1501253 BC Ltd.'s responses to KIA's Review dated March 18, 2025.

Date: March 25, 2025

To: John Roesch, Senior Project Officer, KIA, Department of Lands, Environment and Resources

Copy: Richard Dwyer, Manager of Licensing, Nunavut Water Board

From: Alexandre Jones Vilela da Silva, c/o 1501253 BC Ltd.

Subject: Response to Environmental Protection Operations Directorate's review of 1501253 BC Ltd.'s Type B Water Licence Application 2BE-CPM---- for the Coppermine Project

Region: Kitikmeot

Summary

The Kitikmeot Inuit Association (KIA) has reviewed 1501253 BC Ltd.'s Type B Water Licence Application 2BE-CPM---- for the Coppermine Project and made several recommendations. This document directly addresses these recommendations by either responding directly in this document, and/or amending application documents. The document list below outlines documents that were amended to assist with the queries and recommendations, and have been attached with this response.

Document List:

Closure and Reclamation Plan

Wildlife Management Plan 1501253 B.C. Ltd V3

Water Use Application V2

MAP APPENDIX_1501253 BC Ltd

Spill and Fuel Management Plan 1501253 B.C. Ltd V3

Waste Management Plan 1501253 B.C. Ltd V3

Maps IOL Application V2

Seasonal Ranges_Nagy et al

Subpopulation_Nagy 2011

Recommendation 1: The proponent and the NWB consider cumulative environmental effects from the project in relation to other projects operating in the same area, in particular to water draw down from local water sources.

Response 1: 1501253 BC Ltd. would like to clarify the size and scope of the current proposed work program as being very small and of a short and temporary nature. The project is applying to drill 15 short drillholes (approximately 1250 metres total), which the Company expects to take 2-3 weeks in total, using one drill rig. The rig used will be a small, light, helicopter transportable drill rig as shown in the below photo. At the start of the application process the Company was unsure what type of drill rig was going to be used (diamond core or RC), so applied for water use coincident with a small diamond core drill rig (maximum 20m3/day, more likely 2-3m3/day). Since applications have started, the company has engaged contractors for an RC drill rig, which is a dry drilling method and doesn't use any water. The company would like to note the very small footprint of each drill site (maximum 15x15 metres, the drill rig taking up about 2x3 metres or less). The company has requested up to 1.2 Ha total disturbance, which is 0.001% (one thousandth of a percent) of the company's total claim area, and 0.002% (two thousandths of a percent) of the company's land area which overlaps IOL.

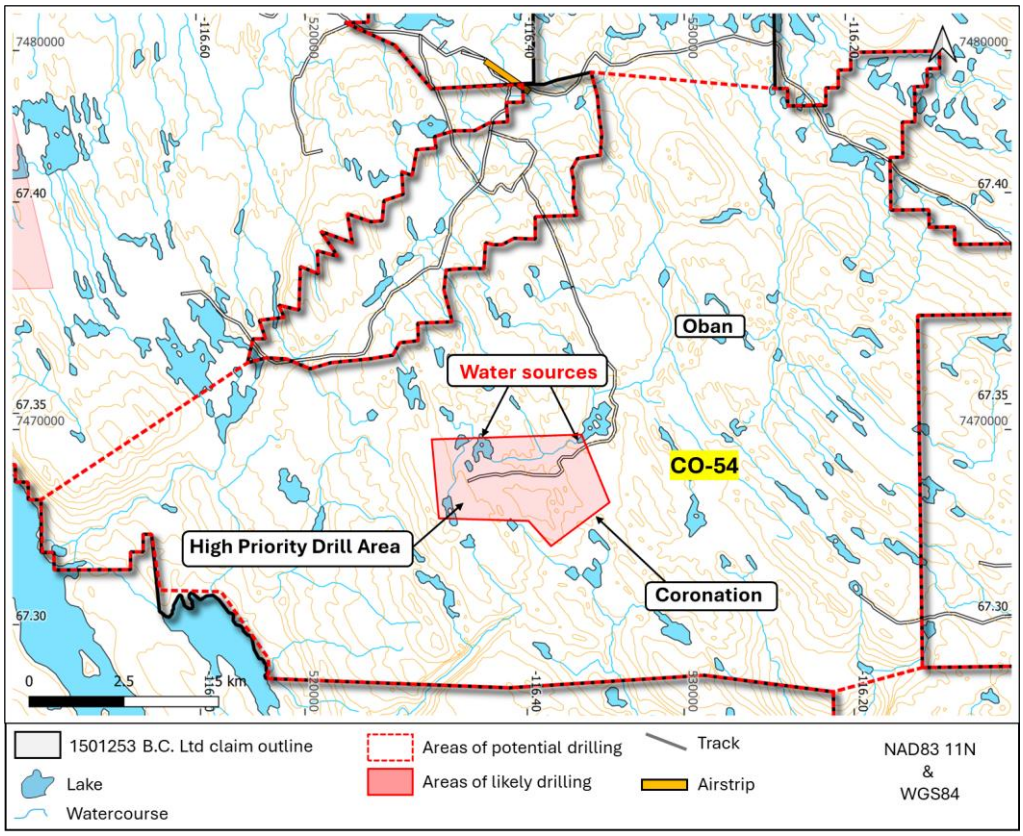
Due to the company only conducting exploration on its own tenements, there will be no crossover with water extraction from neighbouring licence holders, as water would only be taken from lakes on the Companies own licences. However, due to the Company planning on using an RC rig for this season's drilling, the Company doesn't expect to have to draw water from within the project area. Should a diamond rig be used, it is likely that only 2-3m3/day would be used, as recycling tanks are used to re-use water.

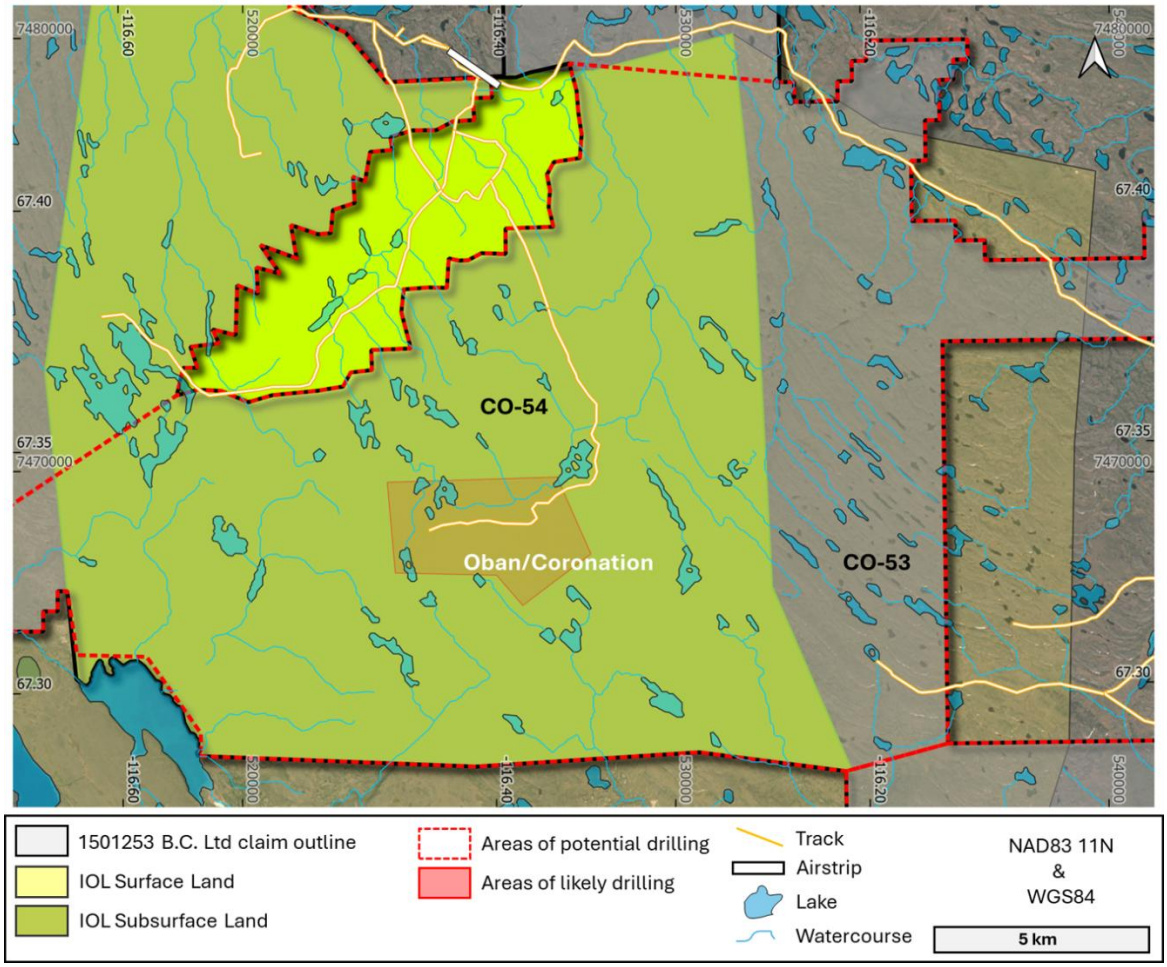
The closest the Company expects to be drilling is at least 10 km away from one of White Cliff's apparent proposed drilling areas.

Recommendation 2: The proponent provide the location of drilling activities in relation to local water sources.

Response 2: Should water be taken for drilling purposes (which is unlikely as we plan on using an RC drill rig, which is a dry drilling method, and no camp is being proposed), water would be taken from nearby small lakes are streams close to the drill location. If water is taken for drilling purposes, it will be done by a small pump sitting in a secondary containment bund, with a mesh fitted over the intake hose.

Please see below image for highest priority drill location on CO-54, where the majority of the 15 planned holes are likely to occur, and lakes and water courses in the area which may be used as water sources. Due to the early-stage nature of mineral exploration, ongoing interpretation, and need to collect further data in the field, it is not possible to dictate the exact collar locations of the drillholes yet. The location where drilling will likely occur is shown on the map. During the entire program, drilling will only occur more than 31 metres away from the ordinary high-water mark of any water body, and no wastewater will be deposited into any water bodies, or closer than 31 metres from the ordinary high-water mark of any water body. Small hand-dug sumps will be used to dispose of any wastewater, none of which will contain any pollutants or hazardous materials.





Also attached in the document list (MAP APPENDIX_1501253 BC Ltd) are maps of the entire project area, showing areas of potential and likely drilling, and potential water sources for any water that is taken.

Recommendation 3: The proponent place coco matting underneath drilling rigs to minimize disturbance to the site.

Response 3: Agreed, this will be adhered to and photos taken for reporting purposes.

Recommendation 4: The proponent update and clarify submitted documents addressing KIA's comments as required.

Response 4:

Acquisition of Prescott Project *announcement dated Dec 10, 2024 – This twenty-three page describes Somerset's acquisition of the Coppermine Project, adjacent to White Cliff Minerals Rae Project.*

Response: N/A

NPC File # 150589 *dated Jan. 10, 2025 – This two-page document lists lead regulatory and Company personnel and summary description of the project and then states that NPC has determined it is exempt from screening by the NIRB, and that NPC has no concerns regarding the cumulative impacts of the project proposal.*

There are good descriptions of the various aspects of the project provided. It mentions this will be the maiden exploration program for the Company in this area. An extensive list of Material and Fuel Use is provided. It mentions the Project Schedule is for a start date of 2025-01-01 and end date of 2028-01-01.

Response: N/A

Mineral Exploration Agreement *between NTI and 1501253 Nunavut Ltd. dated November 1, 2024 – This agreement deals with the two proposed sub-surface IOL parcels the company wants to drill on. The other two parcels (i.e., CO-53 & CO-61) are not included. The document provides guidance for the company based on a template that considers a wide range of exploration projects up to small-scale mining projects.*

Response: N/A

Application for Access to Inuit Owned Land *– This seven-page form was completed and dated Jan. 27, 2025.*

Response: N/A

Appendix A of KIA IOL Application *- Part 1 of this appendix text mentions that an airstrip by Hope Lake may be used for fixed wing aircraft and that ATVs may be used to transport light drill equipment or fuel using existing tracks where possible. And in winter, supplies may be transported from Kugluktuk to the drill sites via winter tracks,*

supported by Kugluktuk based businesses or personnel. No all-weather roads or permanent structures will be built…"

Project Summary - Text states the drills are to sit on 8"x8"x12' timbers. The KIA have identified a deficiency in there being no plans to use coco matting under the drill rigs to minimize disturbance to the underlying vegetation.

Work could be undertaken during any of the four seasons and would cease during caribou calving and post calving periods. In winter, winter tracks may be utilized to access sites from Kugluktuk. No information is provided on how these winter roads would be deactivated. All disturbances should be checked on by regulatory agency inspectors prior to demobilizing them from the project areas and remedied immediately by the company.

Response: The company will place coco matting under the drill rig to minimize disturbance to underlying vegetation. This has been updated in the Wildlife Management Plan document. Details on winter track deactivation has been added to the Closure and reclamation Document.

CPM Annual Report *dated June 30, 2024 – the Annual Report provided in the NWB submission is for Somerset Minerals Ltd. It discussed their project work in the high arctic on several islands including Prince of Wales, Somerset and Cornwallis Islands as well as other locations. There is no mention of the Coppermine project area to be investigated as part of this current application process.*

Response: N/A

Water Sources-IMLE.csv *dated Feb. 10, 2025 – This Excel spreadsheet lists some 766 potential water sources, identifies their centroid lat. & long. locations, surface areas and estimated water volumes available from each assuming a drawdown of 0.1 meter. The closeness of any of these sites to the eventual drill sites has not been demonstrated as the proposed drill site locations have not been identified.*

Response: The drill site locations are outlined in the attached 'MAP APPENDIX_1501253 BC Ltd' document and were submitted in the '2. Maps Water Application' document with the water use permit application. These images clearly show streams, rivers, ponds and lakes, and show the areas where drilling will likely take place. The 766 potential water sources are taken from the centroids of the lakes shown in these maps. The closeness of the drill site to water sources will be up to 600 metres away, with water extracted via a long plastic hose.

NWB Water License Application *dated Feb. 11, 2025 – The application filled in by the company appears to utilize a NWB General Water License Application template from April 2013. A check of the NWB website still shows that version of the application as being current.*

Response: N/A

Section 4 *- Location of Undertaking states the project will utilize a hotel in Kugluktuk for camp requirements for persons working on the project. Up to 15 persons may be involved. The capacity for housing this number of persons in Kugluktuk is unknown and if not what new facilities will be required to accommodate the workers?*

Response: The company has been in contact with and received quotes from all available accommodation centres in Kugluktuk and checked capacity and available dates, and sees no issues regarding accommodation.

Section 15 *– Quantity & Quality of Waste Involved text states waste drill water will be disposed of in hand-dug sumps, whereas Section 17 – Predicted Environmental Impacts…states this water may be disposed of in natural depressions or designated sumps. Care is required to minimize the spread of the waste drill water across a larger footprint and thus a deeper and smaller surface area dug sump is much preferred. And each drill's sump needs to be backfilled with excavated soil once the drilling has been completed at that site. A list of all likely drill additives is not provided. However, the text suggests their selection of additives will ensure minimal potential environmental impacts in the event of any spills.*

Response: Water will be disposed of in deeper and smaller hand-dug sumps, so that each sumps footprint is small as possible. Each sump will be backfilled with soil upon site cleanup. This has been updated in the 'Water Use Application V2' document.

The Company has added potential drill additives and spill materials to the 'Spill and Fuel Management Plan 1501253 B.C. Ltd V3' document, which is attached.

Section 18 *- Water Rights… states "…the Company is not aware of any overlapping water users in these areas". However, White Cliff Minerals propose to be drilling on a number of the same parcels as other companies so there is potential for cumulative impacts of drawing water from the same sources.*

Response: The company would like to direct the reader to Response 1, at the top of this document.

Section 20 *– Consultation discusses communication between Company personnel and the Mayor of Kugluktuk. It is unclear who "Amanda (HTO representative)" is and whether that communication was finally made.*

Response: This section is to show a record of effort made by the Company to engage with the local community of Kugluktuk, to address any concerns that they may have and allow us to introduce ourselves to form a relationship. Amanda Dumond is the Manager of the Kugluktuk HTO. Communication with Kugluktuk HTO is ongoing.

Section 21 *-Security Information provides an estimated cost of $9,600-$18,000 for final reclamation of all the sites and proposes financial security in that range. The upper estimate should be the minimum to be considered as several other elements are not included but should be added which would add to the total; e.g., helicopter cost for transport of reclamation workers between the drill sites, removal costs for any hazardous wastes, restoration of winter tracks or trails between drill sites, etc.*

The KIA suggests security in the order of $40,000 for these reasons, unless the company provide detailed cost estimates for these tasks that support a lower total financial security.

Response: Due to reclamation being conducted on a continuous basis, the Company does not anticipate there to be any chance of unforeseen reclamation, and anticipates this to be very low if it were necessary. However, the Company agrees to the proposed bond from KIA of $40,000 for final reclamation security.

Section 22 – Financial Information mentions the agreement between 1501253 BC Ltd. and Somerset Minerals Limited. It states Somerset is listed on the Australian Securities Exchange and appears to be financially capable to undertake the proposed program based on their claimed cash balance. They should have the funds to be able to provide adequate financial security to cover any potential environmental or other liabilities incurred by the project.

Response: N/A

Section 24 – Proposed Time Schedule only states that Operation and Closure of the project could be all-season. And a two-year window of May, '25 - May, '27 is proposed for Operation of the project. No specific dates are proposed for the other three stages of the project (i.e., Construction, Closure and Post-Closure) although it is anticipated these will be very short-duration stages for this project.

Response: Due to the very early-stage nature and small scale of activities, this work program will not follow a typical '*Construction, Closure and Post-Closure'* format, as there is no camp being constructed, and drill sites will be rehabilitated as they are completed. The Company would like to direct the reader to the 'Closure and Reclamation Plan' for details on how rehabilitation will be done throughout the project.

Waste Management Plan – The document is not dated.

Response: This document has been dated.

Section 1 *- Introduction includes mention of photography to be taken at the drill sites after activities are completed. Figure 1 outlines the areas of potential drilling which does not line up with the area map with all the KIA parcel numbers provided in the Coppermine Summary for WK document (ref: KIA 2025b). The source of the map in that document is not known by KIA and should be properly referenced.*

Response: The company has submitted maps relevant to each department for its applications.

- For the KIA land access application, maps clearly showing areas of proposed drilling in relation to the different IOL parcels were submitted.
- For the water use application, maps clearly showing areas of proposed drilling in relation to water sources were submitted.

The areas of drilling remain the same in all maps and all applications.

The maps have been created on Company GIS software called QGIS, so that the appropriate layers and features can be clearly shown for the appropriate departments. The maps that were submitted to the KIA outlining the areas of proposed drilling are attached as 'Maps IOL Application V2'.

Section 2 *- Waste Types refers to "…activities proposed for the 2024 field season…" It is unclear when this document was prepared and also for which project the material may have been pulled from.*

Response: This was a typo. The document has been corrected, and is attached as 'Waste Management Plan 1501253 B.C. Ltd V3'.

Section 3.0 *- Waste Management Infrastructure mentions the use of a waste staging area in a bear-fenced perimeter of the project's camp location. However, other*

documentation states there will be no camp and that workers will be flown daily to the sites from Kugluktuk where they will be housed in a hotel (ref: Water License Application Section 4.).

Response: This was an error. There will be no camp. The waste staging area details have been updated in the document, and attached as 'Waste Management Plan 1501253 B.C. Ltd V3'.

Wildlife Management Plan *– The document is not dated. Interestingly the site supervisor for the project and main contact for all wildlife-related matters is a person out of Australia. It is presumed this person will be periodically based out of Kugluktuk during the program.*

Response: The document has been dated and attached. The site supervisor is the Company's Exploration Manager who will be on site, managing and overseeing the program.

Section 1 *– Introduction The bulk of this section deals with what is likely material from the Spill and Management Plan where descriptions of fuel and spill management for the project are discussed. This material should be removed from the Wildlife Management Plan.*

Response: This information is relevant to the project, and is incorporated at the start of the document in case the Wildlife Management Plan is read on its own, in isolation to the Spill Management Plan.

Section 4.1 *- Drill Rig Setup mentions the recording of all wildlife encounters to be recorded in a Wildlife Log and discussed with other workers. This log should be available for review by site inspectors.*

Response: Yes, this will be available for review by inspectors.

Section 4.5 *- Reporting mentions wildlife interactions and it outlines agencies that should be contacted in the event of any incidents.*

It is unknown to KIA whether the general locations and dates of when caribou calving and post- calving typically occur in this area (and the parcels themselves) and if so, these should be specified in the MP so as to ensure they aren't missed.

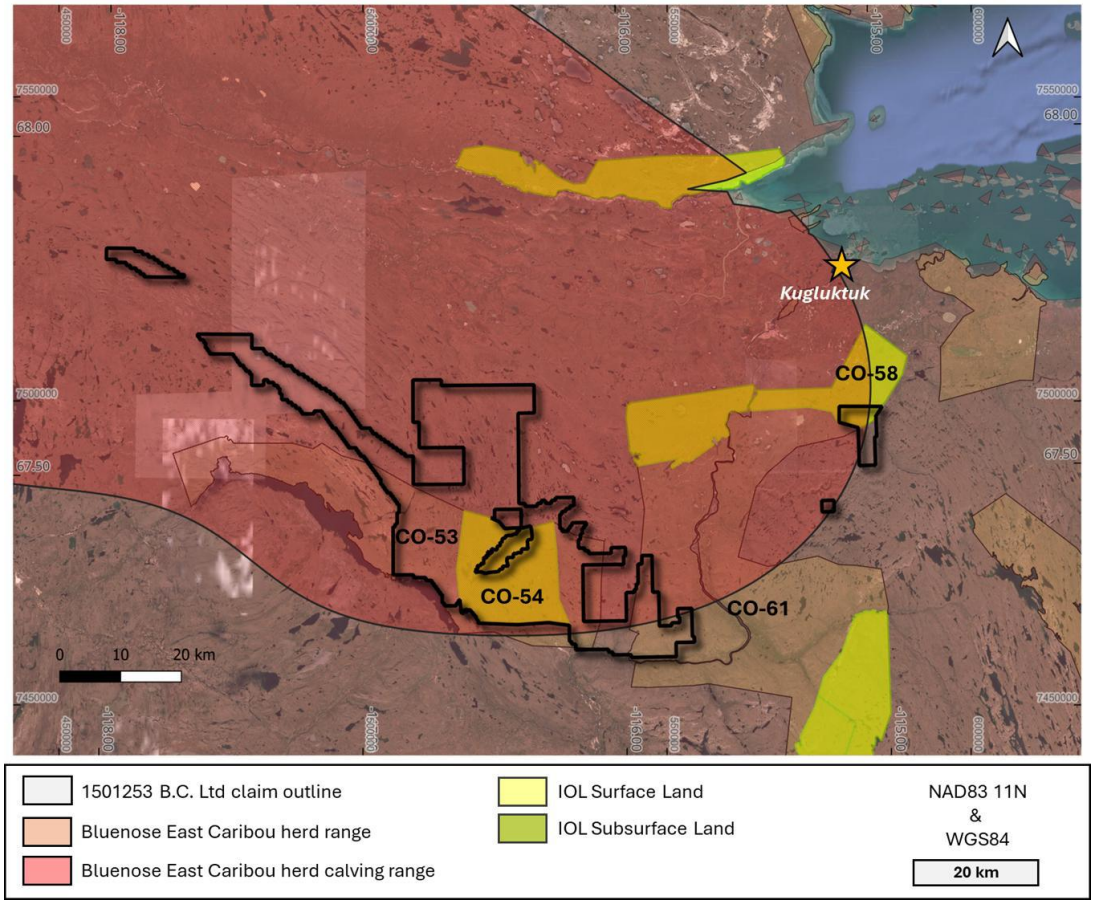
Due to the remoteness of the parcels and the company's plans to do field exploration work with personnel wandering across the parcels emergency communication mechanisms (e.g., all field personnel to carry walkie talkies or satellite phones) in the event there is a wildlife interaction.

Response: The outline for the Bluenose East caribou herd geographical calving range is shown on a map below, in the attached 'Maps IOL Application V2', and was submitted to the KIA in the separate IOL use application. The dates of 28th May – 3rd July are mentioned in the Project Summary and NPC determination attached to the water permit application. This geographic outline of caribou calving comes from the 2011 paper by Nagy et al., titled 'subpopulation structure of caribou (Rangifer tarandus L.) in arctic and subarctic Canada', which shows the annual and calving range of the Bluenose east caribou herd.

Another paper by J.A. Nagy et al, titled 'Seasonal Ranges of the Cape Bathurst, Bluenose-West, and Bluenose East Barren-Ground Caribou Herds', 2005, (attached) defines the bluenose east caribou herd calving and post-calving dates as being from 28th May – 20th June. Delaying work until the 3rd of July as proposed allows a 2-week buffer after post-calving.

This proposed shutdown period calving date range (28th May – 3rd July) used for this application was taken from White Cliff Minerals approved permits (NPC determination 150522, NIRB 24EN047) for exploration work done in 2024. This map and references has been added to the Wildlife Management Plan, which is attached.

