Project Description Report
Nunavut Project, Dismal Lakes

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Introduction

This project description report outlines the "Proposed Diamond Drilling Program" near Dismal Lakes, NU referred to by Guyana Precious Metals Inc. as the Nunavut Project – Dismal Lakes. It was prepared by Guyana Precious Metals Inc. (GPM), Toronto, ON with technical review and assistance from Ken Weagle, Cochrane Ecological Institute, Cochrane, AB. The report accompanies and supports an application for a Class B water Licence from the Nunavut Water Board (NWB), a Class III Land Use Licence from the KITIKMEOT INUIT ASSOCIATION (KIA) and a "Class A" Land Use Permit from Indian and Northern Affairs Canada (INAC). The project description report is provided as additional information required by regulatory agencies and compliments the permit application process.

GPM is proposing to conduct a diamond drilling operation on the claims listed in Table 1 and shown in Figure 1. The program will consist of approximately 40,000 m of diamond drilling, over a period of two (2) years. The holes will be within three target areas. Figures 2, 3a and 3b. The personnel working on the program will be housed in a camp located at the Hope Lake Airstrip.

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Project Location

Claim and Leases

The mineral claims and leases cover by the diamond drilling program, in this application, are (Figure 1 and 2):

Claim Number	Claim Name	Status
F97941	RC 1	ACTIVE
F97942	RC 2	ACTIVE
F97943	RC 3	ACTIVE
F97944	RC 4	ACTIVE
F97945	RC 5	ACTIVE
F97946	RC 6	ACTIVE
F97947	RC 7	ACTIVE
F97948	RC 8	ACTIVE
F97949	RC 9	ACTIVE
F97950	RC 10	ACTIVE
F97951	RC 11	ACTIVE
F97952	RC 12	ACTIVE
F97953	RC 13	ACTIVE
F97954	RC 14	ACTIVE
F97959	RC 19	ACTIVE
F97957	RC 17	ACTIVE
F97963	RC 23	ACTIVE
F97964	RC 24	ACTIVE
F97965	RC 25	ACTIVE
F97966	RC 26	ACTIVE
F97967	RC 27	ACTIVE
F97962	RC 22	ACTIVE
F97956	RC 16	ACTIVE
F97955	RC 15	ACTIVE
F97961	RC 21	ACTIVE
F97968	RC 28	ACTIVE
F98041	RC-102	PENDING
F98042	RC-103	PENDING
F98039	RC-100	PENDING
F98040	RC-101	PENDING
Mineral Lease	2797	Active

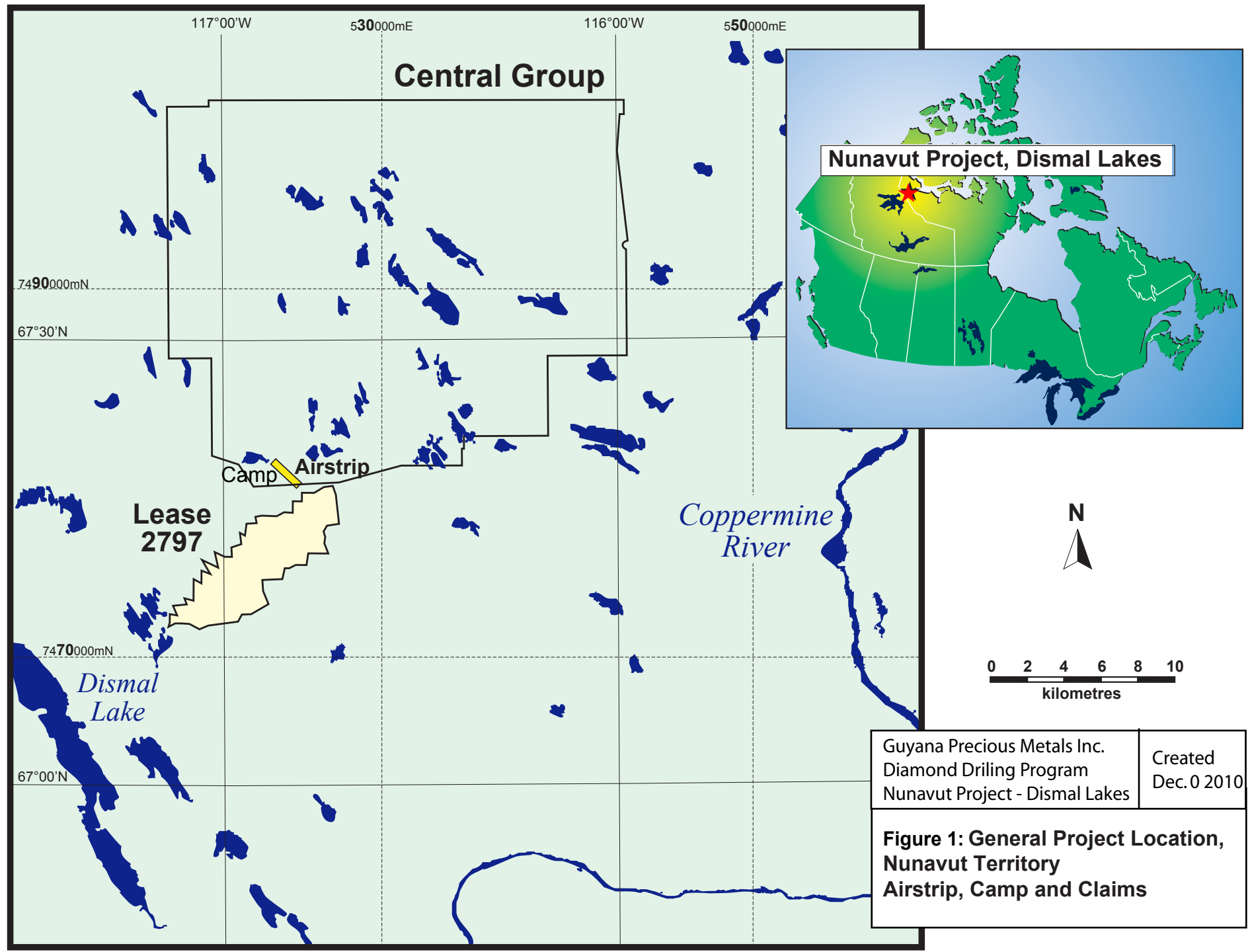
Location of any proposed Camp

The location of the camp is shown in Figures 1 and 2. The proposed camp location is approximately 60 km southwest of Kugluktuk at the Hope Lake Airstrip. The camp will be located on a flat area at coordinates 67° 26.4'N, 116° 27.1'W (NTS 86N/8) along the side of the airstrip. Both the airstrip and the camp are located on private (titled) land.

Land use permit boundaries

The Boundaries of the project area are:

NW corner	67° 38.8' N	116° 34.6'W
SE Corner	67° 17.7' N	116° 03'W



Guyana Precious Metals Inc.
Diamond Driling Program
Nunavut Project - Dismal Lakes

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Dec. 0 2010

Figure 1: General Project Location, Nunavut Territory
Airstrip, Camp and Claims

Drill Targets Area #2

Drill Targets Area #3

Drill Targets Area #1

Location of Camp and Airstrip

AIRFIELD

TUKTUYAK LAKE

COPPER LEAF LAKE

COPPER LEAF LAKE

THREE ISLANDS LAKE

C O P P E R M I N E

M O U N

CREEK

LAKE

N

Guyana Precious Metals Inc. Diamond Driling Program Nunavut Project - Dismal Lakes	Created Dec. 2010

Figure 2: 1:100,000 NST Map Sheets showing camp sitre and drill targets. Claim and lease boundries are approximate.
NTS Map Sheets - 86N07, 86N08, 86N09, 86N10, 86O05, 86O12

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Project Description

Regulatory Requirements

The acts, regulations and guidelines that apply to project activities are:

1. Territorial Lands Act and Regulations
2. Northwest Territories Waters Act and Regulations
3. Nunavut Land Claims Agreement

The approvals, permits and licenses required and the authorizing agency are:

Licence Permit	Activity	Issuing Authority
Water Use License	Camp and Diamond Drilling	Nunavut Water Board
Land Use Permit	Diamond Drilling	INAC
Screening	Camp and Diamond Drilling	Nunavut Impact Review Board
Land Use Licence		KIA

Project History

The general area has been explored for mineral deposits for many decades. The camp and airstrip are situated on titled land owner by the company. The most recent land use permits and water licenses in the area were held by Coronation Minerals, for a similar diamond drilling project. During this activity the camp at the Hope Lake Airstrip was permitted and operated by and by Matrix Aviation Solutions Inc.

Due to poor commodity price and financing in 2007-2008, the former operators, Coronation Minerals Inc (CMI) was not able to execute their 2008 proposed diamond drilling program. The CMI management was changed and the new Guyana Precious Metals Inc. management took over on March 3, 2009.

Project Activities

Table 2 summarizes the yearly activities included in this project.

TABLE 2: Summary of development activities

ACTIVITY	2011/ 2012	2012/2013
Diamond Drilling (m)	20,000	20,000
Access	Air	Air
Fuel (l) Total for Season	81,000	81,000
Operation	Year Round 200 day maximum	Year Round 200 day maximum
Temporary Camp	24 persons for 200 days/year	24 persons for 200 days/year
Total Water Use $M^{3.}$/ year	Drilling - 1,600 $M^{3.}$ / y Camp – 300 $M^{3.}$/ y	Drilling - 1,600 $M^{3.}$/ y Camp – 300 $M^{3.}$/ y

Maps showing the extent of the general location of the diamond drilling can be found in Figures 2. The details of the camp location can be found in Figure 3.

Access

The main access to the project area will be by fixed wing aircraft to the Hope Lake Airstrip. This airstrip has been in existence and consistently used for several decades. The project camp will be located adjacent to this airstrip.

The airstrip will be maintained by the subcontractor that is supplying the camp for the project, Matrix Aviation Solutions, Yellowknife, NT.

All access to the drill sites from the camp will be by helicopter.

