ENERGY
SAFETY
CANADA

Working On and Around Oil Sands Tailings Ponds

Tailings Ponds Program Guideline

National Safety Association
for Canada's Energy Industry

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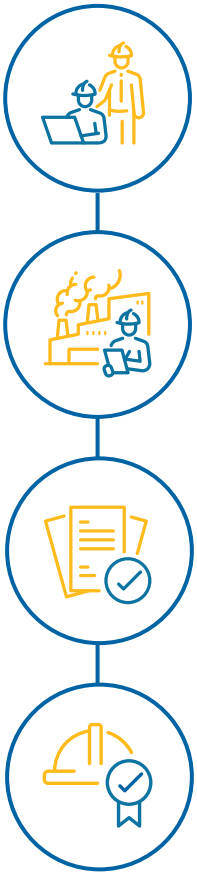

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Preface

Purpose

This document provides guidance for managing hazards and risks associated with working on and around bodies of process-affected water ponds such as oil sands tailings ponds.

This guide will overview:

- *Hazardous ground conditions;*
- *Tailings storage facilities;*
- *Determining ground characteristics;*
- *Working on bodies of water or fluid;*
- *Working on frozen surfaces;*
- *Working in proximity of water or fluid;*
- *Personal protective equipment; and*
- *Marine-specific training; and emergency response preparedness.*

Project Scope and Limitations

This guide provides general guidance and should not be viewed as a complete repository of information.

This document will provide a strong foundation for developing a comprehensive program for working on or around oil sands tailings ponds, water and ice.

The intended audience includes oil sands companies and employers that work in tailings operations but is not limited to health and safety, risk management, maintenance, engineering, and contractor personnel.

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Introduction

The risk associated with tailings operations presents a challenge for the oil sands industry. This guideline specifically focuses on operations and situations in oil sands, tailings and mining.

1.0 Common Language and Concepts

1.1 Working Around Hazardous Ground Conditions in Oil Sands Mining & Tailings Operations

The process of mining and extracting oil sands involves the use of water. Rain, groundwater and snowmelt accumulate in the mine and reclamation salvage areas, collecting in ditches and sumps throughout the mine. Water management and dewatering are critical to mining operations and require workers to maintain earthworks and pumps near water bodies.

In mining operations, the oil sand is transported to a crusher that feeds a hydro-transport facility. The ore is hydraulically pumped as a slurry to the extraction facility, where the bitumen is removed from the sand and soil. The remaining slurry is referred to as “tailings”. The tailings slurry is pumped to a tailings storage facility (TSF) where it is discharged. After discharge, the heavier sand particles begin to settle, creating a sandy beach. The slower-settling fine soil and water flow to the lowest point and create a pond in the center of the facility. Tailings sand is utilized in dyke construction, with water being recycled, and the fluid tailings undergoing treatment and reclamation. Tailings operations involve many operational groups and specialized contractors working on and around ice/water year-round.

Expect to encounter water, soft ground and heavy equipment when in a tailings area.

1.2 Tailings Storage Facilities

Tailings storage facilities are typically several square kilometres in size and the terrain varies throughout and between facilities. Tailings can be stored in the previously mined pit, known as in-pit tailings placement, or in external tailings facilities constructed above grade using engineered dykes.

Image 1: Aerial photo of an oil sands tailings storage facility.

1.3 Ground Characterization Guide

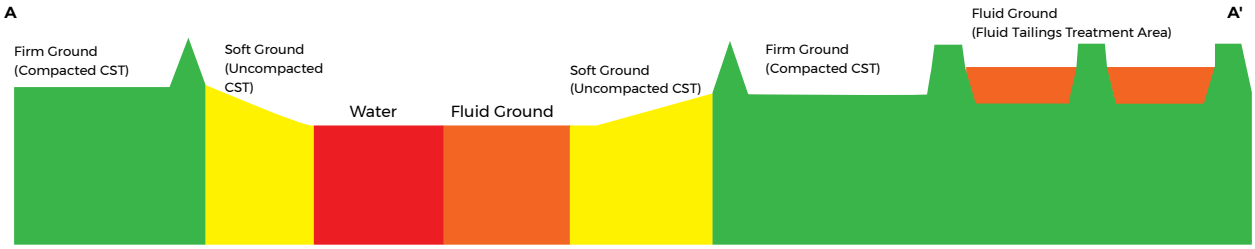
It is critical to recognize the unique hazards associated with the varied ground conditions commonly found in the environments affected by tailings, mining and process water.