All staff will be equipped with necessary communication devices, such as walkie-talkies, satellite phones, or emergency-personal-locator-beacons as needed.



Spill and Fuel Management Plan *- The document is not dated. The document includes phone numbers of lead contacts in the event of a spill. Due to the remoteness of the drill sites and the need to respond to spills immediately the Plan should include names of site personnel who will have satellite phones as well as communication between Company personnel on different land parcels and that can reach appropriate agencies in a timely manner as well as to access any additional resources that may be required for clean-ups.*

Response: This document has been dated.

The document will be updated closer to the time with satellite phone numbers (the company hasn't hired or bought these yet) and specific communication details regarding contacts.

Section 2.0 *- Potential Spill Materials Inventory mentions Jet Fuel and Diesel Fuel. It is unknown whether any of the drill additives or fuels, lubricants, etc. for any of the other mechanical units to be used at the sites should also be included in the inventory. Are any of them classified as Hazardous Materials?*

Response: Potential drill additives and spill materials have been added to the 'Spill and Fuel Management Plan 1501253 B.C. Ltd V3' document, which is attached. Jet fuel and diesel are classified as hazardous materials. All lubricant, fuel and additives will be treated as hazardous and stored appropriately.

Section 5 *– Roles and Responsibilities outlines the three levels of personnel to be involved. It mentions but possibly needs to stress that it is the responsibility of the Site Supervisor to notify the appropriate authorities should there be a reportable spill.*

Response: The Spill and Fuel management plan has been updated to stress that it is the site supervisors role to notify the appropriate authorities should there be a reportable spill.

Recommendation 5: Documentary photos and videos should be provided of each drill site and other disturbance before and after of work and reclamation and that these be provided to KIA.

Response 5: Agreed, this is outlined in the Closure and Reclamation Plan.

Recommendation 6: The proponent provide a more detailed closure & reclamation plan with cost estimates being provided to set an appropriate amount of financial security for reclamation.

Response 6: The Company has set out a detailed Closure and Reclamation Plan, which is attached. Due to reclamation being conducted on a continuous basis, the Company does not anticipate there to be any chance of unforeseen reclamation, and anticipates this to be very low if it were necessary. However, the Company agrees to the proposed bond from KIA of $40,000 for final reclamation security.

If you have any more questions or I can be of any further assistance, please don't hesitate to contact me.

Kind regards,

Alex Vilela
Exploration Manager, 1501253 B.C. Ltd
alex.vilela@sentinelresources.com.au

Closure and Reclamation Plan

1501253 BC Ltd – Coppermine Project

20/03/2025

REVISION HISTORY

The table below is a revision history table that outlines the revisions made by 1501253 B.C. Ltd to this document.

Version	Date	Section	Summary of Changes

This Closure and Reclamation Plan outlines 1501253 BC Ltd's general approach to site reclamation for the exploration activities. Drilling may occur in Summer, Fall, Winter and Spring, but will likely not occur in the middle of winter. Throughout the drill program, all sites will be progressively reclaimed following completion of drilling each hole. The goal of reclamation is to restore disturbed areas to a natural state, and minimize any potential environmental impacts.

Sample bags may be stored in the field for 1-6 months, while the company awaits the assay results. Once assay results are received and verified, then the remaining sample will be tipped out, and contoured to the ground as best as possible. The sample bags will contained crushed rock and dirt and are completely natural and non-toxic.

Closure Objectives

The primary objectives of closure and reclamation are:

- Minimize environmental disturbance and restore impacted areas to a stable and natural condition, making it look as close to original as possible.
- Remove all project infrastructure and rubbish upon completion of exploration.
- Maintain ecosystem integrity.
- Protect water quality and wildlife habitat.

Progressive Reclamation

Progressive reclamation will include:

Drill Hole Management: Drill holes will be securely capped to prevent contamination and subsurface connectivity issues, and marked with a labelled peg for future reference.

Cuttings Management: Any drill cuttings returned to surface will be deposited of in a small hand-dug sump near the drill rig. This will allow solids to settle and water to return to the ground. Sumps will be covered in over the top and afterwards. GPS coordinates will be recorded and photos taken.

Surface Disturbance: Drill pads will be levelled and re-contoured to match the surrounding landscape as it was beforehand, restore topsoil, and any plant material carefully. This will be done by hand tools. When samples are tipped out of bags they will be done so in areas where there is little-no vegetation, in areas of natural depressions. Care will be taken to ensure no animal habitats are disturbed in the process.

Waste: A thorough inspection of the area will be undertaken by the project manager or site supervisor after each drill rig is moved away, to check for any waste that was missed during clean up. The project manager or site supervisor will also be responsible for ensuring safe and responsible removal of any contaminated spill material, and that rubbish and waste is stored and transported correctly.

Photos: Photos will be taken of each site afterwards as a record, and for reporting purposes.

Reporting: The date of drill rig setup, dismantling, and site remediation will be recorded in a document managed by the project manager and site supervisor.

Waste Management

Hazardous and Non-Hazardous Waste: All waste, including fuel containers, chemicals, and general refuse, will be removed from the site and disposed of at approved waste management facilities.

Fuel Storage and Spill Prevention: Any remaining fuel or hazardous materials will be transported off-site, and secondary containment areas will be dismantled with no residual contamination left behind.

Winer Road Closure

A temporary winter track may be used to transport supplies via snowmobile or snowcat from Kugluktuk to the project area. Decommissioning the winter track will involve the following:

1. Remove any stakes or flags used for navigation.

2. Fluff & disperse compacted snow (if needed)

- If the track is heavily compacted, a rake or light grooming equipment will be used to loosen the snow and help it melt evenly. In most cases, this isn't necessary unless there are deep ruts that could cause water pooling in the spring. If frozen water bodies are crossed, v-notches will be cut into the ice.

3. Allow natural terrain recovery.

- Arctic tundra is sensitive, but a well-used snow track typically doesn't cause long-term damage unless deep ruts or exposed soil are present. If a section was damaged by excessive vehicle use (e.g., in late-season thawing conditions), light snow distribution will be placed over it before spring to help prevent erosion.

4. Final Check & Cleanup

- Final inspection of the route to make sure no rubbish or equipment is left behind.
- Take photos for records and reporting purposes.

Final Closure Activities

Upon project completion, a final site assessment will be conducted to ensure all reclamation objectives have been met. This will include:

- A final inspection of drill sites.
- Removal of sample from sample bags and contouring.
- A review of any remaining areas requiring further reclamation efforts.
- Decommissioning of any winter tracks.
- Submission of a Final Reclamation Report to regulatory authorities, including photographic documentation and GIS-referenced data.

This Closure and Reclamation Plan ensures that all drill sites and associated temporary structures, sumps, samples and waste are adequately and responsibly managed, and that the land is progressively reclaimed to minimize environmental impact and restore the land to its natural condition. The Applicant is committed to responsible mineral exploration and will adhere to all applicable environmental regulations and land use requirements.

1501253 B.C. LTD

Wildlife Management Plan

Coppermine Project

Coppermine River area, Kugluktuk

21/03/2025

Contents

REVISION HISTORY

The table below is a revision history table that outlines the revisions made by 1501253 B.C. Ltd to this document.

Version	Date	Section	Summary of Changes
1.2	04/03/2025	Intro	Updated diamond drilling to 'drilling'. Updated map.
1.3	21/03/2025	2.0, 3.0	Added Buff-breasted sandpiper and Red Knot, Transverse Lady beetle
1.3	21/03/2025	4.2, 4.3, 4.4	Added more detail
1.3	21/03/2025	4.6 table 1	Added email for bird sightings
1.3	21/03/2025	Appendix B	Added map of bluenose east caribou herd calving grounds and reference
1.3	21/03/2025	3.0 table 2	Added mitigation methods to reduce effect on fish, and coco matting for tundra plant species

1.0 Introduction

The Coppermine Project is an early-stage mineral exploration program that will likely include a small drilling program for approximately 10-20 holes, geological mapping and prospecting, rock chip and soil sampling, small ground-based non-invasive geophysical surveys, and possibly airborne geophysical surveys. Staff will be based out of Kugluktuk or Hope Lake Camp (managed by White Cliff Minerals, NPC file No 150522) and fly to site via helicopter or fixed wing. Activities will cease during the Bluenose East caribou herd calving and post calving form from 28th may to 3rd July.

Diesel fuel will be used for the drill rig, and aviation fuel (A1) will be used for the helicopter. Small fuel caches up to 3,800l of combined diesel and aviation fuel will be created at the drill site and possibly other locations in the project area to support geological mapping, rock chip sampling and prospecting. Fuel will be stored on a flat area in 205l barrels, and in sit in a secondary pop-up containment bund that is sealed to prevent any spillage or leakage from seeping into the underlying soil. Fuel caches will be stored at least 31 metres away from the ordinary high-water mark of any water body.

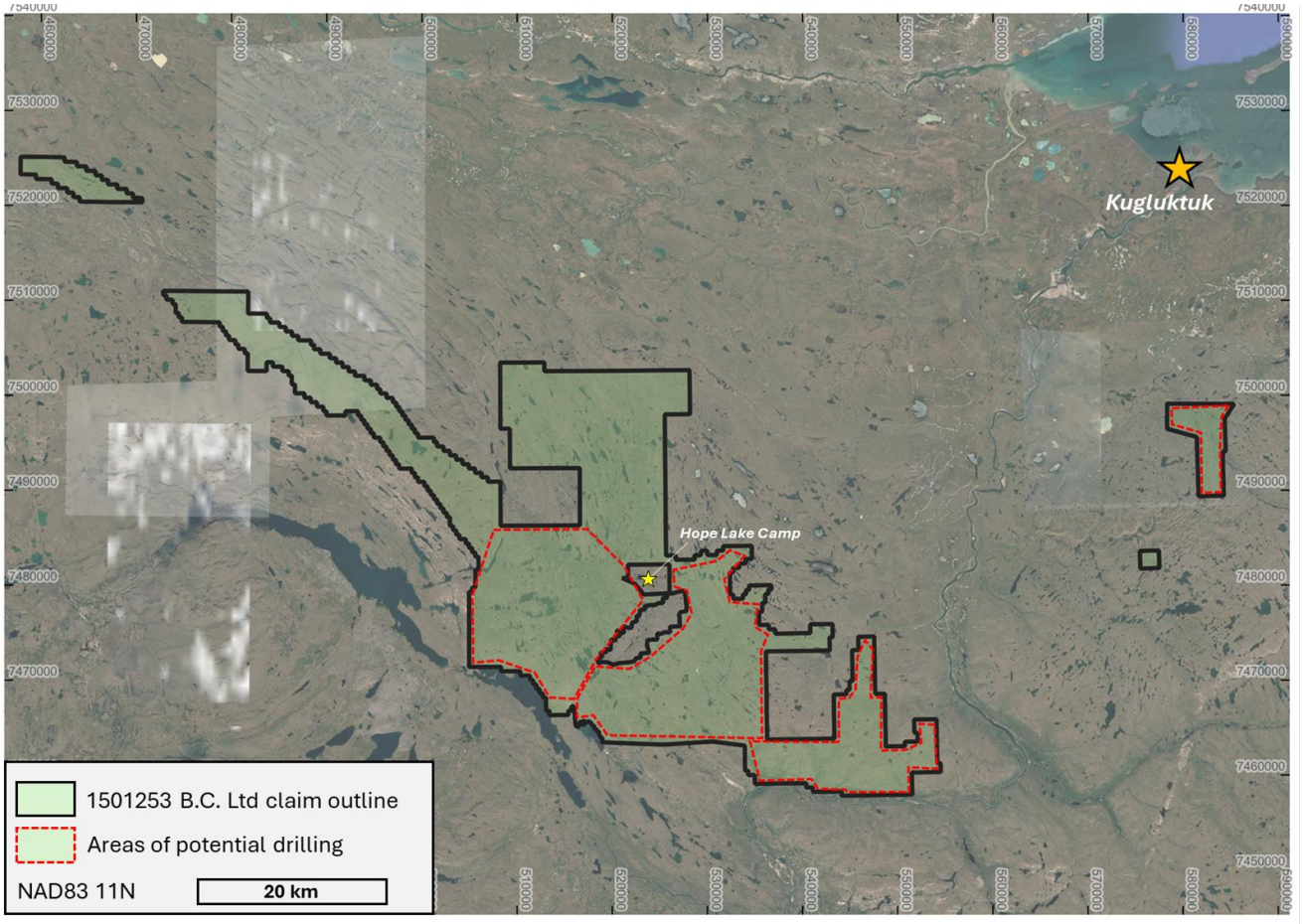
Spill kits will be located at each cache, and at the drill rig. Kits will contain fuel absorbent pads, heavy duty plastic bags, tarps, and empty drums or buckets, and hand tools.

After drilling is complete and the site is remediated, 1501253 B.C Ltd will conduct a thorough inspection of each drill location area to check for:

- Hydrocarbon staining
- Fire and safety hazards
- Debris or litter

1501253 B.C Ltd commits to taking a series of photographs of the drill site locations after the activities are complete, for recording and reporting purposes. All items, waste, and fuel barrels will be removed upon completion of each hole.

Figure 1. Project Location



All employees and contractors working on site must be familiar with the Wildlife management Plan. The Plan will be printed and laminated, and posted at the drill site.

The site supervisor for the Coppermine Project, and main contact for all Wildlife related matters is listed below:

Alex Vilela
Exploration Manager

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+61 45 9298209

2.0 Wildlife and Habitat Features of Concern

Table 1 below lists the terrestrial species that may be encountered in the Project area and marine mammals in the surrounding waters, as well as listings from the federal Species at Risk Act. The Act defines “threatened” as a species likely to become endangered if nothing is done to reverse the factors leading to extirpation or extinction. “Species of special concern” means a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats. None of the specific populations of marine mammals in the Project area are currently listed in Schedule 1 of the Act, though they are in consideration for addition.

Table 1. Species in or proximal to the Project area

Species	Species at Risk Act Status
Land Mammals	
Fox	N/A
Muskox	N/A
Barren-ground Caribou	Special Concern
Dolphin-Union Caribou	Special Concern
Polar Bear	Special Concern
Grizzly Bear	Special Concern
Wolf	Threatened
Wolverine	Special Concern
Birds	
Short Eared Owl	Special Concern
Peregrine Falcon	Special Concern
Eskimo Curlew	Endangered
Harris Sparrow	Special Concern
Red-necked Phalarope	Special Concern
Buff-breasted sandpiper	Special Concern
Red Knot	Endangered
Insects	
Transverse Lady Beetle	Special Concern

Marine Mammals	
Beluga Whale	Endangered
Ringed Seal	Under consideration for addition
Killer Whale	Endangered
Bowhead Whale – Berring-Chukchi-Beaufort population	Special Concern

3.0 Project Impacts and Mitigations

Table 2 below describes the potential direct and indirect impacts on wildlife and/or wildlife habitat and mitigations for the species list in Table 1.

Table 2. Potential wildlife impacts and mitigations

Species	Potential Impacts	Mitigations
Dolphin-Union Caribou Barren-ground Caribou Muskox	• Human-wildlife interactions • Alteration to migratory routes and calving • Sensitivity to disturbance such as noise, dust from drill rig, ATV movement • Disturbance from helicopters • Exposure to hazardous substances	• Always give wildlife the right-of-way, delay working in any locations where caribou or muskox are present • Stop all field activities during the Barren-Ground Caribou Bluenose East Herd calving and post-calving from 28th may to 3rd July. • Avoid landing helicopter or fixed wing aircraft in areas where wildlife is present • Avoid flying below 300 m above ground level or operating snowmobiles/ATVs in areas where caribou or muskox are present • Do not locate any operations so as to block or cause substantial diversion to migration • Adhere to the Waste Management Plan and Spill Management Plan to minimize wildlife attractants in camp, and to ensure no animals are exposed or interact with any hazardous substances such as fuel • Employ a zero-tolerance policy for feeding or harassing wildlife
Polar Bear Grizzly Bear	• Human-wildlife interactions • Attraction to work areas (food, fuel, etc.) • Sensitivity to disturbance such as noise, dust from drill rig,	• Always give wildlife the right-of-way, delay working in any locations where polar bears or grizzlies are present • Avoid landing helicopter or fixed wing aircraft in areas where wildlife is present • Adhere to the Waste Management Plan and Spill Management Plan to minimize wildlife attractants in camp, and to ensure no animals are exposed or interact with any hazardous substances such as

Species	Potential Impacts	Mitigations
	ATV movement, especially during denning or when with their young	fuel • Conduct daily inspections to ensure no significant wildlife attractants are present on the site • Conduct frequent wildlife scans, particularly when first exiting a building or entering a new work area • Stock bear-bangers and noise makers at site to keep approaching wildlife from coming close to camp • Employ a zero-tolerance policy for feeding or harassing wildlife • If needed erect a bear fence around the drill site to prevent wildlife from interacting with personnel or infrastructure • Show the training video *Working in Bear Country* to all contractors, employees, and visitors to site • In the unlikely event that a polar bear or grizzly bear must be euthanized, stock equipment to properly dress the animal to avoid wasting the hide
Wolverine Fox Wolf	• Human-wildlife interactions • Attraction to work areas if food or shelter is available • Rabies potential in the fox population • Sensitivity to disturbance such as noise, dust from drill rig, ATV • Disturbance from helicopters	• Always give wildlife the right-of-way, delay working in locations where wildlife is present • Avoid landing helicopter or fixed wing aircraft in areas where wildlife is present • Adhere to the Waste Management Plan and Spill Management Plan to minimize wildlife attractants in camp, and to ensure no animals are exposed or interact with any hazardous substances such as fuel • Conduct daily inspections to ensure no significant wildlife attractants or wildlife shelter are present on the site • Conduct frequent wildlife scans, particularly when first exiting a building or new area • Stock bear-bangers and noise makers at site to deter wildlife from coming close to camp • Employ a zero-tolerance policy for feeding or harassing wildlife • Assume any fox or wolf acting aggressively or failing to respond to deterrence is rabid and could pose a threat to site personnel • If needed erect a bear fence around the drill rig to prevent wildlife from interacting with personnel or infrastructure

Species	Potential Impacts	Mitigations
Short eared owl Peregrine Falcon Eskimo Curlew Harris Sparrow Red-necked Phalarope Buff-breasted sandpiper Red Knot	• Habitat shifting or alteration • Nest disturbance • Sensitivity to disturbance such as noise, dust from drill rig, ATV • Disturbance from helicopters	• Avoid active nests and relocate work activities if nesting sites are encountered • Aircraft will maintain minimum vertical setback of 1100 m (3500 feet) in areas where concentrations of birds are present, and maintain minimum lateral aerial setback of 1.5 km from concentrations of birds (e.g., bird breeding colonies and moulting areas) • Record all bird sightings, particularly large concentrations • Conduct visual scan of work area for nests prior to any work or land disturbance • Employ a zero-tolerance policy for feeding or harassing wildlife
Bowhead Whale Killer Whale Beluga Whale Ringed Seal	• Sensitivity to disturbance from aircraft or equipment operating near shore • Exposure to hazardous substance spills	• Avoid flying or landing aircraft near the shoreline if marine mammals are present in the area • Employ a zero-tolerance policy for feeding or harassing wildlife • Report all whale sightings immediately to Takuvunga@gov.nu.ca • Adhere to the Waste Management Plan and Spill Management Plan to minimize wildlife attractants in camp
Transverse Lady Beetle	• Habitat shifting or alteration • Ground disturbance	• Avoid areas where beetles are located and relocate work activities if large numbers are encountered • Record sightings, particularly large concentrations • Conduct visual scan of work area for beetles prior to any work or land disturbance
Tundra plant species	• Habitat shifting or alteration • Ground disturbance	• Avoid placing drill rig in areas where there is lots of plant life, stick to rocky outcrops • Place drill rig on 8x8x12' timbers to minimize disturbance to tundra surface • Place coco matting below drill rig to protect tundra and any plants
Fish in water bodies	• disturbance of watercourse beds and banks • fish injury and mortality via entrapment • changes to aquatic habitat	• Place water intake screens a minimum of 30 cm above the bottom of the watercourse to prevent the entrainment of sediment and benthos that dwell in the substrate • Ensure all openings for guides and seals are smaller than the opening width of the screen material (2.54 mm) so fish cannot pass through • When possible, avoid withdrawing water, or reduce the rate of water withdrawal, during critical timing windows to diminish the likelihood of entraining eggs and larval fish

4.0 Monitoring and Mitigation Procedures

1501253 B.C. Ltd commits to respecting local wildlife and associated customary rights of the custodians of the lands. 1501253 B.C. Ltd is committed to taking required measures to mitigate negative impacts to wildlife and the wildlife habitats in which we operate. This section addresses 1501253 B.C. Ltd's approach to several aspects of the operation, including the main camp, waste and fuel management, and internal and external reporting.

4.1 Drill Rig Setup

Prior to any potential land disturbances such as the drill rig setup, fuel caches, or aircraft landing areas, the site supervisor will survey the areas and ensure it is a suitable location and formulate a plan to minimize any ground disturbance. B.C. Ltd will avoid setting up a drill rig or working in areas where wildlife or wildlife habitat have the potential to be impacted. The drill site will site on 8x8x12' timbers placed on the tundra to minimize disturbance to tundra surface. Up to 20m3 of water will be used each day for drilling, which will be taken from a nearby lake or river. Water used for drilling will be recycled in a tank and reused to reduce the amount drawn from water sources. Waste water from drill cuttings will be deposited in a sump more that 31m away from the ordinary high-water mark on any water body, and then filled over the top.

There will be no discharge of any kind into any water bodies. There will not be any pollutants discharged into any water body. All water pumped downhole for drill bit cooling that is returned to surface will be collected in a hand-dug sump and pumped into a settling tank for further drill use. Using returned water will substantially reduce the daily water consumption during drilling. There will not be any deleterious contaminants polluting the ground or water sources during the drill program. No drilling will occur, waste deposited, or sump created within 31 m of the normal high-water mark of any water body. Additionally, all hazardous materials will be placed in secondary containment and stored a minimum of 31 m from the normal high-water mark of any water body. All waste materials will be incinerated, reused, recycled and/or disposed of at an accredited facility.

All signs of wildlife, wildlife dens, or nests will be properly reported, recorded in the Wildlife Log, and discussed at daily meetings with all employees and contractors.

4.2 Land Transport

Minimize overland off-road transit by vehicles except in winter when no rutting or gouging of the ground will occur, and stick to existing tracks when possible. Ensure that if small amounts of offroad ATV driving occurs, it is limited to areas of low vegetation or high

exposed rocky areas. Minimize winter road development by keeping widths to those necessary and using existing roads and corridors where available and practical

4.3 Aircraft

The presence of aircraft can be stressful for animals, particularly during sensitive periods of the years such as calving and rutting. 1501253 B.C. Ltd will work with fixed-wing and helicopter pilots to follow best practices for minimizing disturbance to local wildlife such as caribou, muskox, and polar bears. Aircraft will maintain minimum vertical setback of 1100 m (3500 feet) in areas where concentrations of birds are present. Maintain minimum lateral aerial setback of 1.5 km from concentrations of birds (e.g., bird breeding colonies and moulting areas).

4.4 Waste and Fuel Management

1501253 B.C. Ltd will adhere to the Waste Management Plan and the Spill Management Plan to ensure that animal attractants such as food and waste hydrocarbons are managed properly at the Coppermine Project. The Company will implement a strict 'no feeding of wildlife' policy, and store food waste and wildlife attractants in a manner resistant to wildlife access and that reduces smells. The Company will require all field crews to return any food scraps and associated wastes to the camp for appropriate management.

Domestic waste will be stored in designated waste bins at the drill site infrastructure and incinerated daily to eliminate wildlife attractants. Hazardous waste and waste hydrocarbons will be sorted and placed in sealed metal drums to prevent wildlife access. Fuel will be stored in secondary containment and fuel containers will be inspected daily to check for damage or leaks. All spills will be cleaned up immediately and contaminated snow/ice and soil will be placed in separate sealed drums and backhauled off site for disposal.

4.5 Site Inspections

Designated employees will conduct daily inspections to ensure the site is free of wildlife and wildlife attractants. Site inspections will help ensure personnel are adhering to the Waste Management Plan and Spill Contingency Plan for the Project. Site inspections will also scan for possible wildlife access to site infrastructure, and for any signs of wildlife entering the site (prints, diggings, tracks, etc.). Findings of the site inspections will be reported to the site supervisor and necessary corrective actions will be completed in a timely manner.

4.6 Reporting

In the event of a wildlife sighting, wildlife incident (equipment or human interactions, mortalities, etc.), or a bear sighting/incident, personnel will follow the steps in Table 3 below.