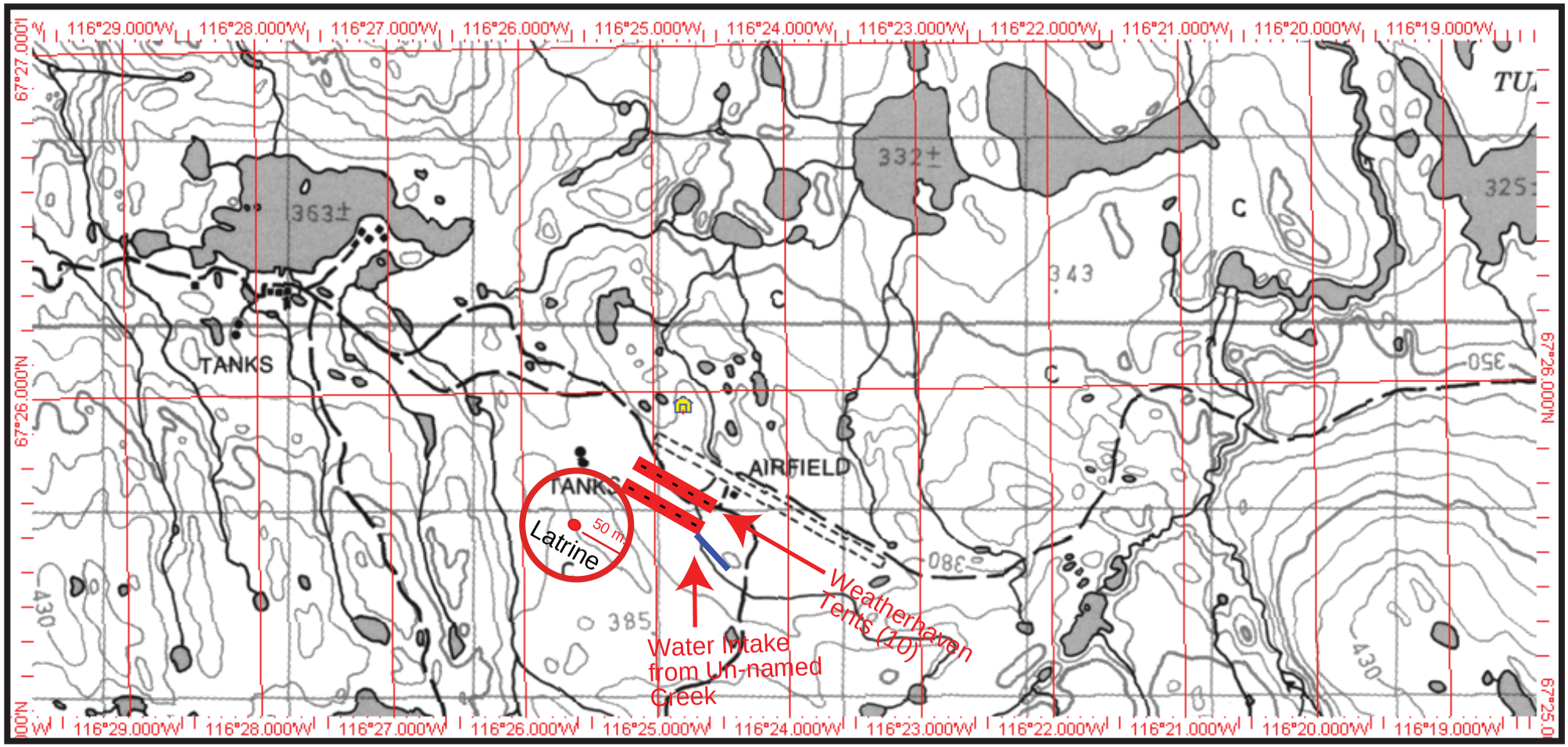
Movement of the diamond drills will be done by helicopter.

Helicopter flight plans will maintain a minimum elevation of 300 m. to avoid disturbance of wildlife.

Camp Facilities

The camp will be located near the Hope Lake Airstrip as shown in Figure 3. The camp will consist of 10 Weatherhaven insulated, six will be used for accommodations, two for

a mess tent, kitchen and dry and two for processing geological samples and equipment maintenance. All tents will be heated with diesel fired space heaters and supplied with electricity from a central 20 kw diesel generator.



Guyana Precious Metals Inc. Diamond Driling Program Nunavut Project - Dismal Lakes	
Figure 3: 1:50,000 Map of Camp location NST Map Sheets - 86N08	Created Dcc 2010

Waste Management

Garbage and waste materials from the camp will be collected daily. Garbage and waste materials (oil, containers, etc.) generated at the drill sites will be collected daily and returned to the camp. The garbage and waste materials will be sorted into combustible and non-combustible material.

Combustible material will be disposed at in the camp A400(A) Inciner8 two stage incinerator. The information sheet on the incinerator is found in Appendix A. Non-combustible material and oils will be flown to an approved disposal site on a weekly basis. Any residue from the incinerator will be returned be flown to an approved landfill for disposal.

Sewage and Grey water

Sewage disposal will be by pit privies located at least 30 meters from any water body and the camp tents.

Camp grey water will be disposed of in a purpose built sump located at least 50 meters from the camp and any water body.

Domestic Water Supply

The estimated water usage for the camp is 1.5 cubic meters per day. The water will be pumped from an unnamed creek near the airstrip to a holding tank at the kitchen and dry tents. From this holding tank water will be distributed to facilities in the camp. Treatment of the domestic water will be by Trojan UV Max system. The specifications for this system can be found in Appendix B.

Fuel Storage

Fuel will be flown to the Hope Lake airstrip in 205 l drums by fixed wing aircraft. The drums will be stored in a central storage area at the airstrip which has been equipped with an impermeable membrane. It is anticipated that no more that 48 barrels (10,000 liters) will be stored at the airstrip at any one time. The breakdown of the fuel types for the project is given in Table 3.

Table 3: estimated fuel usage for the project.

Fuel	Number of Containers and Capacity of Containers	Total Amount of Fuel (in Litres)	Total fuel per year (l)
Diesel	400	205 litre barrels	80,000

Gasoline	10	205 litre barrels	2,000
Aviation fuel	400	205 litre barrels	80,000
Propane	20 tanks	100 lb tanks	
Other			

The diesel for the drill rigs will be moved from the storage area to the drill sites as required. Each drill will have a minimum of two (2) days fuel on site (approximately 4 barrels). The barrels will be stored on an impermeable membrane at least 30 meters from any water body in the area.

Helicopters will only be refueled at the Hope Lake airstrip using electric pumps and pumping from 205 l barrels.

Diamond Drilling

It is proposed that 20,000 m of diamond drilling will be conducted per year over the two year program for a total of 40,000 meters of drilling. The drills will be Heli-portable BBS 25 Surface Drills weighing approximately 4545 kg. They will be moved from site to site by helicopter. All drilling will be land based. A typical drill setup is shown in Figure 4.

The exact location of the drill sites will be chosen on site and be provided to the regulatory authorities when chosen. In choosing the sites GPM will use the conditions of the permits and licence to guide their decisions. The general areas for the drill targets are shown on Figure 2, these general areas have been chosen based on previous geophysical work in the claim blocks and lease.

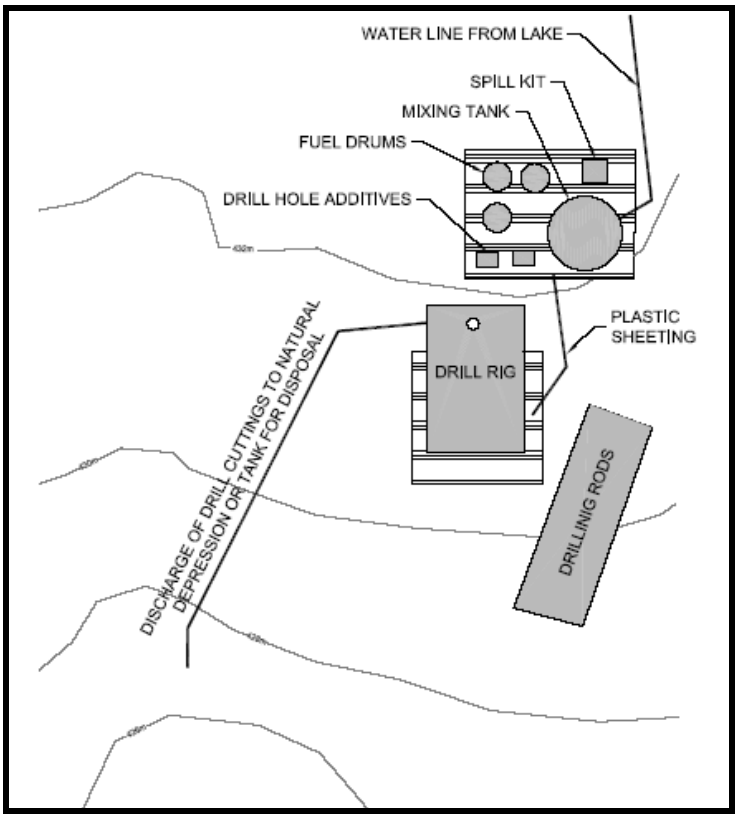
Fuel will be moved to each drill site in 205 liter barrels by helicopter. Fuel will be moved as required with approximately two days supply (4 barrels) being maintained on site.

Drill core will be moved from each drill to the core facility at the camp by helicopter at the end of each shift. The core will be stored in core racks near the camp.

Drills will be operated 24 hours per day, in two shifts of 12 hours each.

To counteract freezing in the drill holes calcium chloride (drill salt) will be added to the drill water. This will only be done when necessary. The MSDS sheets for calcium chloride can be found in Appendix C. Calcium chloride will be brought to the project site on an as needed basis. When on site it will be stored in a weather tight and secured shelter until it is used. The primary storage area will be at the Hope Lake airstrip near the fuel storage area. The drill salt will be moved to the drill sites from the camp as needed. The maximum amount of drill salt stored will be 1000 kg. The drill salt is transported in 20 kg bags.

Figure 4: Typical Diamond Drill Layout



Diamond Drill Water Use

The maximum water use per diamond drill is estimated to be 3.78 m^3/day. With two drills operating daily water use will be approximately 8 m^3/day. The water use depends on the nature of the rock fracturing in the area of the drill. Highly fractured rock results in more water loss down hole and therefore less ability to recycle water. The water usage figures provided above are considered to be maximum usage.

Drill water will be obtained from lakes and creeks near the drill sites. All water intakes will comply with **Freshwater Intake End-of-Pipe Fish Screen Guideline, 1995 (Appendix D).**

Target Minerals

The target minerals for this project are copper gold nickel PGM and diamonds.