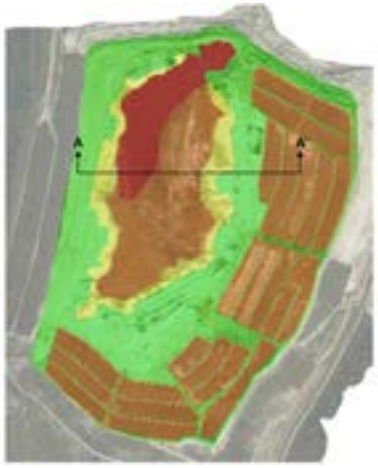
Although the following guide generally describes key ground characteristics, it should be noted that conditions may change, including, but not limited to: weather changes, process upsets, pipeline leaks, etc.

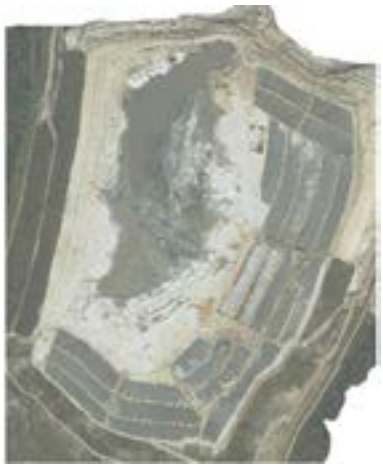
The ground characterization guide (Figure 1) is to be used when:

- Accessing and working around soft or unknown ground conditions off main access roadways
- Working on water or fluid

Figure 1. Ground characterization guide







1.3.1 Water

- Water bodies which support the safe travel of marine vessels
- *Examples:* tailings ponds, deep water sumps, process-affected ponds, ditches or wetlands

RULES:

- A life jacket or personal flotation device should be worn within 5 m of an unprotected water's edge. It should be worn where there is a foreseeable drowning hazard (see Section 5.2 for additional guidance).
- A water safety checklist or departure plan must be completed before leaving shore.
- All vessels being used on water should meet the appropriate requirements from Transport Canada.
- All vessel operators must hold a valid operator certificate applicable to the class of vessel.
- Ensure you have completed a fall protection and emergency response plan for on-water activities.

1.3.2 Fluid Ground

- Fluid-like tailings or other mining waste with limited water cover
- Inaccessible using marine vessels and too soft for terrestrial equipment or foot traffic
- Extreme temperature fluctuations caused by seasonal changes require additional assessment and mitigation
- *Examples:* drying cells, mud dumps, process-thickened tailings

RULES:

- Access to these Fluid Ground locations is restricted.
- Due to unknown fluid/ground conditions caused by seasonal changes, ground competency must be determined. Therefore, the appropriate hazard/risk assessment (e.g., trafficability assessment and recovery plan) should be conducted and approved by the company-designated authority before starting work. See section 6.0 for additional guidance.

1.3.3 Soft Ground

- Uncompacted sand, areas of wet and loose soil
- Accessible using appropriate tracked equipment with a recovery plan and knowledge of geotechnical stability
- Seasonal changes with extreme temperature fluctuations require additional assessment and mitigation
- *Examples:* cell construction, beach, un-trafficked beach, slop dumps.

RULES:

- Soft Ground areas are typically accessed by low-ground pressure and tracked equipment.
- A safe operating distance should be set near live feed/pour or ponded water.
- A recovery plan should be in place before accessing the work area.

1.3.4 Firm Ground

- Engineered or constructed structures
- *Examples:* roads, dykes, and dozer-compacted cells.

