Geographic Response Plan

Sumas District

TRANSMOUNTAIN

GEOGRAPHIC RESPONSE PLAN – SUMAS DISTRICT

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PLAN MAINTENANCE

Responsibility

Single point accountability for the Geographic Response Plan development and maintenance, rests with the Manager, Emergency Management. This accountability is for:

- The development of the Geographic Response Plan and management of any future revisions;
- Ensuring the systems Incident Command System (ICS) and response structure are in place and able to meet the requirements set out in the Plan;
- Ensuring Control Points (CP) are reviewed and confirmed every four years; and
- Ensuring an annual review of the plan is conducted for completeness.

Manual holders are responsible:

- For keeping their copies current and ensuring that all revisions are appropriately filed.
- Studying all new material issued and incorporating it into their work practice.
- Suggesting changes to correct existing material and contributing new text material to improve the quality of the manual.

PLAN REVISIONS

Initiating Revisions

All requests for change must be made through the Manager, Emergency Management using the Revision Request Form.

Revision Distribution

Plan revisions are issued with an Acknowledgement of Receipt Form and a brief description of the changes itemized by chapter. The Acknowledgment of Receipt Form must be signed and returned to the Emergency Management Department as specified. Revisions to the Distribution List will be maintained in a secure Trans Mountain (electronic) location and will be distributed to confidential manual holders only. All other revisions will be distributed to manual holders in a timely manner. A revised date is shown at the bottom of each updated or new page. The original date of the manual is 04/2018. All revisions will be tracked on the Control Sheet.

Revisions after an Incident or Exercise

In the event that Trans Mountain experiences a spill (worst case or otherwise), or conducts an exercise or training session, the effectiveness of the plan will be evaluated and updated as necessary.

Changes in Operating Conditions

If a new or different operating condition or information would substantially affect the implementation of the plan, Trans Mountain will modify the plan to address such a change.

REVISION REQUEST FORM

Requested by:	Date:
Dept/ Agency:	Phone No.:
Revision Type: ___ Addition ___ Deletion ___ Correction	
Manual Section:	Page:
Revision (attach separate sheet if necessary):	
Signature of Requestor:	
Send to: Manager, Emergency Management TransMountain 2700-300 - 5th Avenue S.W. Calgary, AB T2P 5J2 Canada Email: emergency_management@transmountain.com	

To be completed by Manager, Emergency Management	
Date Received:	Comments:
Date Reviewed:	
Issued as Revision: Y/ N	
If No, reason for Rejection:	
Signature Manager, Emergency Management	

CONTROL SHEET

Revision Number	Date of Revision	Change(s)	Name
1	April 2018	New Manual Issued	J. Kereliuk
2	October 2018	Rebranding to Trans Mountain	K. Malinoski
3	October 2019	Annual Review Completed	K. McLernon
4	October 2020	Updated Worst Case Discharge Section 1.3.2, updated minor wording throughout document	K. McLernon
5	January 2023	Updated language to reflect Line 2 operationalization and changes including: • Updates to the location of various response plans (intranet site in the Emergency Toolkit); • Update to Section 1.3 District Specific Information to reflect the addition of Line 2; • Removal of Worst-Case Spill Volume Section 1.3.2. • Update to Section 1.4 Sumas District Map to include Line 2; • Updates to Section 2.0 Initial Response Actions; • Update to Section 2.5.3 Rapid Response Method for Estimating Spill Size; • Update to Section 3.1.2 Spill Verification Flowchart: Internal and External Contacts; • Addition of Section 4.0 Protection of High Consequence Areas; • Addition of Section 5.4 Stormwater Sewer Outfalls; • Addition of Section 5.6 High Consequence Areas Protection Techniques.	K. Malinoski
6	March, 2025	Updated preface, section 1.4 map, section 2.5.3 and 3.2, section 5 (to align with ERPs), control point data sheets (section 7&8) and forms (section 9).	
7			
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DISTRIBUTION

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7111	Sumas OSCAR
7112	Burnaby OSCAR
7113	Kingsvale Rapid Response Trailer
7114	Sumas Station Boom Trailer
7115	Kingsvale Station
7116	Hope Station
7117	Wahleach Station
7118	Sumas Station
7119	Port Kells Station
7120	Burnaby Terminal
7121	Burnaby Terminal ERT Building
7122	Spare
7123	BC MOE
7124	Spare

Note: Field responders receive a copy of the GRP – Field Handbook which is tracked electronically.

HOW TO USE THIS PLAN

There are nine (9) components to this GRP. The GRP works in coordination with the Emergency Response Plan for the pipelines and/or facilities. This document is meant as a field response tool and may serve for background data for the Incident Command Post to assist with the development of Incident Action Plans (IAP).

Introduction - Section 1.0

Provides an overview of the GRP and district specific information.

Initial Response Actions - Section 2.0

The initial responder to arrive at a spill site will take some immediate actions to ensure the safety of responders, public and to the environment and property. Safety is always the number one priority.

The Initial Site Health & Safety Plan (ISHSP) will be completed within one hour of confirmation of the incident and updated as needed to ensure responder safety. While completing the ISHSP, the initial responder will conduct the initial site assessment to determine the early response actions.

Notification Section - Section 3.0

Immediate notification is a key element of any emergency response action. Any employee or contractor is to report any emergency, or suspected emergency, to the Control Centre immediately and, depending upon the situation, will contact local first responders and emergency services.

Protection of High Consequence Areas - Section 4.0

Rapid deployment of response equipment will also assist with the protection of High Consequence Areas. High Consequence Areas (HCA) are those areas where a spill incident can have a significant negative impact on, but not limited to populated areas, ecological areas, heritage resources and essential infrastructure.

Tactical Response Actions - Section 5.0

The information within the GRP increases the initial spill response efficiency by providing guidance on the resources and capabilities required to complete the tactic(s) identified for each Control Point or developed by the Incident Command Post (ICP). The Tactical Response Action section describes when certain tactics are best used and provides instructions on how to implement the tactic(s).

Decontamination Procedures - Section 6.0

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. Decontamination is critical to health and safety at release sites. A decontamination area should be in a safe convenient location for all works to access. Decontamination protects workers from hazardous substances.

Control Points Route Maps - Section 7.0

Pipeline base route maps are composed and indexed, illustrating the routes within the operational district. The maps illustrate:

- Active Pipelines
- Inactive Pipelines
- Pipelines facilities
- Valves
- Equipment locations
- Control Points
- Directions for responders to access the CP

At the beginning of this section is an index map that outlines the corresponding route map numbers. Typically, the map numbers go from smaller to larger in the direction that the pipelines flow within the district. In the Sumas District, the maps start at Map 42 near Line 1 KP 965 / Line 2 KP 993 and ends at Map 52 near KP 1147 / Line 2 KP 1180.

GRP Data Sheets - Section 8.0

The GRP Data Sheets provide responders with quick and detailed information on each Control Point to assist spill responders in deploying containment and recovery tactics and strategies, should an incident occur. The data sheets provide:

- Geographical details
- Waterbody information
- Shoreline information
- Safety concerns
- Resources at risk
- Logistical information, including staging areas
- Staging area photographs
- CP tactical diagram and implementation instructions
- Implementation strategies
- Implementation and equipment resources
- Support and technical services
- Wildlife at risk
- Wildlife mitigation tactics
- Decontamination area information

Forms - Section 9.0

The forms section provides samples of the forms required during the early period of a response.

These include:

- Initial Site Health & Safety Plan
- ICS 201
- Gas Detection Record
- ICS 214
- ICS 211
- Ice Assessment Form

1.0 INTRODUCTION

Geographic Response Plans (GRP's) provide detailed, geographic specific information to assist spill responders in the containment and recovery of released product. The GRPs identify control points and water body access locations (boat launches) to aid in the timely deployment of response equipment to limit and/or prevent migration of product.

The GRP document is designed to be a rapid response document to be used during the early hours of an incident. GRP enables responders to respond more efficiently by identifying control points and pre-approved spill response tactics. Control Points are pre-identified locations where responders can set up equipment to intercept, contain, and recover spilled product. The datasheets found within Section 8.0 GRP Data Sheets of each Operational District GRP identify the site-specific strategies and equipment requirements for individual response locations.

Rapid deployment of response equipment will also assist with the protection of High Consequence Areas. The term High Consequence Areas (HCA) is used to define those areas where a spill incident can have a significant negative impact on, but not limited to:

- Populated areas
- Ecological areas
- Heritage resources
- Essential infrastructure

1.1 Scope of the Plan

This is the Geographic Response Plan for the assets associated with the Trans Mountain Pipeline System operated by Trans Mountain Corporation; specifically, the Sumas District.

1.2 Implementation of the GRP

Activation of the GRP will occur when an emergency is declared. The GRP will be implemented for any incident within the Sumas District that results from the Trans Mountain Pipeline System. This plan will be used in conjunction with other supplemental plans for the response phase of any spill and is expected to be used until the implementation of the Recovery Plan. Unified Command may also approve the use of alternate plans if required.

1.3 District Specific Information

The Sumas District boundary begins at the top of the Coquihalla jump off at Line 1 KP 965 / Line 2 KP 993 and ends at the Westridge Marine Terminal- Line 1 KP 4.05 / Line 2 KP 3.5. The ROW parallels the Coquihalla Highway (Hwy 5) through the Coastal Mountain range. Line 1 ROW transverses the Coquihalla Canyon, while Line 2 ROW continue to parallel Hwy 5.

At approximately, Line 1 KP 988 / Line 2 KP 1017, both Line 1 and Line 2 come back together to lie in the same ROW. Line 2 separates into its own ROW around Langley Line 1 KP 1118 / Line 2 KP 1148, then joins Line 1 ROW at Line 1 KP 1125 / Line 2 KP 1158. Line 2 veers into its own ROW frequently thereafter till it reaches Burnaby Terminal. Line 2 crosses beneath the Fraser River near the Port Mann Bridge into Coquitlam. Line 1 and Line 2 enter the Burnaby Terminal at Line 1 KP 1147 / Line 2 KP 1180.

Line 1 and Line 2 cross the jurisdictional boundaries of Hope, Chilliwack, Abbottsford, Township of Langley, Surrey, Coquitlam, Port Coquitlam, Burnaby, Fraser Valley RD Rural, New Westminster; and

Richmond. The ROW transverses in the Sumas District the Kawkawa Lake 16, Ohamil 1, Peters 1, Peters 1A, Popkum 1, Popkum 2, Grass 15, Tzeachten 13 and Matsqui Main 2 reserves.

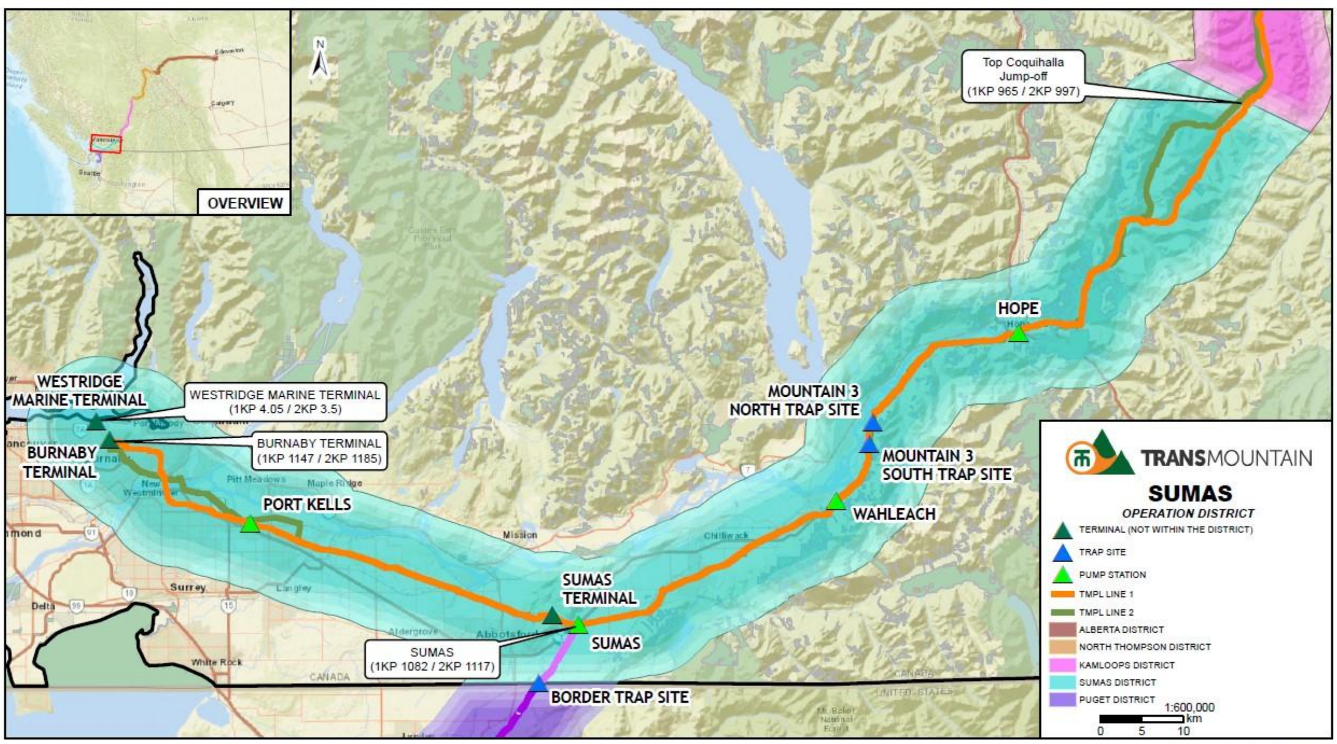
Three 30” delivery pipelines connect the Burnaby and Westridge Marine Terminals to load vessels docked at the Westridge Marine Terminal. The tunnel is 130 metres below the surface and is 2.6 km in length, and 4 metres in diameter. The tunnel is heavy steel-lined and fully sealed with concrete so that there is no cavity for product to pool or seep to the surface. The underground tunnel contains valves at each side with multiple leak detection mechanisms in place. Should a leak be detected, the pipelines will be shut-in, drained and repaired via inline tools.

At Sumas Pump Station, a third pipeline system known as the Puget Sound Pipeline extends to Washington State. The Canadian portion of the Puget Pipeline System travels for approximately 9 kilometres before crossing the Canadian- US international border into the state of Washington.

Spill modeling has shown that a spill should be contained by land. The pipelines crosses a number of HCA’s, streams and rivers including:

- The Chilliwack River,
- The Coquihalla, and
- The Fraser River

1.4 Sumas District Map



Operations_Districts_20250306.aprx

2.0 INITIAL RESPONSE ACTIONS

The initial responder to arrive at a spill site will take some immediate actions to ensure responder safety as well as the public and protect the environment. The initial responder will complete the following things, if appropriate and safe to do so while waiting for the Qualified Individual.

- Ensure the safety of all workers and public in the area of the incident (evacuate non-essential personnel from the immediate area)
- Assess the situation (I.e., incident size, severity, likely impacts)
- Notify the Control Centre and/or Operations Supervisor/Manager immediately to activate the Trans Mountain Alert System (TAS) as outlined in Section 3.0 Notification.
- Take appropriate action to mitigate the impacts to life, safety, the environment, and property prior to the arrival of the Qualified Individual.

Note: the initial responder will begin documentation on an ICS 201 form, and/or notes on other paper, or will relay the information to personnel at the Control Centre or District Supervisor who will initiate an ICS 201 form. This initial documentation will be kept with all other incident documentation.

2.1 Site Assessment

The primary purpose of a site assessment is to evaluate the presence of risk to both incident responders and the public. However, if it is safe to do so, information about the incident should be gathered as quickly as possible in order to evaluate the situation and develop an initial action plan. It might also be possible for the Site Assessment Team to take measures to reduce possible impacts.

NOTE: **Site Assessment Team members should wear all PPE (boots, FR coveralls, gloves, eye protection, hard hat and half-face respirators) while assessing the incident. This may include radiant heat protection.**

If vapour levels reach 10% of the LEL, Site Assessment Team members should leave the area immediately and keep all other responders at a safe distance.

2.1.1 Site Assessment Guidelines

When conducting the initial site assessment of the spill the following parameters must be documented:

- Identify and evaluate the immediate risks to and impacts on human health, the environment, and infrastructure;
- Classify the spill according to the following factors:
  - Substance spilled,
  - Quantity of the substance spilled
- The location and circumstances of the spill
- Assess:
  - What is to be done to protect the safety of response personnel and the public,
  - Whether or not an evacuation is necessary.

2.1.2 Safety Checklist

- Conduct vapour monitoring (see 2.4.1 Vapour Monitoring Flowchart)
- Conduct Pre-Entry Safety Checklist (ISHSP, or HSP)
- Remove all non-intrinsically safe radios, pagers, etc.

- Establish communications with the Control Centre
- Request information regarding the situation (e.g., alarms, product, pipeline reading, shutdown actions and other relevant information)
- Establish communications procedures/schedules
- Don appropriate PPE, as per health and safety plan
- Refer to SDS
- Determine wind speed and direction
- Determine current direction
- Approach spill from upwind/up current if possible
- Conduct vapour monitoring

2.1.3 Incident Intelligence Checklist

- Determine status of any injured personnel
- Determine spill source if known
- Confirm spilled product
- Determine if source is isolated
- Estimate spill rate/volume
- Determine if product has or will reach the water
- Determine if product has escaped local containment

2.1.4 Incident Mitigation Checklist

- Evacuate and attend to any injured personnel
- Isolate spill source
- Close all valves

2.2 Responder Health and Safety

It is important to understand that the different hydrocarbon products handled pose different hazards when spilled, and/or are on fire, depending on their chemical composition. Therefore, the primary hazards, need for vapor monitoring, and the cleanup techniques will depend on the characteristics, volume and type of product.

Many crude oils (including “sweet” crudes) can emit potentially dangerous levels of H_2S, and most crude oils also contain Benzene. Typically, the risks associated with the concentration of potentially- dangerous vapors will diminish with time, due to reduced vapor production as the lighter components volatize, and vapors disperse. There are exceptions to this however, I.e.,, in some cases, where crude oil pools into thick layers, a skin may develop on the surface, trapping vapors. Later, if the skin is broken and the oil disturbed, the oil may emit vapors normally associated with freshly spilled oil. Some crude oils have low flash points, especially during the initial hours after being spilled, when hydrocarbons burn there are other risks to consider, such as the combination of chemicals in the smoke plume and radiant heat emitted by the fire. In all of these cases, the risk of accidental ignition and/or the inhalation of toxic vapors must be mitigated, and a detailed site assessment completed before on-scene operations are initiated. This assessment will be made by the designated Safety Officer. In all cases, the results of the initial site assessment should be used to develop a Health and Safety Plan.

The Initial Site Health and Safety Plan (ISHSP) should be completed as soon as possible by one of the initial responders and updated as required. When completing the ISHSP some of the information may not apply during the initial stages of the response, but may change within a short period, thereby altering the

PPE and/ or other requirements. The ISHSP form is available in Section 9.0 Forms of this manual and on the intranet site in Emergency Toolkit.

The ISHSP:

- Aids the initial responders in assessing hazards related to the incident
- States the required PPE to be used
- Documents important health and safety information
- Establishes on-site communication protocols
- Serves as an interim "Plan" until the Site Health & Safety Plan is developed
- Assigns responsibilities, I.e.,, completion of the ICS 201 and notification
- Identifies "site set-up" features that may be required
- Authorizes work to be completed (in lieu of a Safe Work Permit)

Upon the completion and delivery of the Site Health & Safety Plan, the Initial Site Health & Safety Plan becomes void.

2.3 Safety Guidelines

2.3.1 Skin Contact

The accidental absorption of toxins through skin/eye contact can be greatly reduced through the wearing of oil-resistant Personal Protective Equipment (PPE). These include:

- Approved Fire-Resistant Coveralls
- Hard Hats (where overhead hazards are present)
- Gloves
- Splash Goggles
- Rubber Steel-Toed Boots

Also:

- PPE must be worn properly in order to fully protect responders.
- Damaged or heavily-oiled PPE should be replaced as soon as possible.
- All responders leaving the *Hot Zone* must go through a decontamination zone *(Warm Zone)* to ensure that contamination is not spread into the *Cold Zone.*

2.3.2 Inhalation of Vapours

The need for respiratory protection will be determined by the Safety Officer after a review of the SDS and data retrieved from the initial site assessment. If toxic vapour levels are determined to exceed safe working limits, it may be possible for responders to work while wearing half-face respirators fitted with organic cartridges, or SCBA. In this case, on-going vapour monitoring is essential to ensure that vapour levels do not exceed safe working limits.

2.3.3 Fire/Explosion

All hydrocarbon products are capable of ignition if certain conditions are met. It is important to review the SDS to determine the flash point of the material spilled and perform vapour monitoring (for LEL). Whenever vapour levels are approaching 10% of the LEL for any spilled product, responders will leave the area immediately.

2.3.4 Other Hazards

There are several additional potential hazards faced during spill response including slips, trips and falls, and working around water and equipment. Special care should be taken when walking on oiled surfaces, especially during night-time operations. The Site-Specific Health and Safety Plan shall identify these potential hazards, and they must be clearly communicated to responders.

