0.41	0.55	0.69	0.83	0.97	1.10	1.24	1.38
1.3	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50
1.4	0.16	0.32	0.48	0.64	0.81	0.97	1.13	1.29	1.45	1.61
1.5	0.17	0.35	0.52	0.69	0.86	1.04	1.21	1.38	1.55	1.73
1.6	0.18	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84
1.7	0.20	0.39	0.59	0.78	0.98	1.17	1.37	1.56	1.76	1.96
1.8	0.21	0.41	0.62	0.83	1.04	1.24	1.45	1.66	1.86	2.07
1.9	0.22	0.44	0.66	0.87	1.09	1.31	1.53	1.75	1.97	2.19
2.0	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30
2.1	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93	2.17	2.42
2.2	0.25	0.51	0.76	1.01	1.27	1.52	1.77	2.02	2.28	2.53
2.3	0.26	0.53	0.79	1.06	1.32	1.59	1.85	2.12	2.38	
2.4	0.28	0.55	0.83	1.10	1.38	1.66	1.93	2.21	2.48	
2.5	0.29	0.58	0.86	1.15	1.44	1.73	2.01	2.30		
2.6	0.30	0.60	0.90	1.20	1.50	1.79	2.09	2.39		
2.7	0.31	0.62	0.93	1.24	1.55	1.86	2.17	2.48		
2.8	0.32	0.64	0.97	1.29	1.61	1.93	2.25	Pipe Dia.	Area (m <sup>2</sup> )	Legend
2.9	0.33	0.67	1.00	1.33	1.67	2.00	2.33	400	0.126	
3.0	0.35	0.69	1.04	1.38	1.73	2.07	2.42	500	0.196	
3.1	0.36	0.71	1.07	1.43	1.78	2.14	2.50	600	0.283	
3.2	0.37	0.74	1.10	1.47	1.84	2.21		800	0.503	
3.3	0.38	0.76	1.14	1.52	1.90	2.28		900	0.636	
3.4	0.39	0.78	1.17	1.56	1.96	2.35		1000	0.785	
3.5	0.40	0.81	1.21	1.61	2.01	2.42		1100	0.950	
3.6	0.41	0.83	1.24	1.66	2.07	2.48		1200	1.131	
3.7	0.43	0.85	1.28	1.70	2.13			1300	1.327	
3.8	0.44	0.87	1.31	1.75	2.19			1400	1.539	
3.9	0.45	0.90	1.35	1.79	2.24			1500	1.767	
4.0	0.46	0.92	1.38	1.84	2.30			1600	2.011	
4.1	0.47	0.94	1.41	1.89	2.36			1700	2.270	
4.2	0.48	0.97	1.45	1.93	2.42			1800	2.545	

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