Drill Cuttings and Water

Drill cuttings and water will be directed to a natural depression with no flow to the surrounding environment. The cuttings will settle and water will evaporate. These areas will then be restored during the open water season.

Drill Hole Abandonment

At the end of the program the drill will be dismantled into its main components as per the drilling contractor procedure. The drill will then be demobilized to the Hope Lake airstrip and then removed from the site. At the completion of each hole the drill sites will be inspected for soil contamination. Any remaining waste will be taken to the staging area at the Hope Lake airstrip and incinerated (if possible) or flown out to an approved land fill for disposal. Individual drill sites will be restored immediately after the drill has been moved to the next site. The restoration of the individual drill sites will include:

- Leveling of sumps
- Removal or treatment of oil contaminated soil
- Removal of all drill associated equipment and blocks
- Leveling of any disturbed soil

Photos of all individual drill sites prior to drilling will be taken. Monitoring will be done during occupancy and photos taken. Once the site is restored, it will again be documented with photos. Soil contaminated by hydrocarbons and unnoticed before abandonment will be treated as per the spill contingency plan.

Existing Environment

The environment of the region has been described by Ecological Stratification Working Group. 1995.as the Taiga Shield Ecozone and the Coppermine River Uplands Ecoregion. These descriptions are found below.

Taiga Shield Ecozone

This ecozone lies on either side of Hudson Bay. The eastern segment occupies the central part of Quebec and Labrador, and the western segment occupies portions of northern Manitoba, Saskatchewan, Alberta, and the Northwest Territories. The ecozone is largely defined by two very large biophysical features, the Taiga Forest and the Canadian Shield. The world's oldest rocks are found on the Taiga Shield north of Great Slave Lake.

Climate The subarctic climate is characterized by relatively short summers with prolonged periods of daylight and cool temperatures, and winters that are long and very cold. Mean annual temperatures range from -8°C west of Hudson Bay to O°C in parts of Labrador. In Quebec and Labrador mean annual temperatures usually range between -1^{o}C to -5°C. The cold south flowing Labrador current reduces the moderating effect of the Atlantic Ocean on the climate of the eastern Taiga Shield. Mean summer

temperatures range between 6°C and 11°C, and mean winter temperatures range between 11°C and 24°C. Mean annual precipitation ranges 200-500 mm west of Hudson Bay. East of Hudson Bay it ranges 500-800 mm, except near the Labrador coast where it can locally exceed 1000 mm a year.

Vegetation The pattern is one of innumerable lakes, wetlands and open forests interwoven with shrublands and meadows more typical of the arctic tundra. The forest stands form lichen woodlands that merge into areas of open arctic tundra. It is along the northern edge of this ecozone that the latitudinal limits of tree growth are reached. Latitudinally, the central portion of the zone contains open, stunted black spruce and jack pine, accompanied by alder, willow, and tamarack in the fens and bogs. Open, mixedwood associations of white spruce, balsam fir (in the Quebec portion), trembling aspen, balsam poplar, and white birch are found on upland sites and along rivers and streams.

Landforms and Soils Most of this ecozone consists of broadly rolling terrain composed of a mosaic of uplands and associated wetlands. It is dominated by Precambrian bedrock outcrops and discontinuous hummocky and ridged morainal deposits. Some lacustrine and marine deposits are also present. A characteristic of the ecozone is the largest concentration of long, sinuous eskers in Canada. Dominating the Precambrian landscape are thousands of lakes and wetlands in glacially carved depressions. Lowlands are covered with peatlands and are commonly waterlogged or wet for prolonged periods. Permafrost is discontinuous but widespread. Brunisolic and Humo-Ferric Podzolic soils are dominant in the southern portion, and Cryosols in the northern portion with a mix of these in the latitudinal centre of the ecozone. Gleysols and Organic Cryosols occur mainly in the lowlands.

Wildlife Characteristic mammals include barren-ground caribou which migrate south to winter in the taiga forest and some woodland caribou, moose, wolf, snowshoe hare, arctic fox, beaver, black and grizzly bear, and lynx. There are about fifty species of mammals that inhabit the ecozone. The abundance of water in the Taiga Shield attracts hundreds of thousands of birds (e.g. ducks, geese, loons and swans) which come to nest or rest and feed on their way to arctic breeding grounds. Representative birds include arctic and red-throated loon, northern phalarope, northern shrike, tree sparrow, and gray-cheeked thrush. Along the marine coasts of the ecozone representative species include walrus and seal.

Land Use The total population of the ecozone is approximately 33 600. The major centres include Yellowknife, Labrador City, Uranium City, and Churchill Falls, all of which are associated with mining or hydroelectric developments. The ecozone is still an active exploration and development area for metals and diamonds. A little tourism, recreation, and forestry are the main activities. Despite almost a third of the population being found in resource towns, subsistence hunting, fishing, and trapping remain important land uses.

Coppermine River Upland Ecoregion

This ecoregion extends from the McTavish Arm of Great Bear Lake to Howard Lake in the central District of Mackenzie in the Canadian Shield. It is marked by short, cool summers and very cold winters. The mean annual temperature is approximately -7°C. The mean summer temperature is 9°C and the mean winter temperature is -24.5°C. The mean annual precipitation ranges 200-300 mm. The ecoregion is classified as having a predominantly high subarctic ecoclimate. It is part of the tundra and boreal forest transition, where the latitudinal limits of tree growth are reached. The predominant vegetation consists of open, very stunted stands of black spruce and tamarack with secondary quantities of white spruce and a ground cover of dwarf birch, willow, ericaceous shrubs, cottongrass, lichen, and moss. Poorly drained sites usually support tussocks of sedge, cottongrass, and sphagnum moss. Low shrub tundra, consisting of dwarf birch and willow, is also common. This ecoregion includes the western half of the Bear-Slave Upland, which consists mainly of massive Archean rocks that form broad, sloping uplands, plateaus, and lowlands. The surface is typical of the bare rock parts of the Shield. Numerous lakes fill the lowlands, and rounded rocky hills reach 490 m asl in elevation. Bare rock outcrops are common, and Dystric Brunisols with some Turbic, Static, and Organic Cryosols are the dominant soils in the ecoregion. The soils have formed on discontinuous veneers and blankets of hummocky to rolling, sandy morainal, fluvioglacial, and organic deposits. Permafrost ranges from continuous in the east to extensive discontinuous in the west half of the ecoregion, with low to moderate ice content and sparse ice wedges.

Characteristic wildlife includes caribou, moose, grizzly and black bear, snowshoe hare, fox, wolf, beaver, muskrat, osprey, raven, spruce grouse, and waterfowl. Land uses include hunting and trapping, fishing, and tourism. Diamond exploration is a more recent activity along the northern boundary of the region. Principal communities include Snare Lakes and Rae Lakes.

The population of the ecoregion is approximately 500.

Archaeology Resources

Existing data on archaeology sites in the area has been requested from the Government of Nunavut, Department of Culture, Language, Elders and Youth and will be used by GPM to assist in the selection of drill sites. GPM will also comply with the *Nunavut Archaeological and Palaeontological Sites Regulations* where they apply to this project.

Socio-economic Information

The total expenditure on this project will depend on the success of the drilling. The program as planned will have an initial expenditure of $1M. If drill results are successful the budget will increase.

It is estimated that 40% of the money will go to the drill contractor (this will include some Inuit who will be hired as helpers in running the drill). Servicing the drill camp (supplies/ expediting/ cooks/ bull cook) will be mostly Inuit hire sourced from Kuglugtuk Inuit based human and business resources. This is estimated to be 30% of the budget. The remaining 30% will fund the administration, geologists and assaying costs.

The crew size for e one drill/ one shift/ per day will be:

1 geologist;
1 geologist asst/core sampler;
1 driller;
1 drill helper
1 drill crew factotum (gofer);
1 cook;
1 bull cook;
1 expediter (based in Kugluktuk);
1 helicopter pilot.

Drilling success will increase the project to two drills with an proportional increase in staff. Of the nine crew members it is estimated that five will be Inuit. (Geologist assistant; 1 drill crew factotum; 1 cook; 1 bull cook; 1 expediter).

The geologist assistant will be given training in proper handling /sampling of core intercepts and attendant record keeping; the drill crew factotum will learn rudiments of drilling and may, given time become a drill helper. The bull Cook will learn proper running of exploration camp. All training will be monitored and supervised by GPM staff.

Potential Environmental Effects and Mitigation

Noise

There will be an increase in ambient noise levels associated with camp facilities, drilling activities and fixed wing and helicopter operations. These increased noise levels are typically short in duration and limited to small areas. The level of activity will however be low with two drills. Any increase in this level of activity would be addressed in an application for an amendment to the land use permit.

Past and ongoing operations in the area have not created an acoustic impact on wildlife. These operations are not expected to significantly change the existing situation. Periods of more extensive drilling activity, which could disturb wildlife, will be scheduled to minimize the impact on wildlife. For example, if large concentrations of migrating caribou arrive on site during the operations the operating schedule will be adjusted to avoid impacts on their migration.

Water Quality

No discharge of water of water from the camp or the drilling program will enter surface waters. Water used in the drilling process will be collected or channeled away from lakes and watercourses. Disposal of drill cuttings in natural catchments has the potential to drain excess water. These excess waters are not expected to reach existing lakes or watercourses, however, they will be closely monitored and water flow diverted or impounded if any potential discharge to lakes or watercourses is identified.

Sewage will be contained within the pit privies and grey water will be contained in sumps. Both these facilities will be at least 50 meters from water courses and discharge will not occur.

Groundwater Disturbance

The project will take place in a zone of continuous permafrost; consequently groundwater is restricted to deeper parts of the stratigraphy. Geologic units in the area are steeply dipping and this drilling program is designed to intersect these units at an acute angle. This should minimize the potential for artesian water escaping the drill holes. In the event that artesian waters are encountered in a drill hole, abandonment procedures will include plugging off the ground water course and eliminating the discharge of ground water from the drill hole collar.

Wildlife Disturbance

Impact on wildlife in the area are expected to be minimal and of a limited duration. Waste management is an effective tool to minimize encounters with wildlife and GMP enforces a strict regiment to dispose of wastes. Fixed wing and helicopter operators are trained to minimize encounters with wildlife. Staff and contractors on the Project will receive training to reduce wildlife disturbance and ensure safety during drilling operations. Staff members will not be permitted to hunt or fish from the camp.