2.4 Vapour Monitoring Site Assessment Procedure

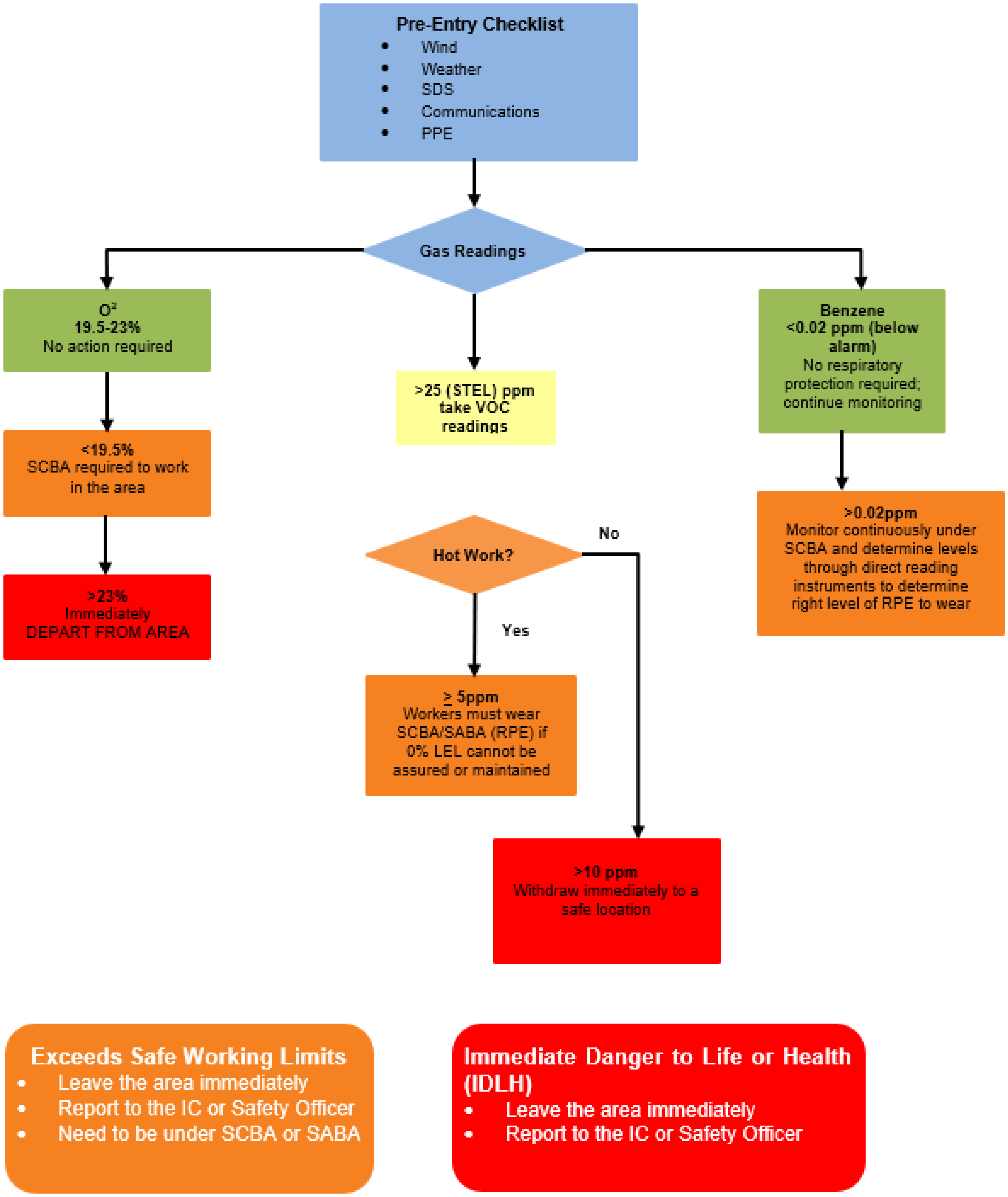
The team should move toward the area and stop at an acceptable location, preferably upwind, to make final preparations for assessment. The team must evaluate its options and decide the best approach route. Frequent reading of air monitoring instruments can ensure the safety of the survey party during the approach. The assessment team leader needs to exercise caution and use controls that will best protect the team.

The survey should continue as long as air monitoring instrument readings remain within acceptable limits, with the objective of (a) obtaining readings across the zone and (b) locating a significant accumulation to provide a detailed assessment. A safe and effective site assessment will require caution, persistence and field decisions.

The team leader must take immediate action if at any time the air monitoring instrument readings meet or exceed safe working limits (see Vapour Monitoring Flowchart, next page). If safe working limits are met or exceeded, move upwind from the spill and halt the assessment. Notify the Incident Commander.

When sufficient representative locations have been recorded, the air-monitoring phase of the initial site assessment is complete. The identification of physical, environmental, or other hazards will complete the assessment.

2.4.1 Vapour Monitoring Flowchart [1]



[1] This flowchart should be used as a guideline only. Follow site-specific SWP and regulatory exposure limits: if there are any questions about safe working vapour levels, consult the Safety Officer.

2.5 Spill Observation/Assessment/Estimation Factors

2.5.1 Spill Surveillance

The following guidelines should assist in spill surveillance:

- Surveillance of an oil spill should begin as soon as possible following discovery to enable response personnel to assess spill size, movement, and potential impact locations. Dispatch observers to crossings downstream or down gradient to determine the spills maximum spread.
- Efforts should be made to approach from an uphill/upwind direction.
- Clouds, shadows, sediment, floating organic matter, submerged sand banks or wind-induced patterns on the water may resemble an oil slick if viewed from a distance.
- Spill surveillance is best accomplished using helicopters or small planes; helicopters are preferred due to their superior visibility and maneuverability.
- All observations should be documented in writing and with photographs and/ or video.
- Record observations on detailed maps.
- Surveillance is also required during spill response operations to gauge the effectiveness of response operations; to assist in locating skimmers; and assess the spill's size, movement, and impact.

2.5.2 Estimating Spill Volume

If possible, the initial assessment should also include an estimate of the volume of oil spilled. Oil volumes can be estimated by multiplying the area of the slick by the average estimated thickness. The following chart applies when the oil is on the water. In the case of an impoundment area the spill can be estimated by multiplying the thickness by the area covered.

Appearance	Slick Thickness	Spill Volume
 Barely visible	0.05 µm	50 L/km^2
 Visible as silvery sheen	0.08 µm	80 L/km^2
 First trace of colours	0.15 µm	150 L/km^2
 Bright bands of colour	0.3 µm	300 L/km^2
 Colours begin to turn dull	1 µm	1,000 L/km^2
 Colours are much darker	2 µm	2,000 L/km^2

2.5.3 Rapid Response Method for Estimating Spill Size

- Transfer operations: Multiply the pumping rate by the elapsed time that the leak was in progress, plus the drainage volume of the line between the two closest valves or isolation points (volume loss = pump rate [bbls/ min] x elapsed time [min] + line contents [bbls])
- Tank overfills: Elapsed time multiplied by the pumping rate
- Visual assessment of the surface area and thickness (note that this method may yield unreliable results):
  - Interpretation of sheen colour varies with different observers
  - Appearance of a slick varies depending upon amount of available sunlight, sea-state/turbulence, and viewing angle
  - Different products may behave differently, depending upon their properties.

3.0 NOTIFICATION

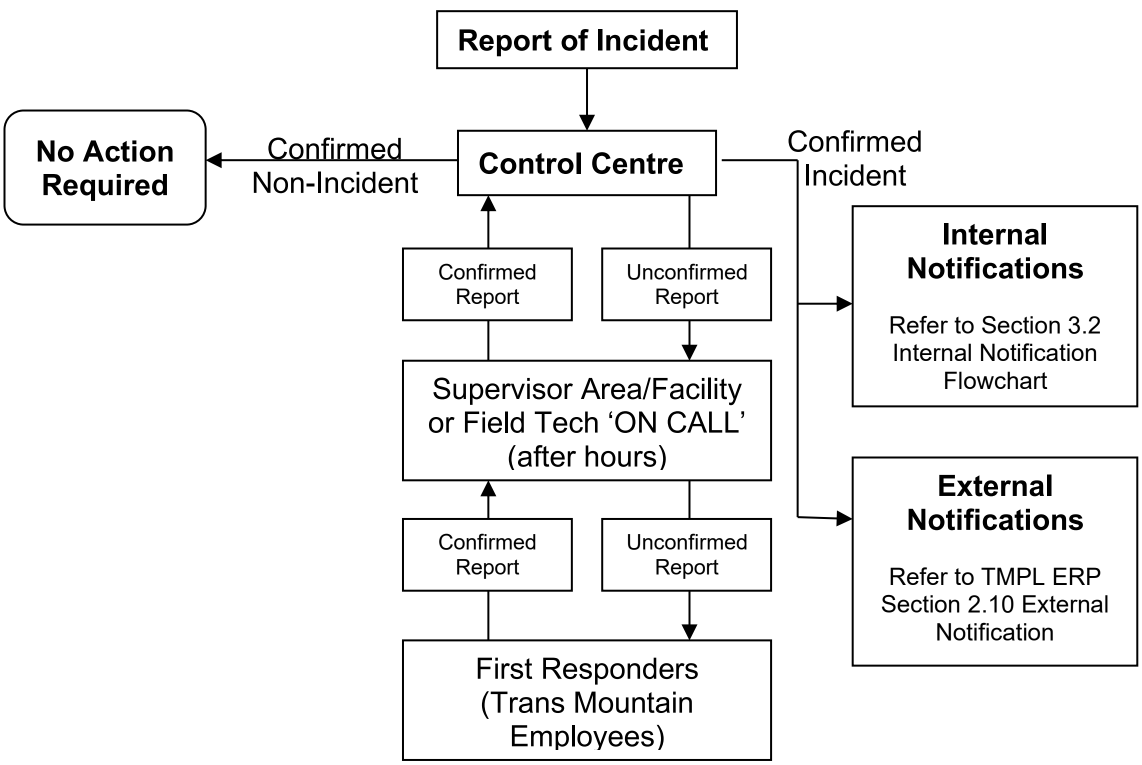
Any employee or contractor will report any emergency or suspected emergency to the Control Centre immediately and depending upon the situation, will contact the local first responders and emergency services.

3.1.1 Control Centre Emergency Line 1-888-876-6711

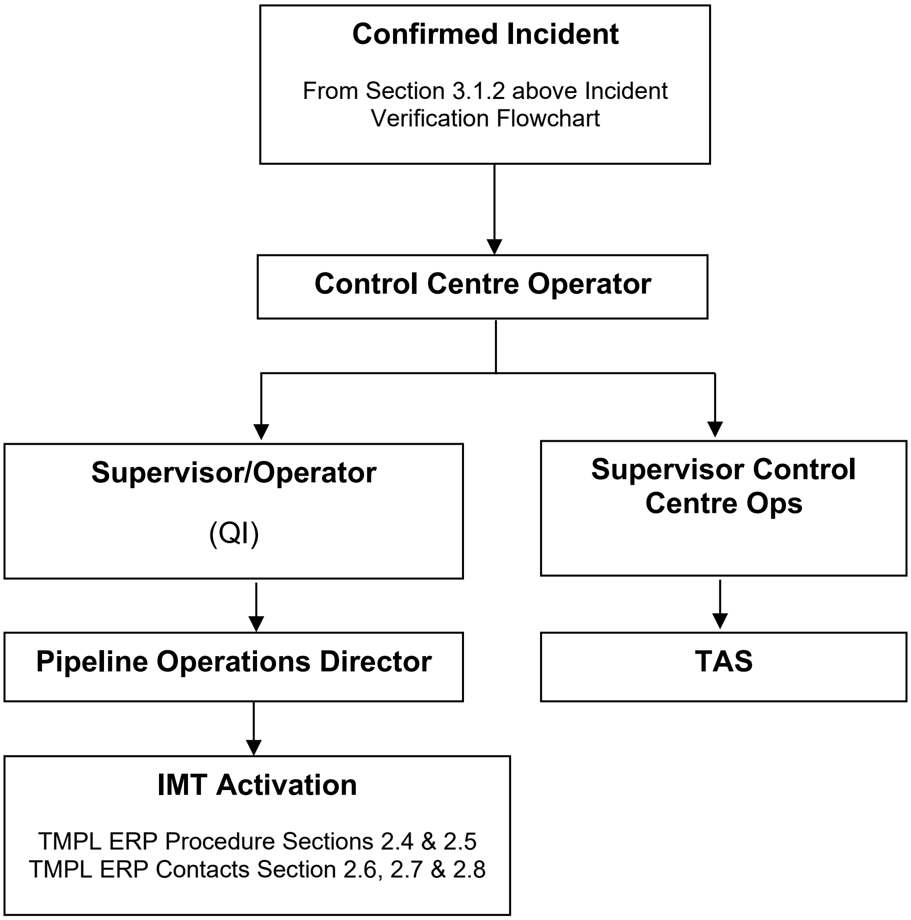
Notes: A field technician or District Supervisor may request a shutdown as the result of local conditions in response to the investigation of a complaint or regular duties where a release or other abnormal operating condition is suspected. The Control Centre Operator (CCO) will comply with the request and initiate the Emergency Condition Response Procedures.

3.1.2 Incident Verification Flowchart

The first step in many incidents is to confirm that a spill has actually occurred. Spill reports may come from several sources including the public, and First Responders (Police, Fire and Ambulance). Once a report is received, the following flowchart shows the direction of communication to verify an incident.



3.2 Internal Notification Flowchart



3.3 Internal Notification Procedure

All spills, regardless of size, must be reported immediately to the Control Center, who will:

- Contact the District Supervisor to verify and assess the situation.
- Determine the Emergency Response Level (See TMPL ERP Introduction Emergency Levels for a description of the 3 Response Levels)
- Initiate the notification of company and external personnel.

3.4 Information to Report

Information about the spill should be as clear, concise, accurate and timely as possible. The minimum information reported, for both the initial report and update reports, should be:

- Name and Telephone Number of the Caller
- Date and Time of the call
- Name of Pipeline
- Location of the Spill
- Product(s) Spilled
- Estimated Quantity

- Actions Taken To-Date
- Assistance Required
- Injuries
- Weather Conditions
- Reasons for discharge (if known)

4.0 PROTECTION OF HIGH CONSEQUENCE AREAS

The term High Consequence Areas (HCA) is used to define those areas where a spill incident can have a significant negative impact on, but not limited to:

- Populated areas
- Ecological areas
- Heritage resources
- Essential infrastructure

Sections of the Trans Mountain Pipeline right-of-way cross through, or are in proximity to, High Consequence Areas. Additionally, Trans Mountain has identified High Consequence Areas which could be impacted should a release of product migrate from the pipeline right-of-way.

The Environmental Unit, operating within the Planning Section, is responsible for identifying the incident-specific areas of concern (I.e., High Consequence Areas), and recommending response priorities. This includes locating sensitive areas, providing response recommendations, and determining the potential extent, fate, and effects of subsequent consequences. GIS specialists (Planning Section) have access to a variety of mapping layers, to prepare incident-specific maps with the information on High Consequence Areas required to support the response. Responders may also use remote electronic devices to access mapping layers for identification of HCAs.

Spills that impact a high consequence area are greatly compounded and may endure far more response actions than a spill elsewhere. If a spill were to impact an HCA, specific response practices should be followed to contain product and reduce the environmental impact. When responding to spills in an HCA, the following measures should be considered:

- Minimize the number of personnel working at each response site
- Minimize use of heavy equipment at each response site
- Eliminate warm/hot water flushing tactics at response sites.

5.0 TACTICAL RESPONSE ACTIONS

The following sections outline the response options for containment and recovery.

5.1 Land and Small Watercourse Spill Response

5.1.1 Vacuum Truck, Gator Vacuum Truck, Port – a – Vac Unit

Vacuum trucks are used to assist in the cleanup and transport of released product and waste material. These trucks are equipped with vacuum pumps and a cylindrical chamber capable of sustaining low internal pressures. Vacuum trucks use 2–4-inch (5-10 cm) diameter hose which is placed slightly below the surface of the oil slick for collection. Depending on the slick thickness and density, a mixture of oil and water will enter the chamber. Positioning the intake end of the hose is critical to minimize the amount of water that is collected.

Responder Considerations	Advantages	Limitations
Vacuum Truck: • Requires an area that is accessible by vehicle. • Vacuum trucks will need to be within 30 m with no more than 5 m of incline to effectively recover released fluids. *Gator Vacuum Truck:* • Can access remote areas not accessible by a vehicle. • May require tree clearing to access recovery points. • Can create extensive environmental damage with multiple trips over the same area. *Port – A – Vac Unit:* • Can access remote areas not accessible by a vehicle or a Gator Vacuum Truck. • Minimal environmental disturbance. • Available in 6 x 6 or tracked configurations.	• Readily available in most operating areas. • Considered a recovery tactic. • Effective free fluid recovery during the initial spill response activities. • Used in conjunction with other containment and recovery techniques. • Can be attached to multiple different types of skimmers. • Best application is to focus and remove large pools of released fluids fast and effectively. • Applicable for all types of released products and volumes. • Volumes that can be recovered at one (1) time range from 1 m^3 to 14 m^3, depending on type and application.	• Not considered a containment measure. • Efficiency and productivity decline over a longer period. • Significant cost over a longer period of time. • Can be restricted by terrain and space. • Restricted by the amount that can be recovered and transported at once. • Will require area to transfer recovered product into tanks or tank trucks. • Significant noise pollution in an urban environment. • Recovers all free fluids, not just the released product.

5.1.2 Earthen Berm and Bell Hole

An earthen berm and bell hole can be used in conjunction with each other or on their own and are applicable for all types of released products and volumes. When constructing an earthen berm, it should be composed of a non-porous substance (I.e., clay, wood, poly or metal) and can be built with mechanical (I.e., backhoe) or hand equipment (I.e., shovel). If a non-porous material is unavailable, sandbags and an impermeable liner can be used instead. Vegetation and other porous materials should be removed prior to constructing the berm which should be built on or keyed into a solid non-porous base (I.e., clay vs. grass/sand). Constructing the berm from high ground to high ground in a crescent shape will provide the highest degree of containment.

When constructing a bell hole in conjunction with a berm it should be created upslope of the berm to allow for additional fluid storage volumes. The material removed from the bell hole can be used to create the berm on the downslope side. Berms and bell holes can be used to separate areas of high impact from areas of low impact and aid in recovery efforts.

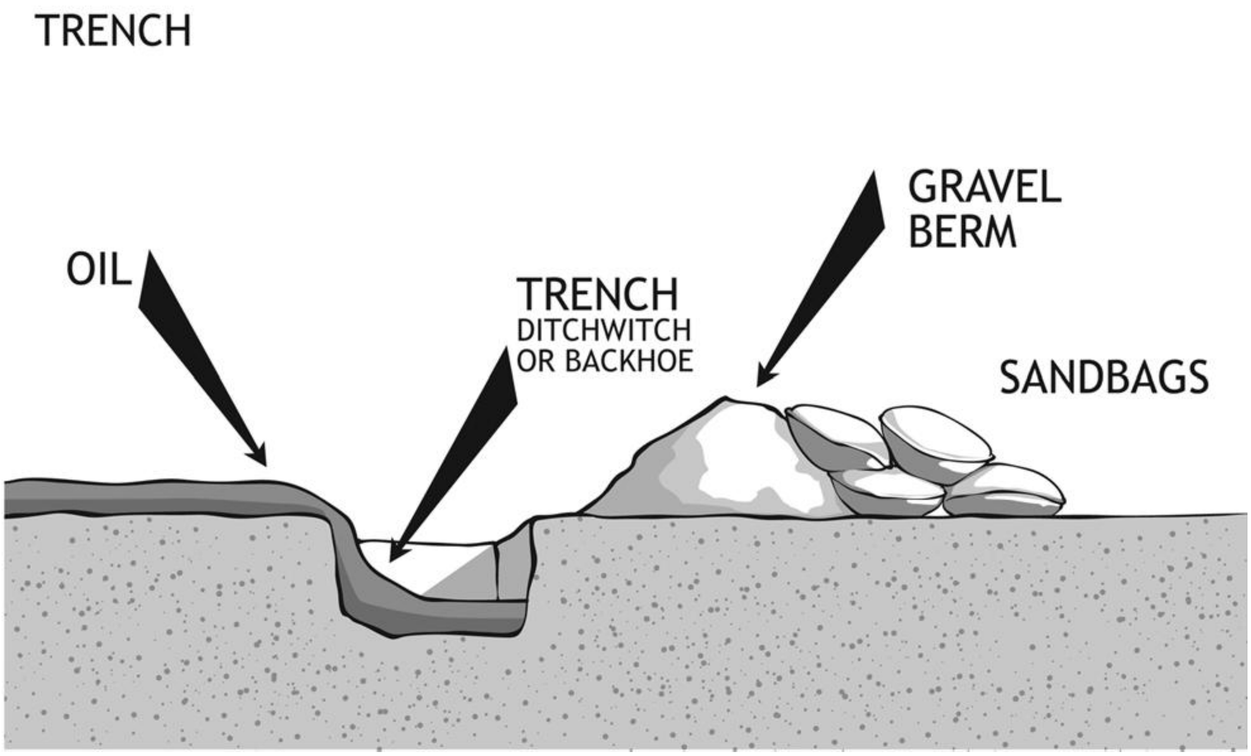
Responder Considerations	Advantages	Limitations
• Construct berm out of a non-porous material (E.g., clay). • Remove vegetation and other porous materials before constructing berm. • An earthen berm can be constructed by mechanical and/or hand equipment. • Berm edges should be keyed into the parent material to provide the highest possible containment. • When possible, an earthen berm should be constructed in natural depressions (E.g., from high ground to high ground) in a U shape configuration for greatest containment potential.	• Considered a containment method to be used with recovery tactic(s). • Can be used to contain and/or divert released fluids and fresh water from high consequence areas (HCAs) (E.g., rivers, wetlands etc.). • Can be used to separate areas of high impact from areas of low impact. • Use this containment technique with multiple different containment and recovery tactics. • Can be constructed in multiple areas as required (E.g., you are not limited to one (1) berm). • Applicable for all types of released products and volumes.	• Environmentally intrusive (high impact). • Not a preferred method in sensitive environments such as wetlands and fens. • Require constant monitoring. • If a bell hole is constructed in porous material, there is the potential to push impacts subsurface. • Require remediation and reclamation at end of life. • If poorly constructed, does not provide adequate containment. • Required to manage inflow of water with pumps or other diversion techniques in order to maintain containment.

