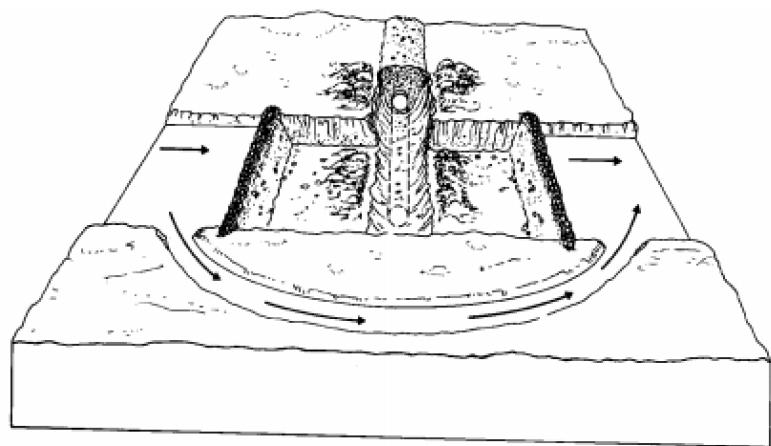


Chapter 9: Environmental Guidelines for Pipe Crossings



**Water Resources Management Division
Water Rights, Investigations, and
Modelling Section
November 29, 2018**



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Chapter 9
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PIPE CROSSINGS

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9.1 General

Almost always, as land is developed for residential, commercial and industrial purposes, the need arises to provide water and sewer services across a watercourse or a body of water. Water and sewer services are, of necessity, buried and therefore, they must normally cross under the body of water. Where grades permit a choice, buried crossings are preferred over aerial crossings (i.e. via bridges) because they are subjected to less exposure, accidental damage or vandalism. Pipe crossings can include water pipe crossings, sanitary sewers, gas pipelines or other pipes but these guidelines are equally applicable to any conduit crossing under a watercourse (ie. electrical or communications cables).

Consideration of factors, such as the hydraulic and hydrologic characteristics of the stream, substrate material and stream bank characteristics, are important in the selection of a suitable site for pipeline crossings. The number of pipeline crossings, if given a choice, should be kept to a minimum during construction in order to reduce the risk of causing any adverse impacts. The potential for streambed scouring and bank erosion must be determined in order to provide the necessary depth and length of burial required to prevent exposure. Pipeline exposure, as well as subsequent scour downstream, could create an obstruction to the upstream movement of fish. In order to provide adequate channel stability, it is necessary to account for channel migration, high velocity flows during peak runoff, ice jamming and scour, and any future stream alterations which may be anticipated during the design stages of a pipeline crossing.

This chapter is intended to provide helpful information for the installation of pipe crossings to ensure that streambed stability is maintained under natural conditions and that construction does not cause unnecessary environmental damage.

9.1.1 Regulations and Regulatory Bodies

Watercourse crossings are regulated under provincial legislation. Federal and municipal statutes and regulations also apply in most situations.

The Province has the mandate to protect all water resources from potential impact such as pollution, changes to domestic, municipal or industrial water supplies, flooding, aesthetic damages, changes in the flow regime, impact to wildlife, or any other alteration. Prior written approval must be obtained from the Department for watercourse crossings because of the potential to adversely affect water resources or the environment in general. In addition to this, the Department of Fisheries and Oceans retains direct management of fisheries and, accordingly, their regulations apply to watercourse crossings, but only if fish habitat is affected; and the Canadian Coast Guard requires approval of all construction in navigable waters under the *Navigable Waters Protection Act*.

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A certificate of environmental approval for a pipe crossing includes terms and conditions which are binding on the proponent and any persons working for the proponent. An application for approval must be completed by the proponent or the proponent's agent or consultant and submitted to the Department.

