Patrick Duxbury

From: Watson, Ernest [WatsonE@DFO-MPO.GC.CA]
Sent: April 5, 2007 10:47 AM
To: Patrick Duxbury
Cc: Alan Ehrlich
Subject: DFO Presentation, April 4th Public Hearing for CGV and Sidon Drilling program (EA0506-005 and EA0506-006)
Attachments: DFO Presentation - Sidon and CGV EA0506-005 and 006 (2007-04-04).pdf; Water Withdrawal Protocol - Jan 05.pdf; FreshwaterIntakeGuidelines.pdf; os-eo09_e.pdf

Hello Patrick:

Please find attached the DFO presentation that as was delivered at the hearing yesterday. <<DFO Presentation - Sidon and CGV EA0506-005 and 006 (2007-04-04).pdf>>

Also, as follow-up to the presentation, I am including as background information 3 documents that were referred to during our presentation:

1. DFO's Protocol for Winter Water Withdrawal In the Northwest Territories (January 2005) <<Water Withdrawal Protocol - Jan 05.pdf>>

2. DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (1995) <<FreshwaterIntakeGuidelines.pdf>>

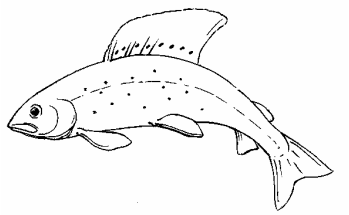
3. DFO's Northwest Territories Operational Statement for Ice Bridges <<os-eo09_e.pdf>>

DFO appreciates the opportunity to participate in the public hearing. Please contact me if you have any questions or wish to discuss any of the attached material in detail.

Sincerely,

Ernie Watson
Area Chief, Habitat
867-669-4927 | facsimile / télécopieur 867-669-4940
watsone@dfo-mpo.gc.ca
Western Arctic Area | Secteur de l'Arctique de l'Ouest
Central and Arctic Region | Région Centrale et de l'Arctique
Fisheries and Oceans Canada | 101-5204 50th Ave, Yellowknife, NT, X1A 1E2
Pêches et Océans Canada | 101-5204 50 Ave, Yellowknife, NT, X1A 1E2

Fisheries and Oceans Pêches et Océans



DFO Protocol for Winter Water Withdrawal In the Northwest Territories

Rationale

In the Northwest Territories, winter activities such as access road construction, exploratory drilling and camp operations often require large amounts of water. Excessive amounts of water withdrawn from ice covered waterbodies or watercourses can lead to oxygen depletion, loss of over-wintering habitat and/or reductions in littoral habitat. The potential for such negative impacts to over-wintering fish and fish habitat has made winter water withdrawal a critical issue for the Department of Fisheries and Oceans (DFO) in the Northwest Territories. To address the issue of water withdrawal, and to provide standardized guidance to water users, including volume limits for certain water source types, DFO has developed this protocol in conjunction with industry and other regulators.

This protocol pertains to works and activities where a total water volume greater than or equal to (≥) $100m^3$ is required from any given waterbody or watercourse during one ice-covered period.

This protocol will **not** apply to the following:

- Winter water withdrawal from the Mackenzie River;
- Any other waterbody or watercourse that is exempted by DFO (i.e. Great Bear Lake, Great Slave Lake, Gordon Lake, and others as and when determined by DFO), and;
- Any waterbody (not including watercourses) from which less than $100m^3$ is to be withdrawn over the course of one ice-covered period.

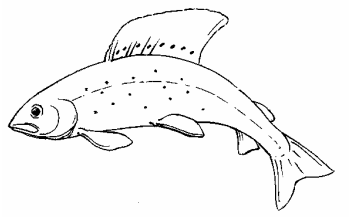
Water Withdrawal from Waterbodies:

For the purposes of this protocol, a **waterbody** is defined as any water-filled basin that is potential fish habitat. A waterbody is defined by the ordinary high water mark of the basin, and excludes connecting **watercourses** (see definition in **Water Withdrawal from Watercourses** below). In order to establish a winter water withdrawal limit for a given waterbody, the following criteria must be adhered to:

1. In one ice-covered season, total water withdrawal from a single waterbody is not to exceed 5% of the available water volume calculated using the appropriate maximum expected ice thickness provided in Table 1.
2. In cases where there are multiple users withdrawing water from a single waterbody, the total combined withdrawal volume is not to exceed 5% of the available water volume calculated using the appropriate maximum expected ice thickness provided in Table 1. Therefore, consistent and coordinated water source identification is essential.
3. Only waterbodies with maximum depths that are ≥1.5m deeper than their corresponding maximum expected ice thickness should be considered for water withdrawal (Table 1). Waterbodies with less than 1.5m of free water beneath the maximum ice are considered to be particularly vulnerable to the effects of water withdrawal.
4. Any waterbody with a maximum expected ice thickness (Table 1) that is greater than, or equal to, its maximum depth (as determined from a bathymetric survey) is exempt from the 5% maximum withdrawal limit.

To further mitigate the impacts of water withdrawal, water is to be removed from deep areas of waterbodies (>2m below the ice surface) wherever feasible, to avoid the removal of oxygenated surface waters that are critical to over-wintering fish. The littoral zone should be avoided as a water withdrawal location. Water intakes should also be properly screened with fine mesh of 2.54 mm (1/10") and have moderate intake velocities to prevent the entrainment of fish. Please refer to the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO, 1995) which is available upon request, or at the following internet address: www.dfo-mpo.gc.ca/Library/223669.pdf.

In order to determine the maximum water withdrawal volume from an ice-covered waterbody and thereby conform to this protocol, the following information must be provided to DFO for review and concurrence, prior to program commencement.



DFO Protocol for Winter Water Withdrawal In the Northwest Territories

Water Source Identification

1. Proposed primary and secondary access routes for all project activities, with proposed water source and crossing locations clearly identified on a map, with geographical coordinates (latitude/longitude and/or UTMs) included.
2. Documented watercourse connectivity (permanently flowing and/or seasonal) between the proposed water source and any other waterbody or watercourse.
3. Aerial photos or satellite imagery of the water sources if available.
4. Estimated total water withdrawal requirement for work or activity and estimated total water withdrawal per water source (in m^3).

Bathymetric Survey Results

1. For all waterbodies: One longitudinal transect, connecting the two farthest shorelines, is to be conducted regardless of waterbody size. **Note: a longitudinal transect may be straight or curved in order to accommodate the shape of a lake (see Figure 1).**
2. For waterbodies equal to or less than 1km in length: a minimum of one longitudinal transect and two perpendicular transects are to be conducted. Perpendicular transects should be evenly spaced on the longest longitudinal transect, dissecting the lake into thirds (Figure 1).
3. For lakes greater than 1km in length: a minimum of one longitudinal transect is to be conducted. Perpendicular transects (min. of 2) should be evenly spaced on the longest longitudinal transect at maximum intervals of 500m.
4. Additional transects should be run as required to include irregularities in waterbody shape such as fingers or bays (Figure 1).
5. All longitudinal and perpendicular transects are to be conducted using an accurate, continuous depth sounding methodology, such as open water echo sounding, that provides a continuous depth recording from one shore to the farthest opposing shore (Figure 1). Any alternative technology should be reviewed by DFO prior to implementing for bathymetric surveys.

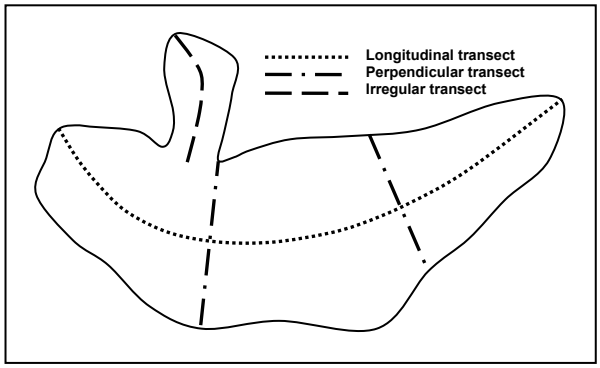
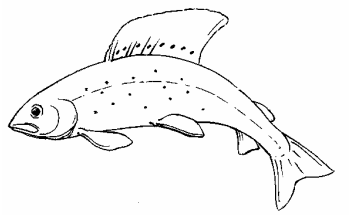


Figure 1. Minimum transect layout for a lake that is less than 1 km in length, with an irregularity.