5.1.3 Earthen Trench

An earthen trench (Figure 5.1) is used to recover and/or divert released fluids and fresh water from waterbodies and can be used to separate areas of high impact from areas of low impact. A trench will require constant monitoring and managing of inflow of water to maintain containment. An earthen trench can be built in porous or non-porous material and can be built with mechanical (E.g., backhoe) or hand equipment (E.g., shovel). The trench should be built in a solid non-porous base (E.g., clay vs. grass/sand) to help prevent migration of product. However, if non-porous material is not available the trench can be constructed and lined with an impermeable substance (I.e., plastic sheeting, hard containment boom skirting etc.). If an earthen trench is constructed in porous material, there is potential for impacts to be pushed subsurface.

Responder Considerations	Advantages	Limitations
• Construct a trench with mechanical and/or hand equipment. • An earthen trench can be constructed in a porous or non-porous substance. • An impermeable barrier (E.g., plastic liner or geotextile) can be placed in the trench to prevent penetration and migration through the downstream substrate. • If possible, construct in non- porous parent material. • Excavated material should be piled on backside of trench to act as barrier to prevent further downstream product movement.	• Considered a recovery and containment tactic if constructed in non-porous material. • An earthen trench is used to recover and/or divert released fluids and fresh water from high consequence areas (HCAs) (E.g., rivers, wetlands etc.). • Can be used to separate areas of high impact from areas of low impact. • An earthen trench can be used with multiple types of containment and recovery tactics. • Can be constructed in multiple areas as required (E.g., you are not limited to one (1) berm). • Applicable for all types of released products and volumes.	• Environmentally intrusive (high impact). • Not a preferred method in sensitive environments such as wetlands and fens. • Require constant monitoring. • If an earthen trench is constructed in a porous material, there is the potential to push impacts subsurface. • Require remediation and reclamation at end of life. • If poorly constructed, does not provide adequate containment or recovery. • Required to manage inflow of water with pumps or other diversion techniques to maintain containment and recovery.

Figure 5.1 Earthen Trench



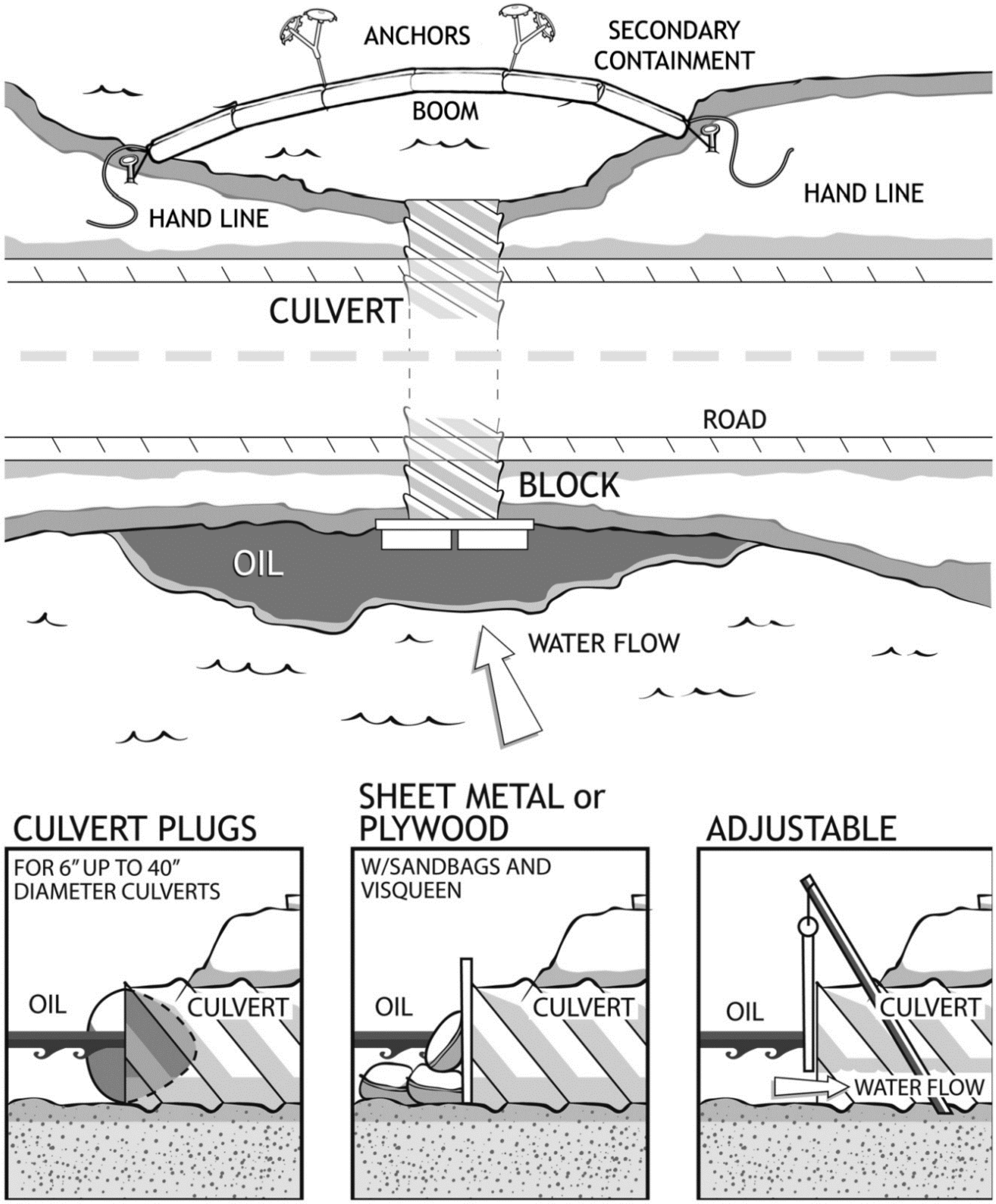
5.1.4 Culvert Block

Blocking a culvert (Figure 5.2) will stop all fluids from traveling through the culvert including any freshwater entering the water system as well as any released product. The largest consideration for blocking a culvert is the amount of fluids entering the water system and the amount of storage available upstream of the culvert to allow backflow. If a gated culvert is available this will allow the fresh water to flow underneath and retain the release product upstream of the culvert. A full culvert block should only be utilized if water flow can be managed by pumps in order to maintain a stable water level. When blocking the culvert use an impermeable material (I.e., non-porous material, a culvert plug, sheet metal, clay etc.).

Responder Considerations	Advantages	Limitations

• Culverts can be blocked with available materials such as:
  ○ Sheet metal,
  ○ Sand bags,
  ○ Plywood,
  ○ Inflatable culvert plugs, and
  ○ Crushing / burying the culvert in non-porous earthen material.
• A gated culvert can be utilized to prevent surface hydrocarbon migration and allow subsurface water to pass.
• If implementing a culvert block is not an option, a closed chevron boom technique can be used to direct product to the left and right descending bank recovery areas away from the culvert mouth.
• A full culvert block should only be utilized if water flow can be managed by pumps in order to maintain a stable water level. Diversionary pumps can be set up to divert incoming fresh water around the impact area and discharge downstream.
	• Considered a containment method to be used with recovery tactic(s).
	• Roadway acts as man-made barrier and choke point to a release.
	• Relatively easy area to block and prevent further downstream product movement.
	• Allows for access of all types of equipment.
	• Ease of access allows for rapid contaminant and recovery to be set up.
	• Applicable for all types of released products and volumes.
		• If a culvert is completely blocked, consideration is to be given to the correct and additional back-up pumping power required in the event of weather and/or melt event to prevent road washout.
		• The ability to block a culvert on a busy roadway is limited.
		• Some culvert blocking techniques may require excavation of the damaged culvert and re-installation.
		• Remediation and reclamation of watercourse banks around the blocked culvert will be required.

Figure 5.2 Culvert Blocking



5.1.5 Inverted Weir / Underflow Dam

An inverted weir (Figure 5.3) is designed to stop free product on the surface while allowing freshwater to continue to flow downstream and can be used in conjunction with additional containment tactics, or in separate areas of low and high impacts. The inverted weir is made up of two components (Figure 5.4), a berm and a culvert. The berm can be constructed out of any non-porous substance (E.g., clay, wood, poly or metal) can be built with mechanical (E.g., backhoe) or hand equipment (E.g., shovel) and must be built on or keyed into a solid non-porous base (E.g., clay vs. grass/sand) to provide the highest level of containment. When constructing the berm build a crescent shape from high ground to high ground with the culvert(s) at the center point of the arc. The culvert or culverts depending on the volume of flow should be designed for the current water flow x 150 percent to withstand any rain and/or melt events. This can be determined based on culvert sizes on engineered roads in the area. The top of the inflow end of the culvert must be lower than the bottom of the discharge end. Typically, a 45-degree angle can be used as a baseline and adjusted based upon water flow, depth, and culvert length. An inverted weir can be used in conjunction with additional containment tactics, or it can be used to separate areas of low and high impacts.

Responder Considerations	Advantages	Limitations
• Construct with mechanical or hand equipment. • Can be constructed with sandbags. • A prefabricated inverted weir can be used to minimize environmental disturbance. • If possible, line upstream side of dam with impermeable barrier (E.g., plastic liner) • Construct in a non-porous material. • Remove vegetation and other porous materials before construction. • Inverted Weir should be keyed into parent material on both sides to provide the highest possible containment. • Culverts to be placed on the upstream side of the dam with the elevated end on the downstream side. • Approximate 45 degrees on incline is required. • The height of the elevated downstream end of the pipe determines the water level behind the inverted weir. • The inverted weir should be designed to withstand future weather and/or melt events up to 150 percent of current water flow. • Additional pumps should be on standby if water flow above 150 percent is expected.	• Considered a containment method to be used with recovery tactic(s). • Contain released fluids on surface of water while allowing water to continue to flow downstream. • Suitable for areas with constant and intermittent water flow to mitigate constant water management. • Can be used to separate areas of high impact from areas of low impact. • Can be used with multiple types of containment and recovery tactics. • Can be constructed in multiple areas as required. • Applicable for hydrocarbon- based products or non- water-soluble products. • Can be constructed with readily available material. No special equipment is required.	• Can be environmentally intrusive (high impact). • Requires remediation and reclamation at end of life. • If poorly constructed does not provide adequate containment and/or will washout. • Requires instream work, proper siltation mitigation measures installed prior to installation. • Regulatory permits will be required outside of the emergency phase of the response. • Requires back-up pumps for an increase of water flow beyond what the inverted weir was initially designed for.

Figure 5.3 Inverted Weir

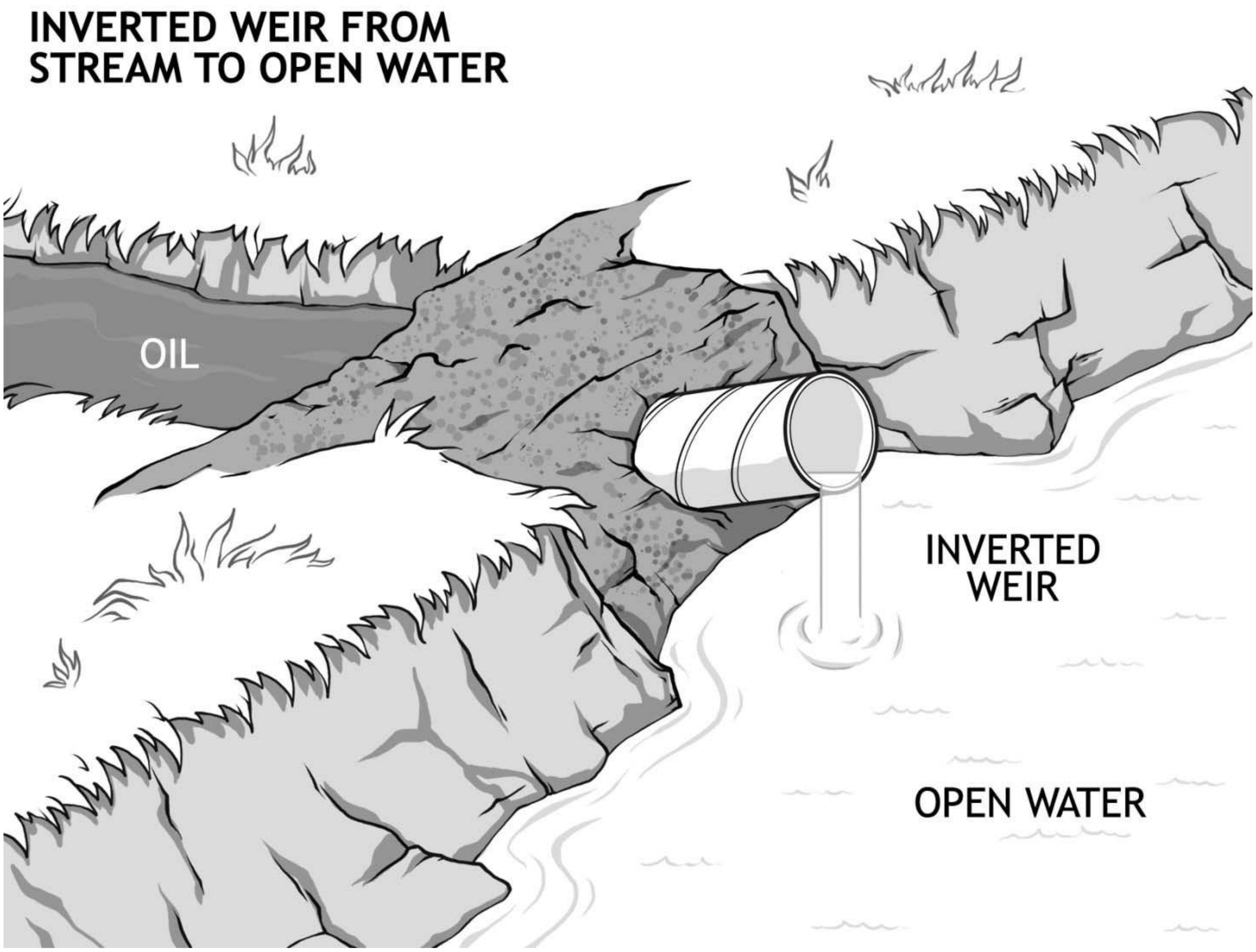
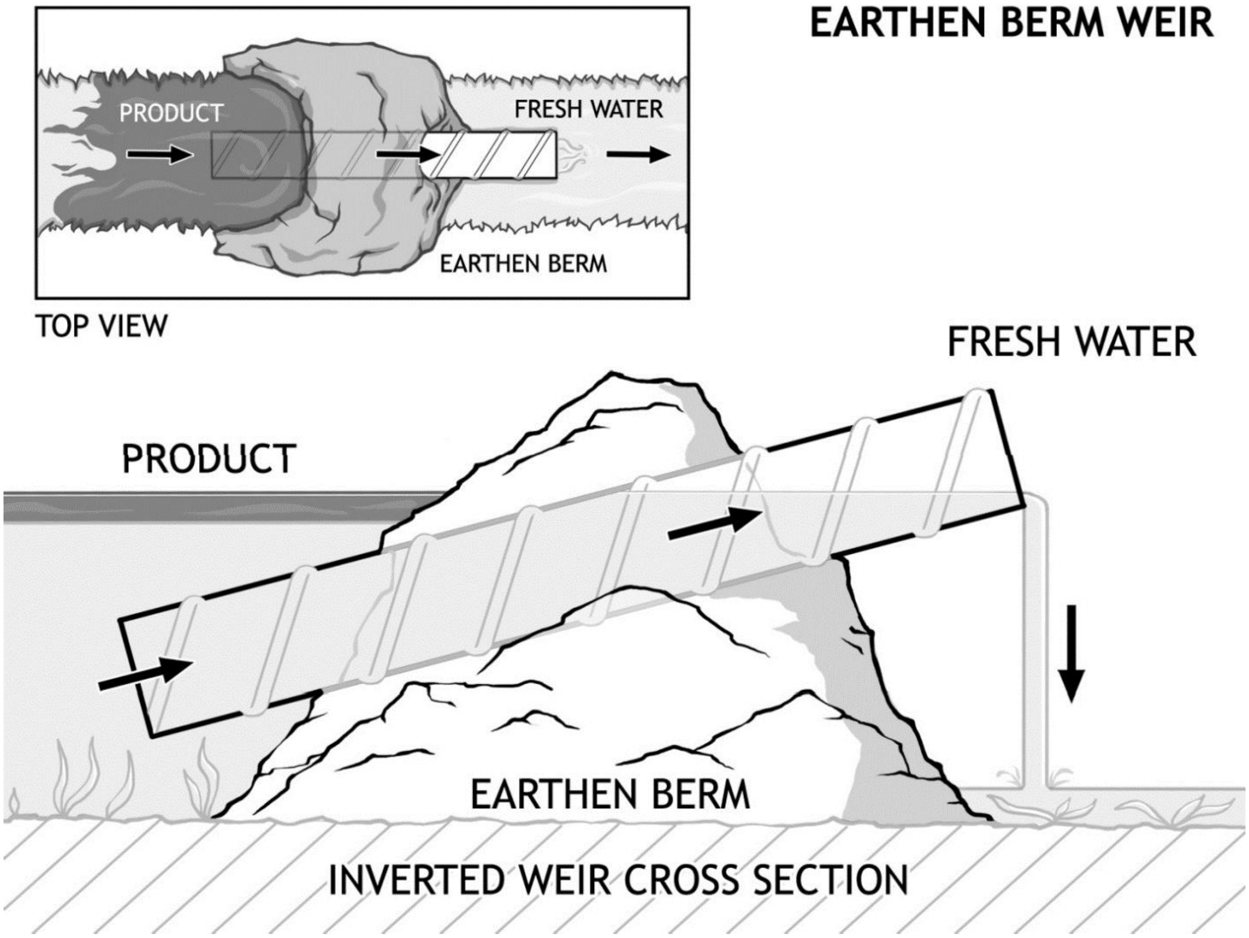


Figure 5.4 Inverted Weir Components



5.1.6 Water – Gate Dam

Water – gate dams are portable quick installation barriers that allow the depth of water upstream to be regulated. Keeping a consistent water depth ensures released product does not become stranded along the shorelines. Water – gate dams can be used in conjunction with additional containment techniques, or it can be used to separate areas of low and high impacts. Water - gate dams are largely used to increase the water depth to allow additional containment and recovery tactics to be more effective upstream of the dam.

Responder Considerations	Advantages	Limitations
• Install water – gate dam across shallow waterbodies to build water volume behind the water-gate. • Allows containment and recovery tactics to be deployed upstream of the water – gate. • Use water outflow gates at bottom of Water-Gate to regulate inflow to outflow of subsurface water to regulate water levels. Weight of inflated water – gate will hold it in place. • Anchors are provided if required. • A water-gate can also be used to divert product.	• Considered a containment method to be used with recovery tactic(s). • Can be quickly deployed into a watercourse with minimal personnel. • Minimal environmental disturbance. • Contains released fluids on surface of water while allowing subsurface water to continue to flow downstream. • Suitable for areas with constant water flow to manage water depth. • Can be used to separate areas of high impact from areas of low impact. • Can be used with multiple types of containment and recovery tactics. • Can be deployed in multiple areas as required. • Applicable for hydrocarbon- based products or non- water-soluble products.	• Requires back-up pumps for an increase of water flow beyond what a water-gate dam is initially designed for. • Requires removal of thick vegetation from watercourse banks to properly install. • Requires shallow, slow to moderate moving watercourse. • Most effective in a watercourse with a depth of • 0.50 m or less and in a defined channel to ensure water does not bypass and erode out the channel banks. • Water-gate dam requires constant monitoring of outflow and inflow to maintain a consistent water depth.

5.1.7 Turner Valley Gate

Turner valley gates are rapidly deployed shallow water containment measures. The turner valley gate consists of two components, a stand and a plastic skirt. The stand allows the watercourse to be spanned, water to flow past and supports the plastic skirt. Typically, the stand is constructed of aluminum or steel grating or mesh with a solid outer frame. The skirt is composed of an oil resistant plastic skirting typically PVC fabric and deflects product to a recovery area. The turner valley gate is deployed consistent with a typical boom angle can be used alone or in conjunction with other containment tactics.