Vegetation

Drilling operations at the Project are not anticipated to create significant long-term impacts on vegetation. Drill and campsite preparation will be with hand tools creating a minimal disturbance to the natural vegetation. In addition the camp site has been occupied in the past. It is anticipated that this disturbance will be much less significant than mechanical site preparation. After abandoning a site, clean-up work will be designed to promote the restoration of the site compatible with the original undisturbed conditions. A log of all activities at each site will be maintained. This will include a photographic record of the site before and after drilling and a record of the activity during drilling (please refer to the A&R Plan for the project).

Fish Habitat

There is little potential to impact fish habitat from the proposed program. Drilling operations will not use toxic additives and drill fluids will not be discharged into lakes or watercourses. Careful design of sites, placement of petroleum products on sites and limited supplies on drill sites will minimize the potential for contamination from fuels. In conjunction with an effective spill contingency plan and an active training program, drilling activities will have little impact on fish habitat.

Archaeological Impacts

The bulk of the archaeological sites in the area are found on eskers landforms. These areas are not anticipated to be impacted by the proposed project. In the drilling program there will be latitude to adjust drill sites that could conflict with archaeological sites and GPM is committed to minimizing it's impact through re-locating sites where required.

Permafrost

No significant or long-term impact on permafrost is anticipated from the drilling program or the camp. Drill holes penetrating the permafrost layer may degrade the active layer in a local area. After abandonment of the site, all conditions that would inhibit the reversal of this degradation will be eliminated.

Air Quality

The scale of the proposed program at the Project will not significantly impact air quality in the region.

Cumulative Impacts

The potential impacts resulting from the Proposal within a regional context will be minimal. The scope and scale of the program is limited and impacts on potential downstream users will be minimized or eliminated through the implementation of a sound environmental management program.

Literature Cited

Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7500 000 scale.

Appendix A
Specifications of Incinerator Model A100(A)

Inciner8 Ltd

Model A400 Waste Incinerator

Efficient, clean and durable

Features overview

- Designed for economical performance.
- Low profile for easy loading and ash removal
- Refractory lined to retain heat for efficiency.
- Available with LP, Natural gas or fuel oil burner
- Optional secondary burner where needed.
- Optional secondary chamber to produce 2 second gas retention time at 850 deg C

Ease of use

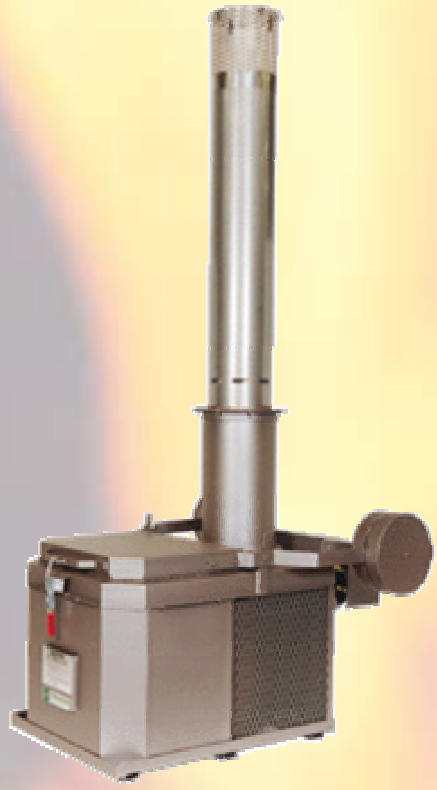
- Auto ignition. No pilots to light. Set the timer and walk away.
- Single burner reduces maintenance cost.
- Built-in skid facilitates placement.

Fuel efficiency

- Rapid incineration means low fuel consumption.
- Higher burn rate than smaller models.
- Thick refractory lining in main chamber retains heat, increasing efficiency.

Quality built to last

- Heat resistant aluminized steel.
- Stainless steel stack.
- Backed by years of incineration experience.



Standard Model A400

View of primary chamber during operation

The benefits of incineration . . .

Hygienic
Waste can be destroyed as fast as it accumulates. Nothing is left to spread disease or to attract rodents and flies.

Convenient
Fill the chamber and turn on the burner. No watching required since timer automatically shuts down burner. Alternative methods frequently require more time to manage and maintain.

Thorough
Leaves only sterile white ash and brittle bone fragments. Reduces animal carcasses to approximately 5% of sterile residue.

CE **BS EN 746-2:1997**

Inciner8 Ltd

Model A400(A)

The Model A400 is the mid size unit that we produce in the range of incinerators burning less than 50kg per hour. It is available in different variations, with the most popular being the UK DEFRA approved Model A400(A), which utilises a secondary chamber providing a gas retention time of 2 seconds at 850 degrees Centigrade and maintains this throughout the burn cycle. This makes the Model A400 (A) version ideal for burning animal carcasses in accordance with the animal-by-product act.

The unit is unique in that it uses a dual fired burner motor rather than two separate burner units, this not only is more efficient but provides low maintenance and fuel costs.
The unit can be preset to burn for the required time and has numerous safety cut off features.
The burners come with a unique post burn cool down system, which allows for quicker cool down before restocking.

The model A400 is a top loading design which also benefits from the large loading door allowing easy access and charging. It also has skids to allow easy handling with a forklift.

DEFRA Approved Unit A400(A)

Specifications

CHARGING RATE - Pathological: Up to 200 kg per charge of typical pathological waste . Batch loaded allowing complete burn-out in approximately 4.5 hours, cool down and ash removal before reloading.
Burn rate: Approximately 45kg/hr.

Model A400

Chamber capacity - 200 kg
Chamber volume (approx.) .36 m3
Chamber size (outside)
Width 91 cm Height 86cm Length 122 cm
Door opening 56 x 74cm
Height to door 77 cm
Height to top of stack 3.3 m
Weight - 896 Kgs
Suggested slab size (l x w x thick) 1.8 m x 2.4 m x 10cm
STACK
Stainless Steel Stack height 1.52 m 30.5 diameter, 16 gauge (1.52 mm) stainless steel
GENERAL
Electrical service Standard—115 volt, 60 HZ, 20 amp. Also available—220 volt, 50 HZ, 10 amp

Model A400(A)

Chamber capacity - 200 kg
Chamber volume (approx.) .36 m3
Chamber size (outside)
Width 91 cm Height 86 cm Length 122 cm
Door opening 56 x 74cm
Height to door 77 cm
Height to top of stack 3.3 m
Suggested slab size (l x w x thick) 1.8 m x 2.4 m x 10cm
Secondary Chamber Volume .52 cubic metres
2 second gas retention time at 850 deg. C
Temperature monitor. Dual fired burner available in LPG, natural gas, Diesel or kerosene.
STACK
Stainless Steel Stack height 1.52 m, 30.5 diameter, 16 gauge (1.52 mm) stainless steel
GENERAL
Electrical service Standard—115 volt, 60 HZ, 20 amp. Also available—220 volt, 50 HZ, 10 amp

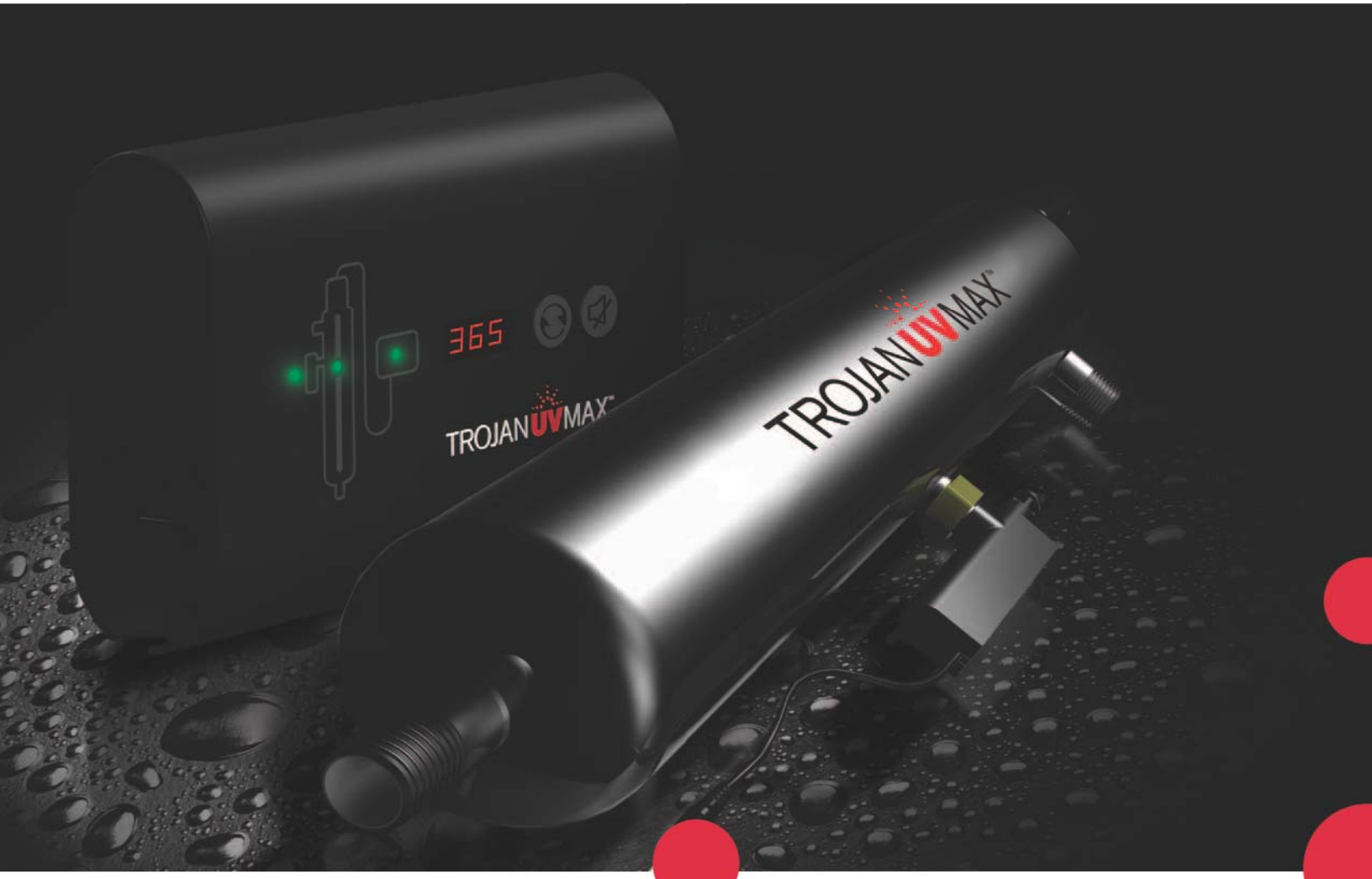
Dealer

Inciner 8 Ltd, Unit 9, Shakespeare House,
37-39 Shakespeare Street, Southport, PR8 5AB
Tel +44 (0) 1704548508 Fax +44 (0) 1704 542461
Email : info@inciner8.com Web : www.inciner8.com

Appendix B
Specifications for Trojan UV Max waster Treatment System

TROJANUVMAX™

RESIDENTIAL AND COMMERCIAL APPLICATIONS



WHO IS VIQUA - a Trojan Technologies Company?