Volume Calculations

1. Document the methods used to calculate surface area. If aerial photos or satellite imagery were used, provide the date (day/month/year) taken, as surface area may change depending on the time of year. If maps were used, provide the year that they were surveyed.
2. Detail the methods used to determine the total volume of free water, incorporating the relevant bathymetric information.
3. Calculate the available water volume under the ice using the appropriate maximum expected ice thickness, i.e. *Total Volume* $_{lake}$ *– Ice Volume* $_{max\ thickness}$ *= Available Water Volume* (see Table 1 for maximum ice thickness).
4. For programs where ice-chipping is used, the total ice volume to be removed from the waterbody should be converted to total liquid volume and incorporated into the estimate of total water withdrawal requirement per water source.



DFO Protocol for Winter Water Withdrawal In the Northwest Territories

Table 1. Maximum expected ice thickness, and corresponding water depth requirements, for different regions in the Northwest Territories.

Area	Maximum Expected Ice Thickness (m)	Minimum Waterbody depth Required for 5% Water Withdrawal (m)
Above the Tree Line	2.0	≥3.5
Below the Tree Line - North of Fort Simpson	1.5	≥3.0
Deh Cho –South of Fort Simpson	1.0	≥2.5

Water Withdrawal from Watercourses:

For the purposes of this protocol, a **watercourse** is defined as a channel through which water flows and is potential fish habitat. A watercourse is defined by the ordinary high water mark of the channel, and excludes connecting waterbodies or watercourses. In order to establish a winter water withdrawal limit for a given watercourse, the following criteria must be adhered to:

1. Total water withdrawal for all activities is not to exceed 5% of the instantaneous flow rate of a single watercourse at the time of withdrawal.
2. In cases where there are multiple users withdrawing water from a single watercourse, the total combined withdrawal rate is not to exceed 5% of the instantaneous flow rate at the time of withdrawal. Therefore, consistent and coordinated water source identification is essential.

To further mitigate the impacts from water withdrawal, water intakes should be properly screened with fine mesh of **2.54 mm (1/10")** and have moderate intake velocities to prevent the entrainment of fish. Please refer to the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO, 1995) which is available upon request, or at the following internet address: www.dfo-mpo.gc.ca/Library/223669.pdf.

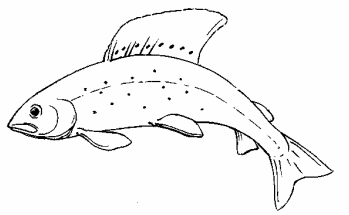
In order to determine the maximum water withdrawal rate from an ice-covered watercourse and thereby conform to this protocol, the following information must be provided to DFO for review and concurrence, prior to program commencement. DFO will only consider watercourses to be used as water sources if no suitable alternatives exist.

Water Source Identification

1. Proposed primary and secondary access routes for all project activities, with proposed water crossings and water source locations clearly identified on a map, with geographical coordinates (latitude/longitude and/or UTMs) included.
2. Aerial photos or satellite imagery of the water sources if available.
3. Estimated total water withdrawal requirement for work or activity, and estimated total water withdrawal per water source (in m^3).

Stream Survey Requirements

1. Location and date of survey (day, month, and year).
2. Photos of the stream location where withdrawal is to occur.
3. An accurate measurement of flow rate (to be confirmed immediately prior to water withdrawal commencing).
4. Stream survey should include; profile (minimum of ten evenly spaced points), depth, width, and flow rate.
5. Survey effort should reflect channel width: <2m wide, three vertical stations; 2-10m, 10 vertical stations; >10m, 20 vertical stations.
6. Pump specifications (type, model, horsepower, and max discharge rate).
7. Information on substrate type, in-water vegetation, riparian vegetation, and bank description is also requested.



DFO Protocol for Winter Water Withdrawal In the Northwest Territories

A brief project summary report documenting and confirming total water volume used per water source, withdrawal rates, flow rates per source and corresponding dates should be submitted to DFO within 60 days of project completion. Information should be provided in the following format (this information would also be useful as part of the project description):

Lake ID	**number and/or name**
Coordinates	**latitude and longitude and/or UTM coordinates**
Surface area	**in m^2**
Total Lake Volume	**in m^3**
Under Ice Volume	**in m^3 (based on max ice thickness for region)**
Max expected ice thickness value used	**in m**
Calculated 5% Withdrawal volume	**in m^3**
Total required water volume extracted	**in m^3**
Photograph of waterbody	
Bathymetric Map(s) of waterbody	

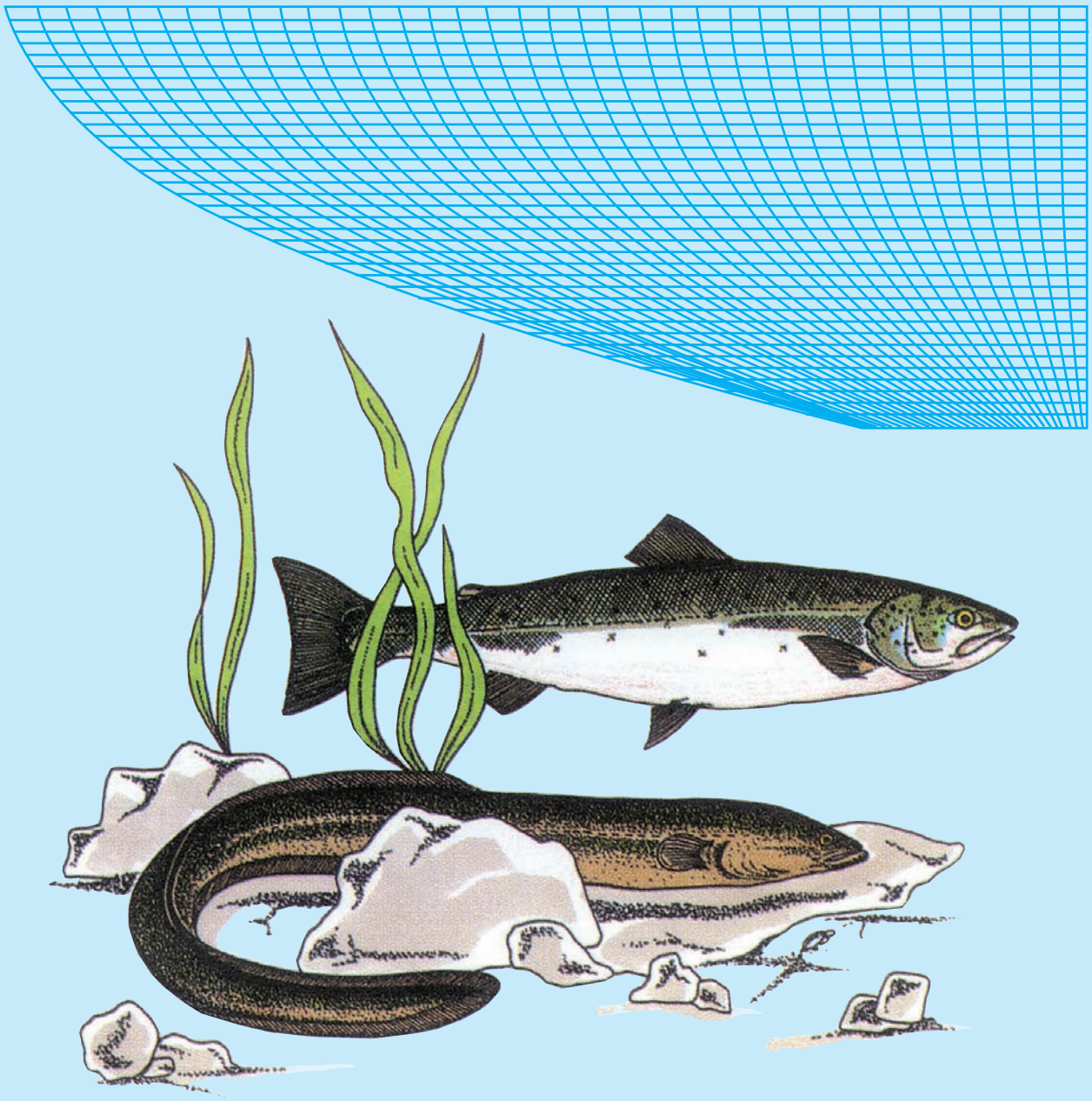
Any requests deviating from the above must be submitted to DFO and will be addressed on a site-specific basis.

Please note that adherence to this protocol does not release the proponent of the responsibility for obtaining any permits, licences or authorizations that may be required.

For more information contact DFO at (867) 669-4900.