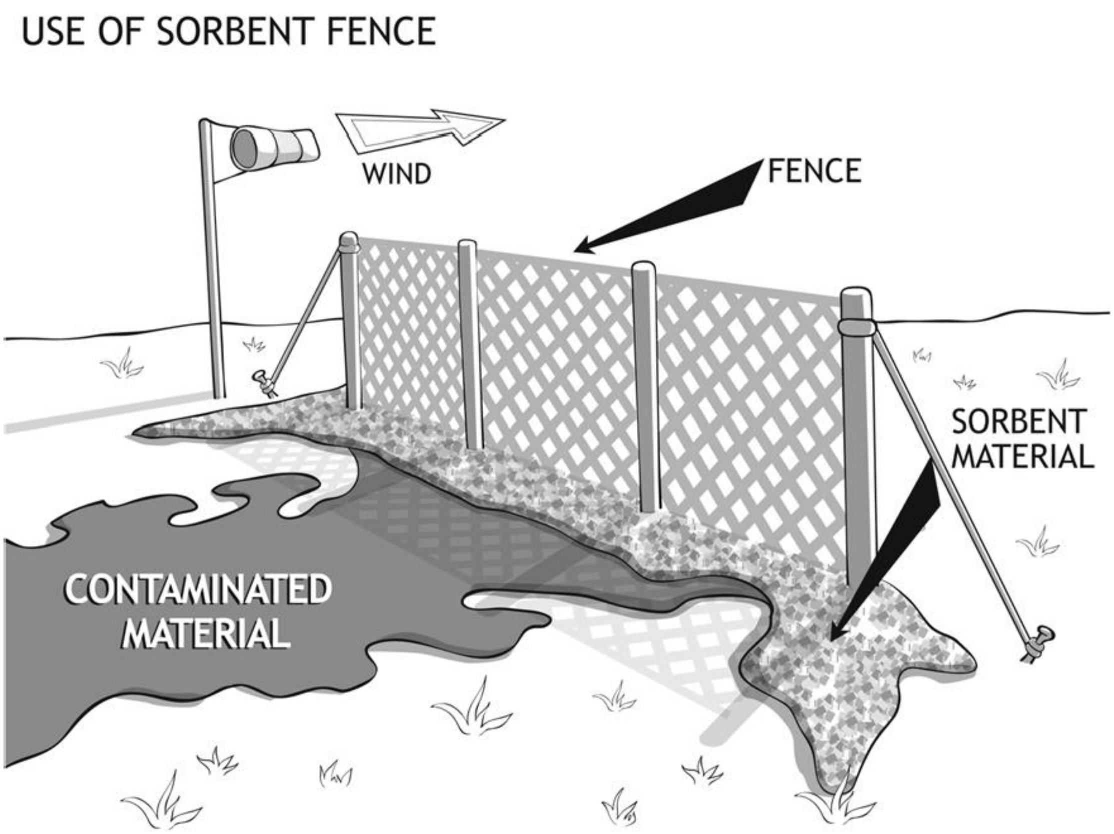
Responder Considerations	Advantages	Limitations
• Install a prefabricated turner valley gate in small watercourses with shallow water depths. • Install the turner valley gate at a 10 / 30-degree angle per current velocity in the watercourse creating a recovery area. • Recover product with hand skimming techniques and/or a vacuum truck. • Can be used to deflect product to a containment and/or recovery area. • Multiple turner valley gates can be used together depending on width of the watercourse.	• Can be quickly deployed into a small watercourse with minimal personnel. • Minimal environmental disturbance. • Skirt can be adjusted depending on water depth to facilitate free product containment. • Applicable for hydrocarbon- based products or non- water-soluble products.	• Requires constant monitoring for product and subsequent hand skimming or vacuum truck removal. • Not effective in fast moving watercourses. • Not effective in water depths exceeding 0.5 m. • Not effective for a large volume of release product.

5.1.8 Sorbent Fence

A sorbent fence (Figure 5.5) is a rapidly constructed containment technique. The largest advantage of a sorbent fence is that it can be constructed very quickly with readily available materials. When constructing the sorbent fence it should be constructed from high ground to high ground or in a U shape for the most effective containment. The sorbent materials should be placed along the water's surface for the entire length of the fence creating a barrier. Once the sorbent material has become saturated, they should be removed and replaced with fresh sorbent material. The sorbent fence can be used in conjunction with other containment and recovery tactics.

Responder Considerations	Advantages	Limitations
• Constructed out of t-posts, fencing, rope, stakes, and sorbent material. • Install the sorbent fence from high ground to high ground.	• Can be quickly deployed. • Requires minimal personnel. • Collects free product and impedes further movement. • Minimal environmental disturbance. • Use with multiple types of containment and recovery tactics. • Applicable for hydrocarbon- based products.	• Requires constant removal and replacement of absorbent materials. • High waste content generated by absorbent materials. • Not an effective recovery technique. • Not effective in water depths over 0.50 m. • Not considered a containment technique.

Figure 5.5 Sorbent Fence



5.1.9 Aquadam / Waterbloc

An aquadam / waterbloc is a water filled inflatable bladder that impedes fluid movement downstream or downslope where installed. An aquadam / waterbloc can be used to contain product, divert freshwater or isolate an area of a waterbody or watercourse. Aquadams / waterblocs are installed by pumping water into the rubber bladders to inflate the tubes and provide fluid control. Aquadams / waterblocs come in numerous sizes depending on the application. Aquadams / water blocks typically come in 50- or 100-foot sections and can be joined together to increase the length if required.

Responder Considerations	Advantages	Limitations
• Install a bladder dam across shallow waterbodies to divert or stop water flow completely. • Can be installed in a U shape configuration to isolate an area within a waterbody. • Can be used to isolate and de-water areas. • Can be used as waste storage in remote areas. • Highly effective in creating a containment and recovery area. • Remove vegetation and other materials that can puncture the bladder. • A water source is required in order to inflate the bladder dam.	• Can be quickly deployed into a watercourse with minimal personnel. • Minimal environmental disturbance. • Reduces sedimentation of watercourse compared to earthen berms. • Highly effective in creating a containment and recovery area. • Use with multiple types of containment and recovery tactics. • Applicable for all types of released products and volumes.	• Require pumps to manage water inflow and outflow. • Require removal of vegetation from banks to create a watertight seal. • Require slow moving or stagnant watercourses or waterbodies. • Removal can be difficult. • Limited by height of the bladder Dam. • A single chamber bladder dam tends to roll. • It is recommended that trained personnel that have experience in installing aquadams / waterbloc complete the installation.

5.2 Moving Watercourse

A moving watercourse is typically referred to as a river or stream. The watercourse has a current and is generally within a channel of some type. The amount of current will dictate the type of response option that is most effective.

5.2.1 Watercourse Boom Angle

The correct boom angle is critical for maintaining containment and to continue recovery operations. The slower the current, the greater the boom angle and the faster the current, the smaller the boom angle.

	Current Speed		
	Less than 4 km/hr.	**Greater than 4 km/hr.**	**Frozen Waterbodies**
Boom Angle (degrees to current)	30 degrees	10 degrees	15 Degrees

5.2.2 River Anchor System

A tandem anchor set is the preferred method for installing an instream hard containment boom. The tandem anchor set consists of a Rake and Sarca anchor, ballast chain, rode line and a marker buoy. The length of ballast chain required should be approximately 120 feet (ft.)

The length of rode line required should be approximately 7 ft. of rode line to 1 ft. of water depth to minimize upward pull on the anchors from the buoy and hard containment boom.

5.2.3 Exclusion Zone

An exclusion zone is characterized as an area you want to protect from being impacted by free product (E.g., sensitive ecosystems, residences, public beach). Boom is placed adjacent to the area and used as either shoreline protection or with instream anchor sets to deflect product from these areas. This tactic is most suited for use in slow to moderate currents and can be used along the banks of a watercourse. A series of smaller boom sets may be preferable to protect longer continuous sensitive areas as opposed to one large set.

Responder Considerations	Advantages	Limitations
• This tactic is used to isolate high consequence areas from being impacted by released product. • Danforth anchors can be used to maintain hard containment boom placement in slow to moderate currents. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw, or natural anchors.	• This tactic is most suited for use in slow to moderate currents. • Hard containment boom is used to direct product away from sensitive areas. • The tactic can be used along the banks of a watercourse at multiple high consequence areas. • A series of smaller boom sets may be preferable to protect longer	• Not recommended for fast moving water environments. • Difficult to maintain boom integrity during ice breakup. • Boom failure due to floating debris or vessel contact is possible.

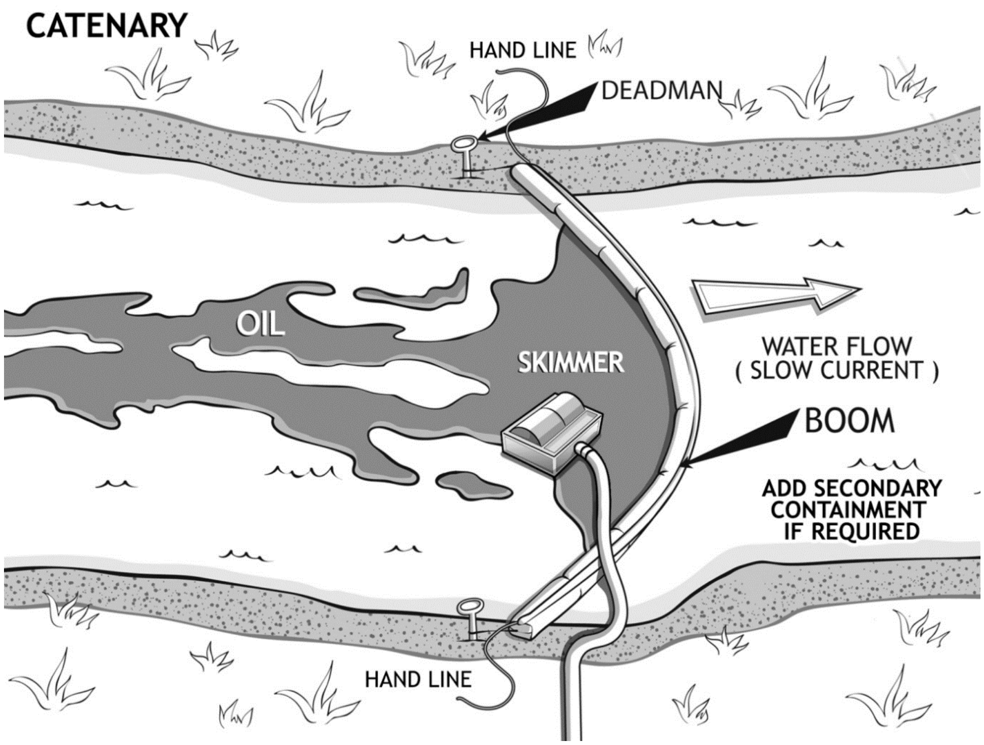
• For smaller waterbodies deployment can be done with hand lines.	continuous sensitive areas as opposed to one large set.	

5.2.4 Catenary Boom Deployment

A Catenary (Figure 5.6) culboom deployment is used in calm water where the channel width does not exceed 15 m. When choosing a deployment location pick areas that will protect any identified priority zones (E.g., sensitive areas, areas that have logistical access issues etc.). This technique consists of one (1) hard containment boom length (50 feet) from shoreline to shoreline, with the boom and/or boom strings anchored above the high-water mark to protect against fluctuating water levels.

Responder Considerations	Advantages	Limitations
• Tactic is used in calm water. • Anchor hard or absorbent boom to shoreline above the high-water mark using shoreline pins, screw in or natural anchors.	• Consists of one (1) hard containment boom length (50 feet) from shoreline to shoreline. • Absorbents can be used to recover product if it is the only recovery method available. • Boom sweeps, water spray or wind can be used to move product to a recovery location for more efficient recovery. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product	• This type of boom deployment typically occurs in waterbodies not conducive to watercraft travel.

Figure 5.6 Catenary Boom



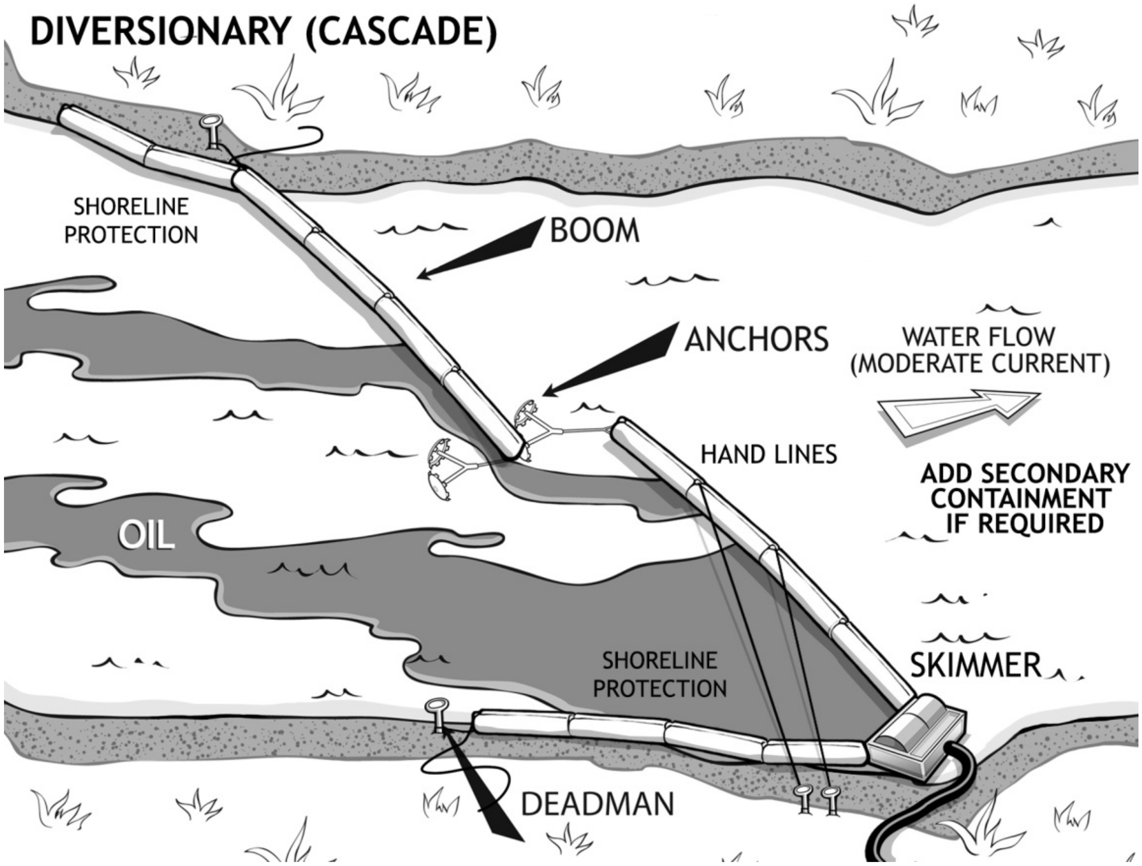
5.2.5 Deflection or Diversion Boom Deployment

A deflection or diversion boom deployment (Figure 5.7) is used to direct product within the watercourse to your recovery area and can be used in slow, moderate and fast currents. Other uses also include protection for sensitive in stream structures (E.g., architectural in stream structures, islands) by deflecting the free product away from these areas. This can be achieved by instream anchor sets or through utilization of a boom vane.

Responder Considerations	Advantages	Limitations
• Boom angle should be at 10 or 30 degrees depending on the current velocity. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw, or natural anchors. • For smaller waterbodies deployment can be completed using hand lines.	• This tactic can be used in slow, moderate, and fast currents. • A boom vane can be used to deflect product (on downstream side) or collect product (on the upstream side) of the hard containment boom. • This tactic can be used to deflect product to a recovery area. • Depending on the water velocity at the recovery area, a mechanical or weir	• Only trained spill responders should attempt deflection or diversion boom deployment tactics.

Responder Considerations	Advantages	Limitations
• For larger waterbodies deployment is completed using response vessels.	skimmer can be deployed to recover the product.	

Figure 5.7 Deflection/Diversion Boom

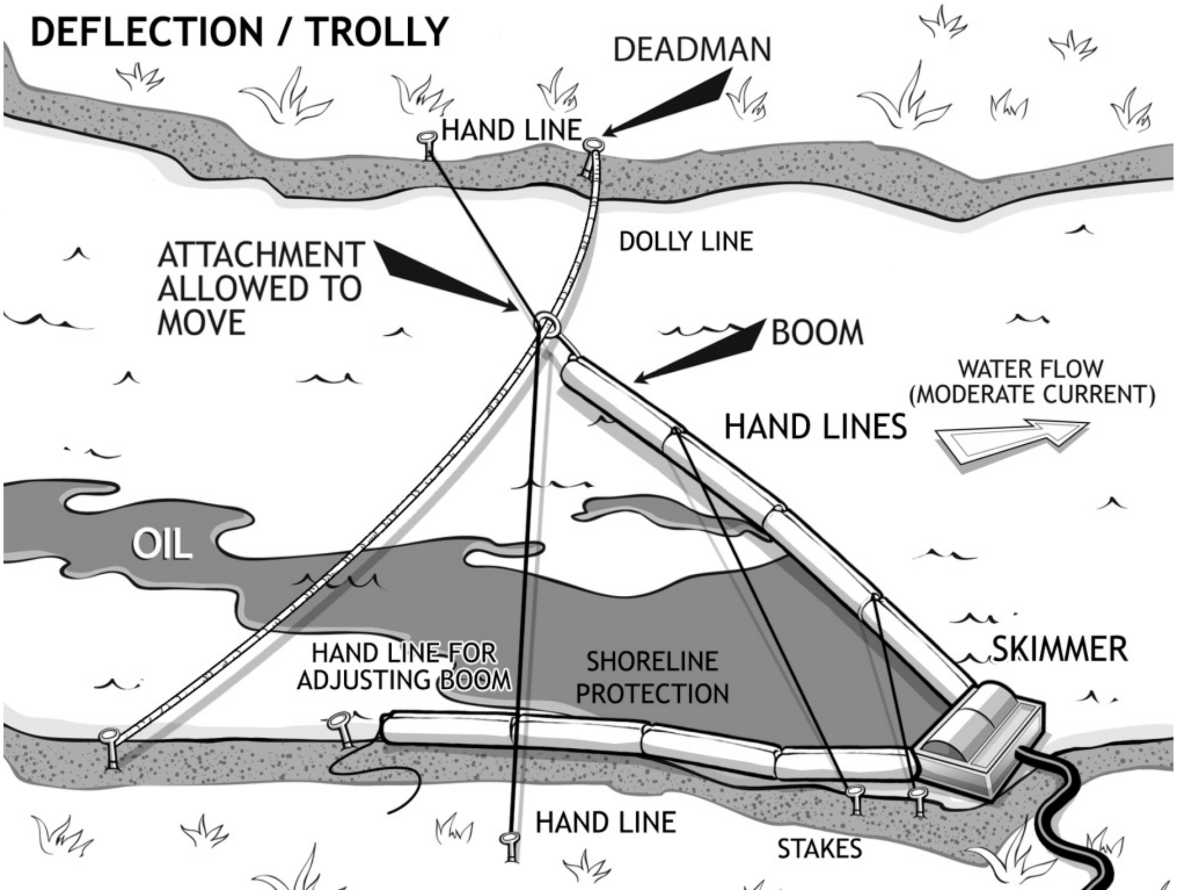


5.2.6 Trolley Line Deflection

A trolley line (Figure 5.8) is utilized to contain product on the surface of small to medium sized watercourses with moderate to strong currents where bank to bank deployment is not feasible and instream anchors can't be used. The boom angle can be adjusted along the trolley line allowing for a larger or smaller recovery area as required which can be beneficial in watercourses with variable flow speeds or a changing product plume size.

Responder Considerations	Advantages	Limitations
• Boom angle should be at 10 or 30 degrees depending on the water velocity. • Anchor the hard containment boom for shoreline projection above the high-water mark to allow for fluctuating water levels using shoreline pins, screw, or natural anchors. • Anchor the trolley line using shoreline pins, screw, or natural anchors. • The trolley line should be anchored at an angle with the opposite shore being downstream. This allows the current to pull the hard containment boom to the location selected by the responder. • For smaller waterbodies deployment can be done with hand lines.	• This tactic can be used in slow, moderate, and fast currents. • Trolley lines are used to deflect product to a recovery area. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.	• Only trained spill responders should attempt a trolley line deflection tactic. • A trolley line can impede boat traffic and should be clearly marked.

Figure 5.8 Trolley Line Deflection



5.2.7 Cascade Boom Deployment

A cascading boom deployment is used to direct product to a recovery point using multiple smaller deflection booms and can be used in slow, moderate and fast currents. Cascading boom deployment allows for the continued passage of watercrafts within a waterbody, is used when the flow speed or length of the waterbody is too great for a single boom to span from one bank to the other and can be achieved with instream anchor sets or using a boom vane.

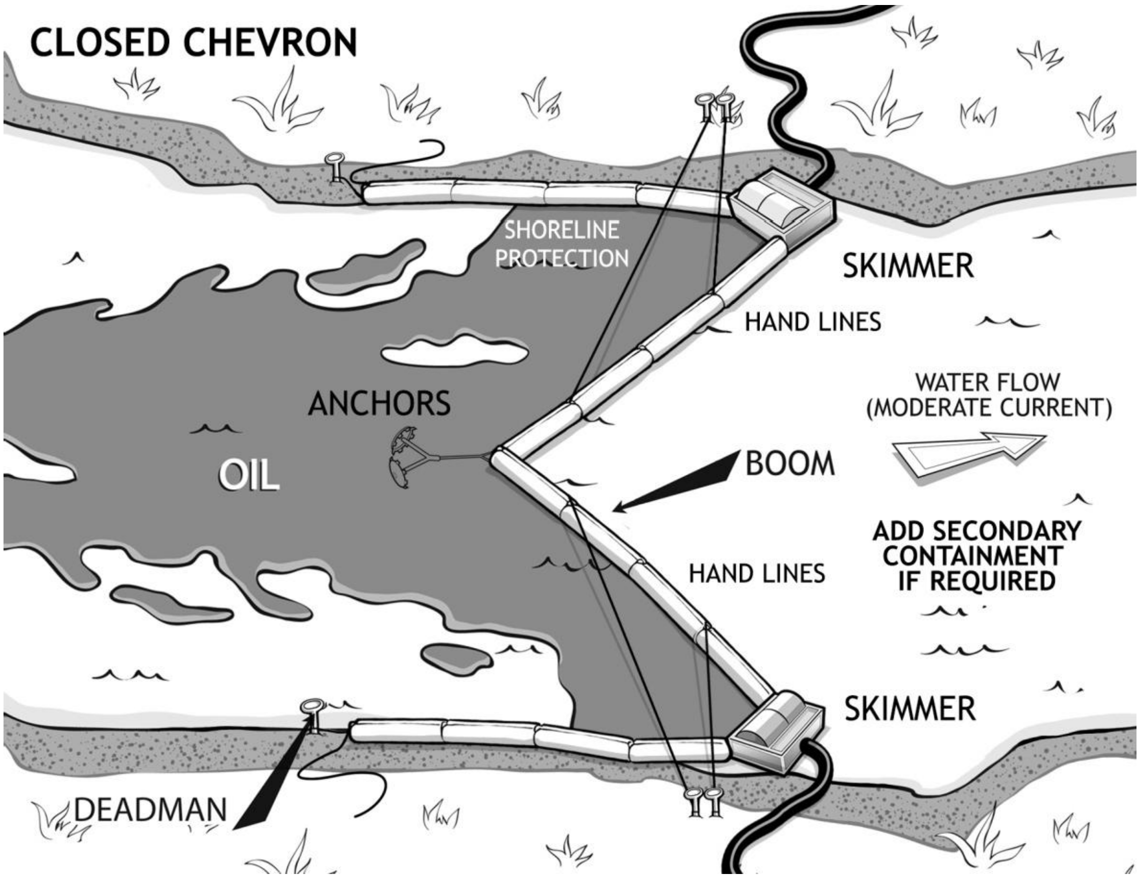
Responder Considerations	Advantages	Limitations
• Boom angle should be at 10 or 30 degrees depending on the current velocity. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw or natural anchors. • This tactic is utilized when one hard containment boom set is insufficient due to water velocity and the amount of boom required.	• This tactic can be used in slow, moderate, and fast currents. • This tactic is used to deflect product to a recovery area. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.	• Response vessels and crew are required to set in-stream tandem anchor sets. • Only trained spill responders should attempt a cascade boom deployment tactic.