9.1.2 Other Applications of the Guidelines

Within these guidelines, the term pipe or pipeline can be substituted to accommodate any type of crossing under a body of water. Most commonly these include ductile iron, PVC and HDPE pipes which are used in water systems, storm and sanitary sewers and drainage applications. In addition, the guidelines also apply to gas and slurry pipelines, electrical conduits, fibre optic cables as well as other communication lines which must be buried under ground and subsequently under streams. Although each product may have a different set of manufacturer's specifications for installation, they all present similar potential for environmental damage to water resources.

The term "watercourse" is used in relation to stream alterations throughout this chapter but these guidelines may also pertain to any body of water in Newfoundland (beaches, marshes and bogs, rivers, lakes, etc.). Therefore, the following guidelines should be taken into consideration wherever an undertaking involves the placing of a pipeline or similar apparatus beneath the substrate of a waterbody.

9.2 Design Considerations

When installing a pipe crossing under a watercourse, the general contractor is responsible for the quality of work done at the site, but the contractor's work is subject to the design constraints of the system to be installed. The designer must ensure that safeguards can be implemented to provide protection of the body of water. The designer must also make the design as efficient and cost-effective as possible while adhering to environmental guidelines and habitat preservation procedures

9.2.1 Potential Low Scour Point

When designing a pipe crossing, one must consider the potential low scour point which is caused by shifting currents. It is generally necessary to maintain a level trench or specified grade for the full length of the crossing in unconsolidated substrates to prevent a pipe from being exposed due to lateral shifts in the low scour point (See **Figure 9.1**). If this is not compensated for in the design, the pipe may become exposed which will

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greatly increase the risk of pipe failure and alteration of the natural substrate of the watercourse.

Figure 9.1 Pipeline crossing a stream with an active substrate

9.2.2 Ditch Plugs

During the excavation stage, a ditch plug should be left in place on both sides of the stream until the pipe is ready for installation. It is important to leave plugs in place until the last possible moment to ensure that little or no flow from the ditch can enter the stream and that no stream flow can enter the ditch (See **Figure 9.2**). All work should be carried out in the dry as much as possible to reduce pumping and minimize the need to treat water for removal of silt.

9.2.3 Buoyancy Control

If buoyancy control at a stream crossing proves to be inadequate, then the pipe will tend to float and have to be repaired. Buoyancy control weights are required at river crossings. Where pipe exposure is inevitable under design flow conditions, these weights must be adequately secured to prevent them from slipping off the pipe. Once the pipe has been backfilled, the soil will have a sufficient internal resistance to prevent movement of the weights.

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Figure 9.2 Leaving a plug to isolate the trench from the main channel during excavation

9.2.4 Scheduling

The scheduling of work that deals with stream alterations is an important consideration in the implementation stage of an undertaking. Proper scheduling is important from the standpoint of environmental and fish habitat protection, and can be economically advantageous as well.

From the standpoint of the Department, the ideal time of year to construct a pipe crossing is when:

- the lowest possible flow rate occurs. This makes it easier to restore the streambank and there is less sediment generated; and when
- the seasonal rainfall period is at its driest because this reduces the chance of flash flooding.

These guidelines mean in practice that the best time to install pipe crossings is during the season lasting from June 1st to October 30th.

Although the Department of Fisheries and Oceans scheduling guidelines are governed by a different set of circumstances, their ideal construction season closely corresponds to that of the Department. The Department of Fisheries and Oceans generally states that the June 1st to September 30th construction season would not severely affect the spawning, incubation and hatching of fish in inland waters. (Note: This is a general guideline. These

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times may vary from river to river and specific scheduling of work should be discussed with a Department of Fisheries and Oceans Regional Habitat Coordinator.)

The amount of time spent constructing a crossing can have an increasingly adverse effect on water quality. The longer the stream bed is disturbed and left exposed, the larger the amount of sediment that will be introduced into the watercourse and the further the sediment will be able to travel within the watercourse.