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline

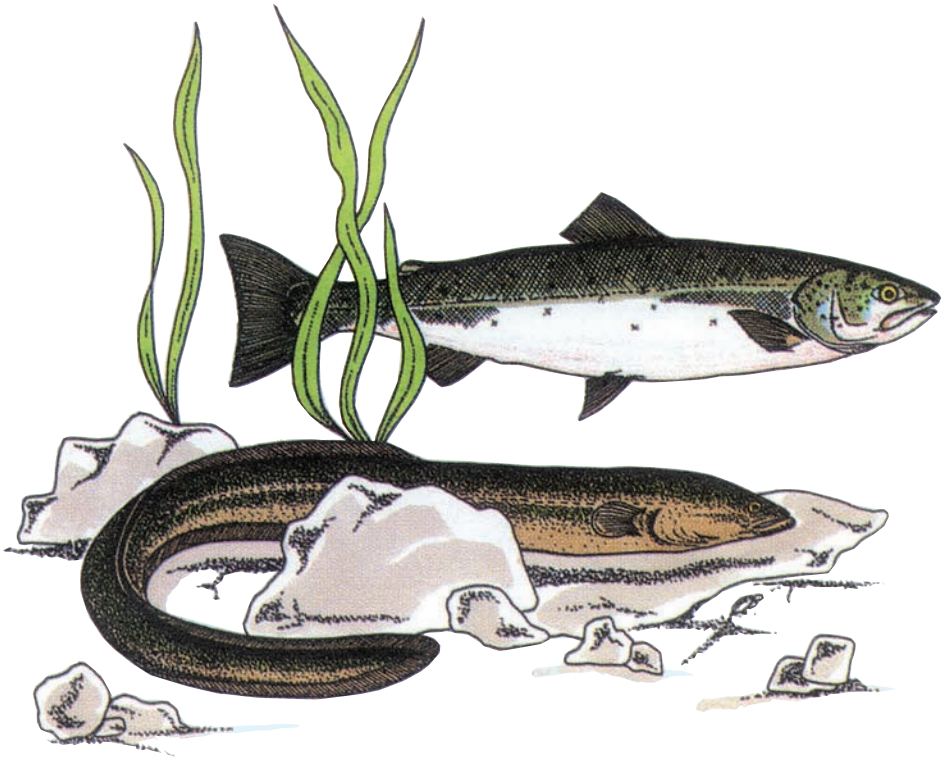


Fisheries and Oceans Pêches et Océans

Canada

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline



Fisheries and Oceans Pêches et Océans

Canada

Published by:

Communications Directorate
Department of Fisheries and Oceans
Ottawa, Ontario
K1A OE6

DFO / 5080

ISBN 0-662-23168-6

Catalogue No. Fs 23-270 / 1995E

Printed on recycled paper

Table of Contents

List of Figures

List of Tables

1.0 Introduction

The Department of Fisheries and Oceans (DFO) has prepared the **Freshwater Intake End-of-Pipe Fish Screen Guideline** to assist proponents in the design and installation of fish screens for the protection of anadromous and resident fish where freshwater is extracted from fish-bearing waters. This guideline will also assist regulatory agencies in the review of fish screen proposals.

A requirement for fish screening is stated under Section 30 of the *Fisheries Act*, where every water intake, ditch, channel, or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters must provide for a fish guard or a screen, covering, or netting over the entrance or intake so as to prevent the passage of fish into such water intake, ditch, channel or canal. Other sections of the *Fisheries Act*, or other Federal, Provincial, or Municipal Legislation and Policy may also apply to associated water extraction activities. Proponents are advised to contact the appropriate regulatory agencies regarding approvals or permits.

2.0 Guideline Objective

The objective of the guideline is to provide a National standard-of-practice and guidance for end-of-pipe fish screens at freshwater intakes to prevent potential losses of fish due to entrainment or impingement. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. The severity of the impact on the fisheries resource and habitat depends on the abundance, distribution, size, swimming ability, and behaviour of the organisms in the vicinity of the intake, as well as, water velocity, flow and depth, intake design, screen mesh size, installation and construction procedures and other physical factors.

The **Freshwater Intake End-of-Pipe Fish Screen Guideline** deals exclusively with the sizing and design of fixed screens that are often placed at the end of a pipe used to extract water up to 0.125 m^3/s, or 125 litres per second (L/s) (i.e., 2000 US gallons per minute (US gpm)). The guideline is intended for use in addressing fish screens for small permanent and temporary withdrawals for irrigation, construction, small municipal and

private water supplies, etc. It is *not* intended for application to hydroelectric or canal screen designs; however, such proposals can be considered by regulatory agencies on a site-specific basis. The guideline focuses on the technical aspects of intake screens and the protection of fish rather than on policy, legislation, or environmental assessment processes and their application. This guideline has been developed to provide protection of freshwater fish with a minimum fork length of 25 mm (approximately 1 inch) since most eggs and fish larvae remain in bottom substrates until they reach the fry stage (i.e., 25 mm fork length). Other designs, in addition to intake screens, may be appropiate to address fish and fish habitat protection associated with water withdrawals. Such proposed designs should be addressed with the appropriate regulatory agencies on a site-specific basis.

3.0

Information Requirements for Evaluation of Intake Screens

Information that should be provided to facilitate evaluation of an end-of-pipe intake screen design intended for fish protection during a freshwater withdrawal is highlighted below. Types of information requirements that may also be applicable to the water intake project as a whole are identified in Appendix A.

- fish presence, species, and possible fish size or fish habitat conditions at the project site
- rate or ranges of rates of withdrawal from the watercourse
- screen open and effective areas
- physical screen open parameters with respect to the intake and the watercourse
- screen material, method of installation and supporting structures
- screen maintenance, cleaning, or other special requirements

4.0

Design, Installation, & Maintenance of Freshwater Intake End-of-Pipe Fish Sereens

The appropriate design of a fish screen is largely dependent upon the species and the size of fish requiring protection. Appropriate installation and maintenance/cleaning of the screen are also important in keeping approach velocities low and ensuring satisfactory operation of the screen. For the purposes of this guideline, emphasis is placed on the protection of freshwater fish with a minimum fork length of 25 mm from entrainment and impingement due to water extraction activities. Depending upon site-specific circumstances, a case may be made whereby the minimum fork length size of fish to be protected is greater than 25 mm. In this instance, the fish screen criteria for open screen area (Table 2 and Figure 1) and screen mesh size (2.54 mm) presented here do not apply. Fish screen criteria and guidance for the protection of fish larger than 25 mm is provided by Katopodis (1992).

The following sections address the appropriate design of fixed freshwater intake end-of-pipe fish screens for the protection of fish with a minimum fork length of 25 mm. Guidance on

installation, cleaning, and maintenance is provided. Common types of intake screens and associated intakes are also presented. Appendix B presents a sample calculation utilizing the guideline to determine the appropriate end-of-pipe intake screen size for the protection of freshwater fish.

4. 1 Fish Screen Criteria

To protect fish from impingement or entrainment, the approach velocity (i.e., the water velocity into, or perpendicular to, the face of an intake screen) should not exceed certain values based on the swimming mode (i.e., subcarangiform or anguilliform) of the fish present in the watercourse. The subcarangiform group includes fish that swim like a trout or salmon, and move through the water by undulating the posterior third to half of their bodies. The anguilliform group includes fish that swim like an eel, and move through the water by undulating most or all of their body. Table 1 presents the swimming modes of most common fish species in Canada. Contact DFO or provincial fisheries agencies regarding fish species that are not included in Table 1.

Envelope curves for approach velocities were developed for each swimming mode corresponding to a minimum fork length of 25 mm and a maximum endurance time of 10 minutes (the time the fish is in front of the face of the screen before it can elude it). To satisfy approach velocities of approximately 0.11 m/s and 0.038 m/s for the subcarangiform and anguilliform groups respectively, curves indicating the required open screen areas, based on fish swimming performance data, including fish species and size (Katopodis, 1990) and related to flows/extractions, were developed. Table 2 presents the required open screen area, in both metric and non-metric units, for end-of-pipe intake screens with a capacity up to 125 L/s (2000 US gpm). The open screen area is the area of all open spaces on the screen available for the free flow of water. The same information is presented graphically in Figure 1.