5.2.8 Closed Chevron Boom Deployment

A closed chevron deployment (Figure 5.9) is applicable in large straight watercourses when access is available to both banks and can be used in slow, moderate and fast currents. Product is contained and directed to both the left and right descending banks to recovery points. Closed chevrons are created off an instream anchor set and limit watercraft traffic as the entire reach of the watercourse is boomed.

Responder Considerations	Advantages	Limitations
• Boom angle should be at 10 or 30 degrees depending on the current velocity. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw or natural anchors.	• This tactic can be used in slow, moderate, and fast currents. • This tactic is used to deflect product to recovery areas located on the right and left descending banks. • This tactic allows the entire watercourse to be boomed therefore preventing further downstream migration of product. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.	• This tactic does not allow response vessel traffic to pass safely. • A response vessel and crew are required to set the in- stream tandem anchor set and attach the boom apex to the anchor set. • Only trained spill responders should attempt a closed chevron boom tactic.

Figure 5.9 Closed Chevron Boom Deployment

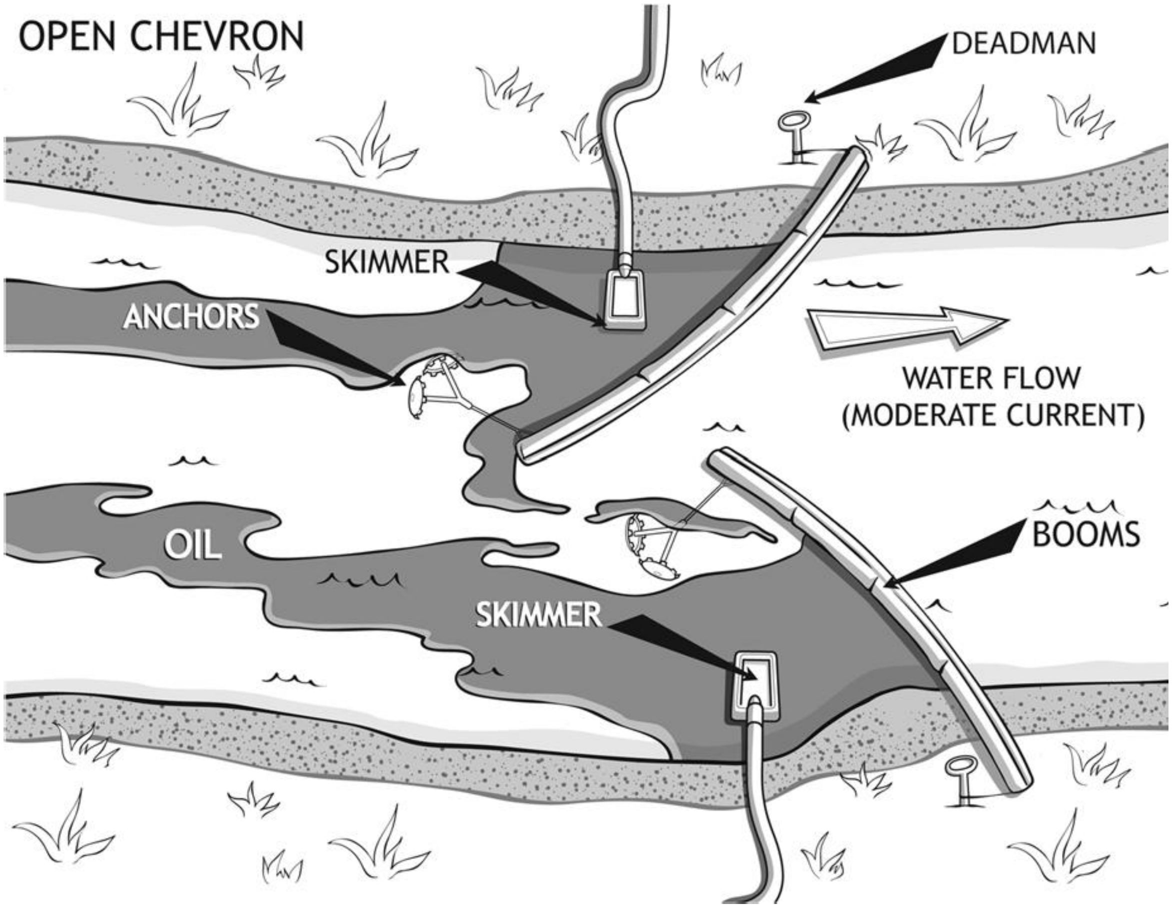


5.2.9 Open Chevron Boom Deployment

An open chevron deployment (Figure 5.10) is similar to a closed chevron in that it's used in large straight watercourses when access is available to both banks, however, it allows you to maintain watercraft passage. Product is contained and directed to both the left and right descending banks to recovery points. Open chevrons are created off two instream anchor sets instead of one.

Responder Considerations	Advantages	Limitations
• Boom angle should be at 10 or 30 degrees depending on the current velocity. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw or natural anchors.	• This tactic can be used in slow, moderate and fast currents. • This tactic is used to deflect product to recovery areas located on the right and left descending banks. • This tactic allows the entire watercourse to be boomed therefore preventing further downstream migration of product. • This tactic allows response vessel traffic to pass safely. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.	• Response vessel and crew are required to set two (2) in-stream tandem anchor sets and corresponding boom strings. • Only trained spill responders should attempt an open chevron boom tactic.

Figure 5.10 Open Chevron Boom Deployment

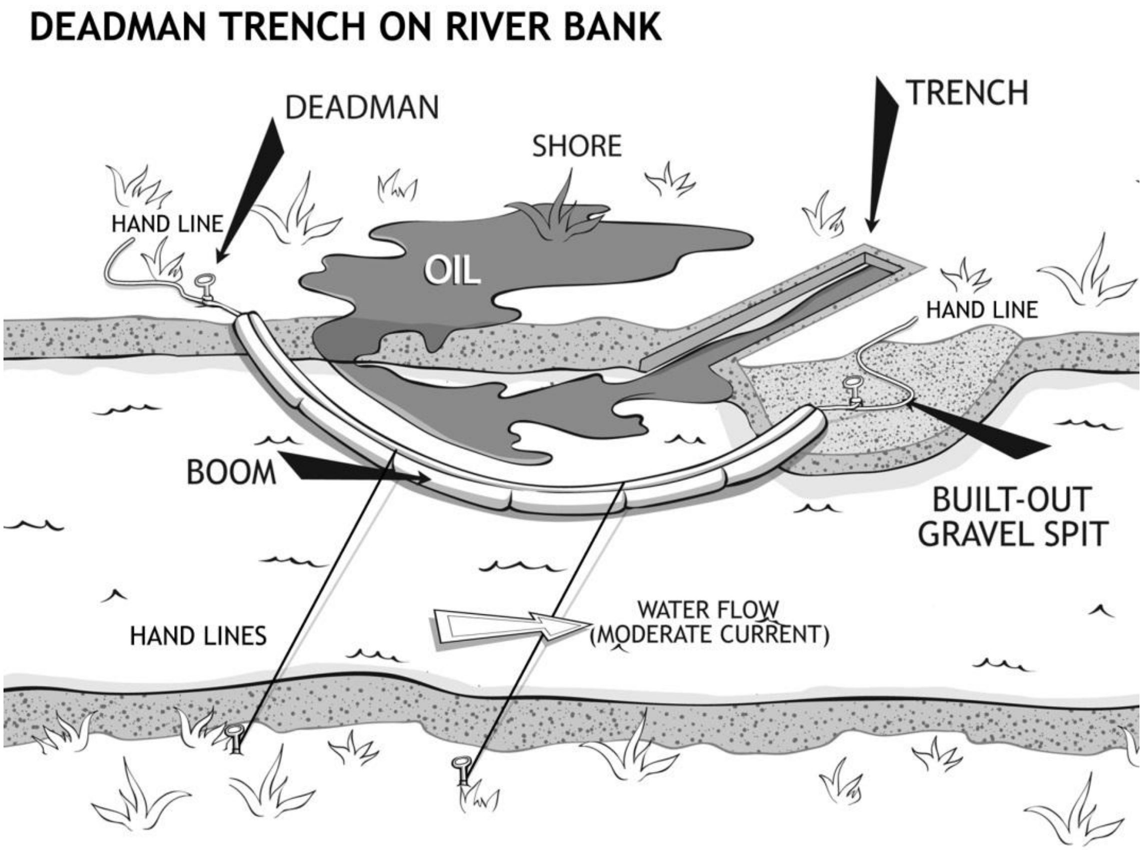


5.2.10 Deadman Trench

A Deadman Trench (Figure 5.11) is used when flow speed or product volume is too great for conventional recovery methods to work. Boom is used to deflect product into a trench created at the recovery point allowing for greater retention of released product. Flow speeds within the main body of the watercourse can hinder the effectiveness of mechanical and weir skimmers. A deadman trench allows for recovery in near stagnant water conditions greatly increasing skimmer efficiency but requires regulatory approval due to alteration of riverbank/bottom

Responder Considerations	Advantages	Limitations
• A built-out gravel spit is utilized to create a retention/containment area and slow water flow to aid in recovery activities. • Used along the bank of a river to stop product from migrating downstream from a land-based spill. • Hard containment boom is used to direct product to the mechanically constructed trench or back channel. • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw, or natural anchors.	• This tactic can be used in slow, moderate, and fast currents. • The mechanically constructed trench serves as the recovery area. • Responders are able to use natural back channels in place of a mechanically constructed trench where available.	• Requires regulatory approval due to alternation of riverbank / bottom. • Only trained spill responders should attempt a deadman trench.

Figure 5.11 Deadman Trench



5.3 Low Current Waterbody

A low current waterbody is generally referred to as a lake or other large body of water, with little to no current at the surface of the water. Hydrocarbon movement occurs in four (4) ways on low current waterbodies:

- Wind driven product movement
- Dispersion of product over the surface of the waterbody
- Watercraft movement and subsequent wave action
- Submersion and/or sinking of product

In cases where significant amounts of product enter a lake, it may be necessary to attempt to contain free-floating oil in open water using the V, U or J- boom techniques.

Responder Considerations	Advantages	Limitations
• Hard containment boom can be installed from land using hand lines or slow-moving watercraft to minimize product movement. • Anchor hard or absorbent boom to shoreline above the high-water mark using shoreline pins, screw in or natural anchors. • Free product is recovered using mechanical skimmers, vacuum trucks and/or surface pumps.	• Hard or absorbent containment boom can be used to contain free product. • Depending on the size of point of entry and/or amount of product in water, the containment area can be expanded or contracted as required. • Danforth anchors can be used on the outside of the hard containment boom to maintain correct boom configuration. • Absorbents can be used to recover product if it is the only recovery method available. • Boom sweeps, water spray or wind can be used to move product to recovery location for more efficient recovery.	• Extra monitoring of potentially impacted wildlife should be considered as large, slow moving waterbodies often host a large variety of wildlife species and often form key breeding ground locations.

5.3.1 V – Boom

A V-boom is utilized in open water where there is negligible flow and the product is located away from the shoreline requiring active oil recovery. A V-boom is created between three work boats with the two leading boats each pulling a section of boom anchored to a third recovery boat in a triangular formation. The recovery boat located at the apex of the triangle is equipped with a bow mounted skimmer or other method to recover the free product from the surface. A V-boom configuration allows for the active recovery of product in place rather than waiting for the product to migrate to a shoreline recovery area.

Responder Considerations	Advantages	Limitations
• 400' – 600' of hard containment boom is attached from each response vessel to the recovery vessel to create a 'V' formation.	• This tactic is used to contain and recover product in open water.	• Requires two (2) response vessels and crews. • Requires one (1) on-water recovery vessel. • Tactic does not work in shallow water environments due to vessel draft. • The recovery vessel must be equipped with a bow skimmer to recover free product. • Constant communication between the two (2) tow vessels and recovery vessel is required for the tactic to be successful. • Not a suitable containment and recovery method in moderate and fast-moving waterbodies. • Only trained spill responders should attempt the V – boom Tactic.

5.3.2 J – Boom

J-Booming is a suitable recovery tactic for lakes only. A single boom can be towed at a low speed (around 0.5 knots) allowing the oil to collect/concentrate in the apex. Once oil is collected, the second vessel drops back and deploys a skimmer into the thickest patches of oil.

5.3.3 U – Boom

A U-boom can be created when two workboats pull a section of boom attached to each in a horseshoe pattern or when one boat pulls a section of boom equipped with a boom vane to create drag and a horseshoe pattern. This method is effective for actively corralling free product in open water scenarios with negligible flow. On water recovery can be completed via a bow skimmer equipped work boat or by ferrying the product to shore within the boom to a designated recovery area.

Responder Considerations	Advantages	Limitations
• 400' – 600' of hard containment boom is attached to each tow vessel. • The recovered product is then towed to a recovery area long shoreline and/or a recovery vessel recovers collected product in U-boom.	• A tow vessel can be replaced with a boom vane when there is a shortage of vessels.	• Requires two (2) response vessels and crews. • Tactic does not work in shallow water environments due to vessel draft. • Constant communication between the two (2) tow vessels is required for the tactic to be successful. • Not a suitable containment and recovery method in moderate and fast-moving waterbodies. • Only trained spill responders should attempt the U- boom tactic.

5.4 Stormwater Sewer Outfall Response

5.4.1 Common Types of Outfalls

Depending on the location there may be several different stormwater or sewer outfalls that could be encountered. The water level of the receiving watercourse and the amount of flow currently in the outfall or forecasted flow in the near future will dictate response efforts and tactics.

Typically released products would enter a stormwater sewer system through manholes, storm drains or above ground retention ponds prior to flowing subsurface. Some municipalities have provided Trans Mountain with GIS files showing the stormwater/sewer systems, check with the GIS department for this information. Alternately, contact the local authorities to see if schematics are available for the storm sewers. The GIS layers/schematics will allow for anticipated flow paths as well as identify additional inflows into the system.

Some of the outfall types that may be encountered while in the field are:

- Concrete structures isolated from a watercourse.
- Concrete structures attached to a slow-moving watercourse.
- Concrete structures attached to a fast-moving watercourse.
- Pipe Suspended above the water's surface.
- Pipe interface with water at slow-moving watercourse.
- Pipe interface with water at fast-moving watercourse.

If it is safe to do so ensure that the entrances to all stormwater sewers within close proximity to a release are blocked to prevent any additional product from entering the stormwater system. This can be done very simply with the use of poly, sandbags, absorbent materials, or storm drain covers.

Immediate communication with the stormwater management division of the affected community should be implemented when a release is confirmed. Some stormwater systems can redirect water to engineered holding ponds or isolate impacted sections through gate valves on discharge points.

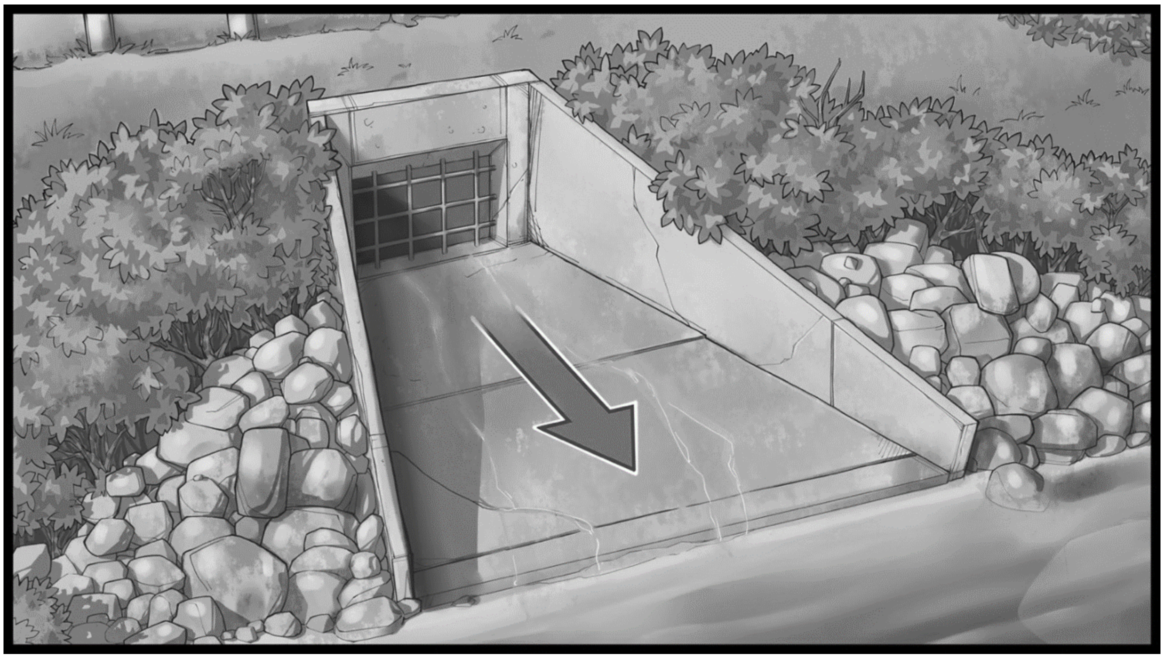
Depending on the volume of the released product that enters the stormwater sewer system and velocity of travel through the system, multiple containment measures may be required. If the product cannot be controlled within the stormwater system or at the outlet and the product is travelling down a watercourse refer to the Moving Watercourse Spill Response section of this manual for further details.

Depending on the product and volume there may be an air quality risk at the outfalls or at the release point. All stormwater sewer systems are considered a confined space and appropriate atmospheric testing, and safe entry procedures must be followed prior to any entry by personnel.

5.4.1.1 Concrete Endwall Structures

Concrete outfall structures come in multiple different designs and configurations. Most have a concrete tunnel and base with wing walls to funnel water into a watercourse called Endwalls. Typically, the entrances are grated to protect the entrances and restrict access. Many of the grates can be removed or propped open to allow work to occur within the sewer system. If additional cleanup is to occur within the sewer system safe access protocols for confined space should be followed. Velocity control devices (I.e., sills, roughness baffles, energy dissipators) may also be present which serve to effectively reduce excessive culvert outlet velocity by inducing turbulence and dissipating energy. These devices must be considered, among other obstructions, to ensure effective spill containment. When assessing the outfall one of the biggest considerations is the water level of the receiving watercourse and whether the levels are or are anticipated to become and stay connected. Multiple adjustments may be required during seasonal fluctuations such as spring freshet. The amount of flow must also be assessed including the anticipated inflows.

Figure 5.12 Concrete Endwall Structure



5.4.1.1 Outfall Pipe

Another common type of outfall is a round pipe generally constructed from steel or concrete. Typically, the flow volumes through a pipe outfall are less than a concrete structure. This may be due to geographical location or the water volume in the sewer system feeding the pipe. Pipe outflows may discharge above the grounds surface, onto the bank of a watercourse or directly into a watercourse.

Figure 5.13 Outfall Pipe

5.4.2 Response Tactics for Outfalls

5.4.2.1 Response Tactics for a Concrete Endwall Structure

When picking the most appropriate response tactic for a release that may travel through a concrete structure associated with a stormwater sewer system it is important to consider the environmental conditions. Conditions like location and terrain, obstructions, seasonality and forecasted weather and precipitation will play a key role in selecting the appropriate tactic. Some tactics that may be appropriate to contain released product within a concrete structure are listed below. It is important to note that it may be appropriate to incorporate multiple tactics during a response.