RULES:

- All identified firm ground areas are considered accessible for personnel and mobile equipment traversing and working, unless determined otherwise in the job safety analysis (JSA) and/or field level hazard assessment (FLHA).

2.0 Working on Bodies of Water

Any developed practices or procedures should align with applicable Transport Canada Standards.

In addition to normal controls, consider the following best practices:

- Modifications on the design and structure of the vessels are strictly prohibited unless they have been reviewed and approved by the manufacturer and/or an engineer. All approved modifications must be documented.
- All loads must be secured to prevent movement and reduce the risk of capsizing.
- Every person operating a vessel is legally responsible for inspecting, equipping, and operating it in compliance with federal and provincial regulations and for any damage that may be caused by the operation of the vessel.
- The person in command of the vessel must know the requirements for the operation and navigation of the vessel, the local regulations, and the policies and procedures within this guideline.
- Passengers are to be seated whenever possible during vessel movement. If seats are unavailable for all crew members, they must maintain three-point contact during movement, with the locations verified by the vessel captain.
- Any vessel should not be operated on the water by a single occupant unless there is an established means of communication for emergency response.
- When work is to be performed on or from the vessel, it is mandatory for a minimum of two occupants. One person must always maintain care and custody of the vessel.
- All vessel occupants must understand the location of and how to use the safety equipment, as required.

Weather considerations when working on water:

- Weather forecasts for the duration of the shift must be reviewed before departure. Under no circumstances should a small vessel be in operation during lightning storms or when a lightning warning is issued for the area.
- Additional mitigations should be considered when there is an increased risk due to high winds, snow, ice, fog or heavy rain.

2.1 Water Departure Plan and Safety Checklist

Each employer is responsible for defining how to best operationalize their plan.

It is recommended that a water safety checklist, departure plan, permit or equivalent be completed before leaving shore. A copy should be carried, and one should be left with the contact on the shore.

At a minimum, the checklist should include:

- Description of the vessel (e.g., Length, colour)
- Departure time
  - » Estimated duration of work

- Duration
- Type of work being performed
- Classification of ground condition
- How emergency response will be initiated, (e.g., radio, cell phone, contact names and numbers)
- Location being travelled to
- Type of water safety PPE required
- List of crew and passenger names
- Forecasted weather conditions

3.0 Working on Frozen Surfaces

Working on or around the ice is high-risk work. Ice found in the oil sands and mining environment may be weak due to fluctuating water levels, process-affected water and hydrocarbons.

Frozen surfaces can disguise dangerous hidden hazards, including undercuts, washouts, and unsupported ice surfaces due to changing water levels.

Due to the significantly increased risk and history of incidents, a risk assessment should be completed before work begins. This could lead to additional activities, such as an ice engineering plan, trafficability assessment, constructability assessment, etc.

4.0 Mobile Equipment Working in Proximity to Water

When work is to be carried out within 5 m of a body of water using mobile equipment:

- Operators should be trained in any provided self-rescue equipment prior to commencing work.
- The area must be inspected beforehand. Inspections must include but are not limited to cracking, soft areas, undercuts and working slopes.
- Where practicable, a safety berm should be built to protect equipment from sliding into the water. Tailings cell dozers will follow safe work practices (where applicable) when building tailings cells.
- Only manually inflatable personal flotation devices (PFDs) are permitted inside closed cab equipment.
- Each piece of mobile equipment must have a means of egress either by an emergency escape hatch and/or glass break tool.

- Conduct a risk assessment, where cabbed equipment has a risk of being submerged in water and consider the following potential controls:
  - » Emergency air supply — Spare-Air or Emergency Underwater Breathing Apparatus (EUBA).
  - » Glass breaking tool. A reminder that they are only useful on tempered glass and an evaluation of equipment working closely to water should be evaluated for glass type.
  - » Keep the door of the equipment open and/or not wear a seatbelt, or use a seatbelt that would provide easy unbuckling in case of emergency and provide a seatbelt cutter, when applicable.
- During winter operations, install ice lugs on tracked equipment. If the equipment does not have ice lugs installed, sand or other material should be placed in the work area to aid traction.