VIQUA is a leading water treatment technology company focused on providing our customers – residential and light commercial – confidence in their water. Offering a complete solution package including UV disinfection, water filtration, softeners and ozone products.

WHAT IS UV?

Ultraviolet (UV) light is at the invisible, violet end of the light spectrum. The water treatment industry uses a high-powered form of UV light called UV-C or "germicidal UV" to disinfect water.

WHO USES UV DISINFECTION SYSTEMS?

For more than 30 years, institutions, consumers and businesses have relied on VIQUA's environmentally friendly UV technology to disinfect their water supplies. Top candidates for UV disinfection systems include:

- Rural homes and cottages
- Nursing homes
- Hospitals
- Schools
- Hotels
- Restaurants
- Resorts and holiday camps
- Community water systems

TROJAN UVMAX™

Ultraviolet (UV) Light is the Right Choice for Water Purification

Instills Water Confidence

Owners of a TrojanUVMax™ can drink with confidence knowing 99.99% of illness-causing microorganisms, including *E. coli, Cryptosporidium* and *Giardia* are destroyed, supplying safe water to every tap.

Environmentally-friendly and Chemical Free

UV water purification is a natural process that adds no chemicals and does not affect the taste or odor of water. Other methods, such as those that use chlorine, may create harmful chemicals that have been linked with serious illnesses, such as cancer.

Trouble-free Maintenance

Maintenance is simple and can be completed in minutes - without tools. It's as easy as replacing the UV lamp once a year and periodically cleaning the sleeve.

TYPICAL **INSTALLATION**

INSTALLATION AND OPERATION REQUIREMENTS

- UV transmittance must be greater than 75%. Through your dealer, Trojan offers a free water testing service for hardness, iron and UV transmittance.
- A 5 micron (nominal) sediment filter must be installed before the UV system.
- Lamps must be replaced after 1 year of operation.
- Sleeve and UV sensor window will require regular cleaning. See Owner's Manual for details.

Hot water heater and faucets

Water Softener (optional)

5 Micron Filter

TrojanUVMax™ Model D4 Plus

Safety Cap and Special Lamp Plug

Our safety cap prevents children from accessing the lamp or electrical components. The special lamp plug ensures that no one can power the UV lamp if it's not in the UV chamber.

Test of Sensor Operation

With the push of a button you can confirm the proper operation of the sensor.

Unique Lamp/ Sleeve Assembly

Lamps and sleeves are assembled together for ease of handling. They can be replaced separately, in minutes and without tools.

Reference Card

The reference card outlines the most important system functions and maintenance for your quick, on-the-spot questions.

Helpful Lamp Replacement Reminder

The Lamp timer display starts at **365** and counts down the days to annual lamp replacement.

Mute Button

If a warning alarm sounds, simply press this button to silence the alarm.

Confidence in Proper System Operation

Indicator lights show the status of system components. Warning lights appear when system maintenance is required.

Lamp Timer Reset Button

Once annual lamp replacement is completed, press this button to restart the Lamp timer.

1 *Model A power supply*

2 *Model B4 and C4 power supply*

MODEL	A	B4	C4	D4/D4 Plus	E4/E4 Plus	F4/F4 Plus
*Flow Rates	0-3 GPM (0-11 LPM)	3-6 GPM (11-23 LPM)	7-16 GPM (26-60 LPM)	7-16 GPM (26-60 LPM)	12-29 GPM (45-110 LPM)	20-45 GPM (76-170 LPM)
No-tools maintenance	✓	✓	✓	✓	✓	✓
Constant current electronic power supply	✓	✓	✓	✓	✓	✓
Safety cap & special lamp plug	Safety cap only	✓	✓	✓	✓	✓
Lamp operation indicator	✓	✓	✓	✓	✓	✓
Power supply operation indicator	✓	✓	✓	✓	✓	✓
Sensor operation indicator	--	--	--	D4 Plus	E4 Plus	F4 Plus
Sensor with diagnostic test	--	--	--	D4 Plus	E4 Plus	F4 Plus
Reference card	--	✓	✓	✓	✓	✓
Lamp timer display	--	--	--	✓	✓	✓
Lamp timer reset button	--	--	--	✓	✓	✓
Mute button	--	--	--	✓	✓	✓
Solenoid valve				Optional	Optional	Optional
External control relay				Optional	Optional	Optional
Chamber material	304 SST	304 SST	304 SST	304 SST	316 SST	316 SST
Inlet/Outlet	3/8" FNPT	3/4" NPT	3/4" NPT	3/4" NPT	1" NPT	1" NPT
ELECTRICAL						
Voltage	120 or 230V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC	100-240V AC
Frequency	50-60 Hz	50-60 Hz	50-60 Hz	50-60 Hz	50-60 Hz	50-60 Hz
Max. current	0.4 Amp	0.4 Amp	0.5 Amp	0.5 Amp	0.85 Amp	1.2 Amp
Max. power consumption	22 Watts	36 Watts	50 Watts	50 Watts	83 Watts	130 Watts
Lamp power	14 Watts	25 Watts	40 Watts	40 Watts	70 Watts	110 Watts
DIMENSIONS						
Chamber	15.5" x 2.5" 39 x 6.5cm	14.5" x 4" 37 x 10cm	20.5" x 4" 52 x 10cm	20.5" x 4" 52 x 10cm	30" x 4" 76 x 10cm	44.25" x 4" 112.5 x 10cm
Power supply	2.8" x 3.3" 7 x 8cm	8.5" x 6" 22 x 15cm	8.5" x 6" 22 x 15cm	8.5" x 6" 22 x 15cm	8.5" x 6" 22 x 15cm	8.5" x 6" 22 x 15cm

** Flow rates are shown at 85% UVT.*

WARRANTY

The TrojanUVMax™ comes with a full, non-prorated three year warranty against manufacturer's defects on the power supply and all electrical components; a ten year guarantee on the UV chamber; and a one year warranty on lamps and sensors. See full warranty at www.viqua.com for a complete set of terms.

General (All Models)	
Operating Parameters	
Maximum operating pressure	125 PSI (862 kPa)
Maximum ambient air temperature	122 ºF (50ºC)
Minimum ambient air temperature	32ºF (0ºC)
Maximum hardness	120 ppm (7 grains per gallon)
Maximum iron	0.3 ppm
Minimum UVT	75%
Installation	Vertical or horizontal *

** Systems with sensors must be installed vertically.*

VIQUA™

A TROJAN TECHNOLOGIES COMPANY

425 Clair Road West Guelph, Ontario, Canada N1L 1R1
T 519 763 1032 F 519 763 5069 www.viqua.com

c UL US LISTED

NRTL/C

CE

kiwa ISO 9001 QUALITY

Appendix C
MSDS Sheet - Calcium chloride

PANTHER INDUSTRIES INC.
BOX 698, DAVIDSON, SASK., CANADA S0G 1A0
PHONE: (306)567-2814 FAX: (306)567-2888

PRODUCT DATA

PRODUCT: Calcium Chloride High Test Fines

ITEM	%	METHOD
Calcium Chloride, min.	94.0	ASTM E449-84
Alkali Chlorides, max.	4.9	ASTM E449-84
Total magnesium, as MgCl,max.	0.4	ASTM E449-84
Heavy Meatal as Pb, max.	0.005	13964
Calcium Hydroxide, max.	0.20	ASTM E449-84
Sulphate (calculated as SO_4), max.	0.20	13964
Calcium Carbonate	0.20	13964
Iron, max	0.005	LDG-AM-82-73
Other Impurities, not including H_2O, max.	0.98	

SIEVE ANALYSIS
Based on STD TYLER MESH

ITEM	%
Passing #10 sieve	99
Passing #20 sieve	45
Passing #35 sieve	20
Bulk density	75 lbs/ft^3

MSDS # CALCIUM CHLORIDE-94%

PRODUCT INFORMATION

CHEMICAL NAME: Calcium Chloride

SYNONYM(S): High Test Fines, High Test Powder, High Test Beads,

CHEMICAL FAMILY: Inorganic salt

Product use: Calcium chloride is used to dehydrate natural gas with high sulfur content, gas from remote or offshore wells, or from wells with low flow rates.

MOLECULAR FORMULA: $CaCl_2$

SHIPPING NAME: Calcium Chloride

PIN - UN NUMBER: Not controlled

WHMIS: D2B

MANUFACTURER: The Dow Chemical Company Ltd.
P.O box 1012
Sarnia, Ontario
N7T 7K7
DOW Emergency Number: 780-998-8282 (Ft Saskatchewan, Alberta)
519-339-3711 (Sarnia, Ontario)
450-652-1000 (Varennes, Quebec)

SUPPLIER: Panther Industries Inc.
Box 628
Davidson, Sask. S0G 1A0

EMERGENCY TELEPHONE NUMBER: (306)567-2814

HAZARDOUS INGREDIENTS

INGREDIENTS:	WEIGHT %	C.A.S. REGISTRY NUMBER:
Calcium Chloride	94-97%	10043-52-4

OTHER INGREDIENTS

INGREDIENTS:	WEIGHT%	C.A.S. REGISTRY NUMBER:
Strontium Chloride	0-1%	10476-85-4
Sodium Chloride	1-2%	07647-14-5
Potassium Chloride	2-3%	07447-40-7
Water		07732-18-5

PHYSICAL DATA

PHYSICAL STATE: Solid.