Table 1
Summary of Common Fish Species and Swimming Modes

SUBCARANGIFORM SWIMMING MODE

Common Name	Scientific Name
Alewife (Gaspereau)	*Alosa pseudoharengus*
Arctic Char	*Salvelinus alpinus*
Arctic Grayling	*Thymallus arcticus*
Atlantic Salmon	*Salmo salar*
Broad Whitefish	*Coregonus nasus*
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Carp	*Cyprinus carpio*
Channel Catfish	*Ictalurus punctatus*
Chinook Salmon	*Oncorhynchus tshawytscha*
Chum Salmon	*Oncorhynchus keta*
Cisco	*Coregonus artedii*
Coho Salmon	*Oncorhynchus kisutch*
Cutthroat Trout	*Oncorhynchus clarki clarki*
Dolly Varden	*Salvelinus malma*
Goldeye	*Hiodon alosoides*
Green Sturgeon	*Acipenser medirostris*
Inconnu	*Stenodus leucichthys*
Kokanee	*Oncorhynchus nerka*
Lake Sturgeon	*Acipenser fulvescens*
Lake Trout	*Salvelinus namaycush*
Lake Whitefish	*Coregonus clupeaformis*
Largemouth Bass	*Micropterus salmoides*
Longnose Sucker	*Catostomus catostomus*
Mooneye	*Hiodon tergisus*
Mountain Whitefish	*Prosopium williamsoni*
Ouananiche	*Salmo salar ouananiche*
Pink Salmon	*Oncorhynchus gorbuscha*
Rainbow Smelt	*Osmerus mordax*
Rainbow Trout	*Oncorhynchus mykiss*
Sauger	*Stizostedion canadense*
Smallmouth Bass	*Micropterus dolomieui*
Sockeye Salmon	*Oncorhynchus nerka*
Walleye	*Stizostedio vitreum*
White Bass	*Morone chrysops*
White Perch	*Morone americana*
White Sturgeon	*Acipenser transmontanus*
White Sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

ANGUILLIFORM SWIMMING MODE

Common Name	Scientific Name
American Eel	*Anguilla rostrata*
Burbot	*Lota lota*
Sea Lamprey	*Petromyzon marinus*

Note: The few data points available for Northern Pike *(Esox lucius)* are close to the anguilliform group.

4.2 Design of Fixed End-of-Pipe Fish Screens

Once the required open area has been found from Table 2 or Figure 1, the effective screen area must be calculated. It is the area occupied by the open spaces (i.e., open screen area) and the screen material available for the free flow of water. The effective screen area should be provided at the intake location and is determined as follows:

$$\text{Effective Screen Area } (m^2 \text{ or } ft^2) = \frac{\text{Open Screen Area (Table 2)}}{\left(\frac{\text{\% Open Area (Table 3)}}{100}\right)}$$

It should be noted that if the percent (%) open screen area is maximized, then the effective screen area required for a given flow is minimized. The narrowest dimension of any opening on the screen is referred to as the design opening, regardless of opening shape. The maximum design opening for a fish of 25 mm fork length is estimated at 2.54 mm (0.10 inches). Guidance on screen openings and materials is presented below.

- The screen openings may be round, square, rectangular, or any combination thereof, but should not have any protrusions that could injure fish.
- Screen materials may include brass, bronze, aluminum, monel metal, galvanized or stainless steel, and plastics. The screen material should be resistant to corrosion and UV light.
- Note: clogging due to corrosion is minimized with the use of stainless steel.
- Welded wedge wire screens offer reduced debris clogging and increased open area and screen stiffness, in comparison to round wire mesh and punch plate.

Table 3 presents several common types of screening material that meet the requirements of wire diameter, clear opening width and percent open area,

The dimensions of the fish screen can be calculated after the correct shape, configuration, location, and method of installation have been determined. This will usually be determined after a site investigation and a review of these guidelines. Included in Figure 2 are common screen shapes and the associated

Table 2
Open Screen Area Required for End-of-Pipe Water Intakes

Metric Units			Non-Metric Units		
Flow (L/s)	Subcarangiform (m^2)	Anguilliform (m^2)	Flow (US gpm)	Subcarangiform (ft^2)	Anguilliform (ft^2)
1	0.01	0.03	10	0.1	0.2
5	0.05	0.13	50	0.3	0.9
6	0.06	0.16	100	0.6	1.8
8	0.07	0.21	150	0.9	2.7
10	0.09	0.26	200	1.3	3.6
12	0.11	0.31	250	1.6	4.5
14	0.13	0.37	300	1.9	5.4
15	0.14	0.39	350	2.2	6.2
16	0.15	0.42	400	2.5	7.1
18	0.17	0.47	450	2.8	8.0
20	0.18	0.52	500	3.2	8.9
22	0.20	0.58	550	3.5	9.8
24	0.22	0.63	600	3.8	10.7
25	0.23	0.65	650	4.1	11.6
26	0.24	0.68	700	4.4	12.5
28	0.26	0.73	750	4.7	13.4
30	0.28	0.79	800	5.0	14.3
32	0.30	0.84	850	5.4	15.2
34	0.31	0.89	900	5.7	16.0
35	0.32	0.92	950	6.0	16.9
36	0.33	0.94	1000	6.3	17.8
38	0.35	0.99	1050	6.6	18.7
40	0.37	1.05	1100	6.9	19.6
45	0.42	1.18	1150	7.2	20.5
50	0.46	1.31	1200	7.6	21.4
55	0.51	1.44	1250	7.9	22.3
60	0.55	1.57	1300	8.2	23.2
65	0.60	1.70	1350	8.5	24.1
70	0.65	1.83	1400	8.8	25.0
75	0.69	1.96	1450	9.1	25.8
80	0.74	2.09	1500	9.4	26.7
85	0.78	2.23	1550	9.8	27.6
90	0.83	2.36	1600	10.1	28.5
95	0.88	2.49	1650	10.4	29.4
100	0.92	2.62	1700	10.7	30.3
110	1.02	2.88	1750	11.0	31.2
120	1.11	3.14	1800	11.3	32.1
125	1.16	3.30	1850	11.6	33.0
			1900	12.0	33.9
			1950	12.3	34.8
			2000	12.6	35.7

Table 3
Examples of Sereen Material

Material	Wire Thickness	Opening Width	% Open Area
8x 8 Stainless Steel Alloy Mesh	0.711 mm (0.028”)	2.44 mm (0.096”)	60
#7 Mesh Wire Cloth	1.025mm (0.041”)	2.54 mm (0.100”)	51
#8 Mesh Wire Cloth	0.875 mm (0.035”)	2.25 mm (0.089”)	52
#8 Mesh Wire Cloth	0.700mm (0.028”)	2.54 mm (0.100”)	62
#60 Wedge Wire Screen	1.50mm (0.059”)	2.54 mm (0.100”)	63
#45Wedge Wire Screen	1.10mm (0.080”)	2.54 mm (0.100”)	69

dimensions and area formulae. These are just examples of the many shapes and sizes in which fish screens can be fabricated. Screens are instream structures and, as such, should have sufficient strength and durability, and be capable of withstanding any potential large forces and impacts. Figure 3, 4, and 5 illustrate some of the various configurations, applications, and screen material types of end-of-pipe fish screens.

4.3 Installation

- Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
- Screens should be located away from natural or man-made structures that may attract fish that are migrating, spawning, or in rearing habitat.
- The screen face should be oriented in the same direction as the flow.
- Ensure openings in the guides and seals are less than the opening criteria to make “fish tight”.
- Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold capped.
- Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical.