4.1 Geotechnical Assessment

When ground conditions are unknown or surface cracks are discovered, a geotechnical or ground constructability assessment must be conducted with geotechnical engineer approval to complete a safe access plan. The plan must be reviewed with the area manager before starting work.

If ground conditions are well-known, the ground characterization guide (Figure 1) may be used to determine the appropriate hazard mitigation.

Examples of precursory signs of instability include signs of a prior failure below the slope, seepage at the face of the slop, sinkholes, cracking or sliding along the crest, material deltas at the bottom, slumping and sloughing (Figure 2).

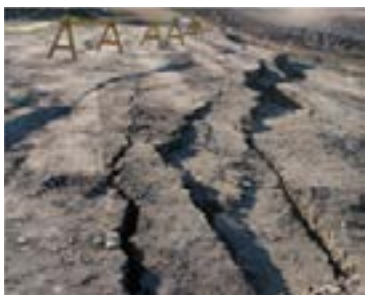
Figure 2. Precursory Signs of Instability

Signs of a prior failure below the slope

Seepage at the face of the slope

Sinkholes

Cracking or sliding along the crest



Material deltas at the bottom

Slumping and sloughing

5.0 Amphibious Equipment

5.1 Amphibious Excavators

Amphibious excavators are used in tailings to support dredging operations, sampling activities, pipeline construction, wildlife management and vegetation control. This work can be done safely, but controls must be put in place to mitigate the risk of capsizing and operator entrapment:

- An engineered stability assessment should be completed before operating in fluids.
- When operating in fluids, all engineered controls for stability assessment should be used, and the cab door should be latched open. The cab door may be latched shut for breaks, but only when all functions are idle.
- Operator must have access to, and be competent in the use of an emergency air supply (Spare-Air or Emergency Underwater Breathing Apparatus (EUBA)).
- Manually inflatable PFDs should be worn inside closed cab equipment.
- Underwater egress training for operators, may be provided.
- A system or process for monitoring pontoon integrity, may be provided.
- Operations in water deeper than the draft of the pontoons should be avoided.

Note: The term "fluids" is used to describe water and slurries of soil and water. Fluids have insufficient bearing capacity to support the amphibious excavator and rely on the buoyancy of the pontoons.

5.2 Amphibious All-Terrain Vehicles

Amphibious all-terrain vehicles (ATV) are used in tailings for the transportation of personnel and equipment. For clarity, brands such as Argo, Fat Truck, Sherp, HydraTrek, and Mudd-Ox are considered Amphibious ATVs for the purpose of this standard. Because of their amphibious design, these ATV's enable travel on most ground characterizations and offer protection to passengers in an ice failure scenario.

Recommended controls:

- Before departure, a pre-use inspection must be completed. If the unit's amphibious features are being relied upon for travel in water, or as a risk mitigation for personnel safety when working on soft ground, the pre-use inspection should also:
  - » Verify that the GVW does not exceed the manufacturer's recommended maximum.
  - » Verify that the buoyant elements of the vehicle are sound.
  - » Verify that drain plugs are installed.
- Ensure a means of equally capable backup is available should the equipment get stuck of suffer a mechanical breakdown.
- Emergency response plans are in place. When operated over fluids, controls should be in place to address the risk of vehicle submersion.

6.0 Personal Protective Equipment

6.1 Communication Devices

A communication device must be available for workers to contact emergency response and site personnel. All vessels and equipment, regardless of location, must have an effective and functional means to communicate with onshore personnel (e.g., cell phone, radio or Marine radio (VHF).

6.2 Life Jackets & Personal Floatation Devices

Life jackets and personal flotation devices (PFDs) are personal protective equipment to protect workers from drowning. Life jackets are designed to keep an unconscious person face up in the water. PFDs provide buoyancy to keep a worker's head above water but may not right an unconscious worker. Life jackets can be bulky and create ergonomic hazards while working. Therefore, the legislation permits workers to wear a PFD while working on a vessel for an extended period, provided that life jackets are available on the vessel. Life jackets and inherently buoyant PFDs come in multiple styles, each with unique applications and limitations.