Table 1. Reporting Procedures and Contacts

Step	Procedure
1	Report the wildlife sighting/incident to the site supervisor
2	**RECORDKEEPING** **Sighting only:** Fill out the Wildlife Observation Log (Appendix A) **Incident:** Fill out the Wildlife Log and proceed to Step 3 Keep copies of all records for discussion with regulators and Indigenous partners
3	**REPORTING** Report all wildlife incidents to: **Local Conservation Officers** Kitikmeot Regional Office: (867) 982-7440 Kugluktuk Wildlife Office: (867) 982-7451 **Local Hunters and Trappers Organizations** Kugluktuk HTO: (867) 982-4908 If it becomes necessary to euthanize an animal due to suspected rabies or aggressive behavior, approval to proceed should be sought from the local Conservation Officer. For foxes, avoid head shots and direct contact with the carcass unless instructed otherwise by the Conservation Officer. **Land Mammals –** Report all mammal sightings (with photos if possible) to Takuvunga@gov.nu.ca **Birds –** report bird sightings to NWT_NUChecklist.TNO_NUReleve@canada.ca **Migratory birds:** Report mortalities or incidents of disturbance to individuals or nests to: Environment and Climate Change Canada – Canadian Wildlife Service (cwsnorth-scfnord@ec.gc.ca) **Whales:** Report all whale sightings (with photos if possible) to Takuvunga@gov.nu.ca

2.1 Roles and Responsibilities

1501253 B.C. Ltd Senior Management - Responsible for ensuring that the site supervisor is aware of wildlife species present in the area, as well as appropriate mitigations to minimize

impact to wildlife and wildlife habitat. The Senior Management team will ensure that management plans are properly implemented and that the site supervisor is familiar with the conditions of site authorizations such as the land use permit.

Site Supervisor – Responsible for ensuring employees and contractors on site are aware of wildlife and wildlife habitat protection measures and appropriate procedures for wildlife encounters. The site supervisor is responsible for implementing management plans such as the Waste Management Plan to minimize wildlife interaction with the Project. Should a wildlife sighting or incident occur, they will ensure proper documentation and that the appropriate authorities are notified in a timely manner.

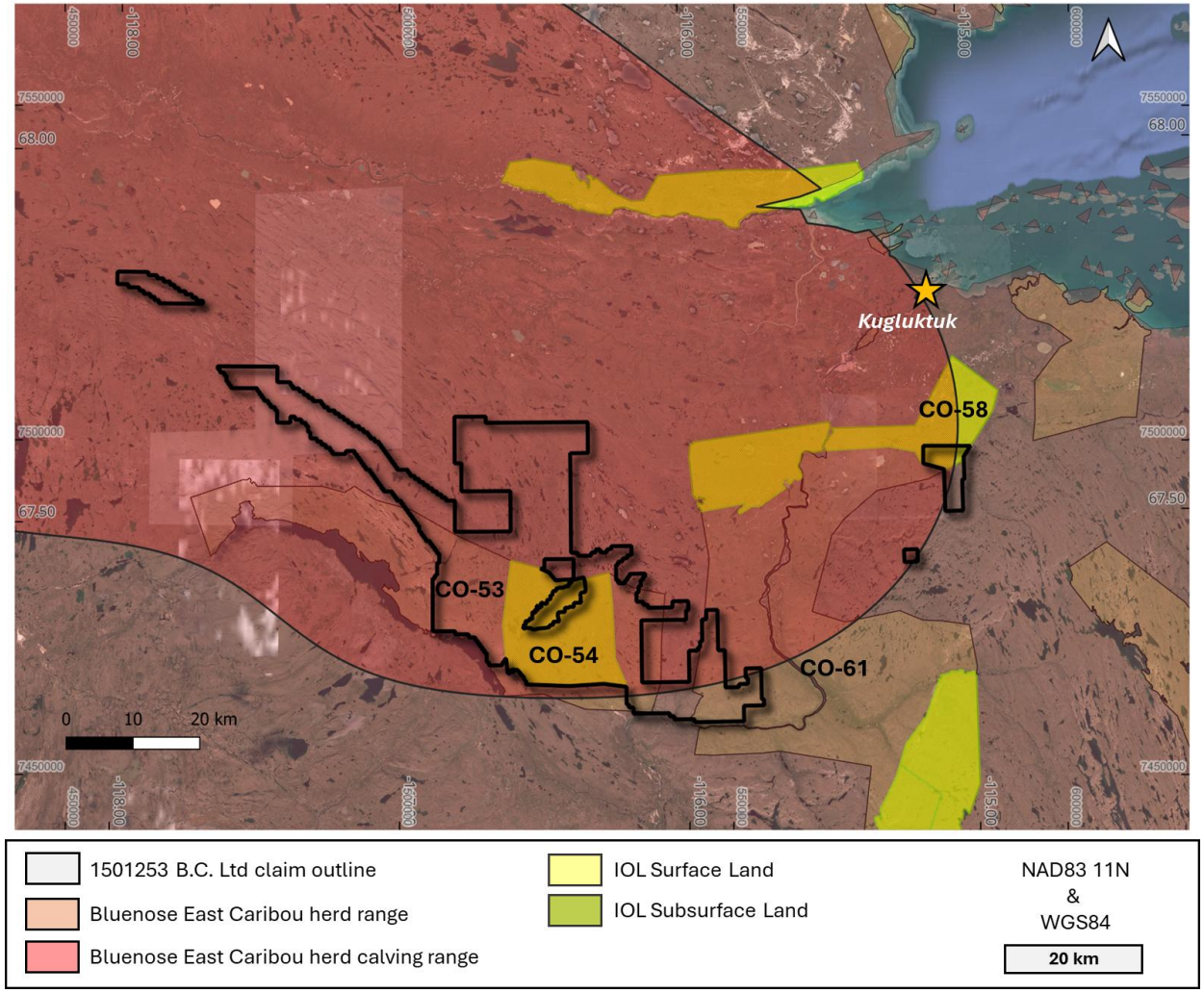
Staff and Contractors – All personnel working on site must be familiar with the Wildlife Management Plan and understand how to respond to a wildlife sighting and/or incident. Staff and contractors must adhere to the Waste Management Plan and Spill Management Plan to help minimize wildlife attractants and environmental risks created by the Project.

Appendix A: Wildlife Observation Log

Date/Time	Name of Observer	Location	Species, number, and description	Comments (direction of movement, deterrents used, response to presence etc.)

Date/Time	Name of Observer	Location	Species, number, and description	Comments (direction of movement, deterrents used, response to presence etc.)

Appendix B.



Map showing outline of Bluenose East Caribou herd annual and calving range, in relation to the Company's claims.
Outline of caribou calving comes from the 2011 paper by Nagy et al., titled 'subpopulation structure of caribou (Rangifer tarandus L.) in arctic and subarctic Canada'. The calving and post-calving dates are taken from J.A. Nagy et al, titled 'Seasonal Ranges of the Cape Bathurst, Bluenose-West, and Bluenose East Barren-Ground Caribou Herds', 2005, which defines the bluenose east caribou herd calving and post-calving dates as being from 28th May – 20th June. The company plans of ceasing all exploration activities from 28th May – 3rd July to prevent any disruption to caribou over this period.

General Water Licence Application
(Application for a new Water Licence)

Document Date: April 2013

Application Submission Date: 02/11/2025
Month/Day/Year

P.O. BOX 119
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NUNAVUT IMALIRIYIN KATIMAYIT
NUNAVUT WATER BOARD
OFFICE DES EAUX DU NUNAVUT

DOCUMENT MANAGEMENT

Original Document Date: April 2010

DOCUMENT AMENDMENTS

	Description	Date
(1)	Updated for public distribution as separate document from NWB Guide 4	June 2010
(2)	Updated NWB logos and reformatted table to allow rows to break across page	May 2011
(3)	Update NWB logo	April 2013
(4)		
(5)		
(6)		
(7)		
(8)		
(9)		
(10)		

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NUNAVUT WATER BOARD
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GENERAL WATER LICENCE APPLICATION
(APPLICATION FOR NEW WATER LICENCE)

The applicant is referred to the NWB's Guide 4: *Guide to Completing and Submitting a Water Licence Application for a New Licence* for more information about this application form.

LICENCE NO: (for NWB use only)	
1. APPLICANT (PROPOSED LICENSEE) CONTACT INFORMATION (name, address) Alexandre Jones Vilela da Silva c/o 1501253 B.C. Ltd 329 HOWE STREET VANCOUVER BC V6C 3N2 CANADA Phone: +61 459298209 Fax: _____ e-mail: alex.vilela@sentinelresources.com.au	**2. APPLICANT REPRESENTATIVE CONTACT INFORMATION** if different from Block 1 (name, address) Phone: _____ Fax: _____ e-mail: _____ (Attach authorization letter.)
3. NAME OF PROJECT (including the name of the project location) **Coppermine Project, Kugluktuk** **For Project Summary please see attached document "1. 1501253 B.C. Ltd Coppermine Project Summary"**	
4. LOCATION OF UNDERTAKING **Project Extents** **NW: Latitude: (67° 50' 16.7568" N) Longitude: (-118° 0' 7.7112" W)** **NE: Latitude: (67° 50' 16.7568" N) Longitude: (-115° 1' 22.2816" W)** **SE: Latitude: (67° 13' 26.2056" N) Longitude: (-115° 1' 22.2816" W)** **SW: Latitude: (67° 13' 26.2056" N) Longitude: (-118° 0' 7.7112" W)** **Camp Location(s)** **Staying in Kugluktuk at a hotel:** **Latitude: (67° 49' 20.1792" N) Longitude: (-115° 7' 13.735" W)**	

5. **MAP** - Attach a topographical map, indicating the main components of the undertaking.
ATTACHED – please see "2. Maps Water Application"

1:50k maps that the project overlaps with are:

NTS_SNRC	NAME_ENG	NOM_FRA	Scale
086N01	ROCKY DEFILE RAPIDS	ROCKY DEFILE RAPIDS	1:50k
086N07	TESHIERPI MOUNTAIN	TESHIERPI MOUNTAIN	1:50k
086N08	TUKTUVAK LAKE	TUKTUVAK LAKE	1:50k
086N11	IMPACT LAKE	IMPACT LAKE	1:50k
086O06			1:50k
086N10	BORNITE LAKE	BORNITE LAKE	1:50k
086N12			1:50k
086N09			1:50k
086O04			1:50k
086N13			1:50k
086O05	BURNT CREEK	BURNT CREEK	1:50k
086O11	ESCAPE RAPIDS	ESCAPE RAPIDS	1:50k

NTS Map Sheet No.: **86N, 86O** Map Name: **Dismal Lakes, Kugluktuk** Map Scale: **250k**

6. **NATURE OF INTEREST IN THE LAND** - Check any of the following that are applicable to the proposed undertaking (at least one box under the 'Surface' header must be checked).

Sub-surface

☒ Mineral Lease from Nunavut Tunngavik Incorporated (NTI)
Date (expected date) of issuance: **November 1st 2024.** Date of expiry: **October 31st 2044.**

☐ Mineral Lease from Indian and Northern Affairs Canada (INAC)
Date (expected date) of issuance: _____ Date of expiry: _____

Surface

☐ Crown Land Use Authorization from Indian and Northern Affairs Canada (INAC)
Date (expected date) of issuance: **Applied 31st January 2025.** Date of expiry: **TBC**
See attached document "3. CIRNAC Land Use Permit 1501253 B.C". Determination may take up to 30 days from application date.

☐ Inuit Owned Land (IOL) Authorization from Kitikmeot Inuit Association (KIA)
Date (expected date) of issuance: **Applied 31st January 2025.** Date of expiry: **TBC**
See attached document "4. KIA 1501253 B.C. Ltd Application". Determination may take up to two weeks(?) days from application date.

☐ IOL Authorization from Kivalliq Inuit Association (KivIA)
Date (expected date) of issuance: _____ Date of expiry: _____

☐ IOL Authorization from Qikiqtani Inuit Association (QIA)
Date (expected date) of issuance: _____ Date of expiry: _____

☒ Commissioner's Land Use Authorization
Date (expected date) of issuance: **January 10th 2025.** Date of expiry: **2nd January 2028.**
See attached document "5. 2025-01-10-NPC File # 150589 Coppermine Project"

☐ Other: _____
Date (expected date) of issuance: _____ Date of expiry: _____

Name of entity(s) holding authorizations:
1501253 B.C. Ltd
For full list of mineral claims and exploration agreements held by 1501253 B.C. Ltd, please see attached document "6. Claim 1501253 B.C. Ltd"

7. NUNAVUT PLANNING COMMISSION (NPC) DETERMINATION

Indicate the land use planning area in which the project is located.

☐ North Baffin
☐ South Baffin
☐ Akunniq
☐ Keewatin
☐ Sanikiluaq
☒ West Kitikmeot

Is a land use plan conformity determination required?

☒ Yes ☐ No

If Yes, indicate date issued and attach copy: **NPC determination attached, called "5. 2025-01-10-NPC File # 150589 Coppermine Project"**

If No, provide written confirmation from NPC confirming that a land use plan conformity review is not required.

8. NUNAVUT IMPACT REVIEW BOARD (NIRB) DETERMINATION

Is an Article 12 Part 4 screening determination required?

☐ Yes ☒ No

If Yes, indicate date issued and attach copy: **NPC determination attached stating a determination is not required.**
If No, provide written confirmation from NIRB confirming that a screening determination is not required.

9. DESCRIPTION OF UNDERTAKING – List and attach plans and drawings or project proposal. Project proposal and maps attached **"2. Maps Water Application". Please also see "0. 1501253 B.C. Ltd Coppermine Project Summary".**

10. **OPTIONS** – Provide a brief explanation of the alternative methods or locations that were considered to carry out the project.

The Company has targeted the areas of highest geological prospectivity for mineral exploration, building off historic data and regional interpretation. The Company has meticulously selected the proposed locations for drilling and field work, to best increase our chances of success. Drilling is required to test the continuity of surface mineralization below surface, and is the only exploration method capable of doing this. There are no suitable alternatives available. The Company will endeavor to drill as little holes as possible while trying to extract the maximum amount of geological information.

11. **CLASSIFICATION OF PRIMARY UNDERTAKING -** Indicate the primary classification of undertaking by checking one of the following boxes.

- ☐ Industrial
- ☐ Agricultural
- ☒ Mining and Milling (includes exploration/drilling/exploration camps)
- ☐ Conservation
- ☐ Municipal (includes camps/lodges)
- ☐ Recreational
- ☐ Power
- ☐ Miscellaneous (describe below):

_____

See Schedule II of *Northwest Territories Waters Regulations* for Description of Undertakings.

Information in accordance with applicable Supplemental Information Guidelines (SIG) must be submitted with a New Water Licence Application. Indicate which SIG(s) are applicable to your application.

- ☐ Hydrostatic Testing
- ☐ Tannery
- ☐ Tourist / Remote Camp
- ☐ Landfarm & On-Site Storage of Hydrocarbon Contaminated Soil
- ☐ Onshore Oil and Gas Exploration Drilling
- ☒ Mineral Exploration / Remote Camp
- ☐ Advanced Exploration
- ☐ Mine Development
- ☐ Municipal
- ☐ General Water Works
- ☐ Power

12. **WATER USE -** Check the appropriate box(s) to indicate the type(s) of water use(s) being applied for.

- ☐ To obtain water for camp/ municipal purposes
- ☐ To obtain water for industrial purposes
- ☐ To divert a watercourse
- ☐ To cross a watercourse
- ☐ To modify the bed or bank of a watercourse
- ☐ To alter the flow of, or store water
- ☐ Flood control
- ☒ Other: Obtain water for drilling

13. **QUANTITY AND QUALITY OF WATER INVOLVED -** For each type of water use indicated in Block 12, provide the source of water, the quality of the water source and available capacity, the estimated quantity to be used in cubic meters per day, method of extraction, as well as the quantities and qualities of water to be returned to source.

Name of water source(s) (show location(s) on map):

Names of water sources are numbered and attached in the **"7. Water Sources"** table.

Describe the quality of the water source(s) and the available capacity:
The lakes are large and thought to be very capable of having a small amount of water taken (up to 0.1 m per metre of surface area per year) for drilling. Please see attached the "7. Water Sources" table with size of lakes and their area.

Provide the overall estimated quantity of water to be used: **less than 20 m^3/day. It is likely to be much less as RC drilling doesn't use water, and diamond drilling can recycle water. For the total amount of water used for the season, it will be less than 1,200 m3.**

Provide the estimated quantity(s) of water to be used from each source: **100-200 m^3**

Indicate the estimated quantities to be used for each purpose (camp, drilling, etc.)
All water will be used for drilling.

Describe the method of extraction(s): **4cyl Kubota Deisel Water Pump and rubber/plastic water line from lake to drill rig. Intake hose will be fitted with mesh. Pump will be located at water source and be contained in a secondary plastic containment bund to stop any spills from reaching the water source. The pump will be checked 2-4 times a day to ensure it is running smoothly and check for any leaks/spills.**

Estimated quantity(s) of water returned to source(s) **0 m^3/day**

Describe the quality of water(s) returned to source(s): **No water will be returned to the source. Water will be deposited more than 31m away from the ordinary high-water mark of any water body, in a hand dug sump. Wastewater will be deposited in the designated sumps, which will have GPS coordinates and photos recorded. Sumps will be up to 2mx1mx0.5m in dimension, and filled in afterwards to best contour of the original land, and restore topsoil and any plant material carefully. The drill rigs used are likely to be an RC drill rig (such as a Super Hornet 200) which don't use any water, or possibly a small diamond drill rig (such as a HydraCore 2000) which will recycle any water used and then deposit wastewater into a sump. If diamond drilling occurs, water will be recycled in a tank to minimize amount needed to be drawn. It is possible only 1-2 m^3 of water will be used a day.**

14. **WASTE** – Check the appropriate box(s) to indicate the types of waste(s) generated and deposited.

- ☐ Sewage
- ☐ Solid Waste
- ☐ Hazardous
- ☐ Bulky Items/Scrap Metal
- ☐ Animal Waste
- ☒ Other (describe): **Muddy water from drilling**
- ☐ Waste oil
- ☐ Greywater
- ☐ Sludges
- ☐ Contaminated soil and/or water

15. **QUANTITY AND QUALITY OF WASTE INVOLVED** – For each type of waste indicated in Block 14, describe its composition, quantity in cubic meters/day, method of treatment and method of disposal. **Please also see attached document "8. Waste Management plan 1501253 B.C. Ltd".**

Type of Waste	Composition	Quantity Generated	Treatment Method	Disposal Method
RC drilling return wastewater	Muddy water	<2-3 m3/day	Let solids settle out in sump, water will percolate	Dispose of in hand dug sump, fill in over after to

			out of sump	original land contour
Diamond Drilling water return	Muddy water	<2-3 m3/day	Re-use water in a holding tank to reduce amount needed	Let water setlle in hand dug sump. Fill in by hand afterwards and re-contour to original land

16. OTHER AUTHORIZATIONS – In addition to the sub-surface and surface land use authorizations provided in Block 6, indicate any other authorizations required in relation to the proposed undertaking. For each provide the following:

Authorization: **N/A**

Administering Agency: _____

Project Activity: _____

Date (expected date) of issuance: _____ Date of expiry: _____

17. PREDICTED ENVIRONMENTAL IMPACTS OF UNDERTAKING AND PROPOSED MITIGATION MEASURES - Describe direct, indirect, and cumulative impacts related to water and waste.

Predicted Environmental Impacts of Undertaking and Proposed Mitigation Measures

The proposed drilling activities have been carefully planned to minimise environmental impacts, particularly concerning water and waste. Through robust mitigation strategies, potential risks are effectively managed to ensure minimal disturbance to the environment.

Water Quality & Habitat Degradation

Potential Impact: Drilling operations pose a risk of contaminating surface and groundwater, which could impair aquatic ecosystems and degrade fish habitats.

Mitigation Measures:

- Water use will be strictly limited to the specific, calculated available water capacity of each lake, preventing over-extraction and maintaining natural hydrological balance.
- A closed-loop system for drilling fluids will be implemented, ensuring that freshwater is recirculated using a holding tank and sedimentation process, significantly reducing overall water consumption.
- Non-toxic drilling additives will be used to avoid chemical contamination, and the use of salt will be minimized to protect water quality.
- Wastewater will be discharged into hand dug sumps located at least 31 meters from the Ordinary High-Water Mark (OHWM) of any watercourse, reducing the risk of water contamination.
- Sumps will be designed with sufficient capacity and structural stability, and they will be properly closed and restored (filled in, contoured) upon project completion to prevent long-term environmental impacts.

With these measures in place, risks to water quality and aquatic habitats are expected to be minimal.

Soil Contamination

Potential Impact: Accidental leaks or spills of drilling fluids and additives could infiltrate the soil, leading to localised pollution.

Mitigation Measures:

- Strict containment and monitoring procedures will be implemented to prevent leaks and spills, including bunding of hydrocarbons.
- A closed-loop drilling system will minimize fluid discharge, reducing the likelihood of soil contamination.
- Drilling equipment will be positioned using helicopters to avoid ground disturbance and prevent unnecessary soil disruption.
- In the unlikely event of a spill, immediate containment and remediation measures will be enacted to prevent further spread, including the use of absorbent pads, socks, and booms to soak up spilled fluids. Contaminated materials will be safely collected and disposed of in designated hazardous waste containers, ensuring minimal environmental impact and compliance with waste management protocols.

These proactive measures significantly reduce the risk of soil contamination and ensure that any potential impacts are quickly and effectively managed.

Land Destabilization & Erosion

Potential Impact: The disturbance of vegetation and permafrost could contribute to land instability, erosion, and long-term environmental degradation.

Mitigation Measures:

- The project will utilise helicopter-supported drilling to eliminate ground disturbance and protect permafrost integrity.
- Water management strategies, including controlled discharge and sump restoration, will help maintain soil stability and prevent erosion.
- The project footprint will be kept to a minimum, ensuring that vegetation is preserved as much as possible to reduce the risk of destabilisation.
- Post-operation site rehabilitation will be conducted to further mitigate any potential long-term environmental effects.

These measures ensure that land stability is maintained, and any potential erosion risks are effectively controlled.

Cumulative Impacts

Due to the comprehensive mitigation measures in place, cumulative environmental impacts from the drilling activities are expected to be minimal. The closed-loop water system, strict waste management practices, and careful operational planning significantly reduce the overall environmental footprint.

For further details on environmental and wildlife management strategies, please refer to:

- 8. Waste Management Plan (1501253 B.C. Ltd)
- 9. Wildlife Management Plan (1501253 B.C. Ltd)
- 10. Spill and Fuel Management Plan (1501253 B.C. Ltd)

By adhering to these best practices, the project remains low-risk with a well-defined environmental management framework in place.

18. WATER RIGHTS OF EXISTING AND OTHER USERS OF WATER

Provide the names, addresses and nature of use for any known persons or properties that may be adversely affected by the proposed undertaking, including those that hold licences for water use in precedent to the application, domestic users, in-stream users, authorized waste depositors, owners of property, occupiers of property, and/or holders of outfitting concessions, registered trapline holders, and holders of other rights of a similar nature.

1501253 B.C. Ltd's water use for drilling will be constrained to 1501253 B.C. Ltd's claims, and the Company is not aware of any overlapping water users in these areas.

Advise the Board if compensation has been paid and/or agreement(s) for compensation have been

reached with any existing or other users.
N/A.

19. INUIT WATER RIGHTS

Advise the Board of any substantial affect of the quality, quantity or flow of waters flowing through Inuit Owned Land (IOL), and advise the Board if negotiations have commenced or an agreement to pay compensation for any loss or damage has been reached with one or more Designated Inuit Organization (DIO).

Due to the nature and scope of the Company's planned drilling activities, as well as the implemented and strictly adhered to mitigation and management measures outlined in this application, no substantial affect on the quality, quantity of flow of waters through Inuit Owned land is expected.

20. CONSULTATION – Provide a summary of any consultation meetings including when the meetings were held, where and with whom. Include a list of concerns expressed and measures to address concerns.

10/12/2024 to 22/01/2025 – Email coms with Ryan Nivingalok Mayor of Kugluktuk and colleagues
23/01/2025 – Introductory call with Ryan Nivingalok Mayor of Kugluktuk and colleagues talking about the project and enquiring about any perceived community issues. No concerns were identified, the council were interested and supportive.
10/12/2024 to 30/03/2025 – Email communications with Amanda (HTO representative), requesting an introductory call to discuss project details and Caribou calving season dates. Amanda has been unable to take a call yet.

21. SECURITY INFORMATION

Provide an estimate of the total financial security for final reclamation equal to the total outstanding reclamation liability for land and water combined sufficient to cover the highest liability over the life of the undertaking. Estimates of reclamation costs must be based on the cost of having the necessary reclamation work done by a third party contractor if the operator defaults. The estimate must also include contingency factors appropriate to the particular work to be undertaken.

Where applicable, the financial security assessment should be prepared in a manner consistent with the principals respecting mine site reclamation and implementation found in the *Mine Site Reclamation Policy for Nunavut,* Indian and Northern Affairs Canada, 2002.

The Company acknowledges its obligation to provide financial security for final reclamation, ensuring that all outstanding reclamation liabilities for both land and water are adequately covered. Given the scale and scope of the proposed maiden exploration campaign—consisting of 10-15 shallow reverse circulation drill holes to a depth of approximately 75-100 metres—the total reclamation liability is expected to be minimal.

Reclamation Approach and Cost Basis
Reclamation will be conducted on a continuous basis throughout the program, reducing the outstanding liability at any given time. Specific measures include:

- **Infill of shallow sumps upon completion of each drill hole.**
- **Relocation of drill chips to a central sample storage area or their appropriate dispersal and scarification on-site.**
- **Adherence to all commitments outlined in the Land Use Permit, including the removal of**

rubbish.