Figure 1
Open Screen Area for End-of-Pipe Water Intake Flow

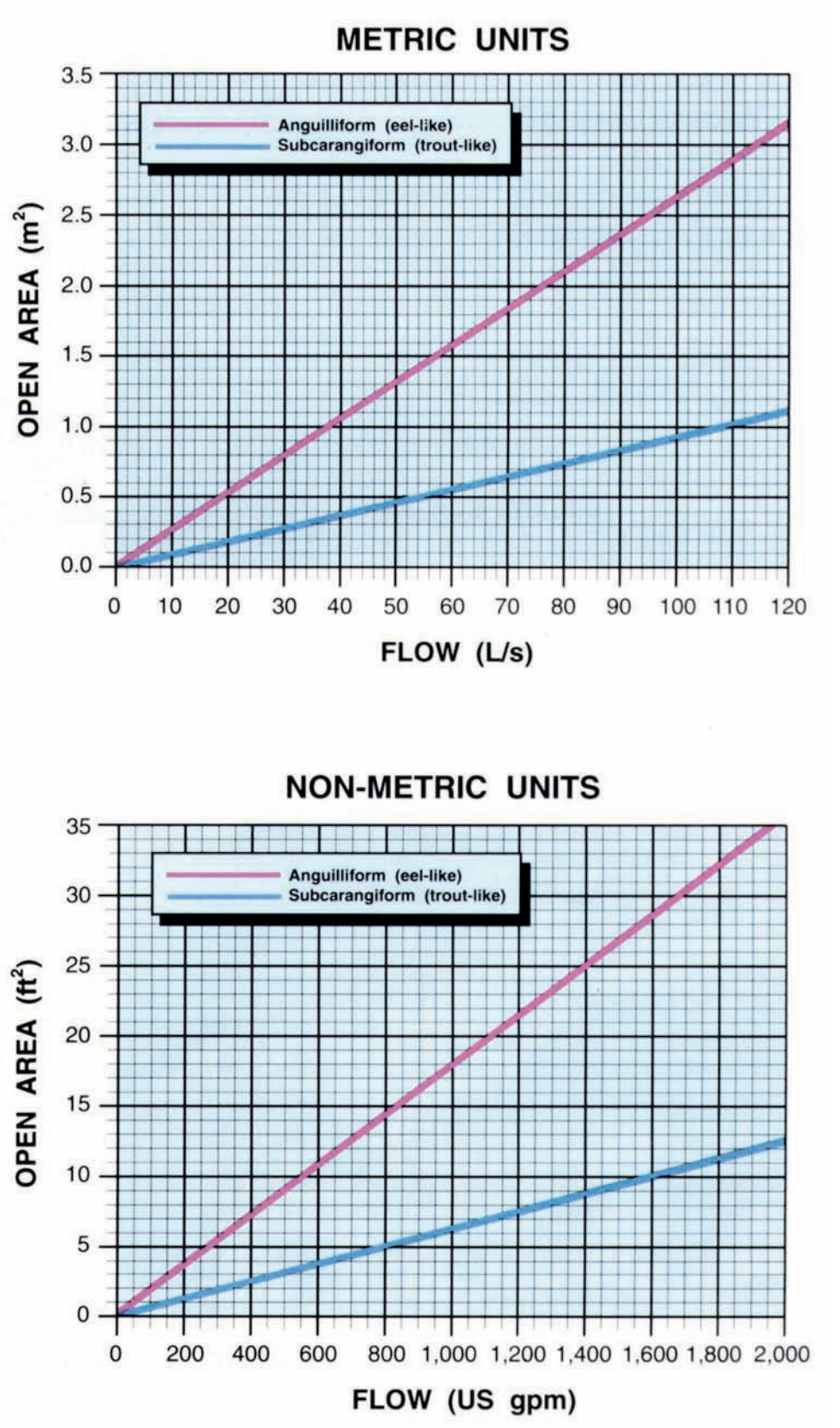


Figure 2
Common Screen Shapes and Area Formulae

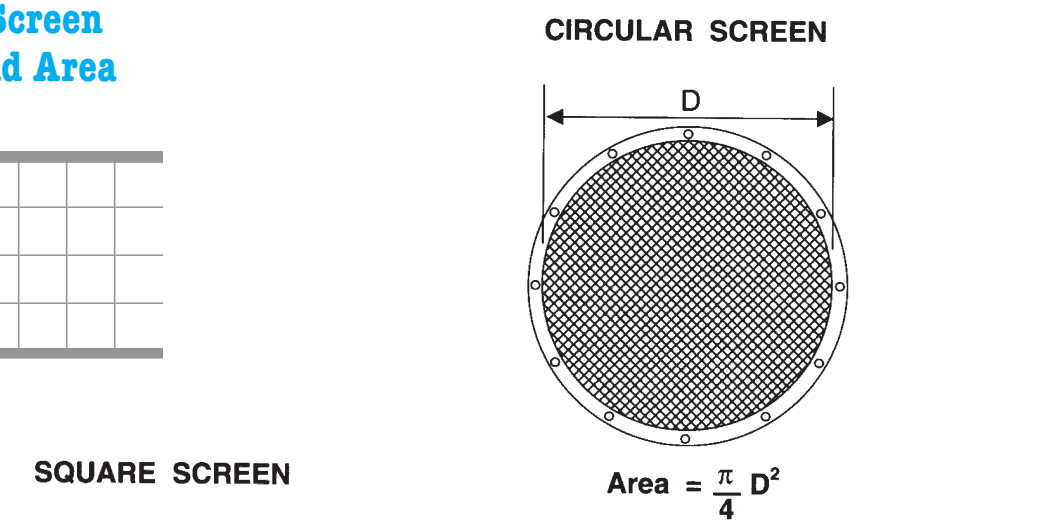
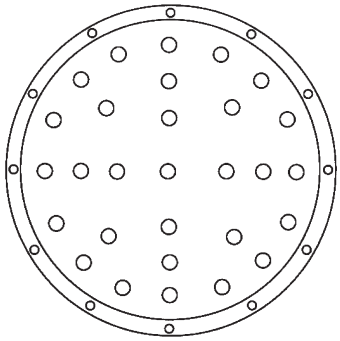
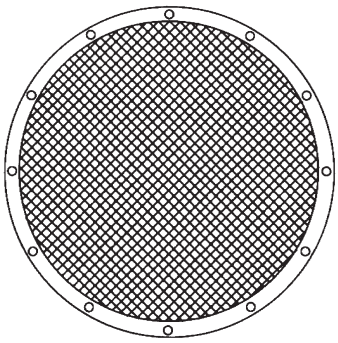


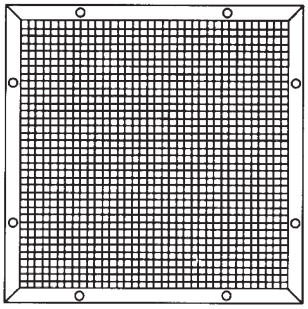
Figure 3
Typical Applications and Features of End-of-Pipe Screens



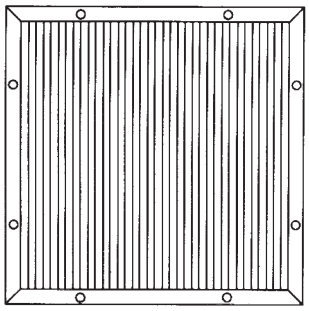
PERFORATED PLATE (PUNCHED)



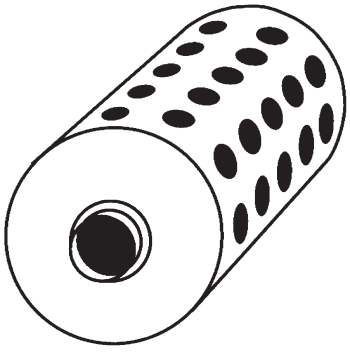
CIRCULAR MESH SCREEN



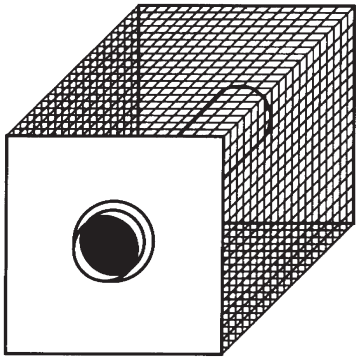
SQUARE MESH SCREEN



SQUARE WEDGE WIRE SCREEN

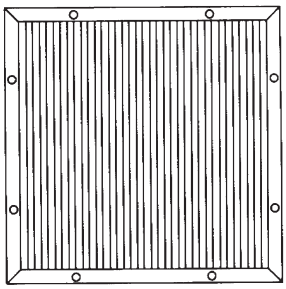


DRUM OR CYLINDER WITH PERFORATED PIPE

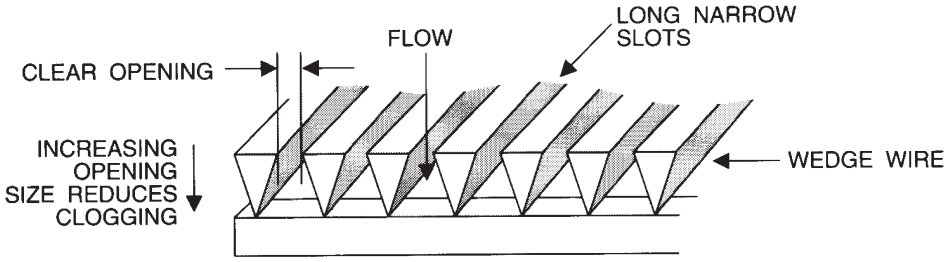


BOX-TYPE WITH MESH SCREEN

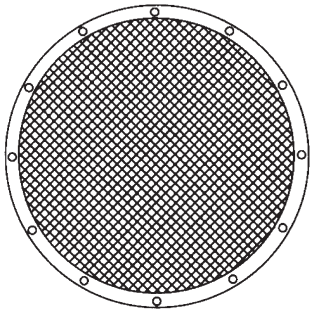
Figure 4
Examples of Typical Screen and Material Types