	Life jacket or pfd	Activation	Typical use
Inherently buoyant	Both	N/A	General duties, all weather
Manual inflation	PFD Only	Pull Cord	Below deck, cab of equipment
Auto inflation	Both	Submersion	General duties, fair weather

All life jackets and PFDs must be inspected, adjusted and worn as per the manufacturer's instructions and must meet applicable regulations. It is advisable to have a sound signalling device (e.g., pea-less whistle) securely attached to the front of the PFD/Lifejacket and easily accessible to the user.

A life jacket or PFD must be worn where there is a foreseeable danger that a worker could be exposed to the hazard of drowning.

A drowning hazard exists to workers when:

- Working within 5 m of an unprotected water's edge
- Working on a vessel
- A risk assessment deems it necessary

All bodies of water must have appropriate and clearly visible signage at the main access points (e.g., docks) warning of the drowning hazard. Signage must clearly state, for example, "OPEN SUMP" or "WATER HAZARD". Required PPE (e.g., double hearing protection, life jacket, etc.) must also be posted.

Lifebuoys must be at least 61 cm (24 in) in diameter and have a Transport Canada approval stamp. Every lifebuoy should be connected to a buoyant line that is at least 15 m long. The line must be securely fastened and maintained according to the manufacturer's specifications. In certain situations, throw bags may be considered acceptable based on a risk assessment.

Note: Life jackets and PFDs are both manufactured with auto inflation technology. However, Alberta legislation only permits the use of intrinsically-buoyant life jackets.

6.3 Specialized Equipment For Consideration – As Identified In A Risk Assessment

6.3.1 Fall Protection

An appropriate fall protection system may be used and secured to an appropriate anchor, along with a life jacket or PFD when there is a risk of workers falling into water or being at risk of drowning from falling from a location other than a vessel, such as a dredge.

Image 2: Example of a life jacket with fall arrest attachment

6.3.1 Thermal Protection Suits (TPS)

This type of PFD provides wearers with a high degree of safety if they fall overboard. The additional buoyancy makes it easier to stay afloat with little or no effort.

TPS is superior if the water is cold (i.e., less than 15 C) because it prevents the body from cold shock. Cold shock is the initial gasping and shallow, rapid breathing that occurs immediately after immersion in cold water. The buoyancy protects against the rapid failure in swimming ability that develops due to exhaustion and cold limbs.

Thermal protection suits are PFDs with added thermal protection to delay the onset of hypothermia if worn for an extended period in cold water. A hazard assessment must be conducted to determine if a thermal protection suit is required if working around cold water.

Thermal protection suit types	
Immersion Suit	
Anti-Exposure/ Survival Suit	
Flotation Coat	

7.0 Marine Specific Training

All employers must ensure adequate training and competencies, including compliance with applicable regulations and site requirements.

Examples of specific training include, but are not limited to:

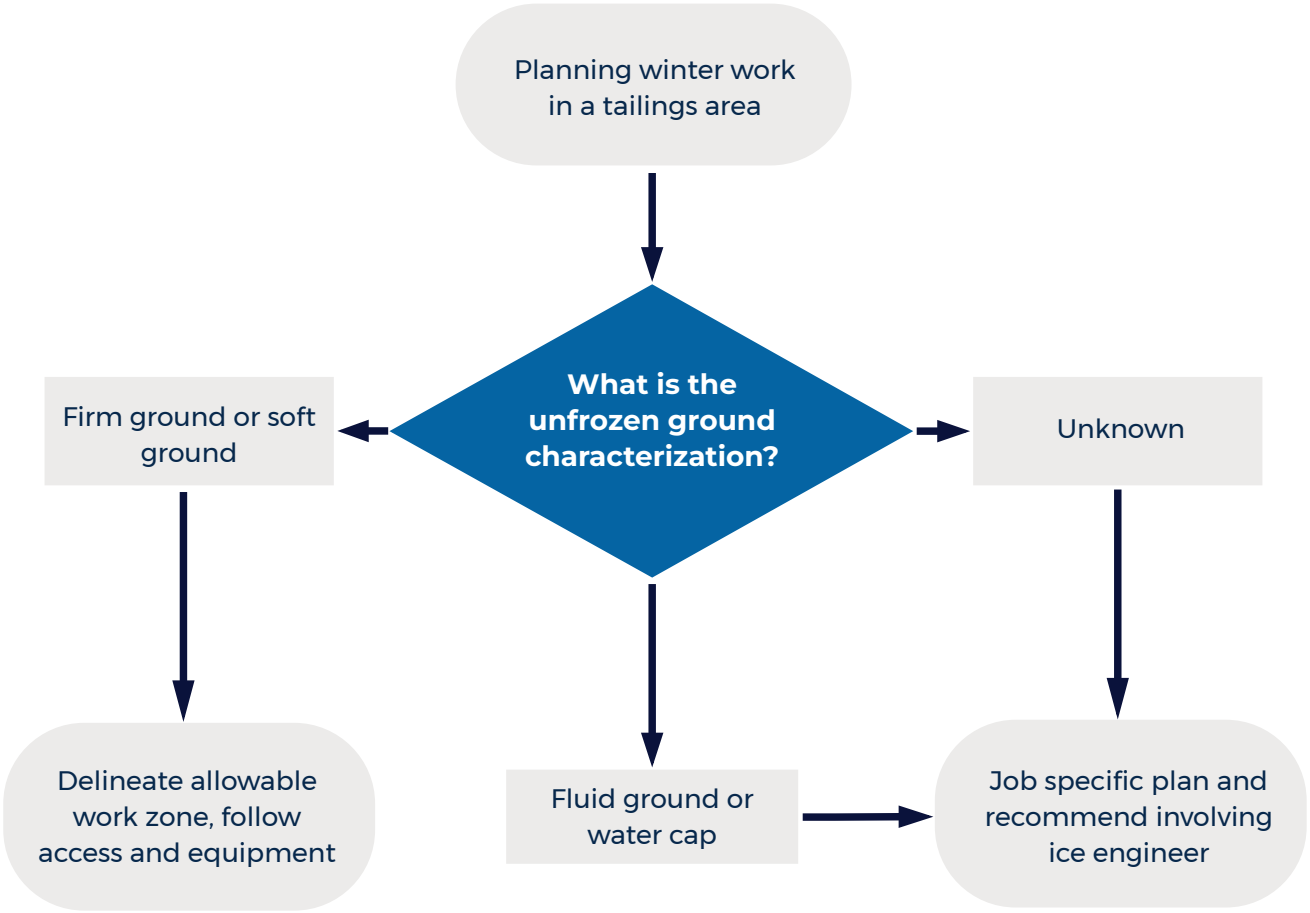
- Vessel competency
- Person overboard training
- Small domestic vessel basic safety (SDVBS) (formerly MEDA3)
- Marine basic first aid
- Pleasure craft operating card (PCOC)
- Small vessel operating proficiency (SVOP)

8.0 Emergency Response Preparedness

The work site should have an Emergency Response Plan that complies with the Alberta Occupational Health and Safety Code (OHS), including but not limited to the following components:

- Identification of potential emergencies
- Procedures for dealing with emergencies
- Procedures for rescue and evacuation
- Identification of emergency responders and evacuation workers
- Identification, location and operational procedures for emergency equipment and PPE for rescue and evacuation workers
- Evaluation of first aid requirements based on emergency response times
- Emergency response training requirements