PH: data to indicate the product is basic

ODOUR AND APPEARANCE: Odourless white to off white pellets.

ODOUR THRESHOLD: Not applicable

VAPOUR PRESSURE: <0.005 mmHg, at 20 ^{o}C.

VAPOUR DENSITY: Not applicable

BOILING POINT: 1670^{o}C

SOLUBILITY IN WATER: Very soluble

MELTING POINT: Approx. 772^{o}C, 1424^{o}F

SPECIFIC GRAVITY: 2.2

FIRE AND EXPLOSION DATA

CONDITIONS OF FLAMMABILITY: Not applicable.

MEANS OF EXTINGUISHING: This material does not burn. If exposed to fire from another

source, use suitable extinguishing agent for that fire.

FLASH POINT: Not applicable.

UPPER FLAMMABLE LIMIT: Not applicable.

LOWER FLAMMABLE LIMIT: Not applicable.

SPECIAL FIRE FIGHTING PROCEDURES: Keep people away. Isolate fire area and deny unnecessary entry. Firefighters should wear positive-pressure self-contained breathing apparatus (SCBA) and full protective fire fighting clothing (included fire fighting helmet, coat, pants, boots, and gloves.)

EXPLOSION HAZARDS: **Hydrogen chloride is a hazardous combustion product at temperatures in excess of 1600 degrees Celsius.**

REACTIVITY DATA

STABILITY: Stable. Hygroscopic.

HAZARDOUS POLYMERIZATION: Will not occur

HAZARDOUS DECOMPOSITION PRODUCTS: Does no decompose.

CONDITIONS TO AVOID: None known.

INCOMPATIBILITY: Corrosive to some metals. Corrosive when wet. Flammable hydrogen may be generated from contact with metals such as zinc or sodium. Avoid contact with sulfuric acid. Heat is generated when mixed with water. Spattering or boiling can occur.

HEALTH HAZARD DATA

INHALATION: Vapors are unlikely due to physical properties. Dust may cause irritation to upper respiratory tract. **Calcium Chloride has an LD_{50} of 1940 mg/kg oral mouse**

SKIN CONTACT: Short single exposure not likely to cause significant skin irritation. Prolonged or repeated exposure may cause skin irritation, even a burn. May cause more severe response if skin is damp or if material is confined to skin. May cause more severe response is skin is abraded (scratched or cut). When dissolving, the heat produced may cause more intense effects as well as thermal burns. Not classified as corrosive according to DOT. A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts.

EYE CONTACT: Dusts may cause severe irritation with corneal injury, pellets may cause slight eye irritation. Effects may be slow to heal. When dissolving, the heat produced may cause more intense effects as well as thermal burns.

INGESTION: Single dose oral toxicity is considered to be low. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury. Ingestion may cause gastrointestinal irritation or ulceration.

Toxicological data: Effects of chronic exposure: These effects are; Repeated exposure may cause irritation or even a burn to the skin, eyes and nasal cavity.

IRRITANCY: Slight.

MUTAGENICITY: Negative

SENSITIZATION TO PRODUCT: Not available.

REPRODUCTIVE TOXICITY: Not available.

ANIMAL TOXICITY DATA:

LD50 - 967-1668 mg/kg oral, rat.
>5000 mg/kg skin, rabbits

FIRST AID PROCEDURES

INHALATION: Remove to fresh air if effects occur. Consult a physician.

EYE CONTACT: Irrigate with flowing water immediately and continuously for 15 minutes. Consult medical personnel.

SKIN CONTACT: Wash off in flowing water or shower.

INGESTION: If swallowed, seek medical attention. Give 2-4 glasses of water or milk and don’t induce vomiting unless directed to do so by medical personnel.

NOTE TO PHYSICIAN: If burn is present, treat as any thermal burn, after decontamination. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

PREVENTATIVE MEASURES

RESPIRATORY PROTECTION: In dusty atmospheres, use an approved dust respirator. Atmospheric levels should be maintained below the exposure guideline.

EXPOSURE GUIDELINES: Calcium chloride: Dow IHG is 10 mg/m3
Sodium chloride: Dow IHG is 10 mg/m3
Potassium chloride: Dow IHG is 10 mg/m3

EYE AND FACE PROTECTION: Use safety glasses. For dusty operations or when handling solutions of the material, wear chemical goggles.

SKIN PROTECTION: When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as faceshield, gloves, boots, apron or full-body suit will depend on operation. Remove contaminated clothing immediately, wash skin area with soap and water and launder clothing before reuse. If hands are cut or scratched, use gloves impervious to this material even for brief exposures.

STORAGE REQUIREMENTS: Keep containers tightly closed when not in use. Store in a dry place. Protect from atmospheric moisture.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

HANDLING: Heat developed during diluting or dissolving is very high. Use cool water when diluting or dissolving (temperature less than 80F, 27C)

ENVIRONMENTAL PROTECTION DATA

PROCEDURES TO BE FOLLOWED IN CASE OF A LEAK OR SPILL: Contain spill. Shovel and sweep up spill and place in a suitable and properly labelled container. Flush residue with large amounts of water. Keep contaminated water from entering sewers and water courses.

WASTE DISPOSAL: All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations.

AQUATIC TOXICITY: Material is practically non-toxic to aquatic organisms on an acute bases (LC50/EC50 > 100 mg/L in most sensitive species).

PREPARATION INFORMATION

MSDS PREPARED BY: Technical Department
Panther Industries Inc.
Davidson, Sask.
Ph. (306) 567-2814

DATE PREPARED/REVISED: Feb 17 2004

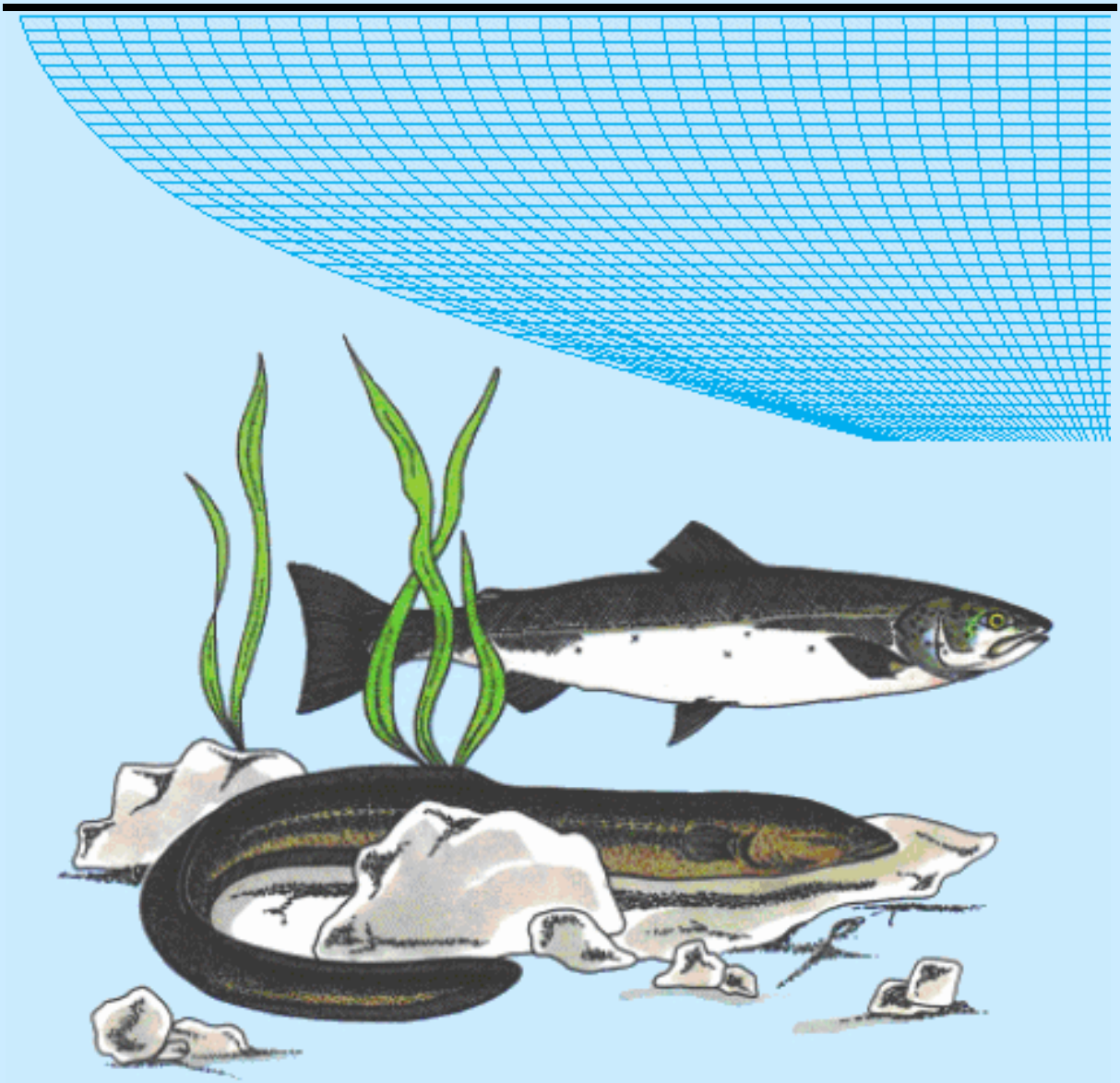
DATE PRINTED: Feb 17 2004

REFERENCES:
1. Patty's Industrial Hygiene and Toxicology 3rd Ed.1981 by Clayton & Clayton John Wiley & Sons, New York.
2. Manufacturer's MSDS.