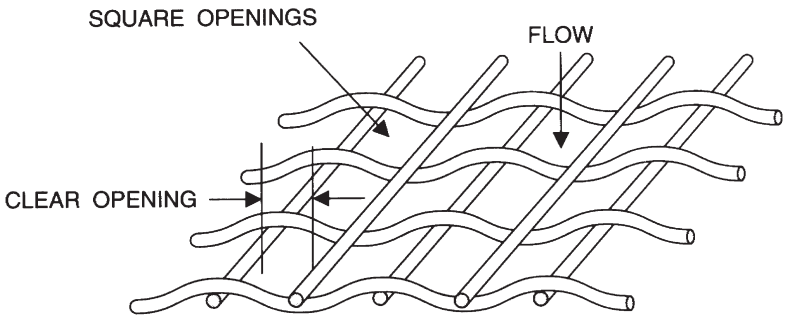
SQUARE WEDGE WIRE SCREEN



WEDGE WIRE PROFILE



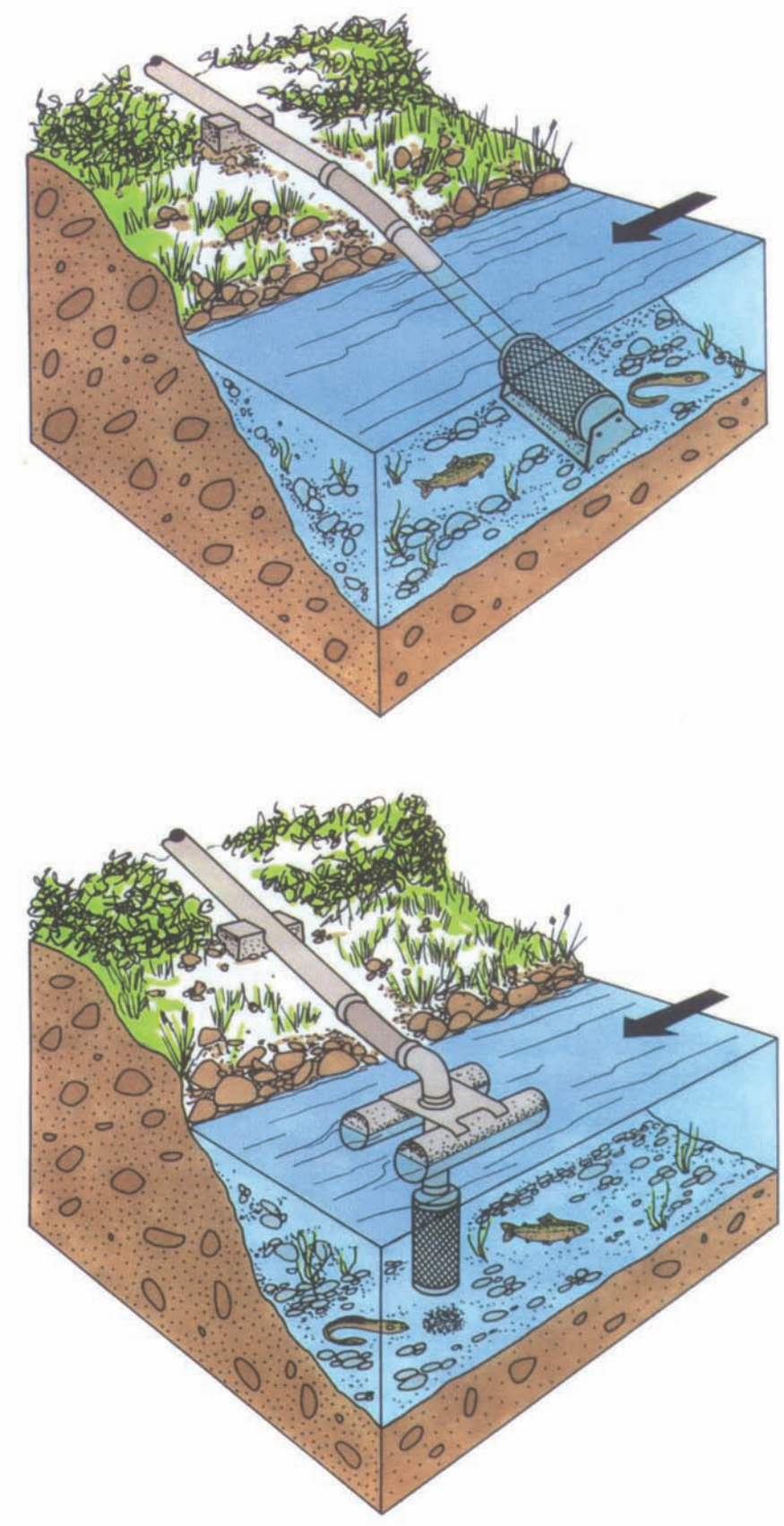
CIRCULAR MESH SCREEN

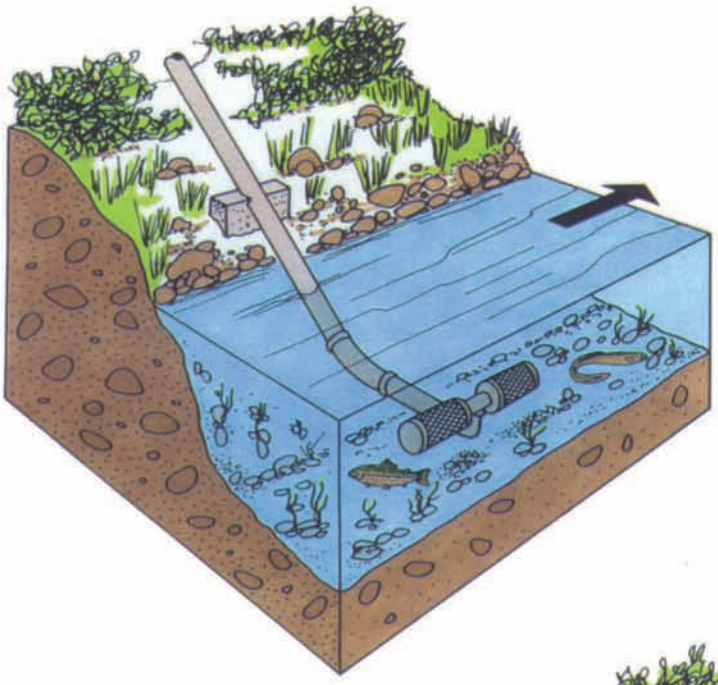


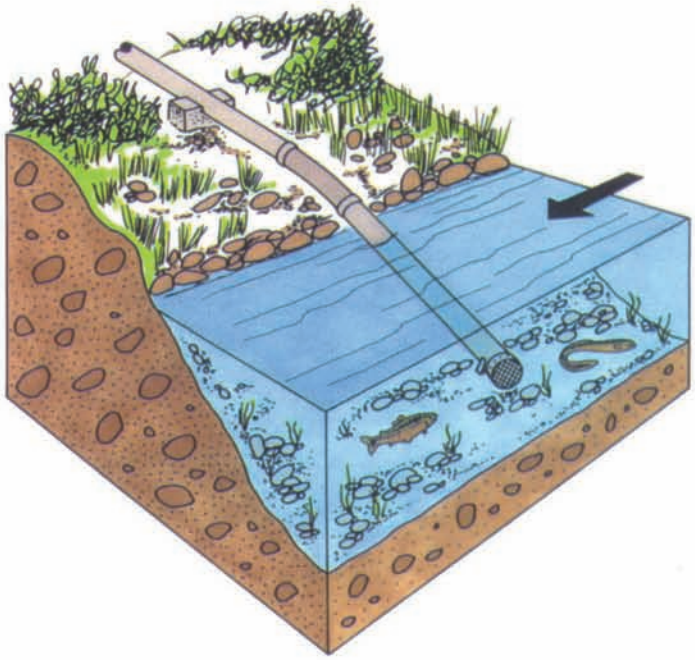
WOVEN WIRE MESH PROFILE

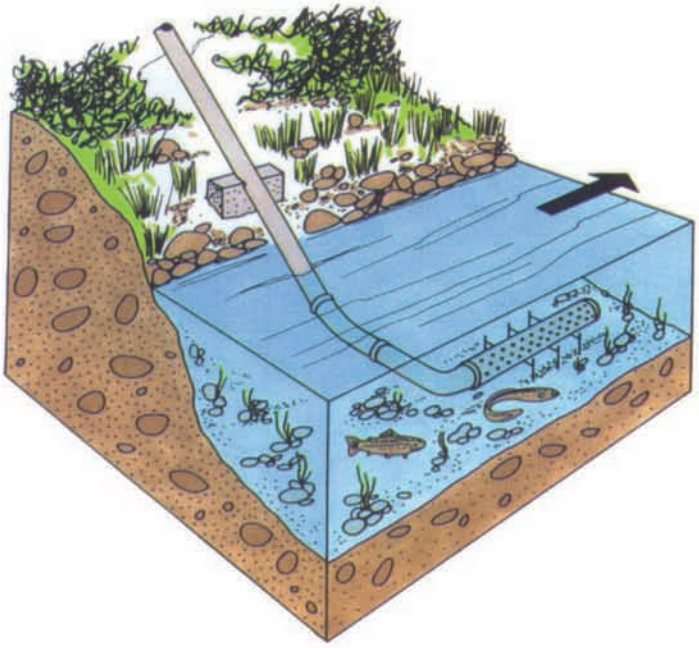
Figure 5

Examples of Typical Installations of End-of-Pipe Screen









4.4 Cleaning and Maintenance

- Provision should be made for the removal, inspection, and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- Screens may be cleaned by methods such as air or water, backwashing, removal and pressure washing or scrubbing.
- Under certain site-specific winter conditions, it may be appropriate to remove screens to prevent screen damage.
- Flexible suction pipe may be used instead of solid, fixed piping for ease of screen removal and cleaning.
- Pump suction pressure can be measured to assess the need for screen cleaning.

To facilitate intake screen cleaning/maintenance, design and installation features such as orientation of the screen (e.g., in a cove) or variation in mesh shape (i.e., square wire/bars versus round wire/bars), etc. may be considered for regularly cleaned screens. For screens that will not be cleaned regularly, provision of considerably more open screen area (e.g., four times more) than determined from Table 2/Figure 1 may be considered. Such design/installation features should be addressed with the appropriate regulatory agencies on a site-specific basis.

Appendix C presents a list of units of conversion.

For more information on the appropriate design of freshwater intake end-of-pipe fish screens, contact the nearest DFO office. In addition, a list of DFO Regional contacts is presented in Appendix D. Other appropriate regulatory agencies should also be contacted.

References

Fish Screening Directive. 1990. Department of Fisheries and Oceans, Ottawa, Ontario,

Katopodis, C. 1990. *Advancing the art of engineering fishways for upstream migrants.* Proceedings of International Symposium on Fishways '90, Oct. 8-10, 1990, Gifu, Japan, p. 19-28.

Katopodis, C. 1992. *Fish screening guide for water intakes*. Working Document, Freshwater Institute, Winnipeg, Manitoba.

Katopodis, C, 1994. *Analysis of ichthyomechanical data for fish passage or exclusion system design*. Proc. International Fish Physiology Symposium, July 16-21, 1994, Vancouver, B.C. American Fisheries Society and Fish Physiology Association.

Katopodis, C. and R. Gervais, 1991. *Icthyomechanics*, Working Document, Department of Fisheries and Oceans, Freshwater Institute, Winnipeg, Manitoba.

Glossary

Anadromous: Fish species that migrate from the sea to freshwater systems in order to spawn.

Anguilliform: The type of swimming mode for fish that swim like an eel, and move through the water by undulating most or all of their body.

Effective Screen Area: The area occupied by the open spaces (i.e., open screen area) and screen material available for the free flow of water.

Entrainment: Occurs when a fish is drawn into a water intake and cannot escape.

Fork Length: The straight line distance measured from the tip of the nose to the fork of the tail of a fish.

Impingement: Occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.

Open Screen Area: The area of all open spaces on the screen available for the free flow of water.

Subcarangiform: The type of swimming mode for fish that swim like trout or salmon, and move through the water by undulating the posterior third to half of their body.

Appendix A Information Requirements

Appendix A Information Requirements

Types of information requirements that may be applicable to a freshwater intake proposal are highlighted below. While this listing is not intended to be all inclusive, it indicates information that may be necessary to enable regulatory agencies to review a water intake and fish screen proposal. The information highlighted below considers Section 30 and other sections of the *Fisheries Act* .These information requirements may also address other Federal, Provincial, and Municipal legislation and policies.

General and Site Information

- gazette or common name of the watercourse
- location of the watercourse