To determine a reasonable financial security amount, the following key cost factors have been considered:

1. **Mobilisation/Demobilisation of Reclamation Equipment & Labour – A small, fixed wing aircraft charter from Yellowknife would be required to mobilise two labourers. Estimated cost: $5,000 - $10,000.**
2. **Labour & Equipment Rental – A third-party contractor would be required for minor surface contouring, sump infill, and site stabilization. Estimated cost: $3,000 - $5,000.**
3. **Contingency Factor – A contingency of 20% is applied to account for unforeseen conditions. Estimated contingency: $1,600 - $3,000.**

Total Estimated Reclamation Security
Based on these considerations, the total estimated financial security for final reclamation is in the range of $9,600 - $18,000. Given the continuous nature of reclamation throughout the program, the peak liability at any given time will be lower.
This estimate aligns with the principles outlined in the *Mine Site Reclamation Policy for Nunavut (Indian and Northern Affairs Canada, 2002)*, ensuring that third-party contractor costs are adequately covered should the operator default.

22. FINANCIAL INFORMATION

Provide a statement of financial responsibility.

1501253 B.C Ltd has entered into a binding agreement with Somerset Minerals Limited (ASX: SMM) for its acquisition, as outlined in the following announcement (see attached "11. Acquisition of Prescott Project"). The transaction is expected to be completed by mid-March 2025, prior to the commencement of any exploration activities.

Somerset Minerals Limited, a publicly listed company on the Australian Securities Exchange (ASX), had a reported cash balance of $1,435,783 as of its most recent financial year ending 30 June 2024 (please see attached "12. Annual Report"). In addition, the company is likely to undertake a capital raising before exploration activities commence, further strengthening its financial position.

Christopher Hansen, who currently serves as a director of both Somerset Minerals Limited and 1501253 B.C Ltd, provides continuity in management and oversight throughout the acquisition process and the subsequent exploration program.

This financial backing ensures that the necessary funds will be available to meet all exploration and reclamation commitments, including any financial security requirements associated with the project.

If the applicant is a business entity, provide a list of the officers of the company.

The directors of the Company are:
Alexandre Jones Vilela da Silva (Director)
Christopher Hansen (Director)

If the applicant is a business entity attach a copy of the Certificate of Incorporation or evidence of registration of the company name.

Please see attached "13. Cert of incorp and notice of Articles", and "14. Certificate_Registration".

23. STUDIES UNDERTAKEN TO DATE - List and attach copies of studies, reports, research, etc.

N/A

24. PROPOSED TIME SCHEDULE – Indicate the proposed start and completion dates for each applicable phase of development (construction, operation, closure, and post closure).

Construction
Proposed Start Date: _____ (month/year) Proposed Completion Date: _____ (month/year)

Operation
Proposed Start Date: 05/2025 (month/year) Proposed Completion Date: 05/2027 (month/year)

Closure
Proposed Start Date: _____ (month/year) Proposed Completion Date: _____ (month/year)

Post - Closure
Proposed Start Date: _____ (month/year) Proposed Completion Date: _____ (month/year)

For each applicable phase of development indicate which season(s) activities occur.

Construction
☐ Winter ☐ Spring ☐ Summer ☐ Fall ☐ All season

Operation
☐ Winter ☐ Spring ☐ Summer ☐ Fall ☒ All season

Closure
☐ Winter ☐ Spring ☐ Summer ☐ Fall ☒ All season

Post - Closure
☐ Winter ☐ Spring ☐ Summer ☐ Fall ☐ All season

25. PROPOSED TERM OF LICENCE

Number of years (maximum of 25 years): **2 years**

Requested Date of Issuance: **April 2025** (month/year) Requested Expiry Date: **April 2027** (month/year)

(The requested date of issuance must be at least three (3) months from the date of application for a type B water licence and at least one (1) year from the date of application for a type A water licence, to allow for processing of the water licence application. These timeframes are approximate and do not account for the time to complete any pre-licensing land use planning or development impact requirements, time for the applicant to prepare and submit a water licence application in accordance with any project specific guidelines issued by the NWB, or the time for the applicant to respond to requests for additional information. See the NWB's *Guide 5: Processing Water Licence Applications* for more information)

26. ANNUAL REPORTING – If not using the NWB's *Standardized Form for Annual Reporting*, provide details regarding the content of annual reports and a proposed outline or template of the annual report.

The Company will report using the NWB's Standardized Form for Annual Reporting.

27. CHECKLIST – The following must be included with the application for the water licensing process to begin.

Written confirmation from the NPC confirming that NPC's requirements regarding land use plan conformity have been addressed.

☒ Yes ☐ No If no, date expected _____

Written confirmation from the NIRB confirming that NIRB's requirements regarding development impact assessment have been addressed.

☒ Yes ☐ No If no, date expected _____

Completed General Water Licence Application form.

☒ Yes ☐ No If no, date expected _____

Information addressing Supplemental Information Guideline (SIG) , where applicable (see Block 11)

☒ Yes ☐ No If no, date expected _____

English Summary of Application.

☒ Yes ☐ No If no, date expected _____

Inuktitut and/or Inuinnaqtun Summary of Application.
See "**15. Coppermine Project Summary Inuinnaqtun"**

☒ Yes ☐ No If no, date expected _____

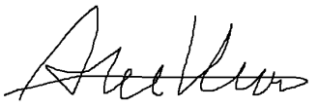
Application Fee of $30.00 CDN (Payee Receiver General for Canada).

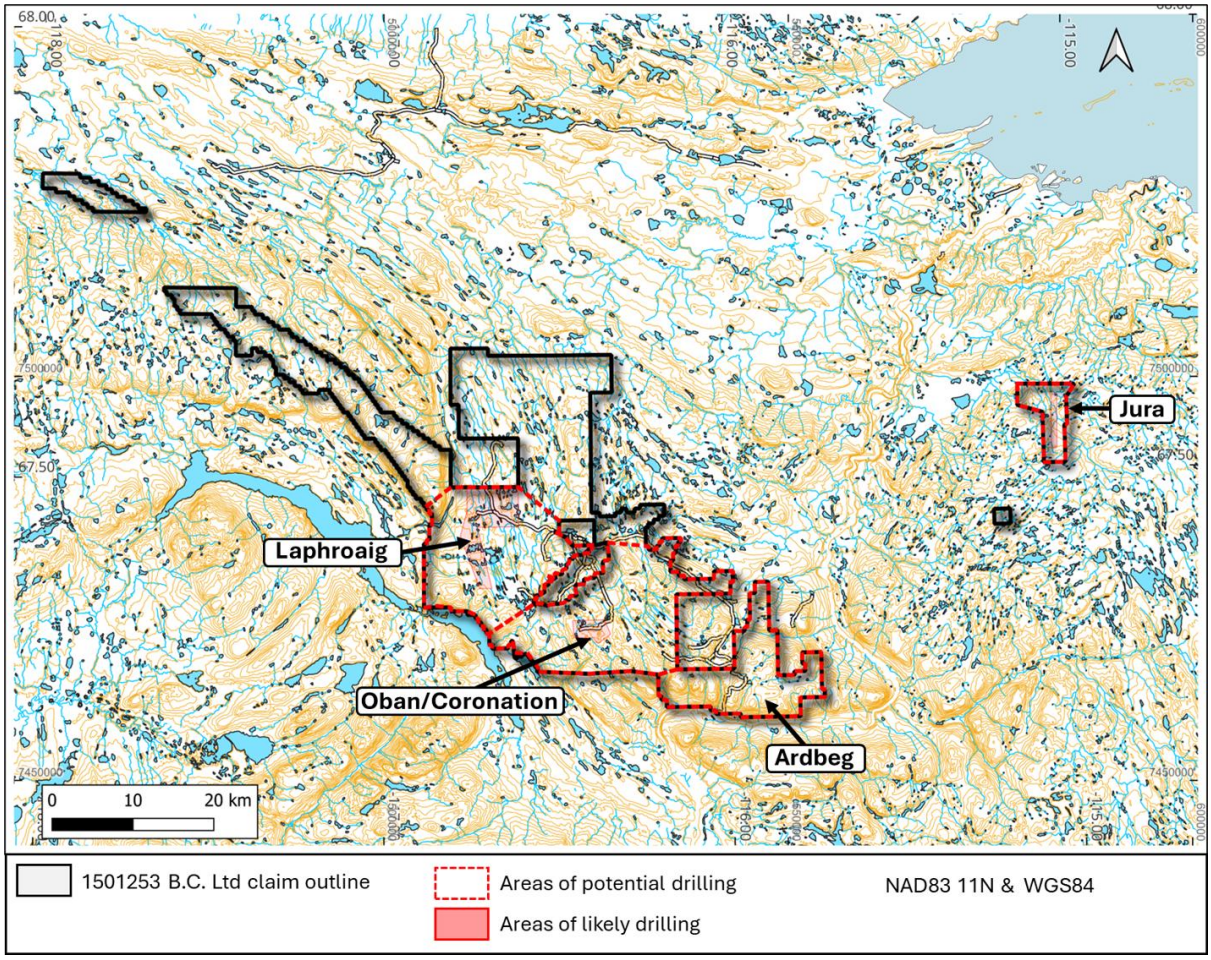
☐ Yes ☒ No If no, date expected: **11/02/2025**

Water Use Fee Deposit of $30.00 CDN (Payee Receiver General for Canada). The actual water use fee will be calculated by the NWB based upon the amount of water authorized for use in accordance with the Regulations at the time of issuance of the licence.

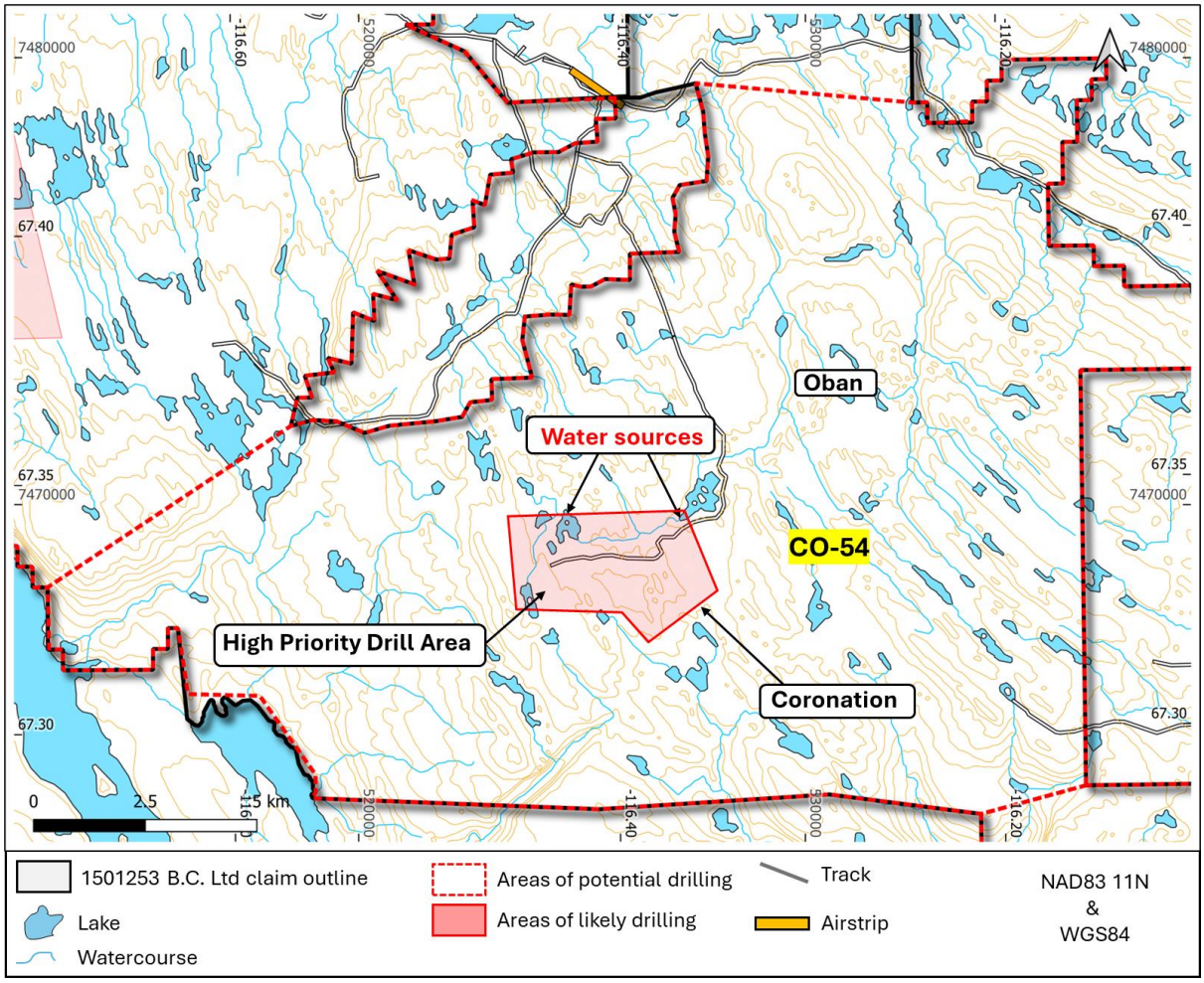
☐ Yes ☒ No If no, date expected: **11/02/2025**

28. SIGNATURE

Name (Print)	Title (Print)	Signature	Date
Alexandre Jones Vilela da Silva	**Exploration Manager**		**10/02/2025**



Overview. 1501253 B.C. Ltd claims and areas of likely and potential drilling, prospecting and funding dependent. 15 holes in total, likely taking 2-3 weeks for drilling. Helicopter-based prospecting may take place anywhere in the Company's claims.

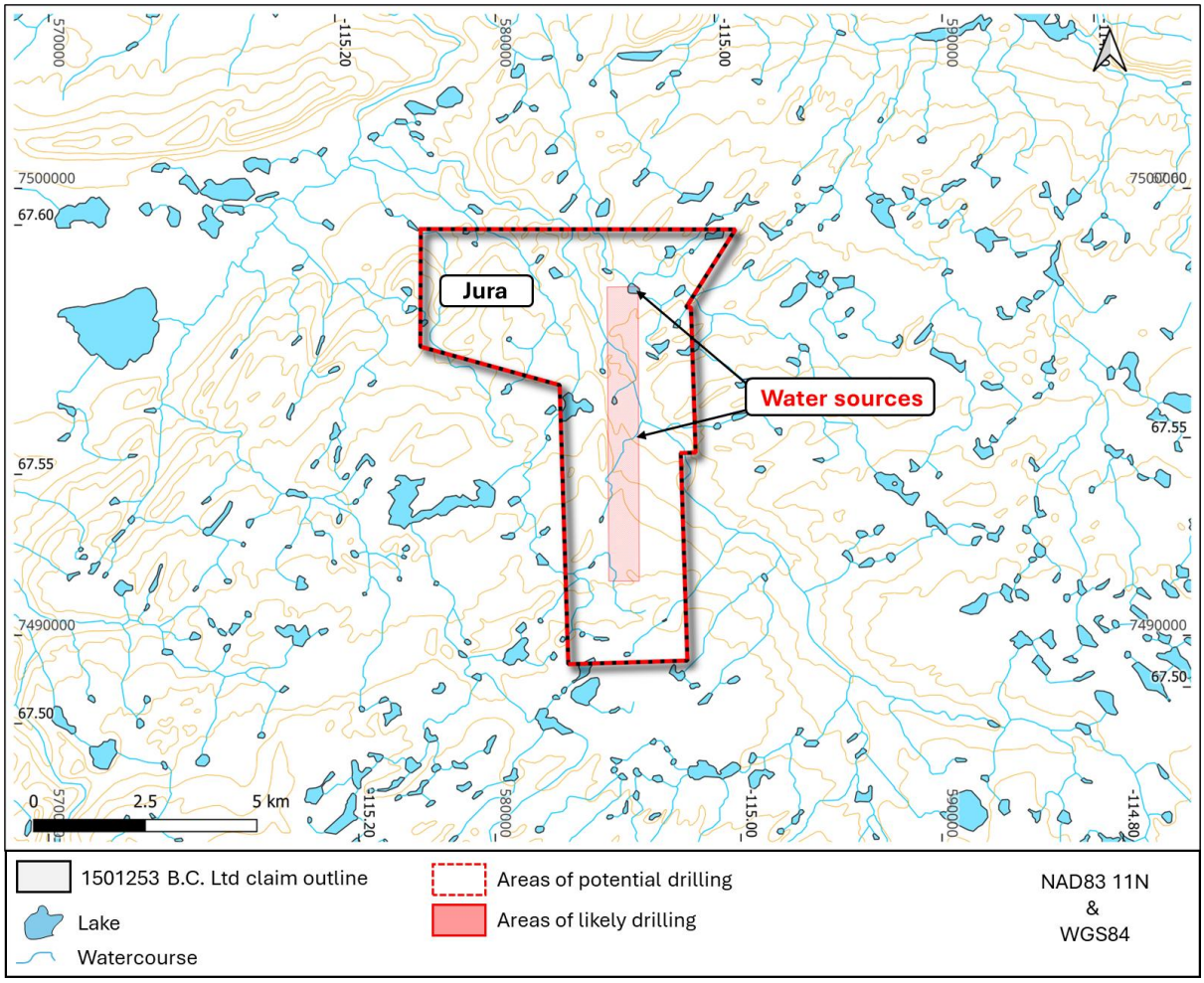


First priority. Oban district showing the Coronation prospect, where the company would like to drill approximately up to 15 short holes, prospecting and funding dependent. This sits on Inuit owned land parcels CO-54 and CO-53. The Company has an Exploration and Mining agreement in place for CO-54.

-No holes drilled within 31m of any water body

-No waste or drill water deposited into any water body

-Up to 15 holes

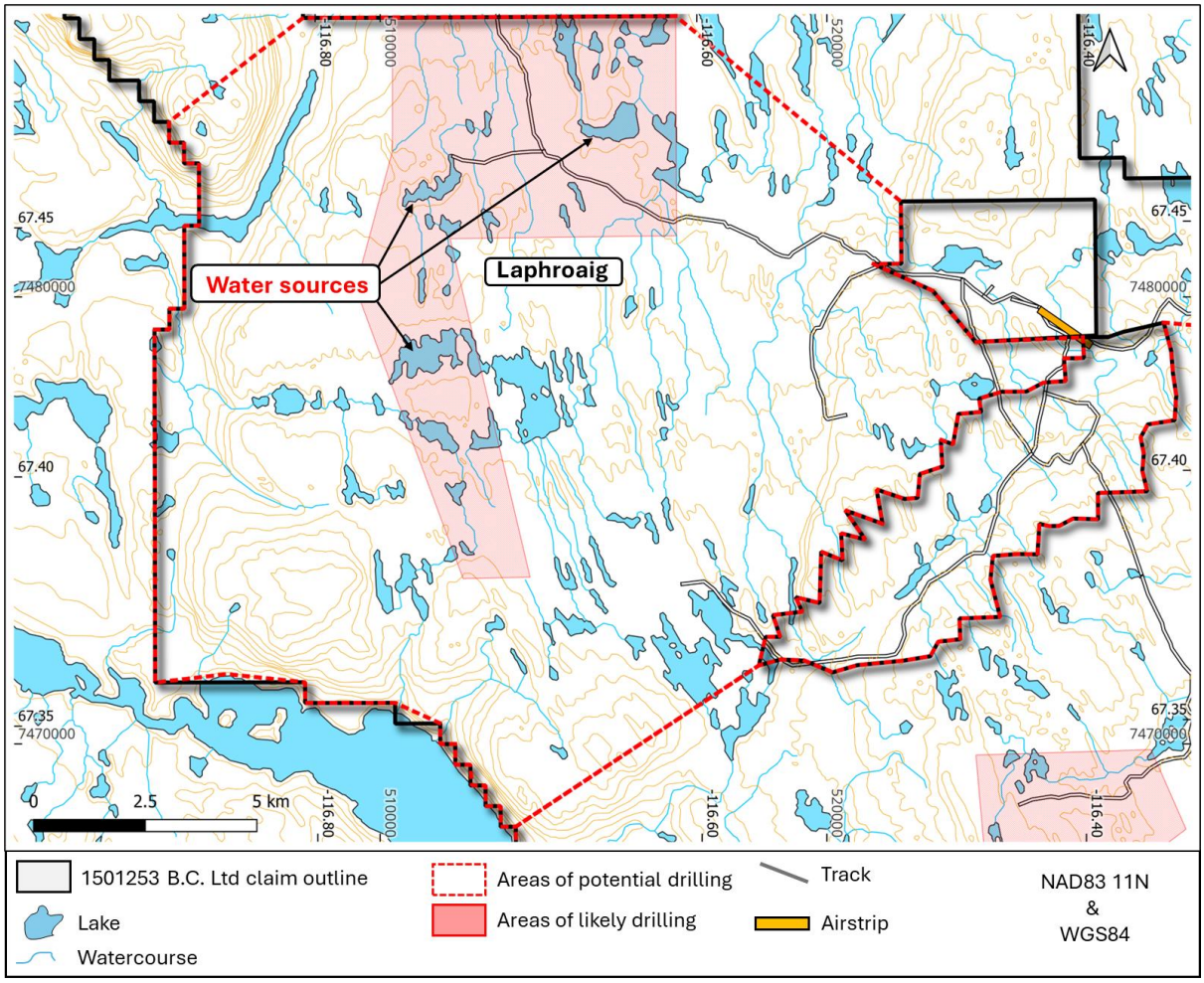


Second priority. Jura district, where the company would like to drill approximately up to 15 short holes, prospecting and funding dependent.

-No holes drilled within 31m of any water body

-No waste or drill water deposited into any water body

-Up to 15 short holes

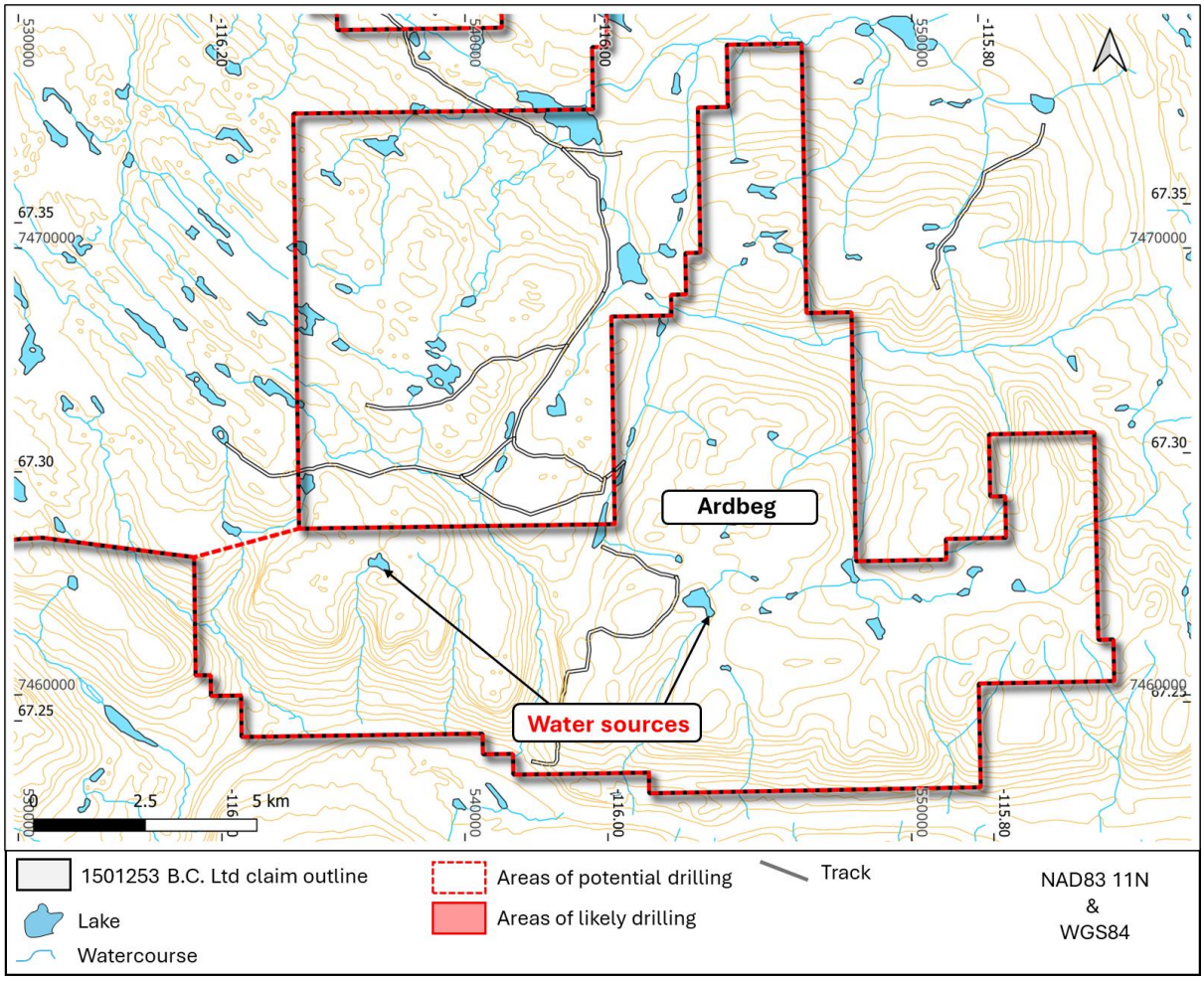


Third priority. Laphroaig district, where the company may possibly drill 1-5 holes, prospecting and funding dependent.