9.2.5 Site Location

With a given undertaking, there may be some flexibility regarding choice of a route. Every water crossing represents increased costs for construction, maintenance and environmental protection requirements. Therefore, whenever possible, one should minimize the number of water crossings and avoid sensitive wetland areas or routes immediately adjacent to watercourses.

When designing a tentative route that includes a pipe crossing, the final location should be:

- downstream from areas such as fish spawning sites or water use intakes
- upstream of natural fish barriers such as waterfalls
- where the stream is straight, unobstructed and well defined
- on an existing right-of-way, if one exists
- where stable geological and soil conditions are present
- where a minimum of scour, deposition or displacement of sediments are expected to occur at or near a crossing
- where it is possible to minimize the risk of damage from environmental hazards such as floods, landslides, etc.

It is highly unlikely that any one stream crossing will meet all of these criteria. The more criteria that can be met, the more efficient the installation will be and the less chance that problems will arise in the future.

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9.3 Pipe Crossing Installation Practices

Pipe crossings can vary in size from a major trunk sewer with a diameter greater than one metre to an 18 millimetre diameter domestic water pipe. Regardless of size, there are a number of general procedures to follow which can limit the potential of causing sedimentation as a result of in-stream or near-stream activities. These vary depending on specific site conditions.

9.3.1 Site Preparation

Clearing and grubbing removes trees and shrubs from the banks of the stream to provide a right-of-way for the pipe crossing. It is important to maintain a minimum 15 metre undisturbed buffer along the approach on both sides of the stream until the pipe installation across the stream is ready to begin. Once the protective covering has been removed, the potential for sedimentation increases. The area to be cleared and grubbed must follow the proposed route of the pipe and the width of the disturbed area should be kept to a minimum.

Wherever possible, the site should be accessed from either side of the stream to reduce the need to have equipment to ford the stream.

9.3.2 Trench Excavation

Once clearing and grubbing has been completed, selective removal and stockpiling of topsoil from the buffer zone is required. All stockpiled material must be located further than 15 metres from the high water mark. The stockpiled topsoil must be reapplied to promote revegetation once the pipe crossing has been completed.

Occasionally, blasting is required in order to excavate the trench to the desired elevation and size. The section of the stream channel where blasting is to be carried out should be isolated by diverting or pumping flows around it. If poorly executed, blasting can be detrimental to fish by destroying their swim bladders.

The excavated trench must be carefully graded in order to evenly support the pipe along its entire length. In some cases, it may be necessary to over excavate the trench and backfill it with a granular material to achieve a proper bedding.

During trenching operations, it is important for the contractor to be extremely careful to prevent sedimentation by strictly adhering to the terms and conditions of the environmental approval.

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9.3.3 Isolation of Work Area

The method used to cross a stream with a pipeline depends on size of the stream, channel hydraulics, cost effectiveness and timing of the project. It is important that the installation be carried out as quickly and efficiently as possible in order to minimize any disturbance to the streamflow, water quality and aquatic environment. A pipeline crossing may involve a diversion of flow around the trench by using pumps and/or cofferdams, fluming small streams over the trench by using culverts and, in some instances, it may be economically feasible to install the pipe by drilled or slip boring procedures. *Chapter 10, "General Construction Practices"*, contains additional information on procedures used to isolate a work area.

9.3.4 Pipe Installation Procedures

From a nearby stockpile, the quantity of pipe required to complete the pipe crossing is hauled in and placed in an end-to-end fashion adjacent to the trench. The sections of pipe are then joined by mechanical joints (ductile, iron, PVC, HDPE) or thermal fusing (HDPE only). Either of these types of construction will ensure that the crossing is both flexible and water tight. When it is necessary to provide a sag in the pipe, it should be located outside the limits of any possible channel meander.

Valves should be located at both ends of the water crossing so the section can be isolated for testing or repairs and to prevent them from flooding. The valve closest to the supply source should be in a manhole. Permanent taps should be made on each side of the valve to allow insertion of a small meter for testing to determine leakage and for sampling purposes.