- type of watercourse (e.g., pond or stream)
- type of water intake
- other activities associated with the development or construction of the intake/screen structure

Biophysical Information

- fish presence, species, and possible fish size or fish habitat conditions at the protect site
- physical description of the watercourse at the intake site, including channel width and depth, direction and velocity of water currents, variations in wafer levels, sediment transport processes, lateral or channel grade movement, debris loading, etc.
- location and position of the intake within the watercourse, including dimensions, alignment, depth in the water column, wetted area, etc.
- description of the site features and characteristics, including site access

Water Use Information

- purpose of water withdrawal

- average rate, or ranges of rates, of withdrawal from the watercourse
- duration and lime of withdrawal
- estimates of ranges of flow (i.e., daily, weekly, monthly) in the watercourse during times of withdrawal with dates and times of year (with particular consideration to periods of low flow)
- expected effects of withdrawal on existing watercourse (e.g., drawdown, downstream dewatering, etc)
- description of structures or activities associated with the development of the intake
- whether the application is for a new intake, or re-development or upgrading of an existing structure

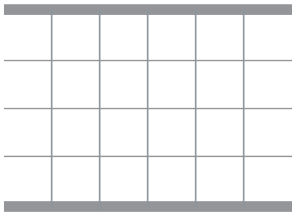
Other Information

- site plans/sketches indicating intake site and location (detailed on 1:50,000 topographic map)
- photographs/video of the site are often useful

Fish Screen Information

- screen open and effective areas
- physical screen parameters with respect to the intake and the watercourse
- screen material, method of installation and supporting structures
- screen maintenance, cleaning or other special requirements

Appendix B
Sample Calculation



A proponent wishes to withdraw water at a rate of 0.075 m^3/s from a nearby pond. The pond supports populations of brown trout, brook trout, and American eel. The intake is proposed to be cylindrical with the ends solid and #60 wedge wire screen around the cylinder.

What size must the intake screen be to satisfy the guideline requirements?

There are 4 steps to finding the answer:

1. Determine the fish swimming mode.
2. Determine the open screen area.
3. Determine the effective screen area.
4. Determine the dimensions necessary to produce the effective screen area.

1. Fish Swimming Mode

The fish swimming mode is found from Table 1. Brook trout and brown trout are listed as subcarangiform swimmers, while the American eel is an anguilliform swimmer.

2. Open Screen Area

Table 2 lists the required open screen area for both subcarangiform and anguilliform swimmers under flows up to 125 L/s (2000 US gpm). To use the table, if is necessary first to convert the flow from cubic metres per second to litres per second.

$$0.075 \frac{m^3}{s} \times \frac{1000\ L}{1\ m^3} = 75 \frac{L}{s}$$

For a flow of 75 L/s, Table 2 indicates that the open screen area must be:

- 0.69 m^2 for subcarangiform swimmers, and
- 1.96 m^2 for anguilliform swimmers.

The higher number (1.96 m^2) is the more stringent requirement, therefore, it is used in the calculation of effective screen area,

3. Effective Screen Area

The screen material in this case is # 60 Wedge Wire. A review of Table 3 indicates that the % Open Area for this material is 63%, With this value and the previously determined area from Step 2, the following formula is used to determine the Effective Screen Area.

$$\text{Effective Screen Area} = \frac{\text{Open Screen Area}}{\left(\frac{\text{\% Open Area}}{100}\right)}$$

$$= \frac{1.96\ \text{m}^2}{\left(\frac{63}{100}\right)}$$

$$= 3.111\ \text{m}^2$$

4. Dimensions of Intake Screen

Figure 2 lists several common screen shapes and their respective area formulae. For a cylindrical screen where the ends are solid and screening is around the cylinder, the following formula applies:

$$\text{Area} = \pi DL$$

The unknown dimensions are diameter (D) and length (L). These dimensions are determined by choosing a value for one and solving the equation for the other.