-No holes drilled within 31m of any water body

-No waste or drill water deposited into any water body

-Possibly 1-5 holes



Fourth priority. Ardbeg district, where the company may possibly drill 1-2 holes.

-No holes drilled within 31m of any water body

-No waste or drill water deposited into any water body

-Possibly 1-2 holes

1501253 B.C Ltd.

Spill and Fuel Management Plan

Coppermine Project

Coppermine River area, Kugluktuk

2025/03/20

Contents

REVISION HISTORY

The table below is a revision history table that outlines the revisions made by 1501253 B.C Ltd to this document.

Version	Date	Section	Summary of Changes
1.2	04/03/2025	Intro	Updated diamond drilling to 'drilling', added possibility of staff staying at Hope Lake Camp. Updated map.
1.2	04/03/2025	2.0	Confirmed total amount of fuel on site which could lead to spill (up to 3,800l combined fuel)
1.3	20/03/2025	3.0	Added more detail to spill plan, added details for water/soil/snow spills
1.3	20/03/2025	3.0	Added materials to spill kit
Appendix	20/03/2025	3.0	Added MSDS sheets

Introduction

The Coppermine Project is an early-stage mineral exploration program that will likely include a small drilling program for approximately 10-20 holes, geological mapping and prospecting, rock chip and soil sampling, small ground-based non-invasive geophysical surveys, and possibly airborne geophysical surveys. Staff will be based out of Kugluktuk and fly to site via helicopter or fixed wing. Activities will cease during the Bluenose East caribou herd calving and post calving form from 28th may to 3rd July.

Diesel fuel will be used for the drill rig, and aviation fuel (A1) will be used for the helicopter. Small fuel caches up to 3,800l of combined diesel and aviation fuel will be created at the drill site and possibly other locations in the project area to support geological mapping, rock chip sampling and prospecting. Fuel will be stored on a flat area in 205l barrels, and in sit in a secondary pop-up containment bund that is sealed to prevent any spillage or leakage from seeping into the underlying soil. Fuel caches will be stored at least 31 metres away from the ordinary high-water mark of any water body.

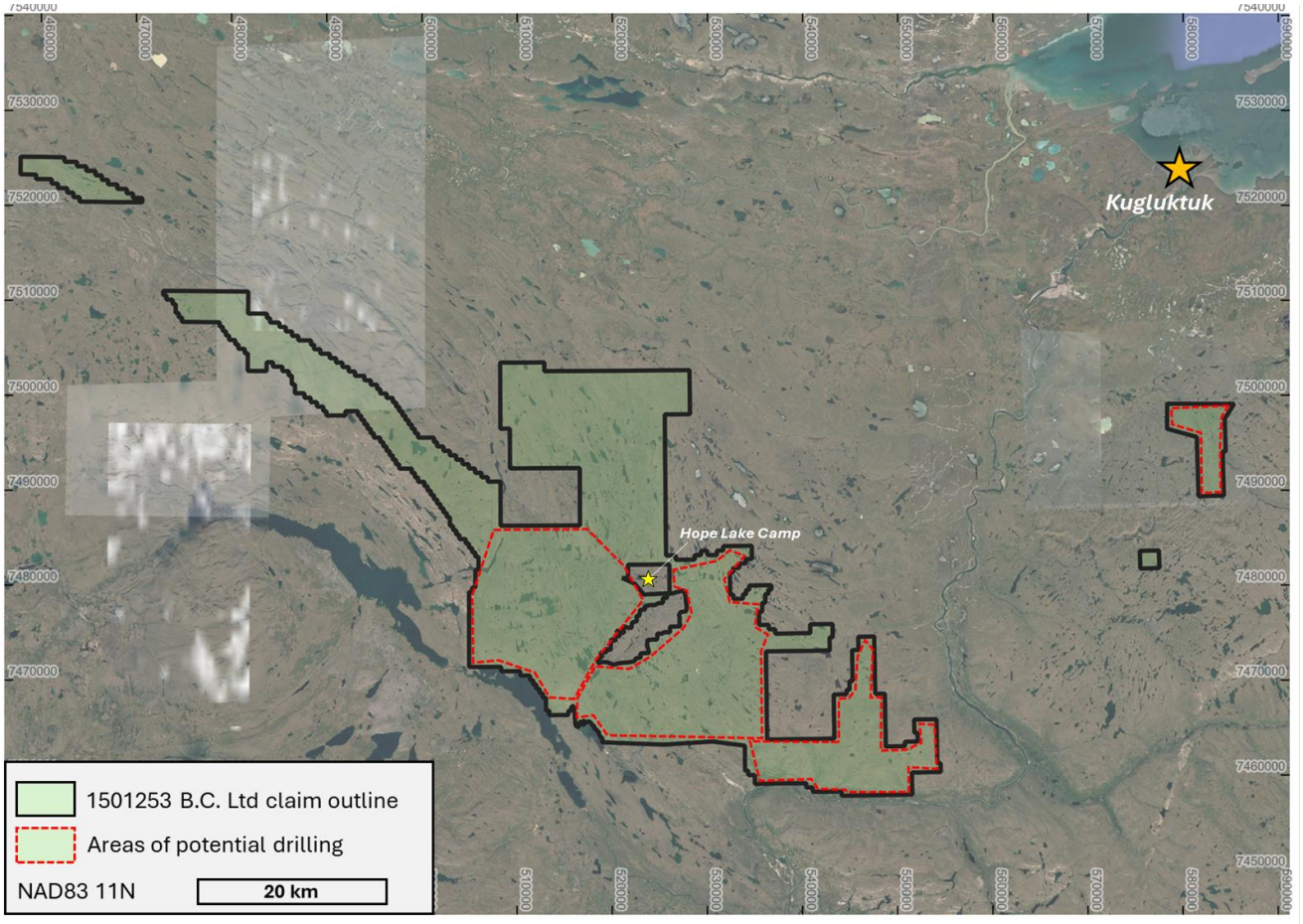
Spill kits will be located at each cache, and at the drill rig. Kits will contain fuel absorbent pads, heavy duty plastic bags, tarps, and empty drums or buckets, and hand tools.

After drilling is complete and the site is remediated, 1501253 B.C Ltd will conduct a thorough inspection of each drill location area to check for:

- Hydrocarbon staining
- Fire and safety hazards
- Debris or litter

1501253 B.C Ltd commits to taking a series of photographs of the drill site locations after the activities are complete, for recording and reporting purposes. All items, waste, and fuel barrels will be removed upon completion of each hole.

Figure 1. Project Location



All employees and contractors working on site must be familiar with the fuel storage practices, spill prevention measures, and spill response actions detailed in this Spill Management Plan. The Plan will be printed and laminated and left at each fuel cache and drill rig.

The site supervisor for the Coppermine Project, and main contact for all spill related matters is listed below:

Alex Vilela
Exploration Manager

Perth, Australia
alex.vilela@sentinelresources.com.au
+61 45 9298209

2.0 Potential Spill Materials Inventory

Given the limited scope of activities proposed for the 2025 field season, a limited number of hazardous materials will be present onsite. All fuel containers will be stored at least 31 metres away from the Ordinary High-Water Mark of any water body. See Table 1 below for a list of hazardous materials stored on site which could lead to a spill.

Table 1. Project Spill Materials Inventory – Confirm totals

Material	Type of Storage Container	Maximum Quantity Onsite	Spill Prevention Measures
Jet fuel	205 L metal drums	3800 L	• Drums stored within secondary containment • Insta-berm and/or absorbent pad used to catch any drips during fuel transfer • Daily inspections of fuel cache to check for leaks or damaged drums, all issues to be addressed immediately • Helicopter fueling only conducted by qualified personnel such as the pilot or engineer • Mark all fuel caches with flags, posts, or similar devices to make them plainly visible, even when buried under snow.
Diesel	205 L metal drums	3800 L	• Drums stored within secondary containment • Insta-berm and/or absorbent pad used to catch any drips during fuel transfer • Daily inspections of fuel cache to check for leaks or damaged drums, all issues addressed immediately • Mark all fuel caches with flags, posts, or similar devices to make them plainly visible, even when buried under snow.

Gasoline	205 L metal drums	410 L	• Containers stored within secondary containment or in drill rig shelter • Insta-berm and/or absorbent pad used to catch any drips during fuel transfer • Daily inspections of fuel storage site to check for leaks or damaged containers, all issues addressed immediately • Mark all fuel caches with flags, posts, or similar devices to make them plainly visible, even when buried under snow.
Engine oils, lubricants, grease, coolant etc.	25 L buckets/containers	125 L	• Containers stored within secondary containment or in drill rig shelter • Insta-berm and/or absorbent pad used to catch any drips during fuel transfer • Daily inspections of fuel storage site to check for leaks or damaged containers, all issues addressed immediately • Mark all fuel caches with flags, posts, or similar devices to make them plainly visible, even when buried under snow.

3.0 Response Plan

In the event of a spill, the following procedures will be followed to ensure a swift and effective response, minimizing impacts to the receiving environment:

General Spill Response Procedures

1. Ensure all personnel are safe and there are no immediate dangers.
2. Remove all potential sources of ignition from the immediate area. Turn off all operating machinery and isolate electronics.
3. Identify the source of the spill and, if possible, stop the flow.
4. Inform the site supervisor immediately. The site supervisor will likely be onsite, but if they aren't, then contact them via radio or satellite phone (contact details to be provided with spill kit).
5. Contain the spill using spill response materials such as absorbent pads, absorbent booms, or barriers.
6. Initiate clean-up and remedial actions, ensuring that GPS coordinates, photographs, and general notes (substance, estimated spill volume, etc.) are taken for reporting purposes.
7. Segregate contaminated soils, snow/ice, water, and absorbents in separate, clearly labelled 205 L metal drums for eventual shipment off-site.
8. Track spill internally using the Spill Tracker (Appendix A).
9. As per the minimum reportable quantities in the Northwest Territories-Nunavut Spill Management Planning and Reporting Regulations (attached as an appendix to this document), all externally reportable spills, or any spill near or into water, will be reported to the 24-Hour Spill Report Line and the Inspector:
   24-Hour Spill Report Line: +1 (867) 920-8130
   Inspector: +1 (867) 975-4284 (or as indicated by Crown-Indigenous and Northern Affairs Canada in the Project land use permit). Though not required by legislation, it is best practice to report all spills to the Spill Line and Inspector.
10. Conduct an investigation into the cause, to prevent a repeat of the incident.
11. Within 30 days of the spill, the site supervisor or designate will submit a detailed report to the Inspector, as per conditions of the Project land use permit.

Spill Response Procedures for Different Media

1. To improve response effectiveness, personnel should follow specific guidance based on the spill medium:

Spills on Snow and Ice

a) Use absorbent materials to contain and collect liquid spills, and to stop spill spreading any further. Once spill is contained, proceed with removing contaminated ice and snow.
b) Shovel contaminated snow/ice into labelled drums, or if none are immediately available, place in plastic-lined containment areas for transfer to drums as soon as possible.
c) Avoid disturbing underlying ice to prevent contamination of water bodies.

Spills on Soil

a) Construct containment berms using shovels etc to dig trenches or build berms, or use spill containment barriers. Create these downhill to focus spill material and prevent it spreading.
b) Excavate contaminated soil using shovels and rakes, and store it in labelled drums for off-site disposal.
c) Apply absorbents if to aid in clean-up.

Spills in Water*

a) Prevent further contamination by stopping the spill source promptly.
b) Deploy absorbent booms, pads and skimmers to contain and absorb spilled substances. Deploy booms with a boat or by hand to prevent spill from spreading and reaching fragile shorelines or being blown away by wind or current.
c) Remove absorbents and store it in labelled drums for off-site disposal, skim off contaminated top layer of water.

The company does not expect there to be any chance of spills in/on water, as **no drilling will be conducted within 31 metres of the high-water mark of any water body. The company will **not** drill on any frozen lakes or rivers.*

2. Resource Inventory

Fully stocked spill kits will be maintained at the Project site and will be placed in an appropriate location near fuel storage and fuel transfer. Miscellaneous equipment present on site will be made available for spill response such as shovels, fuel transfer pumps, hand tools, and hoses/fittings.

A 305 L spill kit and instruction manual will be located at the fuel caches and will include:

Socks	Caution tape
Absorbent pads	Nitrile gloves
Pillows	Safety goggles
Absorbent cloth roll	Protective coveralls
Premixed plugging compound	Plastic disposal bags
Plastic sheets/tarp	Picks/shovels/rakes
Instruction booklet	

Smaller 20 L spill kits will also be used on site for activities such as fuel transfers. These spill kits include:

Socks	Disposal bags
Absorbent pads	5 L polyethylene pail
Nitrile gloves	Instruction booklet

The Company will ensure that empty, sealed-top 205 L metal drums are present on site to manage all waste liquids, or to transfer liquids into if any drums are compromised. Open-top 205 L metal drums and/or lined mega bags will be present on site for disposal and eventual shipment of any contaminated absorbents and contaminated soil.

3. Roles and Responsibilities

1501253 B.C Ltd Senior Management - Responsible for ensuring that the site supervisor is aware of spill response and reporting procedures, as well as appropriate mitigations to prevent spills from occurring. The Senior Management team will ensure that management plans are properly implemented and that the site supervisor is familiar with the conditions of site authorizations such as the land use permit.

Site Supervisor – Responsible for ensuring that all employees and contractors on-site are informed about spill response equipment, procedures, and preventive measures to minimize the risk of spills. The Site Supervisor is tasked with implementing management plans, such as the Spill Management Plan, to reduce the Project's environmental impact. In the event of a reportable spill, it is the **Site Supervisor's responsibility** to ensure proper documentation and to **notify the appropriate authorities without delay.**

Staff and Contractors – All personnel working on site must be familiar with the Spill management Plan and understand how to respond to a spill. Staff and contractors must adhere to the Spill management Plan to help minimize wildlife attractants and environmental risks created by the Project.

1501253 B.C LTD.

Appendix A: Spill Tracker

Date	Time	Location (Lat/Long)	Substance Spilled	Estimated Volume (L)	Spill # (externally reportable only)	Comments (Environment Impact, affected substrate)

Appendix A – Reportable Spill Volumes

Unplanned releases of the materials and volumes listed below are immediately reportable.

Description of Contaminant	Amount Spilled	TDG Class
Explosives	Any amount	1.0
Compressed gas (toxic/corrosive)	Any amount	2.3/2.4
Infectious substances	Any amount	6.2
Sewage and wastewater (unless otherwise authorized)	Any amount	6.2
Radioactive materials	Any amount	7.0
Unknown substance	Any amount	None
Compressed gas (Flammable)	Any amount of gas from containers with a capacity greater than 100 L	2.1
Compressed gas (Non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100 L	2.2
Flammable liquid	≥ 100 L	3.1/3.2/3.3
Flammable solid	≥ 25 kg	4.1 4.2
Substances liable to spontaneous combustion	≥ 25 kg	4.1 4.2
Water reactant substances	≥ 25 kg	4.3
Oxidizing substances	≥ 50 L or 50 kg	5.1
Organic peroxides	≥ 1 L or 1 kg	5.2
Environmentally hazardous substances intended for disposal	≥ 1 L or 1 kg	9.0
Toxic substances	≥ 5 L or 5 kg	6.1 8.0
Corrosive substances	≥ 5 L or 5 kg	9.0
Miscellaneous products, substances or organisms	≥ 5 L or 5 kg	
PCB mixtures of 5 or more parts per million	≥ 0.5 L or 0.5 kg	9.0
Other contaminants, e.g. crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, wastewater, etc.	≥ 100 L or 100 kg	None
Sour natural gas (i.e., contains H2S)	Uncontrolled release or sustained flow of 10 minutes or more	None
Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more	None
Flammable liquid	≥ 20 L	3.1/3.2/3.3
Vehicle fluids	When released on a frozen water body that is being used as a working surface	None
Reported releases or potential releases of any size that: • **Are near or in an open water body;** • **Are near or in a designated sensitive environment or habitat;** • **Pose an imminent threat to human health or safety; or** **Pose an imminent threat to a listed species at risk or its critical habitat**	Any amount	None

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		

C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS

F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION	
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION	
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS		

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC

SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN

FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

SAFETY DATA SHEET
Aviation Jet Fuel JET A-1 (JETA1)

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name Aviation Jet Fuel JET A-1 (JETA1)

Product number ID 10505

Internal identification 145163

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses Distribution of substance (ES01a) Formulation & (re)packing of substances and mixtures (ES02) Use as a fuel (ES12a, ES12b)

Uses advised against Consumer Professional use.
Uses in coatings Use in cleaning agents Lubricants Metal working fluids/rolling oils Use as binders and release agents Use in agrochemicals Road and construction applications Explosives manufacture & use

1.3. Details of the supplier of the safety data sheet

Supplier Neste Oyj
Keilaranta 21, Espoo, P.O.B. 95, FIN-00095 NESTE, FINLAND
Tel. +358 10 45811
SDS@neste.com (chemical safety)

1.4. Emergency telephone number

Emergency telephone +61 2 9186 1132, Chemwatch: International Emergency Response Phone Number

National emergency telephone number +358 800 147 111, +358 9 471 977, Poison Information Centre

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification (SI 2019 No. 720)

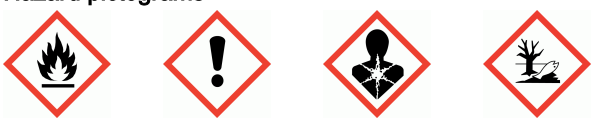
Physical hazards Flam. Liq. 3 - H226

Health hazards Skin Irrit. 2 - H315 STOT SE 3 - H336 Asp. Tox. 1 - H304

Environmental hazards Aquatic Chronic 2 - H411

2.2. Label elements

Hazard pictograms



Signal word Danger

Aviation Jet Fuel JET A-1 (JETA1)

Hazard statements

H226 Flammable liquid and vapour.
H315 Causes skin irritation.
H336 May cause drowsiness or dizziness.
H304 May be fatal if swallowed and enters airways.
H411 Toxic to aquatic life with long lasting effects.

Precautionary statements

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P273 Avoid release to the environment.
P301+P310 IF SWALLOWED: Immediately call a POISON CENTER/ doctor.
P331 Do NOT induce vomiting.
P261 Avoid breathing vapours.
P280 Wear protective gloves.

Contains

Kerosine (petroleum), sweetened, Distillates (petroleum), hydrotreated light; Kerosine - unspecified, Kerosine (petroleum), hydrodesulfurized, Renewable hydrocarbons (kerosine type fraction)

2.3. Other hazards

Other hazards

Evaporates slowly. May cause eye and respiratory system irritation. Risk of soil and ground water contamination.

SECTION 3: Composition/information on ingredients

3.2. Mixtures

Kerosine (petroleum), hydrodesulfurized **0 - 100 %**

CAS number: 64742-81-0 EC number: 265-184-9

Classification
Flam. Liq. 3 - H226
Skin Irrit. 2 - H315
STOT SE 3 - H336
Asp. Tox. 1 - H304
Aquatic Chronic 2 - H411

Distillates (petroleum), hydrotreated light; Kerosine - unspecified **0 - 100 %**

CAS number: 64742-47-8 EC number: 265-149-8

Classification
Flam. Liq. 3 - H226
Skin Irrit. 2 - H315
STOT SE 3 - H336
Asp. Tox. 1 - H304
Aquatic Chronic 2 - H411

Aviation Jet Fuel JET A-1 (JETA1)

Kerosine (petroleum), sweetened **0 - 100 %**

CAS number: 91770-15-9 EC number: 294-799-5

Classification
Flam. Liq. 3 - H226
Skin Irrit. 2 - H315
STOT SE 3 - H336
Asp. Tox. 1 - H304
Aquatic Chronic 2 - H411

Renewable hydrocarbons (kerosine type fraction) **0 - 50 %**

CAS number: —

Classification
Flam. Liq. 3 - H226
Asp. Tox. 1 - H304

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

Composition comments Mixture of a petroleum product and additives. Total aromatics at maximum: 26,5 %. Naphthalene (CAS 91-20-3) < 1 %. Toluene (CAS 108-88-3) < 1%. Benzene (CAS 71-43-2) < 0,1 %.

Other information REACH registration number:, Kerosine (petroleum), hydrodesulfurized: 01- 2119462828-25-XXXX, Distillates (petroleum), hydrotreated light; Kerosine - unspecified: 01- 2119484819-18-XXXX, Kerosine (petroleum), sweetened: 01- 2119502385-46-XXXX, Renewable hydrocarbons (kerosine type fraction): 01- 2119850115-46

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Remove person to fresh air and keep comfortable for breathing. For breathing difficulties, oxygen may be necessary. If breathing stops, provide artificial respiration. Get medical attention if symptoms are severe or persist.

Ingestion Do not induce vomiting. Get medical attention immediately.

Skin contact Remove contaminated clothing immediately and wash skin with soap and water. Get medical attention if irritation persists after washing.

Eye contact Rinse immediately with plenty of water. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation persists after washing.

4.2. Most important symptoms and effects, both acute and delayed

General information Irritating to skin. May irritate eyes. Vapours in high concentrations are narcotic. May cause nausea, headache, dizziness and intoxication. Entry into the lungs following ingestion or vomiting may cause chemical pneumonitis.

4.3. Indication of any immediate medical attention and special treatment needed

Notes for the doctor Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media Water spray, foam, dry powder or carbon dioxide.

Aviation Jet Fuel JET A-1 (JETA1)

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

5.2. Special hazards arising from the substance or mixture

Specific hazards Flammable liquid and vapour. Containers can burst violently or explode when heated, due to excessive pressure build-up.

Hazardous combustion products Carbon dioxide (CO2). Carbon monoxide (CO).

5.3. Advice for firefighters

Protective actions during firefighting Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk. Prevent fire extinguishing water from contaminating surface water or the ground water system.

Special protective equipment for firefighters Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid inhalation of vapours and contact with skin and eyes. Wear adequate protective equipment at all operations.

For emergency responders Prevent unauthorized access. Vapours are heavier than air and may spread near ground and travel a considerable distance to a source of ignition and flash back. Eliminate all ignition sources if safe to do so. Take precautionary measures against static discharge.

6.2. Environmental precautions

Environmental precautions Avoid release to the environment. Stop leak if safe to do so. Avoid the spillage or runoff entering drains, sewers or watercourses. Contain spillage with sand, earth or other suitable non-combustible material. Inform the relevant authorities if environmental pollution occurs (sewers, waterways, soil or air). Risk of soil and ground water contamination.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up Immediately start clean-up of the liquid and contaminated soil. Small Spillages: Absorb spillage with sand or other inert absorbent. Pay attention to the fire and health hazards caused by the product. Take care as floors and other surfaces may become slippery.

6.4. Reference to other sections

Reference to other sections For personal protection, see Section 8.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Usage precautions The product contains volatile substances which may spread in the atmosphere. Avoid heat, flames and other sources of ignition. Take precautionary measures against static discharges. Use only non-sparking tools. Ground/bond container and receiving equipment. All handling should only take place in well-ventilated areas. Avoid inhalation of vapours and contact with skin and eyes. Use personal protective equipment and/or local ventilation when needed. Do not eat, drink or smoke when using this product. Wash hands and any other contaminated areas of the body with soap and water before leaving the work site. Wash contaminated clothing before reuse. During tank operations follow special instructions (risk of oxygen displacement and hydrocarbons).

7.2. Conditions for safe storage, including any incompatibilities

Aviation Jet Fuel JET A-1 (JETA1)

Storage precautions Flammable liquid storage. Vapours may form explosive mixtures with air. Store in accordance with local regulations. Store in a demarcated bunded area to prevent release to drains and/or watercourses. Only store in correctly labelled containers. Use containers made of the following materials: Mild steel. Stainless steel. Keep container tightly closed. Protect from sunlight.

7.3. Specific end use(s)

Specific end use(s) Not known.

SECTION 8: Exposure controls/Personal protection

8.1. Control parameters

Occupational exposure limits

Solvent naphtha, group 3: 100mg/m3 (8h), HTP 2020/FIN.
The individual limit values can be applied for the hydrocarbons.

PNEC Not available.

Renewable hydrocarbons (kerosine type fraction)

DNEL Workers - Dermal; Long term systemic effects: 42 mg/kg/day
Workers - Inhalation; Long term systemic effects: 147 mg/m³

Category: Kerosines

DNEL Consumer - Oral; Long term systemic effects: 18,75 mg/kg bw/day

naphthalene (CAS: 91-20-3)

DNEL Workers - Dermal; Long term systemic effects: 3,57 mg/kg
Workers - Inhalation; Long term local effects: 25 mg/m³
Workers - Inhalation; Long term systemic effects: 25 mg/m³

8.2. Exposure controls

Appropriate engineering controls All handling should only take place in well-ventilated areas. Use personal protective equipment and/or local ventilation when needed. Handle in accordance with good industrial hygiene and safety practice. During tank operations follow special instructions (risk of oxygen displacement and hydrocarbons).