APPENDIX A: GROUND ASSESSMENT GUIDE



APPENDIX B: GLOSSARY

Term	Description
Body of water	Any location where water flows or is present and the hazard of drowning exists.
Extended period of time	A time duration of one hour or more.
Established beach	Tailings sands, beaches and dyke/dyke structures.
Fluids	Water and slurries of soil and water. Fluids have insufficient bearing capacity to support the amphibious excavator and relies on the buoyancy of the pontoons.
Freeboard (marine vessel)	The distance between the water and the working deck of the vessel.
Hazard of drowning	A situation or condition where a worker may succumb to death by being suffocated by water or other liquid.
Life jacket	Designed for wear when abandoning a vessel in an emergency. They generally provide more buoyancy and give the wearer more freeboard (distance between the mouth and the water) by inclining the person onto their back to keep their mouth and nose from the water.
Mobile equipment	Any equipment (not including vessels) capable of moving under its own power or being pulled or carried and not intended to be secured to land or a structure.
Navigable water	A body of water (not accessible by the public) used by vessels, including a canal or any other water body created or altered due to the construction of any work.
Passenger	For the purpose of this code of practice, anyone on a vessel except: • The captain • A member of the crew
PCOC – Pleasure Craft Operator Card	Generally required for pleasure crafts and operating vessels for commercial use in non-navigable waters.
Personal floatation device (PFD)	For use when over-water or in full-float situations. Designed for comfort and constant wear. As a result, most models provide less buoyancy than life jackets and will not roll wearers face up or incline them onto their backs. The wearer must be able to move arms and legs to avoid rolling forward.

TERM	DESCRIPTION
Process Affected Ice	Process Affected Ice: Any frozen pond or water body in an industrial or commercial setting where: • There has been exposure to hydrocarbon based geologic formations, • It has been through processing / plant facilities, or • It has been part of Industrial Waste Water footprint at any time.
Small vessel	Small passenger vessels (non-pleasure craft) operated for commercial purposes and which range from 0 to 150 gross tons.
Soft deposits	Uncompacted sand or areas of wet and loose soil, with insufficient water for any vessel.
Steeply sloped ground	Ground sloped in a manner that would prevent a worker/equipment from stopping momentum before reaching the water's edge if the worker were to slip.
Survival suit / immersion suit	Suits providing the best protection from cold and exposure in water. Must be Transport Canada-approved.
SVOP – Small Vessel Operator Proficiency	A course that provides training specific to the operation of vessels, with practical assessments and examinations.
Trafficability	The ability of a piece of equipment to travel across a tailings deposit. Specific equipment has specific ground pressure requirements.
Unprotected water's edge	The absence of berms, barricades, handrails and midrails or other adequate form of protection to separate the worker from the water within 5m of the water's edge.
Vessel	Any on-water vessel propelled by machinery. Barges and dredgers are not deemed to be vessels.

APPENDIX C: REFRENCES

- Canada Shipping Act
  https://laws-lois.justice.gc.ca/eng/acts/c-10.15/
- Canada Marine Act
  https://laws-lois.justice.gc.ca/eng/acts/C-6.7/
- Marine Personnel Regulations
  https://laws-lois.justice.gc.ca/eng/regulations/sor-2007-115/
- Navigable Waters Works Regulations
  https://laws-lois.justice.gc.ca/eng/regulations/C.R.C._c._1232/page-1.html#h-499646
- Collision Regulations
  https://laws-lois.justice.gc.ca/eng/regulations/c.r.c._c._1416/page-1.html
- Small Vessel Compliance Program
  https://www.tc.gc.ca/en/programs-policies/programs/small-vessel-compliance-program.html
- Vessel Fire Safety Regulations
  https://laws-lois.justice.gc.ca/eng/regulations/SOR-2017-14/index.html
- Construction Standards for Small Vessels
  https://tc.canada.ca/en/marine-transportation/marine-safety/tp-1332-construction-standards-small-vessels-2010
- Alberta OHS Act, Regulation and Code
  https://www.alberta.ca/ohs-act-regulation-code.aspx
- Marine First Aid Training
  https://www.redcross.ca/training-and-certification/course-descriptions/workplace-and-corporate-first-aid-courses/marine-advanced-first-aid
- Marine operation Training
  https://marinetrainingbc.com/
- All Marine Specific Regulations
  https://tc.canada.ca/en/marine-transportation/marine-safety/marine-regulations

Note: These references are included for historical purposes:

- Best Practice for Building and Working Safely on Ice Covers in Alberta
- Field Guide to working Safely on Ice Covers

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