Appendix D
Intake End-of-Pipe Fish Screen Guideline. DFO, 1995

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline

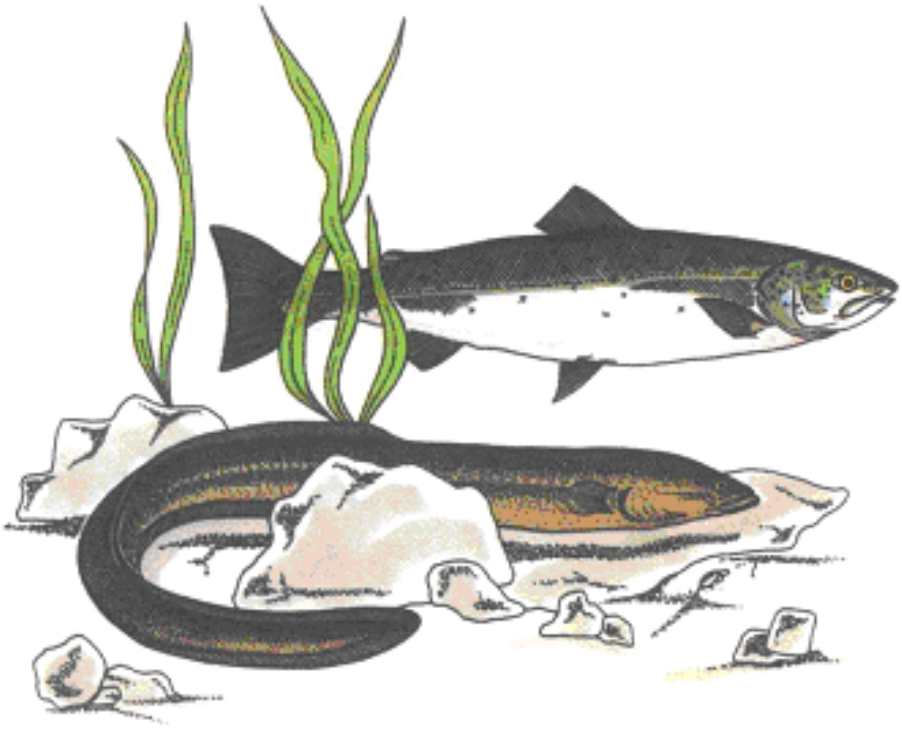


Fisheries and Oceans | Pêches et Océans

Canada

Department of Fisheries and Oceans

Freshwater Intake End-of-Pipe Fish Screen Guideline



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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 appropriate 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 Screens

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 body. 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:

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

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 are 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, 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 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, be durable, and capable of withstanding any potential large forces and impacts. Figures 3, 4, and 5 illustrate some of the various configurations, applications, and screen material types of end-of-pipe fish screens.

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

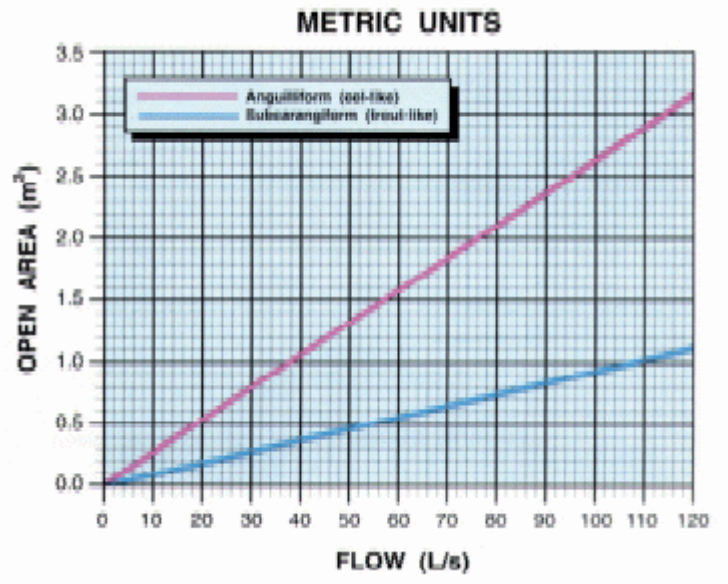
Table 3 Examples of Screen Material

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

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 Areas for End-of-Pipe Water Intake Flow



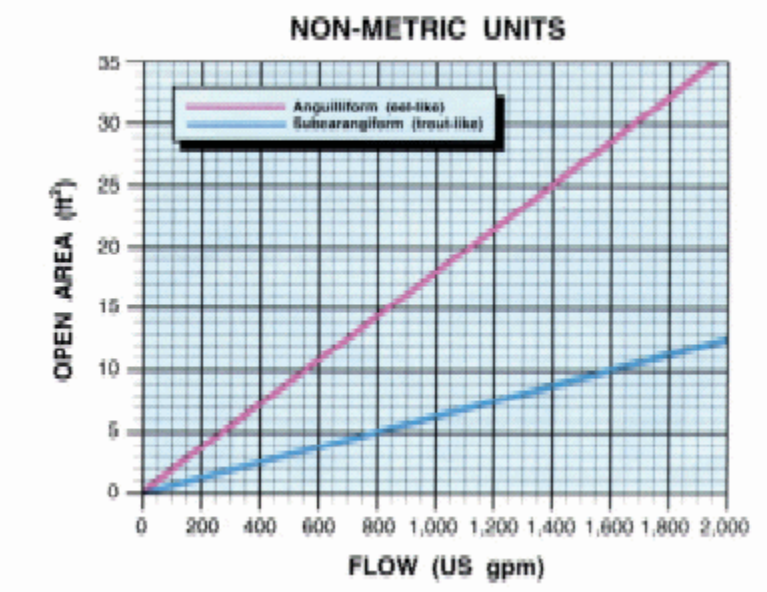


Figure 2 Common Screen Shapes and Area Formulae

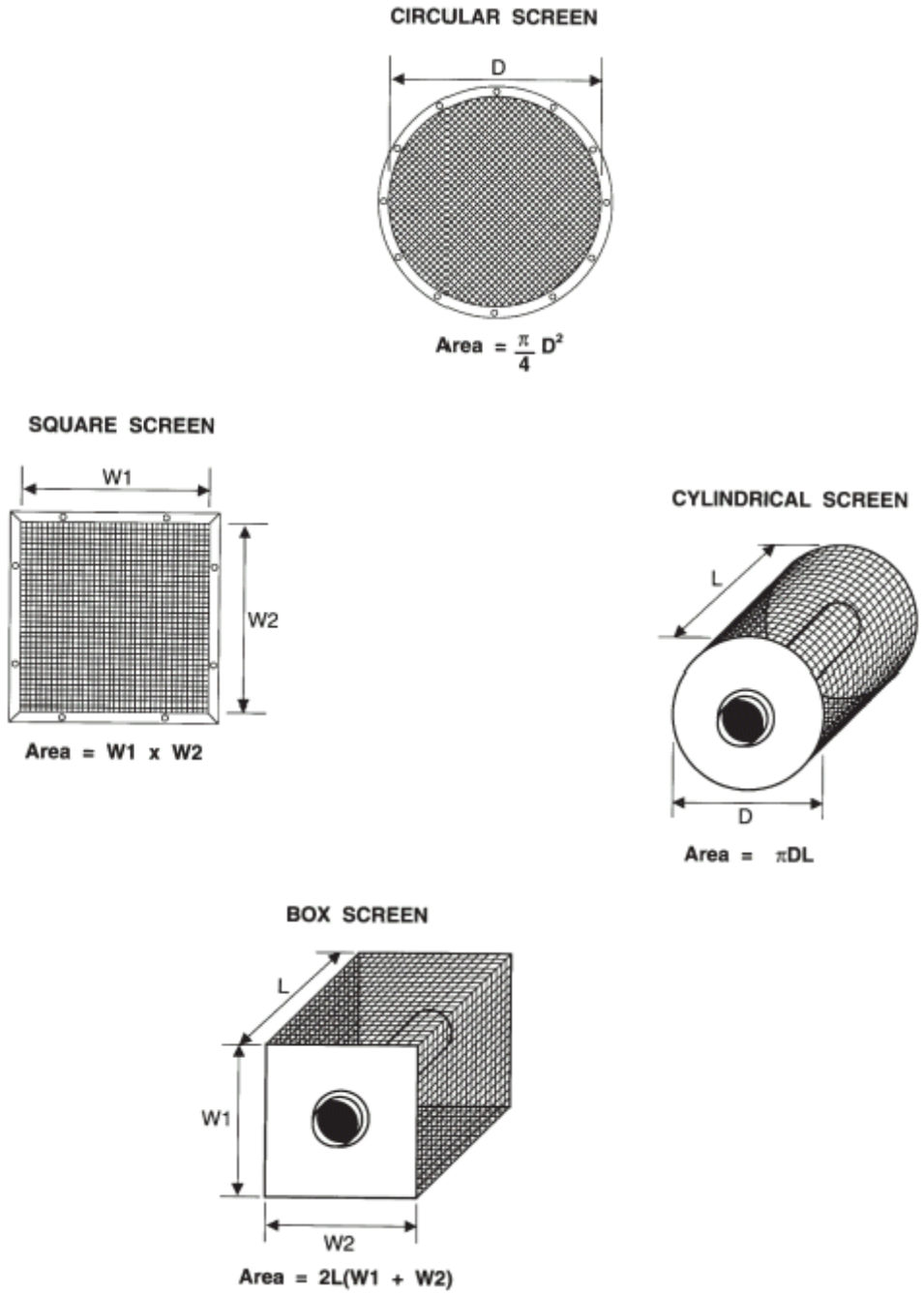
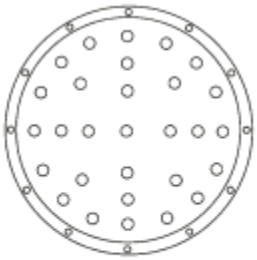
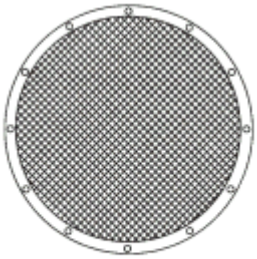


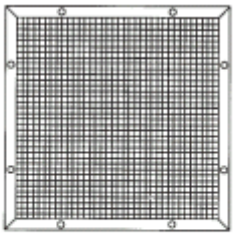
Figure 3 Typical Applications and Features of End-of-Pipe Screens



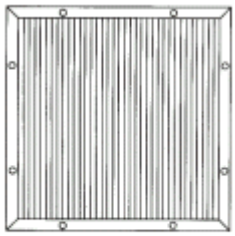
PERFORATED PLATE (PUNCHED)