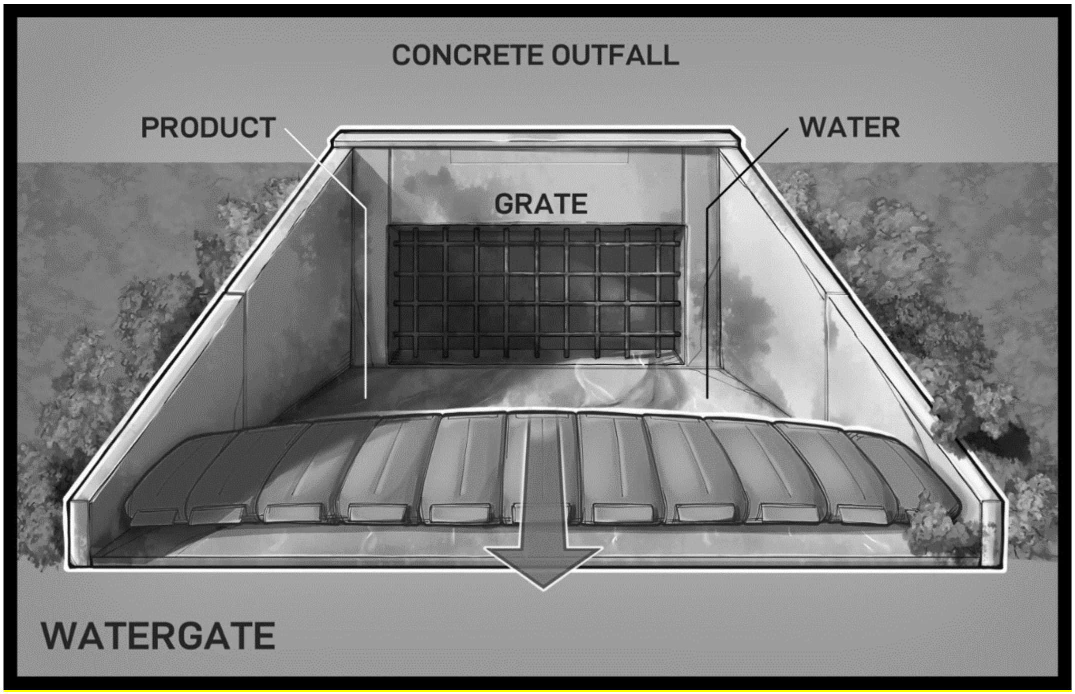
5.4.2.2 Water-Gate Dam

It may be possible to install a Water-Gate Dam within the concrete structure or directly downstream of the structure to increase water depth and facilitate recovery. Water-Gate Dams are portable quick installation barriers that allow the depth of water upstream to be regulated and can be used in conjunction with additional containment techniques. Water-Gate Dams are largely used to increase the water depth to allow additional containment and recovery tactics to be more effective upstream of the dam. Hard containment boom and skimmers can be deployed upstream of the Water-gate dam if sufficient release volumes warrant. Alterations to a Water-Gate Dam include a sandbag berm constructed in the Endwall with culverts placed to allow subsurface flow (Inverted Weir). If flow is minimal and inflowing water can be fully recovered, a full berm can be placed to halt all surface flow. Recovery at the same rate of inflow will be required for this method, or you will need confirmation that the storage capacity of the stormwater sewer is adequate to manage the accumulated backed up fluid.

Responder Considerations	Advantages	Limitations

• Install Water-Gate Dam across shallow waterbodies in order to build water volume behind the Water-Gate.
  ○ Allows containment and recovery tactics to be deployed upstream of the Water-Gate.
• Use water outflow gates at bottom of Water-Gate to regulate inflow to outflow of subsurface water to regulate water levels. Weight of inflated Water-Gate will hold it in place.
  ○ Anchors are provided if required and substrate allows.
	• Considered a containment method to be used with recovery tactic(s).
	• Can be quickly deployed into a watercourse with minimal personnel.
	• Minimal environmental disturbance.
	• Contains released fluids on surface of water while allowing subsurface water to continue to flow downstream.
	• Suitable for areas with constant water flow as a way to manage water depth.
	• Can be used with multiple types of containment and recovery tactics.
	• Can be deployed in multiple areas as required.
	• Applicable for hydrocarbon based products or non-water soluble products with densities less than water.
		• Water volumes are restricted to the amount that can be released through the outflow gates along the bottom.
		• Requires removal of thick vegetation from watercourse banks to properly install.
		• Requires shallow, slow to moderate moving watercourse.
		• Most effective in a watercourse with a depth of 0.5 m or less within a confined channel.
		• Water-Gate dams require constant monitoring out outflow and inflow to maintain a consistent water depth.
		• Cannot be established on a steep downward slope.

Figure 5.14 Water – Gate Dam Installation in Endwall

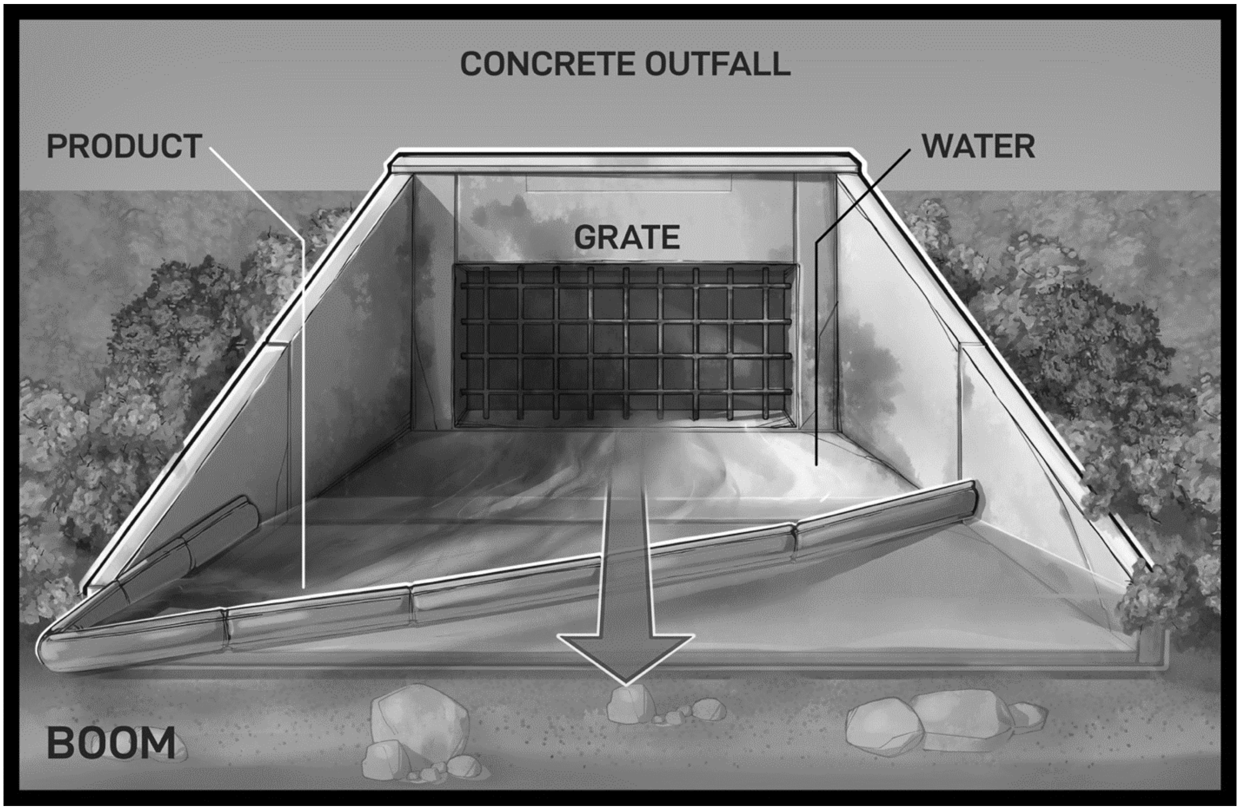


5.4.2.3 Hard Containment Boom

It may be possible to deploy hard containment boom directly at the outfall. This may be an option as long as there is sufficient water depth and room upstream of the receiving watercourse. In these situations, the base of the concrete outfall may be partially or completely submerged. It may be possible to recover product with skimmers or a vacuum truck depending on product volume and water depth. The velocity of the discharging water will need to be matched with an appropriate boom angle. Detailed booming information can be found in the Moving Watercourse Spill Response section including angle calculations.

Responder Considerations	Advantages	Limitations
• Match boom angle to water flow speeds. • Ensure there is adequate water depth to allow the draft of the boom to float above the base of the watercourse and not create a suction. • Ensure there are sufficient and secure anchor points for the boom.	• Considered a containment method to be used with recovery tactic(s). • Can be quickly deployed into a watercourse with minimal personnel. • Minimal environmental disturbance. • Contains released fluids on surface of water while allowing subsurface water to continue to flow downstream. • Can be used in flowing or stagnant waterbodies. • Suitable for areas with depth greater than the draft of the skirt and float. • Can be used with multiple types of containment and recovery tactics. • Can be deployed in multiple areas as required. • Applicable for hydrocarbon based products or non-water soluble products with densities less than water.	• Water depth must be maintained to ensure the skirt of the boom does not create a suction or underflow. • There must be adequate room to allow for an appropriate boom angle to be installed without interference of the receiving watercourse. • Most effective in a watercourse with a depth of 0.3 m or more within a confined channel. • Cannot be installed in turbulent water with excessive riffling.

Figure 5.15 Boom Installation in Endwall



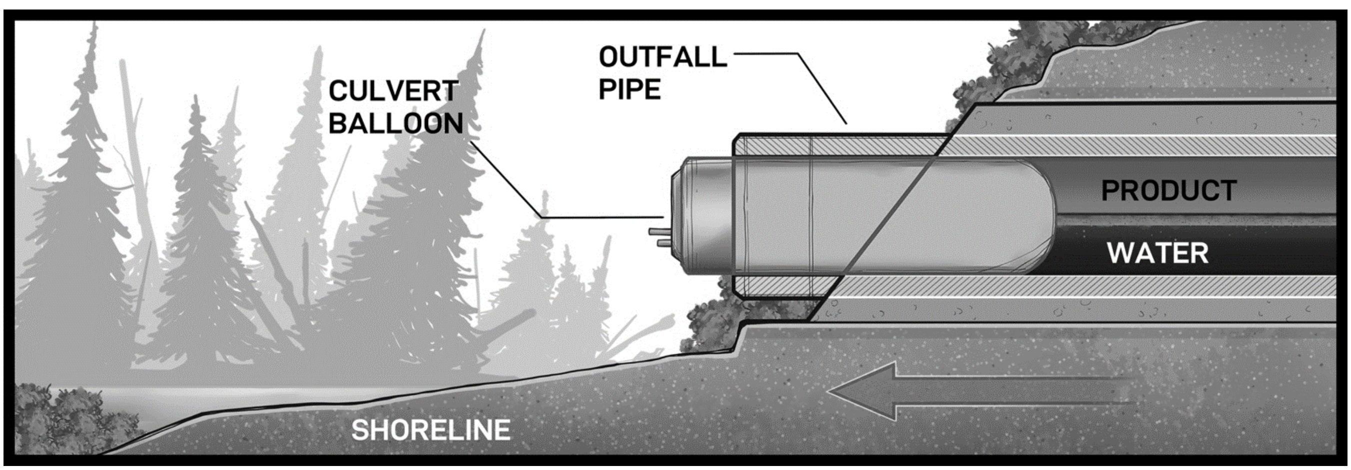
5.4.3 Response Tactics for a Pipe Outfall

5.4.3.1 Pipe Outfall Block

It may be possible to block the outfall pipe completely using an inflatable culvert balloon or other non-porous material and may be an option in arid landscapes with little or no flow in the stormwater sewer systems or if the volume of slow and storage capacity of the stormwater sewer is adequate to manage the accumulated backed up fluid. A number of considerations must be taken into account in order for this strategy to be a viable option, these include volume of flow/anticipated flow and access to the backed-up fluid to facilitate recovery without creating a dangerous atmosphere within a confined space. If a large volume of water does back up behind the culvert plug, ensure the area is cleared as the head pressure on the plug may cause it to exit the pipe.

Responder Considerations	Advantages	Limitations
• The outfall can be blocked with available materials such as: o Sheet metal, o Sandbags, o Plywood, o Inflatable culvert plugs, and o Crushing / burying the culvert in non-porous earthen material. • Only implement a culvert block if here is a manageable volume of fluid that will be retained upstream and a sufficient storage capacity. • Substantial pressure may be built up upstream of the culvert block due to back up of water volumes. • A full culvert block should only be utilized if water flow can be managed in order to maintain a stable water level.	• Considered a containment method to be used with recovery tactic(s). • Outfall acts as man-made barrier and choke point to a release. • Relatively easy area to block and prevent further downstream product movement. • Applicable for all types of released products.	• If an outfall is completely blocked, consideration is to be given to the correct and additional back-up pumping power required in the event of weather and/or melt event to prevent overflowing or excessive backup. • There must be access close to the outfall to allow for fluid management and product recovery. • Some culvert blocking techniques may require repair to an outfall if damage occurs.

Figure 5.16 Pipe Outfall Block



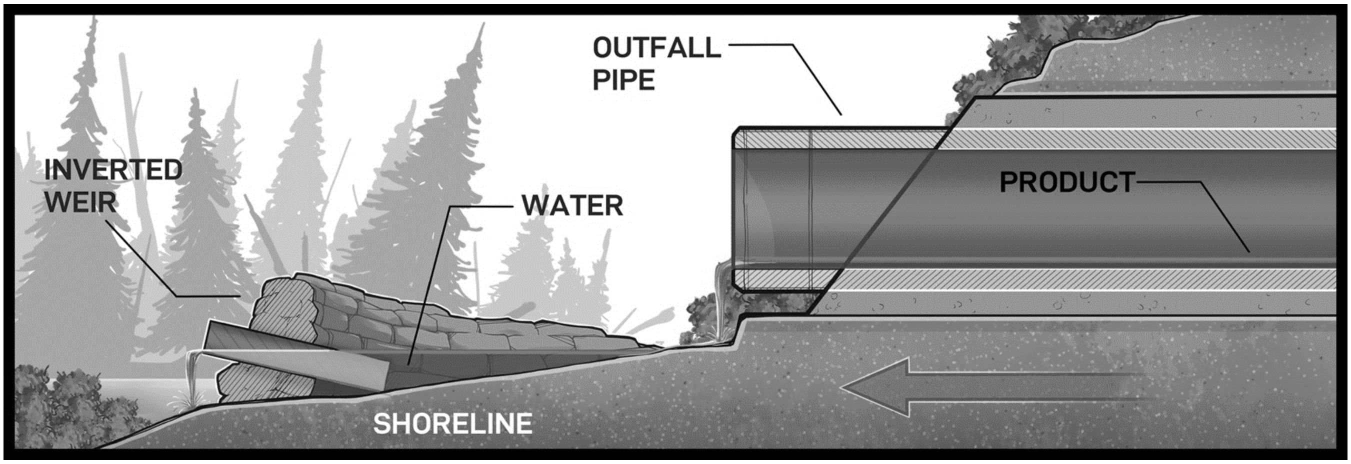
5.4.3.2 Inverted Weir / Underflow Dam

It may be possible to install an inverted weir between the outfall and the receiving watercourse. An inverted weir is designed to stop free product on the surface while allowing fresh water to continue to flow downstream. The inverted weir is made up of two components, a berm and a culvert. The berm can be constructed out of any non-porous substance (E.g., clay, wood, poly or metal) built with mechanical (E.g., backhoe) or hand equipment (E.g., shovel). When constructing the berm build a crescent shape from high ground to high ground with the culvert(s) at the center point of the arc. The culvert or culverts depending on the volume of flow should be designed for the current water flow x 150 percent to withstand any rain and/or melt events. The top of the inflow end of the culvert must be lower than the bottom of the discharge end. Typically, a 45-degree angle can be used as a baseline and adjusted based upon water flow, depth and culvert length.

Responder Considerations	Advantages	Limitations

• Construct with mechanical or hand equipment.
• Can be constructed with sandbags or earthen material.
• A prefabricated Inverted Weir can be used to minimize environmental disturbance.
• If possible, line upstream side of dam with impermeable barrier (E.g., plastic liner)
• Remove vegetation, debris, and other porous materials before construction.
• Culverts to be placed on the upstream side of the dam with the elevated end on the downstream side.
    ○ The height of the elevated downstream end of the pipe determines water level behind the Inverted Weir.
• The Inverted Weir should be designed to withstand future weather and/or melt events up to 150 percent of current water flow.
    ○ Additional pumps should be on standby if water flow above 150 percent is expected.
	• Considered a containment method to be used with recovery tactic(s).
	• Contains released fluids on surface of water while allowing water to continue to flow downstream.
	• Suitable for areas with constant and intermittent water flow to mitigate constant water management.
	• Can be used with multiple types of containment and recovery tactics.
	• Can be constructed in multiple areas as required.
	• Applicable for hydrocarbon based products or non-water soluble products with densities less than water.
	• Can be constructed with readily available material. No special equipment is required.
		• Can be environmentally intrusive (high impact).
		• May require remediation and reclamation at end of life.
		• If poorly constructed does not provide adequate containment and/or will washout.
		• Requires instream work, proper siltation mitigation measures installed prior to installation.
		    ○ Regulatory permits will be required outside of the emergency phase of the response.
		• Large water volumes cannot be managed. Require back-up pumps for an increase of water flow.

Figure 5.17 Pipe Outfall Inverted Weir / Underflow Dam



5.4.4 Response Tactics for Receiving Watercourse

It may not be possible to contain the released product before it discharges into a watercourse. This may be due to direct discharge into the watercourse, difficult terrain at the outfall or high flows that cannot be efficiently managed directly at the outflow. If this is the case, it will be critical to establish containment as close to the outflow as is possible while maintaining containment integrity and prevent further product entry into the waterbody. This tactic can be used in slow, moderate and fast currents.

One of the most effective ways to establish containment is using hard containment boom. Depending on the size of the receiving watercourse and spread of the product within the watercourse the hard containment boom can either be set up from bank to bank, off an instream anchor set or through utilization of a BoomVane. Hard containment boom should be anchored above the high-water mark to allow for fluctuating water levels using shoreline pins, screw or natural anchors. The boom angle should be at 10 or 30 degrees depending on current velocity.

Deploying containment in a receiving watercourse may also be used to add secondary containment to an installed containment measure at the outfall. If the receiving watercourse has minimal flow a horseshoe boom deployment strategy can be implemented around the outflow to capture released fluid and mitigate downstream migration. Additionally, a BoomVane can be used to collect product (on the upstream side) of the hard containment boom if work boats or adequate anchors are not available.

Containment Tactic Considerations
• The first priority is to prevent further product entry into the waterbody. • This tactic can be used in slow, moderate, and fast currents. • Boom angle should be at 10 or 30 degrees depending on the current velocity • Anchor the hard containment boom above the high-water mark to allow for fluctuating water levels using shoreline pins, screw, or natural anchors. • A BoomVane can be used to collect product (on the upstream side) of the hard containment boom if work boats or adequate anchors are not available. • This tactic can be used to deflect product to a recovery area. Ensure there is adequate access to the recovery location for responder safety as well as efficient operations. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.

- For smaller waterbodies deployment can be completed from bank to bank or the use of a trolley line.
- For larger waterbodies deployment is completed using response vessels or a BoomVane.
- Only trained spill responders should attempt a Deflection Boom Deployment Tactic.

Figure 5.18 Endwall Outfall Instream Boom Deployment

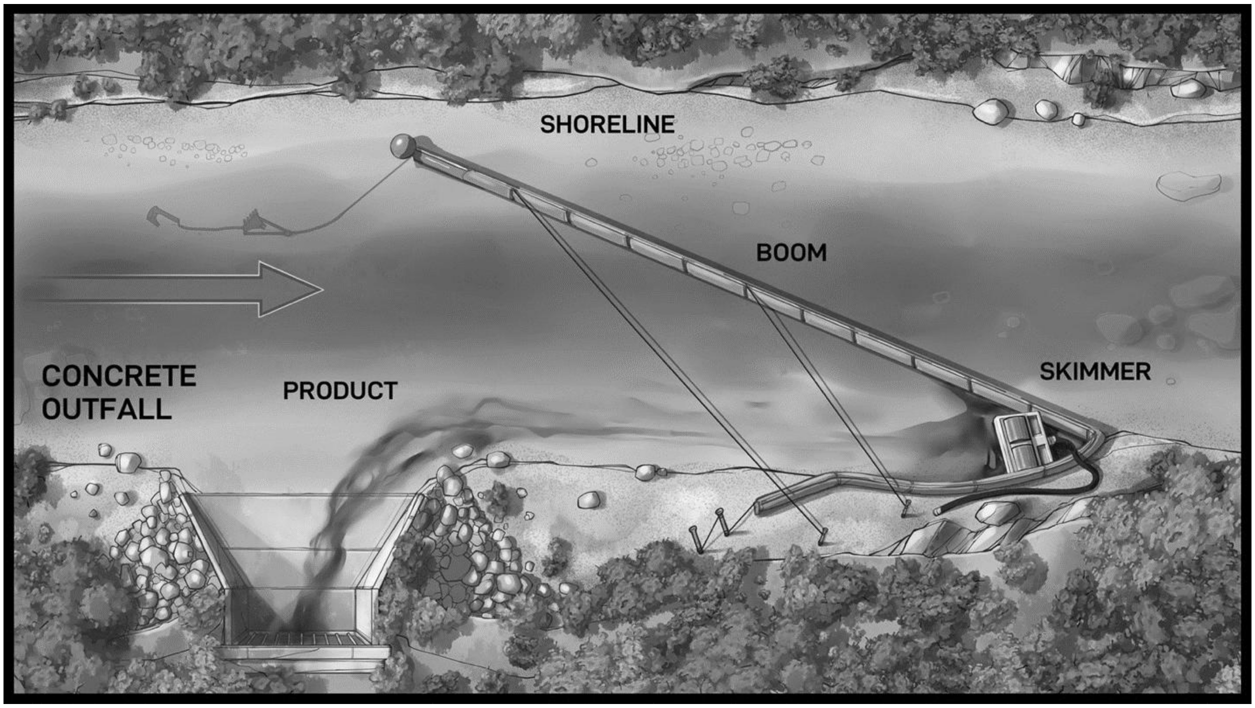
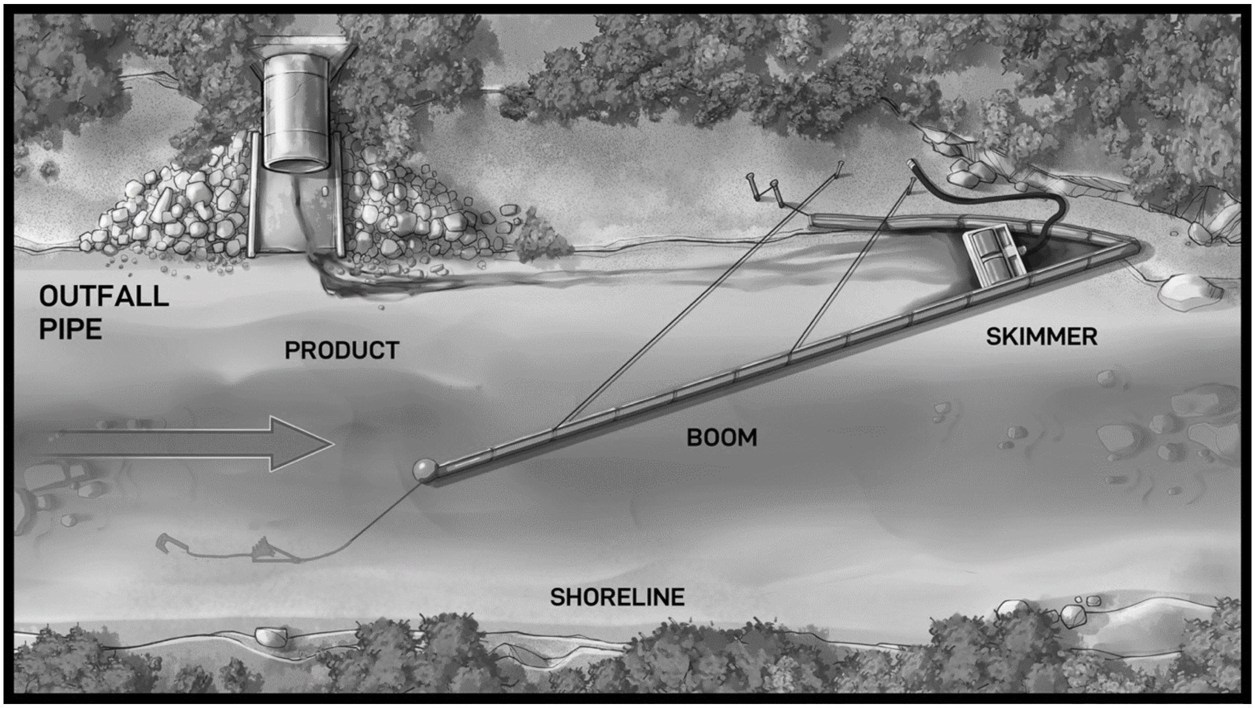


Figure 5.19 Pipe Outfall Instream Boom Deployment



5.5 Winter Response

Winter conditions pose unique challenges for response, and appropriate regard must be made to account for these challenges.