Eye/face protection Spectacles.

Hand protection Wear protective gloves. It is recommended that gloves are made of the following material: Nitrile rubber. Neoprene. Polyvinyl chloride (PVC). The breakthrough time for any glove material may be different for different glove manufacturers. Protective gloves according to standard EN 374. Change protective gloves regularly.

Other skin and body protection Protective clothing when needed. Wear anti-static protective clothing if there is a risk of ignition from static electricity.

Respiratory protection Respiratory protection must be used if the airborne contamination exceeds the recommended occupational exposure limit. Wear a respirator fitted with the following cartridge: Gas filter, type A2. Gas and combination filter cartridges suitable for intended use should be used. Filter must be changed often enough.

Environmental exposure controls Store in a demarcated bunded area to prevent release to drains and/or watercourses.

SECTION 9: Physical and chemical properties

Aviation Jet Fuel JET A-1 (JETA1)

9.1. Information on basic physical and chemical properties

Appearance	Liquid.
Colour	Clear.
Odour	Hydrocarbons.
Odour threshold	-
pH	-
Melting point	≤ -47°C (ASTM D2386, D5972, IP 529)
Initial boiling point and range	130 - 300°C (ASTM D 86)
Flash point	≥ 38°C (IP 170)
Upper/lower flammability or explosive limits	Lower flammable/explosive limit: 0,6 % Upper flammable/explosive limit: 6 %
Vapour pressure	~ 2 kPa @ 38°C
Vapour density	> 3 (Air = 1.0)
Relative density	0,775 - 0,840 @ 15°C (ASTM D4052)
Solubility(ies)	The product has poor water-solubility. < 50 mg/l @ 20°C
Partition coefficient	log Kow: > 3
Auto-ignition temperature	~ 250°C
Decomposition Temperature	-
Viscosity	Kinematic viscosity < 7 mm2/s @ 40°C
Explosive properties	Not considered to be explosive.
Oxidising properties	Does not meet the criteria for classification as oxidising.

9.2. Other information

Other information	Not known.

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity	There are no known reactivity hazards associated with this product.

10.2. Chemical stability

Stability	Stable at normal ambient temperatures and when used as recommended.

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions	No potentially hazardous reactions known.

10.4. Conditions to avoid

Conditions to avoid	Keep away from heat, sparks and open flame.

10.5. Incompatible materials

Materials to avoid	Oxidising agents.

10.6. Hazardous decomposition products

Aviation Jet Fuel JET A-1 (JETA1)

Hazardous decomposition products Does not decompose when used and stored as recommended.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Toxicological effects Based on available data the classification criteria are not met.

Skin corrosion/irritation

Skin corrosion/irritation Irritating to skin. (EPA Guidelines in FR Vol. 44, No. 145, p. 44054-44093) The product irritates mucous membranes and may cause abdominal discomfort if swallowed. May cause respiratory irritation.

Serious eye damage/irritation

Serious eye damage/irritation Based on available data the classification criteria are not met. (EPA OTS 798.4500)

Skin sensitisation

Skin sensitisation Based on available data the classification criteria are not met. (OECD 406, EPA OTS 798.4100)

Germ cell mutagenicity

Genotoxicity - in vitro Based on available data the classification criteria are not met. (OECD 471, modified Ames test, 479)

Genotoxicity - in vivo Based on available data the classification criteria are not met. (OECD 479)

Carcinogenicity

Carcinogenicity Based on available data the classification criteria are not met. (OECD 451)

Reproductive toxicity

Reproductive toxicity - fertility Based on available data the classification criteria are not met. (OECD 415)

Reproductive toxicity - development Based on available data the classification criteria are not met. (OECD 414)

Specific target organ toxicity - single exposure

STOT - single exposure May cause nausea, headache, dizziness and intoxication. Anaesthetic in high concentrations.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure Based on available data the classification criteria are not met. (OECD 408, 411, 413)

Aspiration hazard

Aspiration hazard May be fatal if swallowed and enters airways. Entry into the lungs following ingestion or vomiting may cause chemical pneumonitis.

Toxicological information on ingredients.

Renewable hydrocarbons (kerosine type fraction)

Acute toxicity - oral

Notes (oral LD_{50}) LD_{50} > 2000 mg/kg, Oral, Rat (EC B1 tris)

Acute toxicity - dermal

Notes (dermal LD_{50}) LD_{50} > 2000 mg/kg, Dermal, Rat (EC B3)

Category: Kerosines

Acute toxicity - oral

Notes (oral LD_{50}) LD_{50} > 5000 mg/kg, Oral, Rat (OECD 420, EPA OTS 798.1175)

Aviation Jet Fuel JET A-1 (JETA1)

Acute toxicity - dermal

Notes (dermal LD_{50}) LD_{50} > 2000 mg/kg, Dermal, Rabbit (OECD 402, EPA OTS 798.1100)

Acute toxicity - inhalation

Notes (inhalation LC_{50}) LC_{50} > 5,28 mg/l, Inhalation, Rat (4h) (OECD 403)

SECTION 12: Ecological information

12.1. Toxicity

Toxicity Toxic to aquatic life with long lasting effects.

Acute aquatic toxicity

Ecological information on ingredients.

Renewable hydrocarbons (kerosine type fraction)

Acute aquatic toxicity

Acute toxicity - fish	LL_{50}, 96 hours: > 1000 mg/l, WAF (OECD 203)
Acute toxicity - aquatic invertebrates	EL50, 48 hours: > 100 mg/l, WAF (OECD 202)
Acute toxicity - aquatic plants	EL50, 72 hours: > 100 mg/l, WAF (OECD 201)
Acute toxicity - microorganisms	EC_{50}, 3 hours: > 1000 mg/l, Micro-organisms (wastewater sludge) (OECD 209)

Chronic aquatic toxicity

Chronic toxicity - aquatic invertebrates	NOEC, 21 days: 1 mg/l, LOEC, 21 days: 3,2 mg/l, Daphnia magna WAF (OECD 211) NOEC, 10 days: 373 mg/kg, LC_{50}, 10 days: 1200 mg/kg, Sediment organisms (OSPAR Protocols, Part A: Sediment Bioassay, 2005)

Category: Kerosines

Acute aquatic toxicity

Acute toxicity - fish	LL_{50}, 24 hours: 5-17 mg/l, Oncorhynchus mykiss (Rainbow trout) LL_{50}, 48 hours: 2-5 mg/l, Oncorhynchus mykiss (Rainbow trout) WAF (OECD 203)
Acute toxicity - aquatic invertebrates	EL50, 24 hours: 4,6 mg/l, Daphnia magna EL50, 48 hours: 1,4 mg/l, Daphnia magna NOEL, 48 hours: 0,3 mg/l, Daphnia magna WAF (OECD 202)
Acute toxicity - aquatic plants	EL50, 24 hours: 1-3 mg/l, Pseudokirchneriella subcapitata NOEL, 24 hours: 1 mg/l, Pseudokirchneriella subcapitata WAF (OECD 201)

Chronic aquatic toxicity

Chronic toxicity - fish early life stage	NOEL, 28 days: 0,1 mg/l, Oncorhynchus mykiss (Rainbow trout) (QSAR)

Aviation Jet Fuel JET A-1 (JETA1)

Chronic toxicity - aquatic invertebrates	EL50, 21 days: 0.81 mg/l, Daphnia magna NOEL, 21 days: 0,48 mg/l, Daphnia magna WAF (OECD 211)

12.2. Persistence and degradability

Persistence and degradability	The product contains volatile substances which may spread in the atmosphere. Can be photodegraded in the atmosphere.
Stability (hydrolysis)	No significant reaction in water.

Ecological information on ingredients.

Renewable hydrocarbons (kerosine type fraction)

Biodegradation	Rapidly degradable (OECD 301B)

Category: Kerosines

Biodegradation	Inherently biodegradable. (OECD 301F)

12.3. Bioaccumulative potential

Bioaccumulative potential	Possibly bioaccumulative.
Partition coefficient	log Kow: > 3

12.4. Mobility in soil

Mobility	Evaporates slowly. The product has poor water-solubility. Product can penetrate soil until reaching the surface of ground water. The product contains substances which are bound to particulate matter and are retained in soil.

12.5. Results of PBT and vPvB assessment

Results of PBT and vPvB assessment	This product does not contain any substances classified as PBT or vPvB.

12.6. Other adverse effects

Other adverse effects	Product causes fouling, and direct contact produces harmful effects e.g. to birds and vegetation. Adsorbed hydrocarbon residues can be harmful to sediment organisms.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Disposal methods	Dispose of waste to licensed waste disposal site in accordance with the requirements of the local Waste Disposal Authority. When handling waste, the safety precautions applying to handling of the product should be considered. Care should be taken when handling emptied containers that have not been thoroughly cleaned or rinsed out. Empty containers or liners may retain some product residues and hence be potentially hazardous.

SECTION 14: Transport information

Sea transport notes	This cargo is considered an Energy-rich fuel and effective 1 January 2019 should be carried subject to Annex I of MARPOL, see Annex 12 of MEPC.2/Circ.24. Please also refer to MEPC.1/Circ.879 - GUIDELINES FOR THE CARRIAGE OF ENERGY-RICH FUELS AND THEIR BLENDS

14.1. UN number

Aviation Jet Fuel JET A-1 (JETA1)

UN No. (ADR/RID) 1863

14.2. UN proper shipping name

Proper shipping name (ADR/RID) UN 1863 FUEL, AVIATION, TURBINE ENGINE

14.3. Transport hazard class(es)

ADR/RID class 3

14.4. Packing group

ADR/RID packing group III

14.5. Environmental hazards

Environmentally hazardous substance/marine pollutant

MARINE POLLUTANT

14.6. Special precautions for user

Hazard Identification Number (ADR/RID) 30

Tunnel restriction code (D/E)

14.7. Transport in bulk according to Annex II of MARPOL and the IBC Code

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations EU regulatory references for the safety data sheet:
Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (as amended)
Commission Regulation (EU) No 2015/830 of 28 May 2015
Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures (as amended)

15.2. Chemical safety assessment

A chemical safety assessment has been carried out.

SECTION 16: Other information

Abbreviations and acronyms used in the safety data sheet EU OELV = European Occupational Exposure Limit Value

Key literature references and sources for data Regulations, databases, literature, own research. CONCAWE Report 13/17: Hazard classification and labelling of petroleum substances in the EEA - 2017.
Chemical Safety Report Distillates (petroleum), hydrotreated light, 2019. Chemical Safety Report Kerosine (petroleum), hydrodesulfurized, 2019. Chemical Safety Report Kerosine (petroleum), sweetened, 2019. Chemical Safety Report Renewable hydrocarbons (kerosene type fraction): 2011.

Aviation Jet Fuel JET A-1 (JETA1)

Training advice	DO NOT SIPHON PRODUCT BY MOUTH SUCTION.
Revision comments	Updated, sections: 1.4, 15.1 NOTE: Lines within the margin indicate significant changes from the previous revision.
Revision date	15/08/2022
Supersedes date	08/06/2020
SDS number	5306
Hazard statements in full	H226 Flammable liquid and vapour. H304 May be fatal if swallowed and enters airways. H315 Causes skin irritation. H336 May cause drowsiness or dizziness. H411 Toxic to aquatic life with long lasting effects.

Exposure scenario
Distribution of Substance - Industrial

Identification

Product name	Kerosines
Version number	2018
Es reference	ES01a

1. Title of exposure scenario

Main title	Distribution of Substance - Industrial
Process scope	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading distribution and associated laboratory activities.

Environment

Environmental release category	ERC4 Use of non-reactive processing aid at industrial site (no inclusion into or onto article) ERC5 Use at industrial site leading to inclusion into/onto article ERC6a Use of intermediate ERC6b Use of reactive processing aid at industrial site (no inclusion into or onto article) ERC6c Use of monomer in polymerisation processes at industrial site (inclusion or not into/onto article) ERC6d Use of reactive process regulators in polymerisation processes at industrial site (inclusion or not into/onto article) ERC7 Use of functional fluid at industrial site
SPERC	ESVOC SPERC 1.1b.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC4 Chemical production where opportunity for exposure arises PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing) PROC15 Use as laboratory reagent.

2. Conditions of use affecting exposure (Industrial - Environment 1)

Product characteristics

Substance is complex UVCB. Predominantly hydrophobic.

Amounts used

Fraction of EU tonnage used in region: 0.1
Regional use tonnage: 8,700,000 tonnes/year
Fraction of Regional tonnage used locally: 1
Annual site tonnage: 17,000 tonnes
Maximum daily site tonnage: 58 tonnes

Distribution of Substance - Industrial

Frequency and duration of use

Continuous release.
Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	Release fraction to air from process (initial release prior to RMM): 1.0E-03
Emission factor - water	Release fraction to wastewater from process (initial release prior to RMM): 1.0E-05
Emission factor - soil	Release fraction to soil from process (initial release prior to RMM): 1.0E-05

Environmental factors not influenced by risk management measures

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

Good practice	Common practices vary across sites, thus conservative process release estimates used. Risk from environmental exposure is driven by freshwater sediment.
STP details	Estimated substance removal from wastewater via domestic sewage treatment: 95% Removal efficiency (total): 95% Maximum allowable site tonnage (Msafe), based on release following total wastewater treatment removal: 2.1E+06 kg/day Assumed domestic sewage treatment plant flow (m³/day): 2000.

Technical onsite conditions and measures to reduce or limit discharges to air, water and soil

Air	Treat air emission to provide a typical removal efficiency of 90%.
Water	Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of (%): 0.0 If discharging to domestic sewage treatment plant, no onsite wastewater treatment required.
Soil	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

Conditions and measures related to external treatment of waste for disposal

Waste treatment	External treatment and disposal of waste should comply with applicable local and/or national regulations.

Conditions and measures related to external recovery of waste

Recovery method	External recovery and recycling of waste should comply with applicable local and/or national regulations.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Vapour pressure	Vapour pressure 0.5 - 10 kPa at STP.
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Other given operational conditions affecting workers exposure

Distribution of Substance - Industrial

Setting Assumes a good basic standard of occupational hygiene is implemented.

Temperature Assumes use at not more than 20°C above ambient temperature, unless stated differently.

Organisational measures to prevent/limit releases, dispersion and exposure

Organisational measures General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.

Risk management measures

General exposures (closed systems)
No other specific measures identified.
.
General exposures (open systems)
No other specific measures identified.
.
Process sampling
No other specific measures identified.
.
Laboratory activities
No other specific measures identified.
.
Bulk transfers
No other specific measures identified.
.
Drum and small package filling
No other specific measures identified.
.
Equipment cleaning and maintenance
No other specific measures identified.
.
Bulk product storage
No other specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model. (Hydrocarbon Block Method)

Maximum Risk Characterisation Ratios for air emissions 2.3E-04 Maximum Risk Characterisation Ratios for wastewater emissions 1.3E-02

4. Guidance to check compliance with the exposure scenario (Environment 1)

Guidance is based on assumed operating conditions which may not be applicable to all sites, thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

3. Exposure estimation (Health 1)

Assessment method The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated

Distribution of Substance - Industrial

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Qualitative approach used to conclude safe use. Available hazard data do not support the need for a DNEL to be established for other health effects. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

4. Guidance to check compliance with the exposure scenario (Health 1)

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Exposure scenario
Formulation & (Re)packing of Substances and Mixtures - Industrial

Identification

Product name Kerosines

Version number 2018

Es reference ES02

1. Title of exposure scenario

Main title Formulation & (Re)packing of Substances and Mixtures - Industrial

Process scope Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tabletting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities.

Environment

Environmental release category ERC2 Formulation into mixture

SPERC ESVOC SPERC 2.2.v1

Worker

Process category

PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions
PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions
PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition
PROC4 Chemical production where opportunity for exposure arises
PROC5 Mixing or blending in batch processes
PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities
PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities
PROC9 Transfer of substance or mixture into small containers (dedicated filling line, including weighing)
PROC14 Tabletting, compression, extrusion, pelletisation, granulation
PROC15 Use as laboratory reagent.

2. Conditions of use affecting exposure (Industrial - Environment 1)

Product characteristics

Substance is complex UVCB. Predominantly hydrophobic.

Amounts used

Fraction of EU tonnage used in region: 0.1
Regional use tonnage: 6,800,000 tonnes/year
Fraction of Regional tonnage used locally: 1
Annual site tonnage: 30,000 tonnes
Maximum daily site tonnage: 100 tonnes

Frequency and duration of use

Continuous release.
Emission days: 300 days/year

Formulation & (Re)packing of Substances and Mixtures - Industrial

Other given operational conditions affecting environmental exposure

Emission factor - air	Release fraction to air from process (after typical onsite RMMs consistent with EU Solvent Emissions Directive requirements): 2.5E-02
Emission factor - water	Release fraction to wastewater from process (initial release prior to RMM): 2.0E-04
Emission factor - soil	Release fraction to soil from process (initial release prior to RMM): 1.0E-04

Environmental factors not influenced by risk management measures

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

Good practice	Common practices vary across sites, thus conservative process release estimates used. Risk from environmental exposure is driven by freshwater sediment.
STP type	Municipal STP.
STP details	Estimated substance removal from wastewater via domestic sewage treatment: 95.0% Removal efficiency (total): 95.0% Maximum allowable site tonnage (Msafe), based on release following total wastewater treatment removal: 100 tonne/day Assumed domestic sewage treatment plant flow (m³/day): 2000.

Technical onsite conditions and measures to reduce or limit discharges to air, water and soil

Air	Treat air emission to provide a typical removal efficiency of 0%.
Water	Prevent leaks and prevent soil/water pollution caused by leaks. Onsite wastewater treatment required. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of (%): 94.8 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%): 0.0
Soil	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

Conditions and measures related to external treatment of waste for disposal

Waste treatment	External treatment and disposal of waste should comply with applicable local and/or national regulations.

Conditions and measures related to external recovery of waste

Recovery method	External recovery and recycling of waste should comply with applicable local and/or national regulations.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Vapour pressure	Vapour pressure 0.5 - 10 kPa at STP.
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Other given operational conditions affecting workers exposure

Setting	Assumes a good basic standard of occupational hygiene is implemented.

Formulation & (Re)packing of Substances and Mixtures - Industrial

Temperature Assumes use at not more than 20°C above ambient temperature, unless stated differently.

Organisational measures to prevent/limit releases, dispersion and exposure

Organisational measures General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.

Risk management measures

General exposures (closed systems)
No other specific measures identified.
.
General exposures (open systems)
No other specific measures identified.
.
Process sampling
No other specific measures identified.
.
Laboratory activities
No other specific measures identified.
.
Bulk transfers
No other specific measures identified.
.
Mixing operations
No other specific measures identified.
.
Manual
Transfer from/pouring from containers
No other specific measures identified.
.
Drum/batch transfers
No other specific measures identified.
.
Tabletting, compression, extrusion or pelletisation
No other specific measures identified.
.
Drum and small package filling
No other specific measures identified.
.
Equipment cleaning and maintenance
No other specific measures identified.
.
Bulk product storage
No other specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method Used Petrorisk model. (Hydrocarbon Block Method)

Maximum Risk Characterisation Ratios for air emissions 1.6E-02 Maximum Risk Characterisation Ratios for wastewater emissions 9.7E-01

4. Guidance to check compliance with the exposure scenario (Environment 1)

Formulation & (Re)packing of Substances and Mixtures - Industrial

Guidance is based on assumed operating conditions which may not be applicable to all sites, thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

3. Exposure estimation (Health 1)

Assessment method

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Qualitative approach used to conclude safe use. Available hazard data do not support the need for a DNEL to be established for other health effects. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

4. Guidance to check compliance with the exposure scenario (Health 1)

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Exposure scenario
Use as a Fuel - Industrial

Identification

Product name	Kerosines
Version number	2018
Es reference	ES12a

1. Title of exposure scenario

Main title	Use as a Fuel - Industrial
Process scope	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.

Environment

Environmental release category	ERC7 Use of functional fluid at industrial site
SPERC	ESVOC SPERC 7.12a.v1

Worker

Process category	PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities PROC16 Use of fuels

2. Conditions of use affecting exposure (Industrial - Environment 1)

Product characteristics

Substance is complex UVCB. Predominantly hydrophobic.

Amounts used

Fraction of EU tonnage used in region: 0.1
Regional use tonnage: 1,600,000 tonnes/year
Fraction of Regional tonnage used locally: 1
Annual site tonnage: 1,500,000 tonnes
Maximum daily site tonnage: 5000 tonnes

Frequency and duration of use

Continuous release.
Emission days: 300 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air	Release fraction to air from process (initial release prior to RMM): 5.0E-02
Emission factor - water	Release fraction to wastewater from process (initial release prior to RMM): 1.0E-05
Emission factor - soil	Release fraction to soil from process (initial release prior to RMM): 0

Environmental factors not influenced by risk management measures

Use as a Fuel - Industrial

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

Good practice	Common practices vary across sites, thus conservative process release estimates used. Risk from environmental exposure is driven by freshwater sediment.
STP type	Municipal STP.
STP details	Estimated substance removal from wastewater via domestic sewage treatment: 95.0% Removal efficiency (total): 95% Maximum allowable site tonnage (Msafe), based on release following total wastewater treatment removal: 2.1E+06 tonne/day Assumed domestic sewage treatment plant flow (m³/day): 2000.

Technical onsite conditions and measures to reduce or limit discharges to air, water and soil

Air	Treat air emission to provide a typical removal efficiency of 95%.
Water	Prevent leaks and prevent soil/water pollution caused by leaks. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of (%): 94.4 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%): 0.0
Soil	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

Conditions and measures related to external treatment of waste for disposal

Waste treatment	Combustion emissions limited by required exhaust emission controls. Combustion emissions considered in regional exposure assessment.

Conditions and measures related to external recovery of waste

Recovery method	This substance is consumed during use and no waste of the substance is generated.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Vapour pressure	Vapour pressure 0.5 - 10 kPa at STP.
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Other given operational conditions affecting workers exposure

Setting	Assumes a good basic standard of occupational hygiene is implemented.
Temperature	Assumes use at not more than 20°C above ambient temperature, unless stated differently.

Organisational measures to prevent/limit releases, dispersion and exposure

Organisational measures	General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.

Use as a Fuel - Industrial

Risk management measures

General exposures (closed systems)
No other specific measures identified.
.
Use as a fuel
(closed systems)
No other specific measures identified.
.
Bulk transfers
No other specific measures identified.
.
Drum/batch transfers
No other specific measures identified.
.
Equipment cleaning and maintenance
No other specific measures identified.
.
Bulk product storage
No other specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method

Used Petrorisk model. (Hydrocarbon Block Method)

Maximum Risk Characterisation Ratios for air emissions 2.9E-02 Maximum Risk Characterisation Ratios for wastewater emissions 9.0E-01

4. Guidance to check compliance with the exposure scenario (Environment 1)

Guidance is based on assumed operating conditions which may not be applicable to all sites, thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

3. Exposure estimation (Health 1)

Assessment method

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Qualitative approach used to conclude safe use. Available hazard data do not support the need for a DNEL to be established for other health effects. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

4. Guidance to check compliance with the exposure scenario (Health 1)

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Exposure scenario
Use as a Fuel - Professional

Identification

Product name Kerosines

Version number 2018

Es reference ES12b

1. Title of exposure scenario

Main title Use as a Fuel - Professional

Process scope Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.

Environment

Environmental release category ERC9a Widespread use of functional fluid (indoor)
ERC9b Widespread use of functional fluid (outdoor)

SPERC ESVOC SPERC 9.12b.v1

Worker

Process category PROC1 Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions
PROC2 Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions
PROC3 Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition
PROC8a Transfer of substance or mixture (charging and discharging) at non-dedicated facilities
PROC8b Transfer of substance or mixture (charging and discharging) at dedicated facilities
PROC16 Use of fuels

2. Conditions of use affecting exposure (Industrial - Environment 1)

Product characteristics

Substance is complex UVCB. Predominantly hydrophobic.

Amounts used

Fraction of EU tonnage used in region: 0.1
Regional use tonnage: 4,600,000 tonnes/year
Fraction of Regional tonnage used locally: 1
Annual site tonnage: 2300 tonnes
Maximum daily site tonnage: 6.4 tonnes

Frequency and duration of use

Continuous release.
Emission days: 365 days/year

Other given operational conditions affecting environmental exposure

Emission factor - air Release fraction to air from wide dispersive use (regional only): 1.0E-03

Emission factor - water Release fraction to wastewater from wide dispersive use: 1.0E-05

Emission factor - soil Release fraction to soil from wide dispersive use (regional only): 1.0E-05

Environmental factors not influenced by risk management measures

Use as a Fuel - Professional

Dilution	Local freshwater dilution factor: 10 Local marine water dilution factor: 100

Risk management measures

Good practice	Common practices vary across sites, thus conservative process release estimates used. Risk from environmental exposure is driven by fresh water.
STP type	Municipal STP.
STP details	Estimated substance removal from wastewater via domestic sewage treatment: 95.0% Removal efficiency (total): 95.0% Maximum allowable site tonnage (Msafe), based on release following total wastewater treatment removal: 2.9E+05 kg/day Assumed domestic sewage treatment plant flow (m³/day): 2000.