9.3.5 Backfilling

During the backfilling operation, the stockpiled material is selectively placed in the trench. This prevents material capable of damaging the pipe from being placed against it. If the excavated material contains boulders, frozen soil, organic material or other materials which do not meet the required specifications, it may be necessary to replace it with granular material. The material must be able to withstand erosion and scouring and must not extend above the original grade of the channel.

To prevent possible damage or failure to a pipe crossing, resulting in severe pollution, it is required that a minimum cover of 0.6 metres of stable compact soil be provided. Where the pipe crossing is located in bedrock, a minimum cover of 0.3 metres is acceptable.

In areas where high groundwater occurs, pipe zone cutoff walls, or other means, are required to prevent drawdown of the water table due to groundwater flow through the porous pipe zone material.

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9.3.6 Pressure Testing

As a final step to ensuring a water tight pipeline, pressure testing is done. The pipeline is pressurized (by pumping water into it) to a test pressure of 1.25 times the working pressure. The line is then left for at least two hours. If a leak is encountered through a loss of pressure, it is located and repaired and the line is retested.

9.4 Site Rehabilitation and Restoration

As with any stream alteration, it is necessary to carry out site rehabilitation in order to stabilize slopes, disturbed areas and other areas vulnerable to erosion, to provide revegetation and to ensure the site is left in a condition which is environmentally acceptable. *Chapter 10, "General Construction Practices"*, contains detailed information on site rehabilitation.

9.4.1 Erosion Control

Once the backfilling has been completed, some form of erosion control must be implemented. If not, the banks of the stream will quickly erode especially when there are higher flows later. This will introduce sediment into the watercourse and could ultimately alter the substrate of the watercourse.

One of the most effective methods of erosion control is to return the disturbed right-of-way to as close to its original condition as possible and then to seed or sod the affected area. Replacement of vegetation will only work however, if the vegetation can get proper root before higher flows occur. Other things that can be done to prevent erosion are rip-rapping the bank to one metre above the high water mark, installing diversion ditches, etc. (See **Figure 9.3**).

9.4.2 Fish Habitat Preservation

The installation of a pipe under a watercourse has the potential to impede or block fish migration and destroy fish population or fish habitat. These installations, if carried out improperly, can result in siltation and pollution which can kill fish or incubating eggs and ruin spawning locations.

The Fisheries Act contains sections which govern the alteration of fish habitat. Therefore, approval from Fisheries and Oceans Canada may be required in addition to approval from the provincial Department.

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Figure 9.3 Erosion control on sloped approached to streams

9.5 Inspection and Maintenance

Once the initial construction and clean-up of a pipeline crossing is completed, the potential for environmental damage is not eliminated. Through incorrect construction procedures or inefficient design, unforeseen factors could cause damage to the pipe system or the crossing site itself. However, the effect of these problems can be minimized by simple periodic inspections, routine general maintenance and some remedial work, if necessary.

9.5.1 Periodic Inspection

Pipeline crossings require periodic inspections in order to determine:

- The effectiveness of the erosion control measures used to stabilize the streambed and stream banks
- Evidence of scouring around pipeline structure
- Evidence of lateral migration of the channel
- Signs of pipe movement caused by buoyancy or frost heave
- Signs of leakage in the pipe
- Changes in water quality
- Signs of channel constriction.

9.5.2 General Maintenance

General and minor maintenance work should be carried out from time to time. Minor flaws in a pipeline could be temporarily repaired during sensitive periods using a low impact procedure with more permanent repairs to be made during non-sensitive periods.

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9.5.3 Remedial Work

Where serious problems are evident, such as streambed instability, pipe failure or systems malfunction, remedial measures may be required. Such problems are often the result of inadequate installation procedures or lack of erosion protection which should have been addressed in the design stage. If, however, erosion control or river training works are to be carried out subsequent to the development of such problems, a comprehensive investigation or evaluation of the problem should be conducted. A new environmental approval will be required to carry out remedial work to a pipeline.