For additional information, see the Ice Safety Assessment Guideline located on the winter response trailer prior to setup and on the intranet site in the Emergency Toolkit.

5.5.1 Ice Types

There are five types of ice; each of which is created under different atmospheric conditions and differs *significantly* in strength.

- Blue Ice – Strongest form of ice and is blue or clear in appearance, generally it is void of bubbles and/or debris.
- White Ice – has half the load bearing capacity of blue ice and is generally white in colour.
- Frazil Ice - Frazil ice is a collection of loose, randomly oriented needle-shaped ice crystals in water. It resembles slush and has the appearance of being slightly oily when seen on the surface of water. It sporadically forms in open, turbulent, super cooled water, which means that it usually forms in rivers, lakes and oceans, on clear nights when the weather is colder, and air temperature reaches −6 °C or lower.
- Jam Ice - Is a stationary accumulation of fragmented ice or frazil ice that restricts flow. This most often occurs in the spring, however can form during the freezing cycle in early winter. The surface will be uneven and will not have the strength of blue or white ice, although the jam can be made up of both.
- Layered Ice – a layered combination of blue and/or white ice intermittently mixed with layers of water or slush. This ice may form as part of a continued freezing and thawing process. This is a

dangerous mixture of ice and can provide incorrect thickness readings and subsequent weight bearing capacity calculations. Extreme caution should be used if working near this type of ice formation.

5.5.2 Ice assessment Methodology

Prior to commencing any activity over a frozen waterbody, the type, strength and thickness of the ice must be established. Utilize the following steps for measuring ice thickness and determining weight bearing capacity.

- Prior to conducting the ice assessment, a tailgate meeting should be conducted which includes a review of the Initial Site Health and Safety Plan (ISHSP). In addition to the ISHSP, an Ice Rescue Plan should be developed and communicated with all responders. If required, a trained ice rescue crew should be on standby.
- Personal Protective Equipment should be reviewed during the tailgate meeting and donned prior to conducting operations.
- Ice assessors will work in pairs and don safety harnesses secured with rope to shoreline crews before moving onto ice.
- Utilizing an ice auger, the assessors should drill the first test hole while standing on the shoreline to determine if it is safe to proceed onto the frozen waterbody.

In order to determine ice weight bearing capacity, utilize the ice measurement stick located on the Winter Response Trailer. The measuring stick is placed into the drill hole to determine total ice thickness. All measurements should be recorded on the Ice Assessment Form located in Section 9.0 Forms of this manual and on the intranet site in Emergency Toolkit.

To calculate the weight bearing capacity utilize the following formula.

Gold's Formula - $P = A \times h^2$
where:

P is the calculated allowable load in kilograms

A is the selected risk tolerance value

h is the effective thickness of good quality blue/white ice (cm)

"A" values range from 3.5 to 6 depending on overall risk tolerance. Selecting a lower "A" value when completing the calculation allows for a more conservative weight bearing capacity. **For Trans Mountain's purposes a preliminary "A" value of 3.5 should be utilized.**

- When determining total ice thicknesses exclude any surface snow in the measurement. Record the thickness for each test hole using the Ice Assessment Form located in Section 9.0 Forms of this manual and on the intranet site in Emergency Toolkit.
- Assessment should only continue if ice thickness is determined to be adequate.
- Subsequent test holes should be drilled working in a straight line from the original hole. Distance between test holes should never exceed 10 metres (5 metres on moderate to fast moving river systems). Ensure that each test hole is indicated on a site diagram and that holes are marked with a pylon or other device for visual reference. Additionally, a GPS reference for each drill hole may be taken and recorded.

- Augured test holes should be reevaluated at minimum every two days to ensure that thickness has not significantly decreased. If substantial temperature changes occur during response operations, then test holes should be reevaluated more frequently.
- Once the identified work area for containment and recovery operations has been reached an additional weight bearing capacity assessment for response equipment must be completed. This is done by cutting and extracting an ice block from the work area, moving the block to the safety of the shoreline and measuring the different types of ice formed within the block sample. Utilize Gold's Formula to then determine the work areas total weight bearing capacity which will in turn indicate the type and number of responders and response equipment that may be utilized for safe operations.

5.5.3 Additional Considerations

On lakes, the distance between test holes may be substantially increased with the trailing responders remaining well behind. Extra caution needs to be exercised along shore, as the floating ice cover may actually be thinner near the shore. In addition, as progress is made across the lake, sampling distances will need to be shortened as the ice thickness begins to decrease. **If any sample reveals clear blue ice less than 10 centimeters thick, responders are to leave the area immediately.**

In addition to Gold's Formula the following table may be referenced as a general guideline for ice thickness weight bearing capacity.

Potential Load of Blue Ice	Effective Ice Thickness (Millimeters)	
	Lake^	River^
*One person on foot	10 cm minimum	11.5 cm minimum
*Group, single file	10 cm minimum	11.5 cm minimum
Passenger car 2000 kilograms	20 cm minimum	23 cm minimum
Light truck 2500 kilograms	20 cm minimum	23 cm minimum
Medium truck 3500 kilograms	28 cm minimum	32 cm minimum
Heavy truck 7000 – 8000 kilograms	41 cm minimum	41 cm minimum

*NOTE: if a person/persons plan to be in one area for more than 2 hours the ice must be a minimum of 15 cm thick.

^ Guide applies to blue/clear ice only.

Additional information regarding Best Practices for Building and Working on Ice Covered Waterbodies is located within each Trans Mountain Winter Response Trailer and on the intranet in the Emergency Toolkit.

5.5.4 Ice Slot ('J' slot)

The ice J slot can be used within waterbody's that exhibit flow when product is under the ice. The ice slot is created at an angle to the current (angle dependent on current velocity) resulting in the oil surfacing within the slot and being directed to the recovery area by the current. This tactic is used for accessing, containing and recovering product underneath ice.

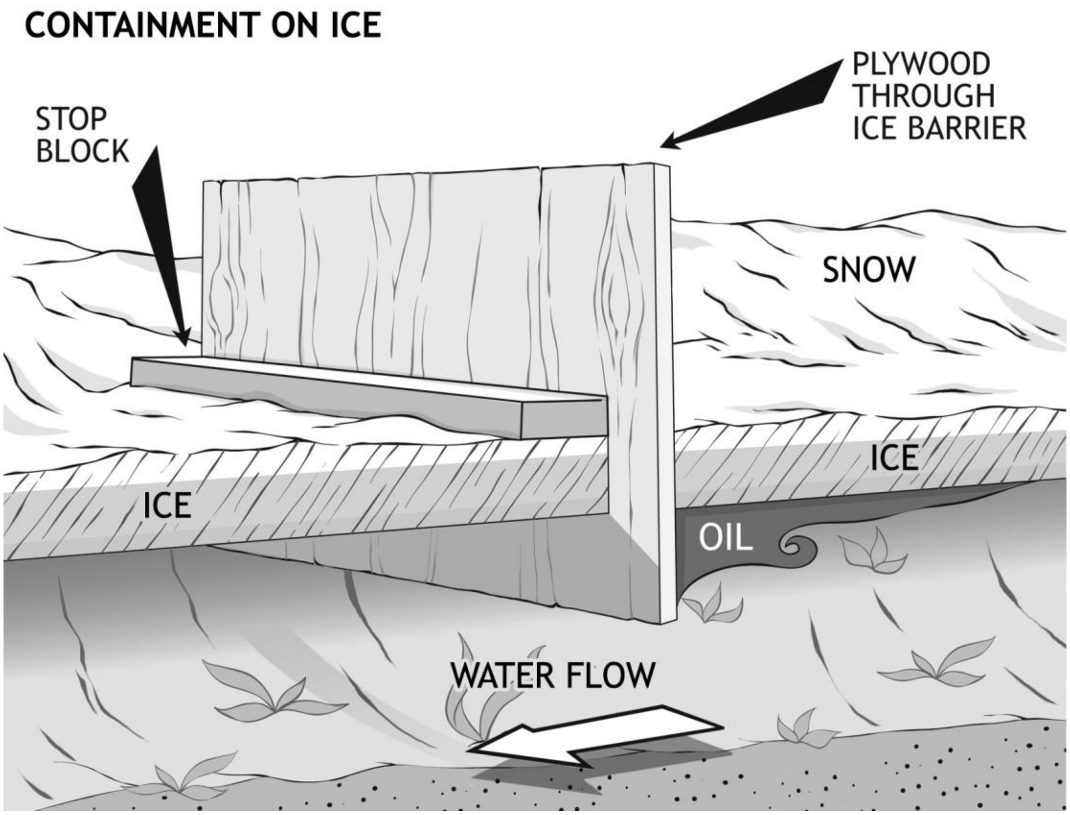
Responder Considerations	Advantages	Limitations
• Boom angle should be at 15 degrees depending on the current velocity. • Tactic can be used on ice covered waterbodies. • Hand and/or power tools can be used to create an ice slot in a 'J' configuration. • The ice slot configuration can be marked out on ice before installation. • Ice blocks should be cut in approximately 1 – 2 foot intervals to facilitate removal from the ice slot. • The ice slot should be narrow at the top and wider at the bottom.	• This tactic is used for accessing, containing and recovery of product underneath ice. • Ice blocks are floated down the slot to the recovery area for removal. • The ice slot is used for both containment and recovery tactics. • Depending on the water velocity at the recovery area, a mechanical or weir skimmer can be deployed to recover the product.	• An ice evaluation must be completed prior to response activities. • Ice quality may rapidly deteriorate due to abrupt weather changes. • Only trained spill responders should attempt the ice slot tactic.

5.5.5 Ice Slot with a Barricade

The ice slot with a barricade (Figure 5.20) is created in the same fashion as the J slot. A barrier is placed within the ice slot to allow for greater retention of free product within the surface water. The barrier is placed within the water profile as to allow for retention of only the surface water and product while permitting the subsurface water to continue unhindered. The ice slot with a barricade is deployed for containment purposes only under ice.

Responder Considerations	Advantages	Limitations
• Hand and/or power tools can be used to create an ice slot. • The ice slot configuration can be marked out on ice before installation. • Ice blocks should be cut in approximately 1 – 2-foot intervals to facilitate removal from the ice slot. • A barrier is inserted through the slot (the barrier can consist of sheet metal, plywood, plastic etc.).	• Tactic can be used on ice covered waterbodies. • This tactic is used for accessing, containing, and recovering product under ice. • The barrier stops downstream migration of product underneath of ice.	• An ice evaluation must be completed prior to response activities. • Ice quality may rapidly deteriorate due to abrupt weather changes. • The barrier should not be inserted to bottom of waterbody. Water must be allowed to flow underneath the barrier. • Insert a stop block on the downstream side of barrier to keep the barrier rigid and upright. • The ice slot with a barricade is deployed for containment purposes. • Only trained spill responders should attempt the ice slot with a barricade.

Figure 5.20 Ice Slot with Barricade



5.5.6 Trench on Ice

An ice trench (Figure 5.21) is the same concept as an earthen trench. Ice trenches are used to contain and recover (Figure 5.22) free product moving on the surface of a frozen waterbody or in situations where free product is trapped within layers of ice. This tactic is used for accessing and containing product on ice. Ice pits or bell holes can also be advanced for product containment and recovery. Ensure the ice depth is known before installing a trench or bell hole as not to advance the cut below the depth of the ice allowing product into the water below. Ice trenches can be used in conjunction with ice slots if the free product has impacted the flowing water beneath the ice.

Responder Considerations	Advantages	Limitations
• Use hand and/or power tools to create a shallow trench within the ice. • Using hard containment boom lay the skirt within the shallow trench to create a barrier. • Fill trench partly with snow and/or water to freeze the hard containment boom skirt in place.	• This tactic can be used on ice covered waterbodies. • This tactic is used for accessing and containing product on ice.	• An ice evaluation must be completed prior to response activities. • Ice quality may rapidly deteriorate due to abrupt weather changes.

Figure 5.21 Ice Trench

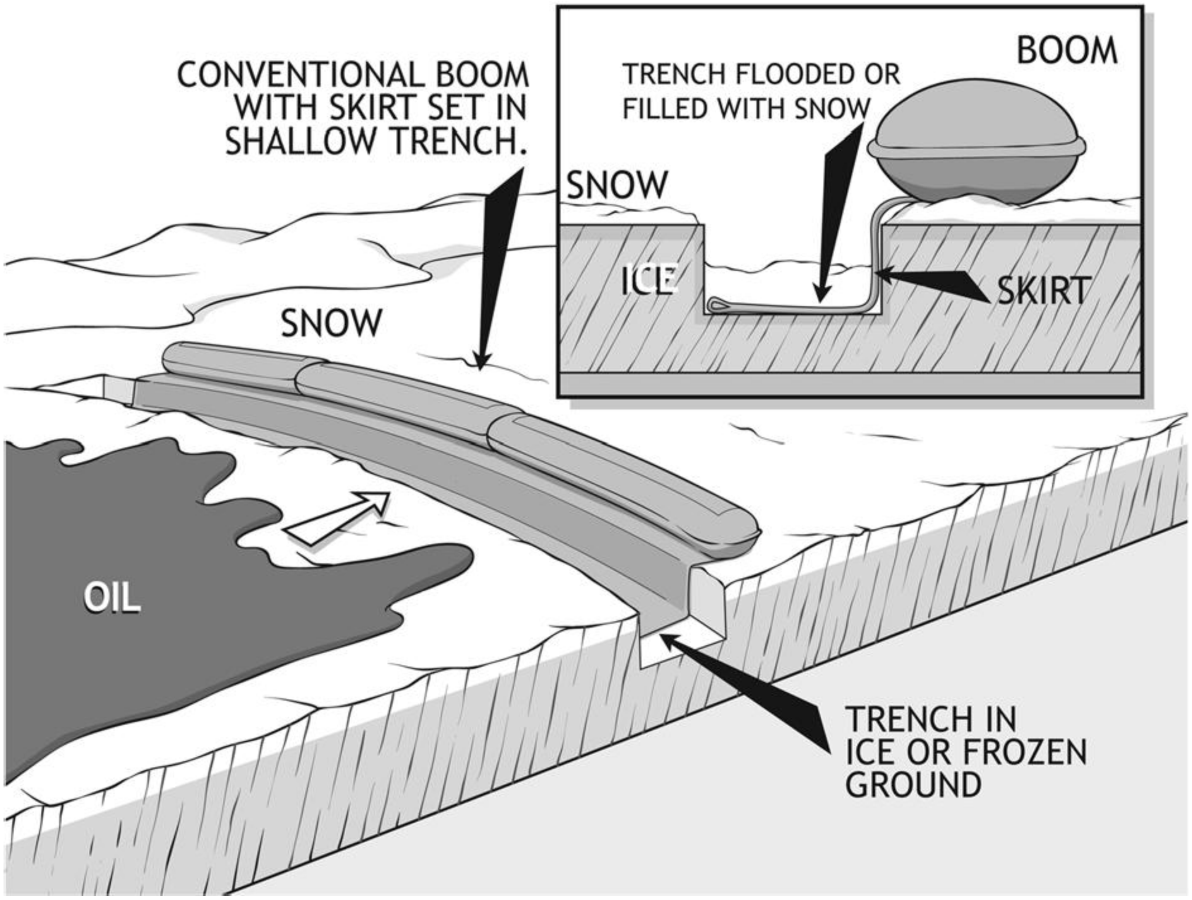
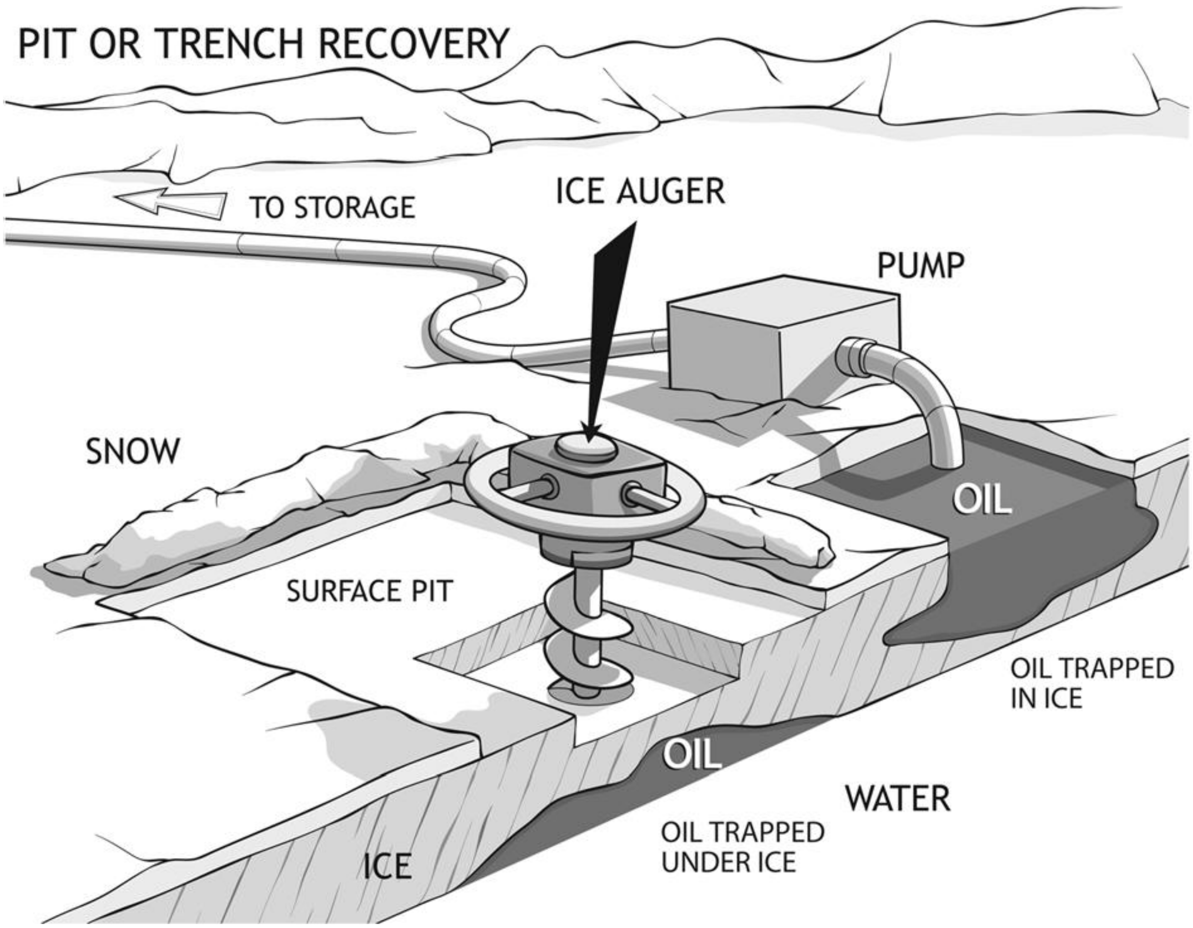


Figure 5.22 Ice Pit



5.5.7 Snow Covered Land Response

Response in snow covered environments can be equated to response on earthen material. Use shovels or heavy equipment, such as graders, loaders, bulldozers, or track hoes, to build a berm of either soil or snow to stop the flow of free fluids. Berms should be lined to prevent cross contamination of the berm materials. Snow can be disposed of in solid form or melted and disposed of as a liquid.