CIRCULAR MESH SCREEN

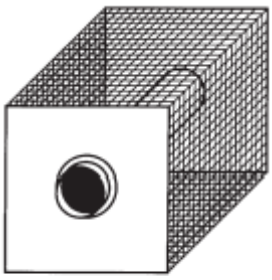


SQUARE MESH SCREEN



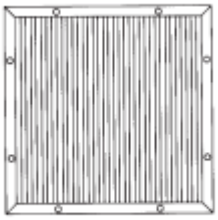
SQUARE WEDGE WIRE SCREEN

DRUM OR CYLINDER WITH PERFORATED PIPE

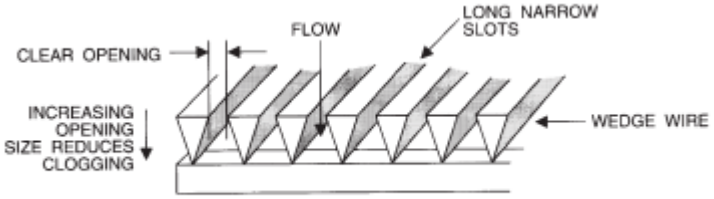


BOX-TYPE WITH MESH SCREEN

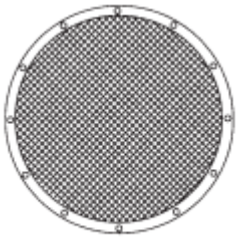
Figure 4 Examples of Typical Screen and Material Types



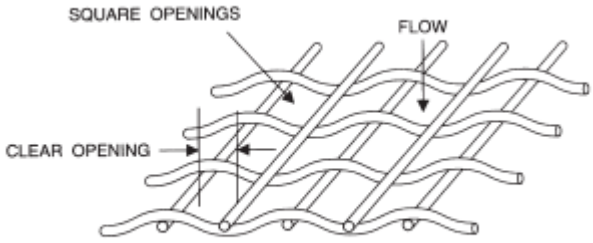
SQUARE WEDGE WIRE SCREEN



WEDGE WIRE PROFILE

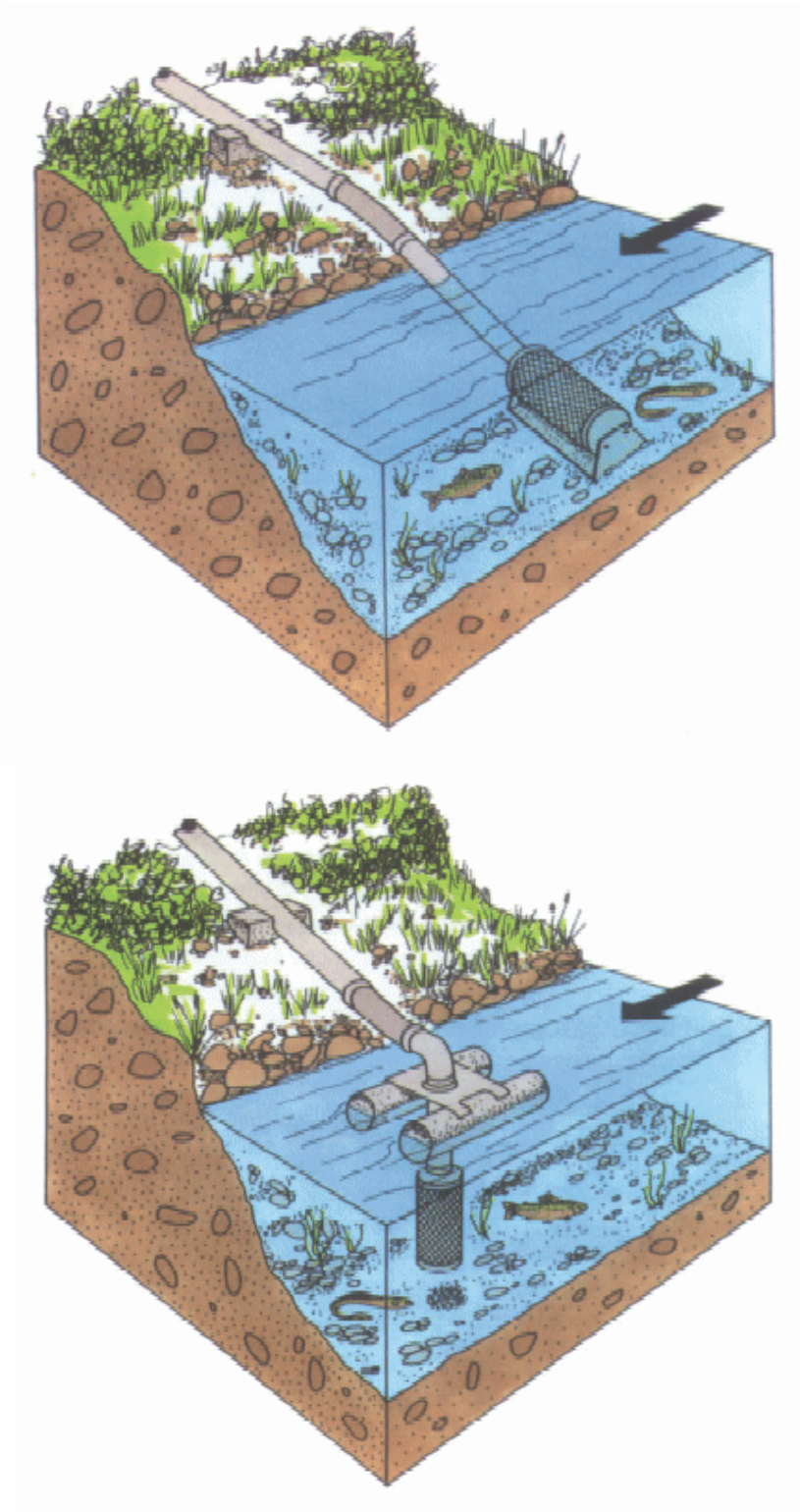


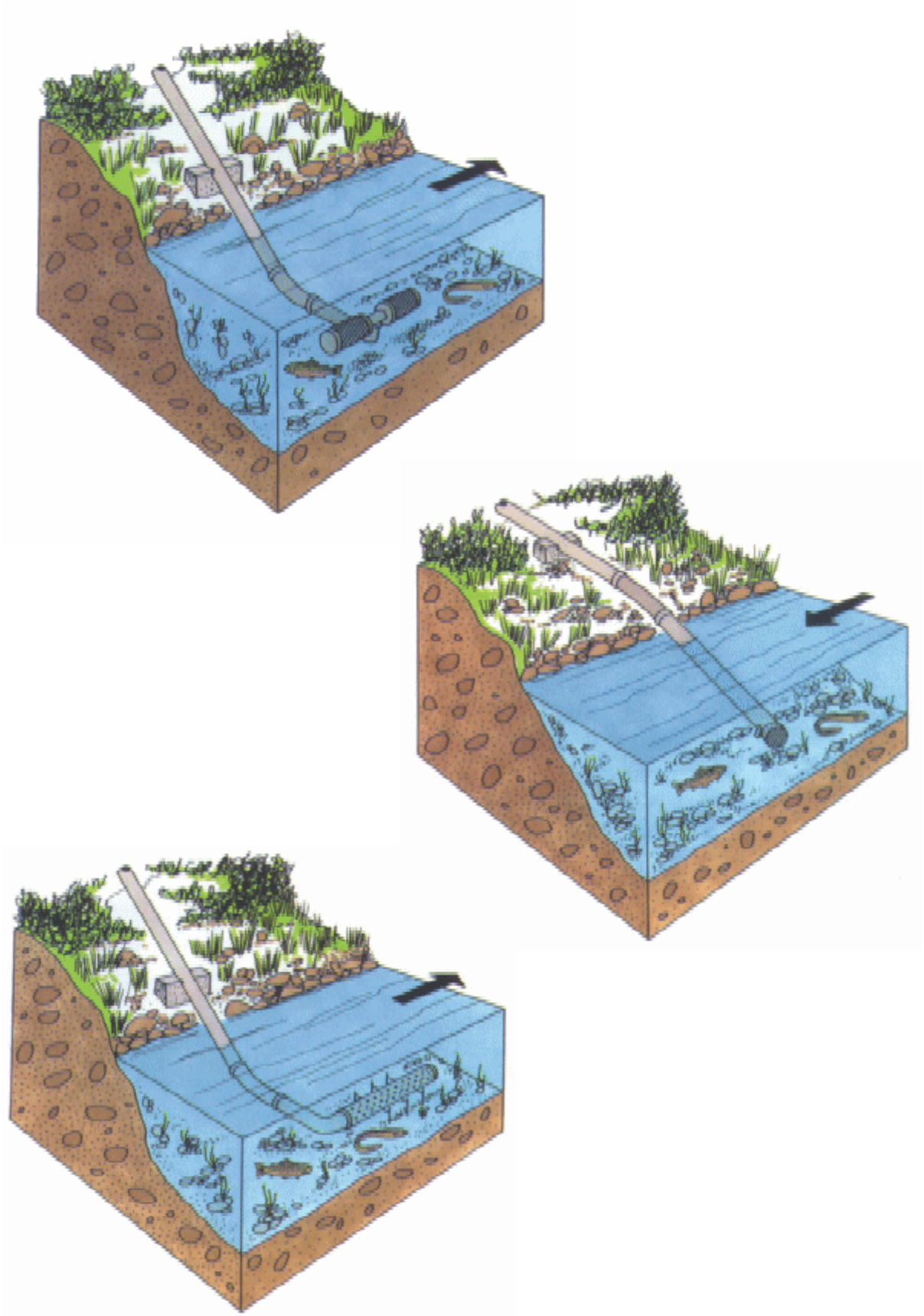
CIRCULAR MESH SCREEN



WOVEN WIRE MESH PROFILE

Figure 5 Examples of Typical Installations of End-of-Pipe Screens





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 are carried out to prevent debris fouling and impingement of fish.
- Pumps should be shutdown 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

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 project site
- physical description of the watercourse at the intake site, including channel width and depth, direction and velocity of water currents, variations in water 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 time 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, it is first necessary to convert the flow from cubic metres per second to litres per second.

$$0.0075\frac{\mathrm{m}^3}{\mathrm{s}} \times \frac{1000\mathrm{L}}{1\mathrm{m}^3} = 75\frac{\mathrm{L}}{\mathrm{s}}$$

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.

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

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

$$= 3.111 m^2$$

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:

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

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:

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

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

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

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

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

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 Cresent 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.