Technical onsite conditions and measures to reduce or limit discharges to air, water and soil

Air	Treat air emission to provide a typical removal efficiency of N/A%.
Water	Prevent leaks and prevent soil/water pollution caused by leaks. Onsite wastewater treatment required. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of (%): 0.0 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of (%): 0.0
Soil	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

Conditions and measures related to external treatment of waste for disposal

Waste treatment	Combustion emissions limited by required exhaust emission controls. Combustion emissions considered in regional exposure assessment.

Conditions and measures related to external recovery of waste

Recovery method	This substance is consumed during use and no waste of the substance is generated.

2. Conditions of use affecting exposure (Workers - Health 1)

Product characteristics

Physical state	Liquid
Vapour pressure	Vapour pressure 0.5 - 10 kPa at STP.
Concentration details	Covers percentage substance in the product up to 100% (unless stated differently).

Frequency and duration of use

Covers daily exposures up to 8 hours (unless stated differently).

Other given operational conditions affecting workers exposure

Setting	Assumes a good basic standard of occupational hygiene is implemented.
Temperature	Assumes use at not more than 20°C above ambient temperature, unless stated differently.

Organisational measures to prevent/limit releases, dispersion and exposure

Organisational measures	General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.

Use as a Fuel - Professional

Risk management measures

General exposures (closed systems)
No other specific measures identified.
.
Use as a fuel
(closed systems)
No other specific measures identified.
.
Bulk transfers
No other specific measures identified.
.
Transfer from/pouring from containers
No other specific measures identified.
.
Equipment cleaning and maintenance
No other specific measures identified.
.
Bulk product storage
No other specific measures identified.

3. Exposure estimation (Environment 1)

Assessment method

Used Petrorisk model. (Hydrocarbon Block Method)

Maximum Risk Characterisation Ratios for air emissions 4.4E-04 Maximum Risk Characterisation Ratios for wastewater emissions 3.4E-03

4. Guidance to check compliance with the exposure scenario (Environment 1)

Guidance is based on assumed operating conditions which may not be applicable to all sites, thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using onsite technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

3. Exposure estimation (Health 1)

Assessment method

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Qualitative approach used to conclude safe use. Available hazard data do not support the need for a DNEL to be established for other health effects. Users are advised to consider national Occupational Exposure Limits or other equivalent values.

4. Guidance to check compliance with the exposure scenario (Health 1)

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

SAFETY DATA SHEET

Automotive Diesel Fuel

Section 1. Identification

GHS product identifier Automotive Diesel Fuel

Other means of identification Truck diesel, G10, BP 10 ppm diesel fuel, Ultra Low Sulphur diesel fuel, Automotive Diesel fuel, AD20, AD40, Alpine Diesel and Biodiesel up to B5.

Product code 0000002718

SDS no. 0000002718

Historic SDS no. AD0K1

Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/ mixture Fuel for compression ignition diesel engines.

Manufacturer

Supplier

BP Australia Pty Ltd
Level 17, 717 Bourke Street
Docklands, Victoria 3008
ABN 53 004 085 616

www.bp.com.au

Technical Helpline Number: 1300 139 700

EMERGENCY TELEPHONE NUMBER 1800 638 556

Section 2. Hazard(s) identification

Classification of the substance or mixture

FLAMMABLE LIQUIDS - Category 4
ACUTE TOXICITY (inhalation) - Category 4
SKIN CORROSION/IRRITATION - Category 2
CARCINOGENICITY - Category 2
SPECIFIC TARGET ORGAN TOXICITY - REPEATED EXPOSURE - Category 2
ASPIRATION HAZARD - Category 1

GHS label elements

Hazard pictograms

Signal word DANGER

Hazard statements

H227 - Combustible liquid.
H304 - May be fatal if swallowed and enters airways.
H315 - Causes skin irritation.
H332 - Harmful if inhaled.
H351 - Suspected of causing cancer.
H373 - May cause damage to organs through prolonged or repeated exposure. (bone marrow, liver, thymus)

Precautionary statements

General

P102 - Keep out of reach of children.
P101 - If medical advice is needed, have product container or label at hand.

Section 2. Hazard(s) identification

Prevention

P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P281 - Use personal protective equipment as required.
P280 - Wear protective gloves, protective clothing and eye or face protection.
P210 - Keep away from flames and hot surfaces. No smoking.
P271 - Use only outdoors or in a well-ventilated area.
P260 - Do not breathe vapour or spray.
P264 - Wash hands thoroughly after handling.

Response

P308 + P313 - IF exposed or concerned: Get medical attention.
P304 + P340, P312 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor if you feel unwell.
P301 + P310, P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
P362 - Take off contaminated clothing and wash before reuse.
P302 + P352 - IF ON SKIN: Wash with plenty of soap and water.
P332 + P313 - If skin irritation occurs: Get medical attention.

Storage

P405 - Store locked up.
P403 + P235 - Store in a well-ventilated place. Keep cool.

Disposal

P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements

Not applicable.

Other hazards which do not result in classification

Static accumulating flammable liquid can become electrostatically charged even in bonded and grounded equipment. Sparks may ignite liquid and vapour may cause flash fire or explosion.
Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency.
See 'Notes to physician' under First-Aid Measures, Section 4 of this Safety Data Sheet.

Section 3. Composition and ingredient information

Substance/mixture Mixture

May contain Fatty Acid Methyl Esters (FAME). May also contain small quantities of proprietary performance additives. Contains small quantities of polycyclic aromatic hydrocarbons (PAHs).

Ingredient name	% (w/w)	CAS number
Fuels, diesel	≥75	68334-30-5
Alkanes, C10-20-branched and linear	≤20	928771-01-1

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.

Inhalation

If inhaled, remove to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention.

Section 4. First aid measures

Skin contact

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Drench contaminated clothing with water before removing. This is necessary to avoid the risk of sparks from static electricity that could ignite contaminated clothing. Contaminated clothing is a fire hazard. Contaminated leather, particularly footwear, must be discarded. Clean shoes thoroughly before reuse. Get medical attention.

Ingestion

Do not induce vomiting. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Aspiration hazard if swallowed. Can enter lungs and cause damage. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician

Treatment should in general be symptomatic and directed to relieving any effects. Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias.

Note: High Pressure Applications
Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. Injuries may not appear serious at first but within a few hours tissue becomes swollen, discoloured and extremely painful with extensive subcutaneous necrosis.
Surgical exploration should be undertaken without delay. Thorough and extensive debridement of the wound and underlying tissue is necessary to minimise tissue loss and prevent or limit permanent damage. Note that high pressure may force the product considerable distances along tissue planes.

Specific treatments

No specific treatment.

Protection of first-aiders

No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Section 5. Firefighting measures

Extinguishing media

Suitable extinguishing media

In case of fire, use water fog, foam, dry chemical or carbon dioxide extinguisher or spray.

Unsuitable extinguishing media

Do not use water jet.

Specific hazards arising from the chemical

Combustible liquid. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Runoff to sewer may create fire or explosion hazard. Vapours can form explosive mixtures with air. Vapours are heavier than air and can spread along the ground or float on water surfaces to remote ignition sources. Vapours may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. This product is a poor conductor of electricity and can become electrostatically charged. If sufficient charge is accumulated, ignition of flammable mixtures can occur. To reduce potential for static discharge, use proper bonding and grounding procedures. This liquid may accumulate static electricity when filling properly-grounded containers. Static accumulation may be significantly increased by the presence of small quantities of water or other contaminants. Liquid will float and may reignite on surface of water.

Section 5. Firefighting measures

Hazardous thermal decomposition products

Combustion products may include the following:
carbon oxides (CO, CO_2) (carbon monoxide, carbon dioxide)

Special protective actions for fire-fighters

No action shall be taken involving any personal risk or without suitable training. Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters

Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Immediately contact emergency personnel. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Eliminate all ignition sources.

For emergency responders

Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots. See also the information in "For non-emergency personnel".

Environmental precautions

Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities. Collect recovered product and other contaminated materials in suitable tanks or containers for recycle, recovery or safe disposal.

Methods and material for containment and cleaning up

Small spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres.

Large spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Dike spill area and do not allow product to reach sewage system and surface or ground water. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Contaminated absorbent material may pose the same hazard as the spilt product. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres. Dispose of via a licensed waste disposal contractor.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not swallow. Aspiration hazard if swallowed. Can enter lungs and cause damage. Never siphon by mouth. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not reuse container. Avoid contact of spilt material and runoff with soil and surface waterways. Handling operations that can promote accumulation of static charges include but are not limited to: mixing, filtering, pumping at high flow rates, splash filling, creating mists or sprays, tank and container filling, tank cleaning, sampling, gauging, switch loading, vacuum truck operations. Restrict flow velocity according to API 2003 (2008), NFPA 77 (2007), and Laurence Britton, “Avoiding Static Ignition Hazards in Chemical Operations”. To reduce potential for static discharge, ensure that all equipment is properly grounded and bonded and meets appropriate electrical classification requirements.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidising materials. Keep container tightly closed and sealed until ready for use. Store and use only in equipment/containers designed for use with this product. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Light hydrocarbon vapours can build up in the headspace of tanks. These can cause flammability/explosion hazards even at temperatures below the normal flash point (note: flash point must not be regarded as a reliable indicator of the potential flammability of vapour in tank headspaces). Tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks. Do not enter storage tanks. If entry to vessels is necessary, follow permit to work procedures. Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. When the product is pumped (e.g. during filling, discharge or ullaging) and when sampling, there is a risk of static discharge. Ensure equipment used is properly earthed or bonded to the tank structure. Electrical equipment should not be used unless it is intrinsically safe (i.e. will not produce sparks). Explosive air/vapour mixtures may form at ambient temperature. If product comes into contact with hot surfaces, or leaks occur from pressurised fuel pipes, the vapour or mists generated will create a flammability or explosion hazard. Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use.

Section 8. Exposure controls and personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Fuels, diesel	**ACGIH TLV (United States). Absorbed through skin.** TWA: 100 mg/m³, (measured as total hydrocarbons) 8 hours. Issued/Revised: 1/2007 Form: Inhalable fraction and vapor

Appropriate engineering controls

All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures (e.g. engineering controls) have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained.
Your supplier of personal protective equipment should be consulted for advice on selection and appropriate standards. For further information contact your national organisation for standards.
Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits.
The final choice of protective equipment will depend upon a risk assessment. It is important to ensure that all items of personal protective equipment are compatible.

Environmental exposure controls

Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Chemical splash goggles.

Skin protection

Hand protection

Wear chemical resistant gloves. Recommended: Nitrile gloves.

Do not re-use gloves. Protective gloves must give suitable protection against mechanical risks (i.e. abrasion, blade cut and puncture). Protective gloves will deteriorate over time due to physical and chemical damage. Inspect and replace gloves on a regular basis. The frequency of replacement will depend upon the circumstances of use.

Skin protection

Use of protective clothing is good industrial practice.
Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Cotton or polyester/cotton overalls will only provide protection against light superficial contamination that will not soak through to the skin. Overalls should be laundered on a regular basis. When the risk of skin exposure is high (e.g. when cleaning up spillages or if there is a risk of splashing) then chemical resistant aprons and/or impervious chemical suits and boots will be required.
Wear suitable protective clothing.
Footwear highly resistant to chemicals.
When there is a risk of ignition wear inherently fire resistant protective clothes and gloves.
When there is a risk of ignition from static electricity, wear anti-static protective clothing. For greatest effectiveness against static electricity, overalls, boots and

Section 8. Exposure controls and personal protection

gloves should all be anti-static.
When the risk of skin exposure is high (from experience this could apply to the following tasks: cleaning work, maintenance and service, filling and transfer, taking samples and cleaning up spillages) then a chemical protective suit and boots will be required.
Work clothing / overalls should be laundered on a regular basis. Laundering of contaminated work clothing should only be done by professional cleaners who have been told about the hazards of the contamination. Always keep contaminated work clothing away from uncontaminated work clothing and uncontaminated personal clothes.

Other skin protection

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

Use with adequate ventilation.
If there is a requirement for the use of a respiratory protective device, but the use of breathing apparatus (independent of ambient atmosphere) is not required, then a suitable filtering device must be worn.
The filter class must be suitable for the maximum contaminant concentration (gas/vapour/aerosol/particulates) that may arise when handling the product.

Recommended: If ventilation is inadequate, use respirator that will protect against organic vapour and dust/mist.

Refer to standards:

Respiratory protection:AS/NZS 1715 and AS/NZS 1716
Gloves:AS/NZS 2161.1
Eye protection:AS/NZS 1336 and AS/NZS 1337

Section 9. Physical and chemical properties

Appearance

Physical state Liquid.

Colour Water white to straw including fluorescent green, blue or yellow.

Odour Mild

Odour threshold 0.7 ppm (Based on Fuels, diesel)

pH Not applicable. Based on Solubility in Water (Very slightly soluble in water)

Melting point -29 to -18°C (-20.2 to -0.4°F) (Based on Fuels, diesel)

Boiling point 180 to 380°C (356 to 716°F)

Flash point Closed cup: >61.5°C (>142.7°F) [Pensky-Martens.]

Evaporation rate Not relevant/applicable due to nature of the product. Based on low volatility

Flammability (solid, gas) Not applicable. Based on - Physical state

Lower and upper explosive (flammable) limits Lower: 0.5%
Upper: 7.5%

Vapour pressure 0.1 kPa (0.755 mm Hg) (Based on Concawe Category: Vacuum Gas Oils, Hydrocracked Gas Oils & Distillate Fuels (VHGO))

Vapour density >1 [Air = 1]

Relative density 0.83

Density 820 to 850 kg/m³ (0.82 to 0.85 g/cm³) at 15°C

Solubility Very slightly soluble in water

Partition coefficient: n-octanol/water Not applicable. Based on Fuels, diesel - Substance is a hydrocarbon UVCB. Standard tests for this endpoint are intended for single substances and are not appropriate for this complex substance.

Auto-ignition temperature 240°C (464°F) (Based on Fuels, diesel)

Decomposition temperature Not observed to decompose by final boiling point: 380°C (716°F)

Viscosity Kinematic: 2 to 4.5 mm^2/s (2 to 4.5 cSt) at 40°C

Section 10. Stability and reactivity

Reactivity	No specific test data available for this product. Refer to Conditions to avoid and Incompatible materials for additional information.
Chemical stability	The product is stable.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur. Under normal conditions of storage and use, hazardous polymerisation will not occur.
Conditions to avoid	Avoid all possible sources of ignition (spark or flame). Avoid excessive heat.
Incompatible materials	Reactive or incompatible with the following materials: oxidising materials.
Hazardous decomposition products	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Fuels, diesel	LC50 Inhalation Dusts and mists	Rat	4.1 mg/l	4 hours
	LD50 Dermal	Rabbit	>4300 mg/kg	-
	LD50 Dermal	Rabbit	>4300 mg/kg	-
	LD50 Oral	Rat	17900 mg/kg	-
	LD50 Oral	Rat	7600 mg/kg	-

Conclusion/Summary Harmful if inhaled.

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Fuels, diesel	Skin - Irritation	Rabbit	-	-	-
	Skin - Irritation	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-

Skin Causes skin irritation.

Eyes Not classified. Based on available data, the classification criteria are not met.

Sensitisation

Product/ingredient name	Route of exposure	Species	Result
Fuels, diesel	skin	Guinea pig	Not sensitising
	skin	Guinea pig	Not sensitising

Skin Not classified. Based on available data, the classification criteria are not met.

Mutagenicity

Product/ingredient name	Test	Experiment	Result
Fuels, diesel	OECD 471	Experiment: In vitro Subject: Non-mammalian species	Positive
	Equivalent to OECD 476	Experiment: In vitro Subject: Mammalian-Animal Cell: Germ	Negative
	not guideline	Experiment: In vivo Subject: Unspecified Cell: Somatic	Negative

Conclusion/Summary Not classified. Based on available data, the classification criteria are not met.

Carcinogenicity

Product/ingredient name	Result	Species	Dose	Exposure

Fuels, diesel	Positive - Dermal - Unspecified	Mouse	-	2 years

Conclusion/Summary Suspected of causing cancer.

Reproductive toxicity

Product/ingredient name	Maternal toxicity	Fertility	Developmental toxin	Species	Dose	Exposure
Fuels, diesel	-	-	Negative	Rat	Dermal	20 days
	-	-	Negative	Rat	Dermal	10 days
	-	-	Negative	Rat	Dermal	10 days

Conclusion/Summary Development: Not classified. Based on available data, the classification criteria are not met.
Fertility: Not classified. Based on available data, the classification criteria are not met.
Effects on or via lactation: Not classified. Based on available data, the classification criteria are not met.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Fuels, diesel	Category 2	-	bone marrow, liver, thymus

Aspiration hazard

Name	Result
Fuels, diesel	ASPIRATION HAZARD - Category 1
Alkanes, C10-20-branched and linear	ASPIRATION HAZARD - Category 1

Information on likely routes of exposure Routes of entry anticipated: Oral, Dermal, Inhalation.

Potential acute health effects

Eye contact No known significant effects or critical hazards.

Inhalation Harmful if inhaled.

Skin contact Causes skin irritation.

Ingestion Irritating to mouth, throat and stomach. Aspiration hazard if swallowed -- harmful or fatal if liquid is aspirated into lungs.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness

Skin contact Adverse symptoms may include the following:
irritation
redness

Ingestion Adverse symptoms may include the following:
nausea or vomiting

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Section 11. Toxicological information

Eye contact Vapour, mist or fume may cause eye irritation. Exposure to vapour, mist or fume may cause stinging, redness and watering of the eyes.

Inhalation Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mist or fume may irritate the nose, mouth and respiratory tract.

Skin contact As with all such products containing potentially harmful levels of polycyclic aromatic hydrocarbons, prolonged or repeated skin contact may eventually result in dermatitis or more serious irreversible skin disorders including cancer.

Ingestion If swallowed, may irritate the mouth, throat and digestive system. If swallowed, may cause abdominal pain, stomach cramps, nausea, vomiting, diarrhoea, dizziness and drowsiness.

General May cause damage to organs through prolonged or repeated exposure. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer. Vapour, mists or fumes may contain polycyclic aromatic hydrocarbons some of which are known to produce skin cancer.

Carcinogenicity Suspected of causing cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity No known significant effects or critical hazards.

Teratogenicity No known significant effects or critical hazards.

Developmental effects No known significant effects or critical hazards.

Fertility effects No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Inhalation (dusts and mists)	4.1 mg/l

Other information Diesel exhaust particulates have been classified by the National Toxicological Program (NTP) to be a reasonably anticipated human carcinogen. Exposure should be minimized to reduce potential risk.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Fuels, diesel	EL50 >1000 mg/l Nominal Fresh water	Micro-organism	40 hours
	NOELR 3.217 mg/l Nominal Fresh water	Micro-organism	40 hours
	Acute EL50 22 mg/l Nominal Fresh water	Algae	72 hours
	Acute EL50 210 mg/l Nominal Fresh water	Daphnia	48 hours
	Acute EL50 68 mg/l Nominal Fresh water	Daphnia	48 hours
	Acute ErL50 78 mg/l Nominal Fresh water	Algae	72 hours
	Acute LL50 65 mg/l Nominal Fresh water	Fish	96 hours
	Acute LL50 21 mg/l Nominal Fresh water	Fish	96 hours
	Acute NOELR 10 mg/l Nominal Fresh water	Algae	72 hours
	Acute NOELR 1 mg/l Nominal Fresh water	Algae	72 hours

Section 12. Ecological information

	Acute NOELR 46 mg/l Nominal Fresh water	Daphnia	48 hours
	Chronic NOEL 0.083 mg/l Nominal Fresh water	Fish	14 days
	Chronic NOELR 0.2 mg/l Nominal Fresh water	Daphnia	21 days

Conclusion/Summary Toxic to aquatic life with long lasting effects.

Persistence and degradability

Expected to be biodegradable.

Product/ingredient name	Test	Result	Dose	Inoculum
Fuels, diesel	OECD 301 F	60 % - Readily - 28 days	30 mg/l	-
	OECD 301 F	57.5 % - Not readily - 28 days	25 mg/l	-
	Equivalent to EPA OTS 796.3100	35 % - Not readily - 28 days	5 mg/l	-

Conclusion/Summary Persistent per IMO criteria

Bioaccumulative potential

This product is not expected to bioaccumulate through food chains in the environment.

Mobility in soil

Soil/water partition coefficient (K_{OC}) Not available.

Mobility Spillages may penetrate the soil causing ground water contamination. This material may accumulate in sediments.

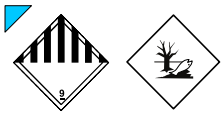
Other ecological information Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

Section 13. Disposal considerations

Disposal methods The generation of waste should be avoided or minimised wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapour from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Special Precautions for Landfill or Incineration Empty packages may contain some remaining product. Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed.

Section 14. Transport information

	ADG	IMDG	IATA
UN number	Not regulated.	UN3082	UN3082
UN proper shipping name	-	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.. Marine pollutant (Fuels, diesel)	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (Fuels, diesel)
Transport hazard class(es)	-	9 	9 
Packing group	-	III	III
Environmental hazards	No.	Yes.	Yes.
Additional information	**Remarks** Combustible liquid Class C1 (AS 1940).	This product is not regulated as a dangerous good when transported in sizes of ≤5 L or ≤5 kg, provided the packagings meet the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8. **Emergency schedules** F-A, S-F	This product is not regulated as a dangerous good when transported in sizes of ≤5 L or ≤5 kg, provided the packagings meet the general provisions of 5.0.2.4.1, 5.0.2.6.1.1 and 5.0.2.8.

Special precautions for user Not available.

Transport in bulk according to IMO instruments **Proper shipping name** MARPOL Annex 1 rules apply for bulk shipments by sea.
Category: gas oils, including ship's bunkers

Section 15. Regulatory information

Standard for the Uniform Scheduling of Medicines and Poisons

Not scheduled

Consumer products - This product is exempt per Appendix A of the SUSMP.
Industrial Products - Labelling requirements for SUSMP do not apply to a poison that is packed and sold solely for industrial, laboratory or manufacturing use. However, this product is labelled in accordance with NOSHC National Code of Practice for labelling of workplace substances.

Model Work Health and Safety Regulations - Scheduled Substances

No listed substance

Montreal Protocol

Ingredient name	List name	Status
Not listed.		

Stockholm Convention on Persistent Organic Pollutants

Ingredient name	List name	Status
Not listed.		

Rotterdam Convention on Prior Informed Consent (PIC)

Section 15. Regulatory information

Ingredient name	List name	Status
Not listed.		

International lists

National inventory

REACH Status	For the REACH status of this product please consult your company contact, as identified in Section 1.
Australia inventory (AICS)	Contact local supplier or distributor.
Canada inventory	Not determined.
China inventory (IECSC)	Not determined.
Japan inventory (ENCS)	Not determined.
Korea inventory (KECI)	Not determined.
Philippines inventory (PICCS)	Not determined.
Taiwan Chemical Substances Inventory (TCSI)	Not determined.
United States inventory (TSCA 8b)	Not determined.

Section 16. Any other relevant information

History

Date of printing	5/14/2021
Date of issue/Date of revision	5/14/2021
Date of previous issue	8/6/2019
Version	4
Prepared by	Product Stewardship

Key to abbreviations

ADG = Australian Dangerous Goods
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
NOHSC = National Occupational Health and Safety Commission
REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006]
STEL = Short term exposure limit
SUSMP = Standard Uniform Schedule of Medicine and Poisons
UN = United Nations
TWA = Time weighted average
VOC = Volatile Organic Compound
SADT = Self-Accelerating Decomposition Temperature
Varies = may contain one or more of the following 64741-88-4, 64741-89-5, 64741-95-3, 64741-96-4, 64742-01-4, 64742-44-5, 64742-45-6, 64742-52-5, 64742-53-6, 64742-54-7, 64742-55-8, 64742-56-9, 64742-57-0, 64742-58-1, 64742-62-7, 64742-63-8, 64742-65-0, 64742-70-7, 72623-85-9, 72623-86-0, 72623-87-1

Procedure used to derive the classification

Section 16. Any other relevant information

Classification	Justification
FLAMMABLE LIQUIDS - Category 4	On basis of test data
ACUTE TOXICITY (inhalation) - Category 4	Calculation method
SKIN CORROSION/IRRITATION - Category 2	Calculation method
CARCINOGENICITY - Category 2	Calculation method
SPECIFIC TARGET ORGAN TOXICITY - REPEATED EXPOSURE - Category 2	Calculation method
ASPIRATION HAZARD - Category 1	Calculation method

Indicates information that has changed from previously issued version.

Notice to reader

All reasonably practicable steps have been taken to ensure this data sheet and the health, safety and environmental information contained in it is accurate as of the date specified below. No warranty or representation, express or implied is made as to the accuracy or completeness of the data and information in this data sheet.

The data and advice given apply when the product is sold for the stated application or applications. You should not use the product other than for the stated application or applications without seeking advice from BP Group.

It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. The BP Group shall not be responsible for any damage or injury resulting from use, other than the stated product use of the material, from any failure to adhere to recommendations, or from any hazards inherent in the nature of the material. Purchasers of the product for supply to a third party for use at work, have a duty to take all necessary steps to ensure that any person handling or using the product is provided with the information in this sheet. Employers have a duty to tell employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken. You can contact the BP Group to ensure that this document is the most current available. Alteration of this document is strictly prohibited.