Responder Considerations	Advantages	Limitations
• Use heavy equipment to create snow berms to stop the movement of free product.	• Tactics can be used in snow covered environments. • Recovery of free product can be done with vacuum trucks. • Contaminated snow can be removed by dump trucks, lined on-site containment cell or open top tanks.	• Natural or person-made objects covered by snow may not be seen by equipment operators. Area must be assessed prior to operations.

5.6 High Consequence Areas Protection Techniques

5.6.1 Low Impact Access Activities

Low impact access activities involve accessing and completing response activities in a manner which limits the overall response footprint. The response is still effective and efficient, but care is taken in cultural, historical, or ecologically sensitive areas such as wetland complexes, waterbodies, and watercourses.

These activities tend to represent an increased requirement for personnel and equipment during the initial stages of a response. The final reclamation requirements are typically reduced due to the minimized disturbance.

Techniques that can be used to maintain the structural integrity of sensitive areas include:

- Accessing areas by foot traffic only.
- Establishing pallet or plywood walkways for access.
- Restricting travel to the established pathways.
- Staging matting for heavy equipment access into sensitive areas.
- Using Low Ground Pressure (LGP) heavy construction equipment to reduce soil compaction; rutting, and overall disturbance.
- Using specialized tracked equipment.
- Utilizing portable vacuum units.
- Deploying helicopters and long lines to transport supplies and personnel in and out of worksites.
- Establishing staging areas in appropriate areas to prevent damage to the ecosystem.

The use of pre-existing trails, roads, or disturbed areas should always be the preferred access point(s). By using these previously disturbed areas we can reduce the overall impact that occurs to the environment during initial response.

5.6.2 Exclusion Booming

Boom is deployed across or around sensitive areas and anchored in place. The approaching oil is deflected or contained by boom. This method is often used across small bays, harbor entrances, inlets, river, and creek mouths with currents less than 1 knot (0.5 m/s) and breaking waves of less than 1.5 ft (0.5 m) high. Typically, environmental effects are limited to minor disturbance to substrate at shoreline anchor points.

5.6.3 Deflection Booming

Boom is deployed at an angle to the approaching slick. Oil is diverted away from the HCA to a less sensitive location for recovery. This technique is often used across small bays, harbor entrances, inlets, river and creek mouths with currents exceeding 1 kt (0.5 m/s) and breaking waves of less than 1.5 ft (0.5 m). It should be used only on straight coastline areas to protect specific sites, where breaking waves are less than 1.5 ft (0.5 m). Typically, environmental effects are limited to minor disturbance to substrate at shoreline anchor points; however, diverted oil may cause shoreline oil contamination down-wind and down-current. A Net Benefit Analysis should be conducted to determine if deflection booming should be conducted.

5.6.4 Along-Shore Booming

Boom is positioned along the shoreline to provide a barrier to floating oil. Oil is diverted away from the sensitive area to a less-sensitive location for recovery. Along-shore booming might be difficult during a falling tide because constant attention is required to ensure the boom doesn't strand. This technique can be used in quiet areas with breaking waves of less than 1 ft (0.3 m). Typically, environmental effects are limited to possible shoreline oil contamination down-wind and down-current.

5.6.5 Shore-Seal Booming

Specially designed, shore-sealing boom is positioned in the inter-tidal zone to deflect oil. This technique can be used in a wide range of substrates but is most often used on mud and sand flats. Typically, environmental effects are limited to minor disturbance to substrate at shoreline anchor points.

5.6.6 Use of Passive Sorbents

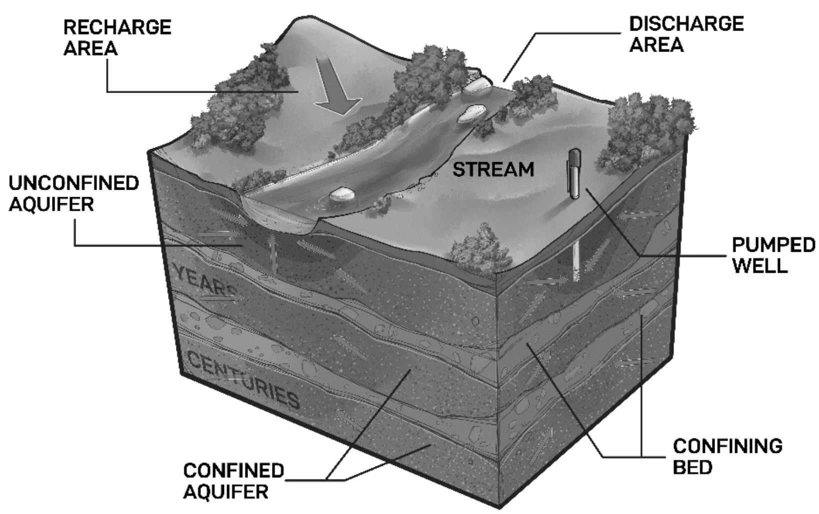
Sorbents are positioned in the swash zone to absorb incoming oil. This technique can be used in a wide range of low-slope substrates. Pom-Poms normally work best on heavier, weathered crude oil, while sorbent rolls work best on lighter, fresher crudes. The environmental effects of passive sorbents are typically limited to minor disturbance to the substrate.

5.6.7 Aquifers

Aquifers are underground water-bearing formations that are composed of permeable rock, rock fractures or unconsolidated materials. The pore space of the material stores water and allows for water movement throughout. Aquifers vary greatly in depth and can be either confined or unconfined.

It is important to understand the properties of an aquifer to know how it may respond to contamination or other influencing factors such as withdrawals. The direction and speed of groundwater travel are two very important factors in understanding an aquifer. Assessment of hydrogeological conditions and identification of groundwater uses will be conducted by the Environmental Unit as a first step towards developing an appropriate response strategy.

Prompt product recovery and expedited mechanical removal of impacted overburden will be the top priority to minimize vertical migration of contaminants and retention time within soils over a potential aquifer. If an aquifer is impacted, the main recovery process can be the extraction of groundwater to both contain lateral spread of the subsurface plume and recover and treat the impacted groundwater. See 5.1.1 Vacuum Truck, Gator Vacuum Truck, Port-a-Vac Unit for guidance on extraction.



An incident specific approach will be generated; see the *Groundwater Assessment Plan*.

6.0 DECONTAMINATION

6.1 Introduction

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. Decontamination is critical to health and safety at release sites. A decontamination area should be in a safe, convenient location for all workers to access. Decontamination protects workers from hazardous substances which may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on site. Decontamination protects site personnel and the environment by minimizing the transfer of harmful materials into clean areas. Decontamination can help prevent the mixing of incompatible chemicals which may create a harmful substance increasing the risks associated with cleanup activities. Decontamination protects the community by preventing uncontrolled transportation of contaminants from the site. Without an established decontamination area, clean up and remediation costs are increased as personnel transport releases material into clean areas increasing the impacted footprint and subsequent cleanup activities.

6.2 Decontamination Plan

Ensure that all site personnel are informed of the decontamination process including the location of hot, cold, and warm zones.

All Trans Mountain Decontamination Trailers contain the required equipment for the establishment of effective decontamination. In addition to the required equipment, each trailer contains a detailed Decontamination Plan which outlines the process for establishing effective decontamination stations.

The plan is also available on the intranet site in the Emergency Toolkit.

Included in the Decontamination Plan are details regarding;

- Roles and responsibilities for persons assigned to the Decontamination Group
- Location and layout considerations
- Personnel decontamination
- Small equipment and watercraft decontamination
- Guidelines for marine vessel decontamination
- Sample layouts for the decontamination of equipment and personnel

Refer to the Decontamination Plan located on the trailer prior to setup and on the intranet site in the Emergency Toolkit.

7.0 CONTROL POINT ROUTE MAP

8.0 GRP DATA SHEETS

9.0 FORMS

- Initial Site Health & Safety Plan
- ICS 201
- Gas Detection Record
- ICS 214
- ICS 211
- Ice Assessment Form
- Site Diagram

9.1 Initial Site Health & Safety Plan

INCIDENT PARTICULARS		
Incident Name:		Date/ Time:
Command Post Location:		Site Phone Number:
Product:	Est. Vol: m^3	MSDS Available: ☐ Yes ☐ No
ICS 201 Form Initiated:	☐ Yes ☐ No	Person Responsible:
Internal/ External Notifications Made:	☐ Yes ☐ No	Person Responsible:

SITE CHARACTERIZATION					
☐ Pipeline	☐ Storage Facility	☐ Truck	☐ Land	☐ Water	☐ Other (please specify)

SITE SECURITY & ACCESS POINTS
Description:

SITE HAZARDS				
☐ Fire Explosion	☐ Equipment Operations	☐ Trenching Excavation	☐ Fatigue	☐ Slips, Trips, and Falls
☐ Chemicals	☐ Motor Vehicles	☐ Confined Spaces	☐ Heat Stress	☐ Restricted Work Area
☐ Electrical	☐ Boat Operations	☐ UV Radiation	☐ Cold Stress	☐ Heavy Lifting
☐ Steam/ Hot Water	☐ Helicopter Operations	☐ Overhead/ Buried Utilities	☐ Weather	☐ Drum Handling
☐ Noise	☐ Shore Line Operations	☐ Pumps and Hoses	☐ Visibility	☐ Plants/ Wildlife
				☐ Other:

ATMOSPHERIC MONITORING – INITIAL READING				
O_2	%	LEL	%	Other (specify):
H_2S	ppm	Benzene	ppm	

NOTE: Additional results to be recorded in 'Emergency Response/ Safety Watch Log'

CONTROL MEASURES	SITE SETUP	
☐ Source of Release Secured	Communications Established	☐ Yes ☐ No
☐ Site Secured	Hot Zone Established	☐ Yes ☐ No
☐ Valve(s) Closed	Fire Extinguisher Accessible	☐ Yes ☐ No
☐ Energy Sources Locked/ Tagged Out	Decontamination Stations Established	☐ es ☐ No
☐ Facility Shut Down	Illumination Equipment Provided	☐ Yes ☐ No
☐ Other:	Medical Surveillance Provided	☐ Yes ☐ No
	Sanitation Facilities Provided	☐ Yes ☐ No

HOT ZONE PPE REQUIREMENTS

General	Other			Respiratory		
☐ Hard Hat	☐ Face Shield	☐ Rubber boots	☐ Leather gloves	☐ SABA/ Air Line w/ Esc		
☐ FR Clothing	☐ Tinted Lens	☐ High Vis. Vests	☐ Nitrile gloves	☐ SCBA to be worn	☐ Cartridge Type	OV
☐ Steel toes	☐ Impact Goggles	☐ PFD's	☐ Rubber gloves	☐ SCBA to be avail. #	☐ Cartridge Type	P(M)-100
☐ Safety Glasses	☐ Chemical Res. Clothing	☐ Safety Harness	☐ Hearing Protection	☐ Air Purifying (full mask)	☐ Cartridge Type	P(M)-100/OV
		☐ FR Rain Gear	☐ FR Tyvek	☐ Air Purifying (half mask)		

WARM ZONE PPE REQUIREMENTS

General	Other			Respiratory		
☐ Hard Hat	☐ Face Shield	☐ Rubber boots	☐ Leather gloves	☐ SABA/ Air Line w/ Esc		
☐ FR Clothing	☐ Tinted Lens	☐ High Vis. Vests	☐ Nitrile gloves	☐ SCBA to be worn	☐ Cartridge Type	OV
☐ Steel toes	☐ Impact Goggles	☐ PFD's (within 1m of shoreline)	☐ Rubber gloves	☐ SCBA to be avail. #	☐ Cartridge Type	P(M)-100
☐ Safety Glasses	☐ Chemical Res. Clothing	☐ Safety Harness	☐ Hearing Protection	☐ Air Purifying (full mask)	☐ Cartridge Type	P(M)-100/OV
		☐ FR Rain Gear	☐ FR Tyvek	☐ Air Purifying (half mask)		

TRAINING AND REVIEW	
Hazwoper Training Records Verified for U.S.A. Operations ☐ Yes ☐ No	All Responders have reviewed this Plan ☐ Yes ☐ No
Completed by:	

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9.2 ICS 201 Incident Briefing Form

1. Incident Name	**2. Prepared by:** (name) Date Time:	INCIDENT BRIEFING ICS 201-OS (pg 1 of 4)
3. Map/Sketch (include maps drawn here or attached, showing the total area of operations, the incident site/area, overflight results, trajectories, Impacted shorelines, or other graphics depicting situational and response status)		
INCIDENT BRIEFING	January 2025	ICS 201-OS (pg 1 of 4)

1. Incident Name	**2. Prepared by:** (name) Date Time:	INCIDENT BRIEFING ICS 201-OS (pg 2 of 4)

4. Initial Incident Objectives

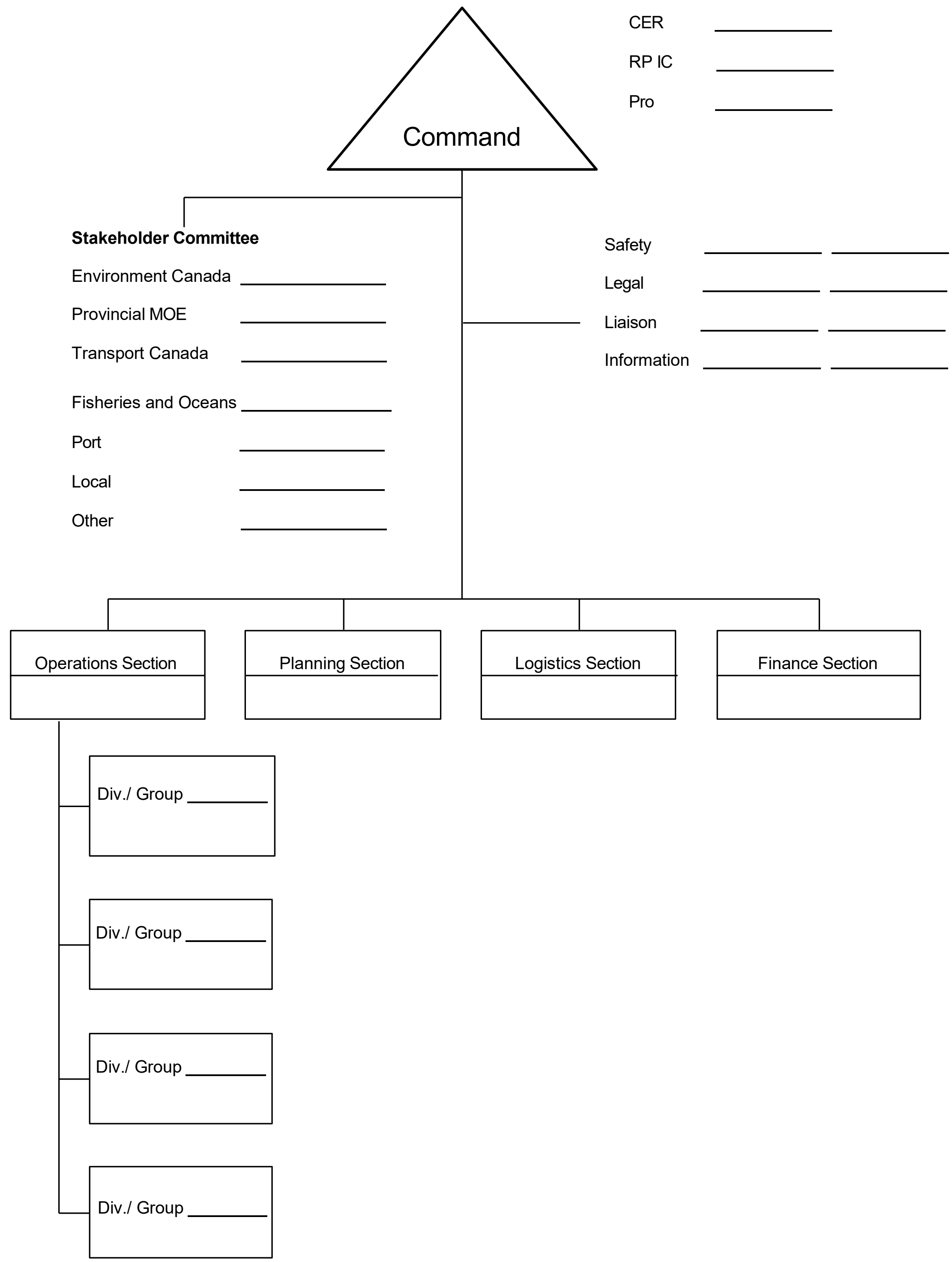
5. Summary of Current Actions

Time	Action/Note

INCIDENT BRIEFING January 2025 ICS 201-OS (pg 2 of 4)

1. **Incident Name**	2. **Prepared by:** (name) Date Time:	INCIDENT BRIEFING ICS 201-OS (pg 3 of 4)

3. Current Organization



INCIDENT BRIEFING January 2025 ICS 201-OS (pg 1 of 4)

1. Incident Name	**2. Prepared by:** (name) Date Time:	INCIDENT BRIEFING ICS 201-OS (pg 4 of 4)

7. Resources Summary

Resources Needed	Time Ordered	Resources Identifier	ETA	On-Scene? (X)	NOTES: (Location/Assignment/Status)

INCIDENT BRIEFING January 2025 ICS 201-OS (pg 4 of 4)

9.3 Gas Detection Record

GAS DETECTION RECORDS

DATE:	**PAGE NUMBER:**
DATA COLLECTOR:	**OTHER:**

GAS DETECTION EQUIPMENT INFORMATION

MANUFACTURER:	**MANUFACTURER:**
MODEL:	**MODEL:**
SERIAL NUMBER:	**SERIAL NUMBER:**
TYPE:	**TYPE:**
DATE OF LAST CALIBRATION / TEST:	**DATE OF LAST CALIBRATION / TEST:**

			Benzene					
Location	Time	VOC ppm	ppm	STEL	O_2 %	LEL %	H_2S ppm	CO ppm

EHS Rev. 0 19-Nov-2011

9.4 ICS 214 Unit Log

UNIT LOG	1. Incident Name	2. Date Prepared	3. Time Prepared
4. Unit Name/Designators	5. Unit Leader (Name and Position)		6. Operational Period

7. Personnel Roster Assigned		
Name	ICS Position	Home Base

8. Activity Log	
Time	Major Events

9. Prepared by (Name and Position)

9.5 ICS 211 Check-in List

1. Incident Name	2. Operational Period (Date / Time) From: To:	3. Check-in Location ☐ Command Post ☐ Other ____ ☐ Staging Area ____	CHECK-IN LIST (Personnel) ICS 211p-OS

Personnel Check-in Information

4. Name	5. Company / Agency	6. ICS Section / Assignment / Quals.	7. Contact Information	8. Initial Incident Check-In? (X)	9. Time In	9. Time Out
				☐		
				☐		
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10. Prepared by: Date / Time	11. Date / Time Sent to Resources Unit

CHECK-IN LIST (Personnel) January 2025 ICS 211p-OS

9.6 Ice Assessment Form

Date:	**Location (Control Point):**	**GPS Coordinates:**
Completed by:		
Climate Condition: Calm/Snow/Rain/Wind	List Names of Responders Present or use 211p Form	3)
Visibility Factors: Clear/Fog/Light/Dark	1)	4)
Today's Temperature: __________0 C	2)	5)

Ice Measurement Data		**Control Record**	**Yes**	**No**	**If No a corrective action is required**
Hole Distances Are Measured		Tailgate Meeting Completed			
From the east/north to west/ south shore		Ice Safety Plan Completed			
		Environment River Forecast Reviewed			
Test Hole #	**Ice Depth**	Safety Signs in Correct Position			
#1-	cm/inches	Safety Signs Clean/Visible			
#2-	cm/inches	Barricades in Correct Position			
#3-	cm/inches	Test Holes—Staked & Numbered			
#4-	cm/inches	Work Area Clear of Snow			
#5-	cm/inches	Access Path Surface Visible			
#8-	cm/inches	Unusual or Deep Cracks Observed			
#9-	cm/inches	Water Visible in Cracks			
#10-	cm/inches	Thin Ice On/Near Shoreline			
#14-	cm/inches	Shore Inspection: Water on Surface—Shore Ice Lifting or Bulging—Shore Ice Falling or Dropping—Shore Ice Bulging/Breaking Up Stream—Water on Surface Up Stream			
#15-	cm/inches				
#16-	cm/inches	**Ice Weight Bearing Capacity Data**			
#17-	cm/inches	Yesterday's Load Capacity Rating: ___________________KG/lbs.			
#18-	cm/inches	Today's Load Capacity Rating: _______________________KG/lbs.			
#19-	cm/inches	List Potential Problems Developing on Work Area or Up Stream:			
#20-	cm/inches				
#21-	cm/inches	**Gold's Formula - P = A x h²** where: P is the calculated allowable load in kilograms, A is the selected risk tolerance value, h is the effective thickness of good quality blue/white ice (cm/inches). Refer to Section 4.4.2 of this manual for instructions in completing the formula.			
#22-	cm/inches				
#23-	cm/inches				
#24-	cm/inches				
#25-	cm/inches	**List Name (s) of Persons Notified**			**List Time of Notification**
#26-	cm/inches	1) On-scene Supervisor:			am/pm
#27-	cm/inches	2) Safety Officer (Incident Command):			am/pm
#28-	cm/inches	3) Safety Watch:			am/pm
#29-	cm/inches	4) Rescue Team:			am/pm
#30-	cm/inches	5)Environment Unit:			am/pm

9.7 Site Diagram