If the diameter is 0.600 m, then the length follows as:

$$\text{Area} = \pi DL$$

$$3.111\ \text{m}^2 = (0.600\ \text{m})L$$

$$3.111\ \text{m}^2 = (1.885\ \text{m})L$$

$$L = \frac{3.111\ \text{m}^2}{1.885\ \text{m}}$$

$$L = 1.65\ \text{m}$$

A 0.600 m diameter, 1.65 m long cylindrical screen would meet the design requirements. It should be noted that the dimensions given are representative of the screening area only; they do not include any screen that may be blocked by framing, etc. By comparison, if the pond only supported trout (subcarangiform), a 0.600 m diameter, 0.58 m long cylindrical screen would meet the design requirements.

Appendix C
Units of Conversion

To Convert	Into	Multiply By
cubic feet per second	cubic metres per second	0.0283
cubic feet per second	litres per second	28.3
cubic feet per second	US gallons per minute	448.9
cubic metres per second	cubic feet per second	35.3
cubic metres per second	US gallons per minute	15850
litres per second	cubic feet per second	0.0353
litres per second	cubic feet per minute	2.12
litres per second	cubic metres per second	0.001
litres per second	US gallons per minute	15.85
square metre	square foot	10.76
square metre	square inch	1550
square foot	square metre	0.0929
US gallons per minute	litres per second	0.0631
US gallons per minute	cubic feet per second	0.00223
US gallons per minute	Imperial gallons per minute	0.833
Imperial gallons per minute	litres per second	0.0758

Appendix D
DFO Regional Contacts

NEWFOUNDLAND REGION	Habitat Management Division P.O. Box 5667 St. John's NF A1C 5X1 Tel: 709-772-6157 Fax: 709-772-5562
GULF REGION	Habitat Management Division P.O. Box 5030 Moncton NB E1C 9B6 Tel: 506-851-6252 Fax: 506-851-6579
SCOTIA-FUNDY REGION	Habitat Management Division P.O. Box 550 Halifax NS B3J 2S7 Tel: 902-426-6027 Fax: 902-426-1489
QUEBEC REGION	Fish Habitat Management P.O. Box 15550 Quebec QC G1K 7Y7 Tel: 418-648-4092 Fax: 418-648-7777
CENTRAL & ARCTIC REGION	Habitat Management 501 University Crescent Winnipeg MB R3T 2N6 Tel: 204-983-5181 Fax: 204-984-2404
PACIFIC REGION	Habitat Management 555 W. Hastings St. Vancouver BC V6B 5G3 Tel: 604-666-6566 Fax: 604-666-7907

Local DFO offices should be contacted. Other appropriate regulatory agencies should also be contacted.

ICE BRIDGES

Northwest Territories Operational Statement
Habitat Management Program

VERSION 2.0
Valid until March 31, 2007

Ice bridges and snowfills are two methods used for temporary winter access in remote areas. Ice bridges are constructed on larger watercourses that have sufficient stream flow and water depth to prevent the ice bridge from coming into contact with the stream bed or restricting water movement beneath the ice. Snowfills, however, are temporary stream crossings constructed by filling a stream channel that is dry or frozen to the bottom with clean compacted snow.

This Operational Statement applies only to ice bridges, and only those constructed of clean (ambient) water, ice and snow, which will not restrict water-flow at any time.

Ice bridge crossings provide cost-effective access to remote areas when watercourses are frozen. Because the ground is frozen, the ice bridge can be built with minimal disturbance to the bed and banks of the watercourse. Ice bridges can still have negative effects on fish and fish habitat. Clearing shoreline and bank vegetation increases the erosion potential and instability of the banks and can lead to deposition of sediment into fish habitat. There is also potential for a blockage of fish passage during spring break-up.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under Section 35 of the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with Subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to be incorporated into the design, construction, and decommissioning of your Ice Bridge project in order to avoid negative impacts to fish habitat. **You may proceed with your Ice Bridge project without a DFO review when you meet the following conditions:**

- your planned work is not located in a critical area, as identified in a NWT Community Conservation Plan or other applicable land use plan,
- the ice bridge is constructed only of clean (ambient) water, ice and snow,
- the work does not include realigning the watercourse, dredging, placing fill, or excavating the bed or bank of the watercourse,
- materials such as gravel, rock, soil, and loose woody material are not used,
- where logs are required for use in stabilizing shoreline approaches, they are clean and securely bound together, and they are removed either before or immediately following spring ice-out,
- the withdrawal of any water will not exceed 5% of the instantaneous flow, in order to maintain existing fish habitat,
- natural, under ice water flow is maintained where it occurs,
- this Operational Statement is posted at the work site and is readily available for reference by workers, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Constructing an Ice Bridge* listed below.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of Subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area (see Northwest Territories DFO office list) if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

This Operational Statement does not release you from the responsibility of obtaining any other permits or approvals that may be required under local, municipal, provincial and federal legislation that apply to the work being carried out in relation to this Operational Statement.

We ask that you notify DFO, preferably 10 working days before starting your work, by filling out and sending in, by mail or by fax, the Northwest Territories notification form to the DFO office in your area. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement.

Measures to Protect Fish and Fish Habitat when Constructing an Ice Bridge

1. Use existing trails, winter roads or cut lines wherever possible as access routes to limit unnecessary clearing of additional vegetation and to prevent soil compaction.

2. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to accommodate the access. This vegetation removal should be kept to a minimum and should not be wider than the road surface.

3. Construct approaches using clean (ambient), compacted snow and ice to a sufficient depth to protect the stream banks or shoreline. Clean logs may be used where necessary to stabilize approaches.

4. Where logs are used to stabilize the approaches of an ice bridge:

4.1. The logs are to be clean and securely cabled together so they can be easily removed.

4.2. No logs or woody debris are to be left within the water body or on the banks or shoreline where they can wash back into the water body.

Note: The use of material other than ice or snow to construct a temporary crossing over any ice-covered stream is prohibited under section 11 of the *Northwest Territories Fishery Regulations*, unless authorized by a Fishery Officer. Please contact the nearest NWT DFO office.

5. Operate machinery from on land or on ice and in a manner that minimizes disturbance to the banks of the water body.

5.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.

5.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent deleterious substances from entering the water or spreading onto the ice surface.

5.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

6. If extracting water from a watercourse, follow DFO's *NWT Winter Water Withdrawal Protocol* (available from the DFO offices listed below), and ensure that the intakes are sized and adequately screened to avoid entrainment and impingement of fish (refer to DFO's *Freshwater Intake End-of-Pipe Fish Screen Guidelines, 1995,* available from DFO offices, and at **www.dfo-mpo.gc.ca/Library/223669.pdf**).

7. Appropriate measures should be taken to prevent the ice bridge from blocking fish passage, or from causing channel erosion and flooding in the spring. For example, on a flowing watercourse, prior to spring break-up, breach the ice bridge using physical means or create one or more v-notches, of adequate size to accommodate spring runoff, in the middle of the ice bridge to allow it to melt from the centre.

8. At the end of the crossing season and prior to snow-melt, install appropriate sediment and erosion control measures on all disturbed areas and approaches to prevent sediment from entering the watercourse. Inspect and maintain sediment and erosion control measures until complete re-vegetation is achieved or until such areas have been permanently stabilized by other effective sediment and erosion control measures, in the event that re-vegetation is not possible.

9. As soon as possible following snow-melt, plant and seed preferably native trees, shrubs or grasses on disturbed areas. Cover seeded/planted areas with appropriate cover (e.g., mulch, matting) to prevent soil erosion and to help seeds germinate. If re-vegetation is not possible due to climatic extremes and/or lack of appropriate seed or stock, the site should be stabilized using effective sediment and erosion measures. In areas with permafrost, care should be exercised to ensure these measures do not cause thawing or frost heave.

FISHERIES AND OCEANS CANADA OFFICES IN NORTHWEST TERRITORIES

Yellowknife Area Office
Fisheries and Oceans Canada
Suite 101 – Diamond Plaza
5204 - 50th Ave.
Yellowknife, NT X1A 1E2
Phone: (867) 669-4900
Fax: (867) 669-4940

Inuvik District Office
Fisheries and Oceans Canada
Box 1871
Inuvik, NT X0E 0T0
Phone: (867) 777-7500
Fax: (867) 777-7501

Aussi disponible en français.
www.dfo-mpo.gc.ca/canwaters-eauxcan/