SAFETY DATA SHEET

Unleaded 91

Section 1. Identification

GHS product identifier Unleaded 91

Other means of identification regular unleaded petrol

Product code 0000002733

SDS no. 0000002733

Historic SDS no. 875; 0000002889

Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/ mixture Use only as a motor fuel for spark ignition engines. NOT for aviation use. Should NOT be used as a solvent nor cleaning agent.
For specific application advice see appropriate Technical Data Sheet or consult our company representative.

Manufacturer

Supplier

BP Australia Pty Ltd
Level 17, 717 Bourke Street
Docklands, Victoria 3008
ABN 53 004 085 616

www.bp.com.au

Technical Helpline Number: 1300 139 700

EMERGENCY TELEPHONE NUMBER 1800 638 556

Section 2. Hazard(s) identification

Classification of the substance or mixture

FLAMMABLE LIQUIDS - Category 1
SKIN CORROSION/IRRITATION - Category 2
GERM CELL MUTAGENICITY - Category 1B
CARCINOGENICITY - Category 1B
SPECIFIC TARGET ORGAN TOXICITY - SINGLE EXPOSURE (Narcotic effects) - Category 3
ASPIRATION HAZARD - Category 1

GHS label elements

Hazard pictograms

Signal word DANGER

Hazard statements

H224 - Extremely flammable liquid and vapour.
H304 - May be fatal if swallowed and enters airways.
H315 - Causes skin irritation.
H336 - May cause drowsiness or dizziness.
H340 - May cause genetic defects.
H350 - May cause cancer.

Precautionary statements

General

P102 - Keep out of reach of children.
P101 - If medical advice is needed, have product container or label at hand.

Section 2. Hazard(s) identification

Prevention

P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P281 - Use personal protective equipment as required.
P280 - Wear protective gloves, protective clothing and eye or face protection.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P241 - Use explosion-proof electrical, ventilating or lighting equipment.
P242 - Use non-sparking tools.
P243 - Take action to prevent static discharges.
P271 - Use only outdoors or in a well-ventilated area.
P261 - Avoid breathing vapour.
P264 - Wash hands thoroughly after handling.

Response

P308 + P313 - IF exposed or concerned: Get medical attention.
P304 + P340, P312 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor if you feel unwell.
P301 + P310, P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
P362 - Take off contaminated clothing and wash before reuse.
P302 + P352 - IF ON SKIN: Wash with plenty of soap and water.
P332 + P313 - If skin irritation occurs: Get medical attention.

Storage

P405 - Store locked up.
P403 + P233 - Store in a well-ventilated place. Keep container tightly closed.
P403 + P235 - Keep cool.

Disposal

P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements

Not applicable.

Other hazards which do not result in classification

Static accumulating flammable liquid can become electrostatically charged even in bonded and grounded equipment. Sparks may ignite liquid and vapour may cause flash fire or explosion.

Section 3. Composition and ingredient information

Substance/mixture

Mixture

A complex mixture of volatile hydrocarbons containing paraffins, naphthenes, olefins and aromatics with carbon numbers predominantly between C4 and C12. May contain oxygenates. May also contain small quantities of proprietary performance additives.

Ingredient name	% (w/w)	CAS number
Gasoline	≥90	86290-81-5
Contains:		
Benzene	<1	71-43-2
Polycyclic aromatic hydrocarbons (PAHs)	<1	mixture
diisopropyl ether	<1	108-20-3
2-methylpropan-2-ol	<1	75-65-0
tert-butyl methyl ether	<1	1634-04-4

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.

Inhalation

If inhaled, remove to fresh air. Get medical attention. If exposure to vapour, mists or fumes causes drowsiness, headache, blurred vision or irritation of the eyes, nose or throat, remove immediately to fresh air. Keep patient warm and at rest. If any symptoms persist obtain medical advice.

Skin contact

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Drench contaminated clothing with water before removing. This is necessary to avoid the risk of sparks from static electricity that could ignite contaminated clothing. Contaminated clothing is a fire hazard. Contaminated leather, particularly footwear, must be discarded. Clean shoes thoroughly before reuse. Get medical attention.

Ingestion

Do not induce vomiting. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Aspiration hazard if swallowed. Can enter lungs and cause damage. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician

Treatment should in general be symptomatic and directed to relieving any effects. Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias.

Specific treatments

No specific treatment.

Protection of first-aiders

No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

Section 5. Firefighting measures

Extinguishing media

Suitable extinguishing media

In case of fire, use water fog, foam, dry chemical or carbon dioxide extinguisher or spray.

Unsuitable extinguishing media

Do not use water jet.

Specific hazards arising from the chemical

Extremely flammable liquid and vapour. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Runoff to sewer may create fire or explosion hazard. Vapours can form explosive mixtures with air. Vapours are heavier than air and can spread along the ground or float on water surfaces to remote ignition sources. Vapours may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. This product is a poor conductor of electricity and can become electrostatically charged. If sufficient charge is accumulated, ignition of flammable mixtures can occur. To reduce potential for static discharge, use proper bonding and grounding procedures. This liquid may accumulate static electricity when filling properly-grounded containers. Static accumulation may be significantly increased by the presence of small

Section 5. Firefighting measures

quantities of water or other contaminants. Liquid will float and may reignite on surface of water.

Hazardous thermal decomposition products

Combustion products may include the following:
carbon oxides (CO, CO_2) (carbon monoxide, carbon dioxide)

Special protective actions for fire-fighters

No action shall be taken involving any personal risk or without suitable training. Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters

Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear.

Hazchem code

3YE

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Immediately contact emergency personnel. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling. Eliminate all ignition sources.

For emergency responders

Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. Wear self-contained breathing apparatus. Wear a suitable chemical protective suit. Chemical resistant boots. See also the information in "For non-emergency personnel".

Environmental precautions

Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities. Collect recovered product and other contaminated materials in suitable tanks or containers for recycle, recovery or safe disposal.

Methods and material for containment and cleaning up

Small spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres.

Large spill

Eliminate all ignition sources. Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Dike spill area and do not allow product to reach sewage system and surface or ground water. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Contaminated absorbent material may pose the same hazard as the spilt product. The method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres. Dispose of via a licensed waste disposal contractor.

Section 6. Accidental release measures

Section 7. Handling and storage

Precautions for safe handling

Protective measures

Do not fill container while it is in or on a vehicle. Static electricity may ignite vapour and cause fire. Place container on ground when filling and keep nozzle in contact with container.

Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not swallow. Aspiration hazard if swallowed. Can enter lungs and cause damage. Never siphon by mouth. Avoid breathing vapour or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container. Avoid contact of spilt material and runoff with soil and surface waterways. Handling operations that can promote accumulation of static charges include but are not limited to: mixing, filtering, pumping at high flow rates, splash filling, creating mists or sprays, tank and container filling, tank cleaning, sampling, gauging, switch loading, vacuum truck operations. Restrict flow velocity according to API 2003 (2008), NFPA 77 (2007), and Laurence Britton, “Avoiding Static Ignition Hazards in Chemical Operations”. To reduce potential for static discharge, ensure that all equipment is properly grounded and bonded and meets appropriate electrical classification requirements.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidising materials. Keep container tightly closed and sealed until ready for use. Store and use only in equipment/containers designed for use with this product. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

Light hydrocarbon vapours can build up in the headspace of tanks. These can cause flammability/explosion hazards even at temperatures below the normal flash point (note: flash point must not be regarded as a reliable indicator of the potential flammability of vapour in tank headspaces). Tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks. Do not enter storage tanks. If entry to vessels is necessary, follow permit to work procedures. Entry into a confined space or poorly ventilated area contaminated with vapour, mist or fume is extremely hazardous without the correct respiratory protective equipment and a safe system of work. When the product is pumped (e.g. during filling, discharge or ullaging) and when sampling, there is a risk of static discharge. Ensure equipment used is properly earthed or bonded to the tank structure. Electrical equipment should not be used unless it is intrinsically safe (i.e. will not produce sparks). Explosive air/vapour mixtures may form at ambient temperature. If product comes into contact with hot surfaces, or leaks occur from pressurised fuel pipes, the vapour or mists generated will create a flammability or

Section 7. Handling and storage

explosion hazard. Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use.

Section 8. Exposure controls and personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Gasoline	**ACGIH TLV (United States).** TWA: 300 ppm 8 hours. Issued/Revised: 5/1996 TWA: 890 mg/m³ 8 hours. Issued/Revised: 5/1996 STEL: 500 ppm 15 minutes. Issued/Revised: 5/1996 STEL: 1480 mg/m³ 15 minutes. Issued/Revised: 5/1996
Benzene	**Safe Work Australia (Australia).** TWA: 3.2 mg/m³ 8 hours. Issued/Revised: 4/2003 TWA: 1 ppm 8 hours. Issued/Revised: 4/2003
Polycyclic aromatic hydrocarbons (PAHs)	**Safe Work Australia (Australia).** TWA: 0.2 mg/m³ 8 hours.
diisopropyl ether	**Safe Work Australia (Australia).** STEL: 1300 mg/m³ 15 minutes. Issued/Revised: 5/1995 STEL: 310 ppm 15 minutes. Issued/Revised: 5/1995 TWA: 1040 mg/m³ 8 hours. Issued/Revised: 5/1995 TWA: 250 ppm 8 hours. Issued/Revised: 5/1995
2-methylpropan-2-ol	**Safe Work Australia (Australia).** STEL: 455 mg/m³ 15 minutes. Issued/Revised: 5/1995 STEL: 150 ppm 15 minutes. Issued/Revised: 5/1995 TWA: 303 mg/m³ 8 hours. Issued/Revised: 5/1995 TWA: 100 ppm 8 hours. Issued/Revised: 5/1995
tert-butyl methyl ether	**Safe Work Australia (Australia).** STEL: 275 mg/m³ 15 minutes. Issued/Revised: 4/2002 STEL: 75 ppm 15 minutes. Issued/Revised: 4/2002 TWA: 92 mg/m³ 8 hours. Issued/Revised: 4/2002 TWA: 25 ppm 8 hours. Issued/Revised: 4/2002

Section 8. Exposure controls and personal protection

Appropriate engineering controls

All activities involving chemicals should be assessed for their risks to health, to ensure exposures are adequately controlled. Personal protective equipment should only be considered after other forms of control measures (e.g. engineering controls) have been suitably evaluated. Personal protective equipment should conform to appropriate standards, be suitable for use, be kept in good condition and properly maintained.
Your supplier of personal protective equipment should be consulted for advice on selection and appropriate standards. For further information contact your national organisation for standards.
Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits.
The final choice of protective equipment will depend upon a risk assessment. It is important to ensure that all items of personal protective equipment are compatible.

Environmental exposure controls

Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation.

Individual protection measures

Hygiene measures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Chemical splash goggles.

Skin protection

Hand protection

Wear chemical resistant gloves.

Do not re-use gloves. Protective gloves must give suitable protection against mechanical risks (i.e. abrasion, blade cut and puncture). Protective gloves will deteriorate over time due to physical and chemical damage. Inspect and replace gloves on a regular basis. The frequency of replacement will depend upon the circumstances of use.

Recommended: Gloves made from fluoroelastomer resistant to hydrocarbons and a wide range of chemicals.
Wear a chemically resistant multi-layer laminate inner glove inside an outer nitrile glove. The purpose of the outer glove is to protect the inner glove from cuts and mechanical damage. The presence of aromatic hydrocarbons in the product will significantly shorten the length of time that nitrile gloves will provide protection. Do not re-use nitrile gloves if exposed to aromatic hydrocarbons.

Skin protection

Use of protective clothing is good industrial practice.
Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Cotton or polyester/cotton overalls will only provide protection against light superficial contamination that will not soak through to the skin. Overalls should be laundered on a regular basis. When the risk of skin exposure is high (e.g. when cleaning up spillages or if there is a risk of splashing) then chemical resistant aprons and/or impervious chemical suits and boots will be required.
Wear suitable protective clothing.
Footwear highly resistant to chemicals.
When there is a risk of ignition wear inherently fire resistant protective clothes and gloves.
When there is a risk of ignition from static electricity, wear anti-static protective clothing. For greatest effectiveness against static electricity, overalls, boots and gloves should all be anti-static.
When the risk of skin exposure is high (from experience this could apply to the following tasks: cleaning work, maintenance and service, filling and transfer, taking samples and cleaning up spillages) then a chemical protective suit and boots will be

Section 8. Exposure controls and personal protection

required.
Work clothing / overalls should be laundered on a regular basis. Laundering of contaminated work clothing should only be done by professional cleaners who have been told about the hazards of the contamination. Always keep contaminated work clothing away from uncontaminated work clothing and uncontaminated personal clothes.

Other skin protection

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

Use with adequate ventilation.
If there is a requirement for the use of a respiratory protective device, but the use of breathing apparatus (independent of ambient atmosphere) is not required, then a suitable filtering device must be worn.
The filter class must be suitable for the maximum contaminant concentration (gas/ vapour/aerosol/particulates) that may arise when handling the product.

Recommended: Avoid breathing of vapours, mists or spray. Select and use respirators in accordance with AS/NZS 1715/1716. When mists or vapours exceed the exposure standards then the use of the following is recommended: Approved respirator with organic vapour and dust/mist (Type P1) filters. Filter capacity and respirator type depends on exposure level.

Refer to standards:

Respiratory protection:AS/NZS 1715 and AS/NZS 1716
Gloves:AS/NZS 2161.1
Eye protection:AS/NZS 1336 and AS/NZS 1337

Section 9. Physical and chemical properties

Appearance

Physical state	Liquid. Clear and Bright
Colour	Pale colour. Yellow. to Red.
Odour	Hydrocarbon.
Odour threshold	Not available.
pH	Not available.
Melting point	Not available.
Boiling point	30 to 210°C (86 to 410°F)
Flash point	Closed cup: <-40°C (<-40°F)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable. Based on - Physical state
Lower and upper explosive (flammable) limits	Lower: 1.4% Upper: 7.6%
Vapour pressure	30.1 to 100.3 kPa (225.6 to 752 mm Hg)
Vapour density	>1 [Air = 1]
Relative density	Not available.
Density	710 to 750 kg/m³ (0.71 to 0.75 g/cm³)
Solubility	insoluble in water.
Partition coefficient: n-octanol/water	Not available.
Auto-ignition temperature	>350°C (>662°F)
Decomposition temperature	Not available.
Viscosity	Kinematic: 0.4 to 0.55 mm^2/s (0.4 to 0.55 cSt) at 40°C
Remarks	Reid vapor pressure (RVP): 55 to 100 kPa (40 °C)

Section 10. Stability and reactivity

Reactivity	No specific test data available for this product. Refer to Conditions to avoid and Incompatible materials for additional information.
Chemical stability	The product is stable.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur. Under normal conditions of storage and use, hazardous polymerisation will not occur.
Conditions to avoid	Avoid all possible sources of ignition (spark or flame). Avoid excessive heat.
Incompatible materials	Reactive or incompatible with the following materials: oxidising materials.
Hazardous decomposition products	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Gasoline	LC50 Inhalation Vapour	Rat	>7630 mg/m³ Nominal	4 hours
	LC50 Inhalation Vapour	Rat	>5610 mg/m³ analytical	4 hours
	LD50 Dermal	Rabbit	>2000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-
diisopropyl ether	LC50 Inhalation Vapour	Rat	40.5 mg/m³	1 hours
	LD50 Dermal	Rabbit	2000 mg/kg	-
	LD50 Oral	Rat	8470 mg/kg	-
2-methylpropan-2-ol	LC50 Inhalation Vapour	Rat	>10000 ppm	4 hours
	LD50 Oral	Rabbit	3559 mg/kg	-
	LD50 Oral	Rat	2743 mg/kg	-
tert-butyl methyl ether	LC50 Inhalation Vapour	Rat	85 mg/l	4 hours
	LD50 Dermal	Rat	>2000 mg/kg	-
	LD50 Oral	Rat	>2000 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Gasoline	Skin - Irritant	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-
tert-butyl methyl ether	Skin - Irritation	Rabbit	-	-	-
	Eyes - Non-irritating to the eyes.	Rabbit	-	-	-

Skin Causes skin irritation.

Skin Not classified. Based on available data, the classification criteria are not met.

Mutagenicity

Product/ingredient name	Test	Experiment	Result
Gasoline	Equivalent to OECD 476	Experiment: In vitro Subject: Mammal - species unspecified	Negative
	Equivalent to OECD 471	Experiment: In vitro Subject: Non-mammalian species	Negative
	EPA OPPTS 870.5395	Experiment: In vivo Subject: Unspecified Cell: Germ	Negative
	Equivalent to OECD 475	Experiment: In vivo	Negative

		Subject: Unspecified Cell: Germ	
tert-butyl methyl ether	EU B 13/14	Experiment: In vitro Subject: Non-mammalian species	Negative
	OECD 471	Experiment: In vitro Subject: Non-mammalian species	Negative
	OECD 476	Experiment: In vitro Subject: Non-mammalian species	Negative
	Equivalent to OECD 473	Experiment: In vitro Subject: Non-mammalian species	Negative
	Equivalent to OECD 486	Experiment: In vivo Subject: Unspecified Cell: Somatic	Negative
	Equivalent to EPA OPPTS 870.5385	Experiment: In vivo Subject: Unspecified Cell: Somatic	Negative
	Equivalent to EPA OPPTS 798.5385	Experiment: In vivo Subject: Unspecified Cell: Somatic	Negative

Conclusion/Summary May cause genetic defects.

Carcinogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Gasoline	Negative - Inhalation - Unspecified	Rat	-	113 weeks
	Negative - Dermal - Unspecified	Mouse	-	102 weeks
tert-butyl methyl ether	Positive - Inhalation - Unspecified	Rat	-	2 years

Conclusion/Summary May cause cancer

Reproductive toxicity

Product/ingredient name	Maternal toxicity	Fertility	Developmental toxin	Species	Dose	Exposure
Gasoline	-	Negative	-	Rat	Inhalation	2 generation
	-	-	Negative	Rat	Inhalation	14 days
tert-butyl methyl ether	-	Negative	-	Rat	Inhalation	2 generation
	-	-	Negative	Rat	Inhalation	9 days

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Gasoline	Category 3	-	Narcotic effects
Benzene	Category 3	-	Respiratory tract irritation
	Category 3		Narcotic effects
diisopropyl ether	Category 3	-	Narcotic effects

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Benzene	Category 1	-	blood system

Section 11. Toxicological information

Aspiration hazard

Name	Result
Gasoline	ASPIRATION HAZARD - Category 1

Information on likely routes of exposure Routes of entry anticipated: Dermal, Inhalation.

Potential acute health effects

Eye contact No known significant effects or critical hazards.

Inhalation Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.

Skin contact Causes skin irritation.

Ingestion Irritating to mouth, throat and stomach. Aspiration hazard if swallowed -- harmful or fatal if liquid is aspirated into lungs.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation Adverse symptoms may include the following:
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness

Skin contact Adverse symptoms may include the following:
irritation
redness

Ingestion Adverse symptoms may include the following:
nausea or vomiting

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Eye contact Vapour, mist or fume may cause eye irritation. Exposure to vapour, mist or fume may cause stinging, redness and watering of the eyes.

Inhalation Vapour, mist or fume may irritate the nose, mouth and respiratory tract.

Skin contact Prolonged or repeated contact can defat the skin and lead to irritation, cracking and/or dermatitis.

Ingestion If swallowed, may irritate the mouth, throat and digestive system. If swallowed, may cause abdominal pain, stomach cramps, nausea, vomiting, diarrhoea, dizziness and drowsiness.

General Solvent "sniffing" (abuse) or intentional overexposure to vapours can produce serious central nervous system effects, including unconsciousness, and possibly death.

Carcinogenicity May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity May cause genetic defects.

Teratogenicity No known significant effects or critical hazards.

Developmental effects No known significant effects or critical hazards.

Fertility effects No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value

Inhalation (vapours)	1156.79 mg/l

Other information

Gasoline - Excess exposure to vapors may produce headaches, dizziness, nausea, drowsiness, irritation of eyes, nose and throat and central nervous system depression. Aspiration of this material into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lungs can occur while vomiting after ingestion of this product. Inhalation of unleaded gasoline vapors did not produce birth defects in laboratory animals. Ingestion of this material can cause gastrointestinal irritation and diarrhea.

In a long-term inhalation study of whole unleaded gasoline vapors, exposure-related kidney damage and kidney tumors were observed in male rats. Similar kidney effects were not seen in female rats or in mice. At the highest exposure level (2056 ppm), female mice had an increased incidence of liver tumors. Results from subsequent scientific studies have shown that a broad variety of chemicals cause these kidney effects only in the male rat. Further studies have discovered the means by which the physiology of the male rat uniquely predispose it to these effects. Consequently, the Risk Assessment Forum of the Environmental Protection Agency has recognized that these responses are not predictive of a human health hazard. The liver tumors that were increased in the high-dose female mice are likewise of questionable significance because of their high spontaneous occurrence even without chemical exposure and because the rate of their occurrence is accelerated by a broad spectrum of chemicals not commonly considered to be carcinogens (e.g., phenobarbital).
Thus, the significance of the mouse liver tumor response in terms of human health is questionable.

Gasoline is a complex mixture of hydrocarbons and contains benzene (typically no more than 2 volume%), toluene, and xylene. Chronic exposure to high levels of benzene has been shown to cause cancer (leukemia) in humans and other adverse blood effects (anemia). Benzene is considered a human carcinogen by IARC, NTP and OSHA. Over exposure to xylene and toluene can cause irritation to the upper respiratory tract, headache and narcosis. Some liver damage and lung inflammation were seen in chronic studies on xylene in guinea pigs but not in rats.

Solvent "sniffing" (abuse) or intentional overexposure to vapors can produce serious central nervous system effects, including unconsciousness, and possibly death.

Gasoline: Additional toxicity information on components.

Overexposure to n-hexane may cause progressive and potentially irreversible damage to the peripheral nervous system, particularly in the arms and legs.
Studies in occupationally exposed individuals indicate that toluene exposure has been associated with impaired color vision and decreased performance in some neurobehavioral tests.
Prolonged high level exposure to toluene or xylene has caused some degree of hearing loss in experimental animals.
Inhalation of very high concentrations of gasoline vapors and some of its components can result in cardiac sensitization and irregular heartbeats, leading to potentially fatal changes in heart rhythms. Injection of adrenaline-like agents may enhance this effect.

Benzene: Acute toxicity of benzene results primarily from depression of the central nervous system (CNS). Inhalation of concentrations over 50 ppm can produce headache, lassitude, weariness, dizziness, drowsiness, or excitation. Exposure to very high levels can result in unconsciousness and death.

Section 11. Toxicological information

Benzene: Long-term overexposure to benzene has been associated with certain types of leukemia in humans. In addition, the International Agency for Research on Cancer (IARC), the National Toxicology Program, and OSHA consider benzene to be a human carcinogen. Chronic exposures to high levels of benzene have been reported to cause adverse blood effects including anemia. Benzene exposure can occur by inhalation and absorption through the skin.
Inhalation and forced feeding studies of benzene in laboratory animals have produced a carcinogenic response in a variety of organs, including possibly leukemia, other adverse effects on the blood, chromosomal changes and some effects on the immune system. Exposure to benzene at levels up to 300 ppm did not produce birth defects in animal studies; however, exposure to higher dosage levels resulted in a reduction of body weight of the rat pups (fetotoxicity). Changes in the testes have been observed in mice exposed to benzene at 300 ppm, but reproductive performance was not altered in rats exposed to benzene at the same level. Aspiration of this material into the lungs can cause chemical pneumonia and can be fatal. Aspiration into the lungs can occur while vomiting after ingestion of this material.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Gasoline	Acute EC50 15.41 mg/l Nominal Fresh water	Micro-organism	40 hours
	Acute EL50 3.1 mg/l Nominal Fresh water	Algae	72 hours
	Acute EL50 3.7 mg/l Nominal Fresh water	Algae	96 hours
	Acute EL50 4.5 mg/l Nominal Fresh water	Daphnia	48 hours
	Acute LL50 10 mg/l Nominal Fresh water	Fish	96 hours
	Acute LL50 8.2 mg/l Nominal Fresh water	Fish	96 hours
	Acute NOELR 0.5 mg/l Nominal Fresh water	Algae	72 hours
	Acute NOELR 0.5 mg/l Nominal Fresh water	Daphnia	48 hours
	Chronic EL50 10 mg/l Nominal Fresh water	Daphnia	21 days
	Chronic EL50 >40 mg/l Nominal Fresh water	Daphnia	21 days
	Chronic EL50 10 mg/l Nominal Fresh water	Fish	21 days
	Chronic LL50 5.2 mg/l Nominal Fresh water	Fish	14 days
	Chronic NOELR 2.6 mg/l Nominal Fresh water	Daphnia	21 days
	Chronic NOELR 16 mg/l Nominal Fresh water	Daphnia	21 days
	Chronic NOELR 2.6 mg/l Nominal Fresh water	Fish	14 days
	Chronic NOELR 2.6 mg/l Nominal Fresh water	Fish	21 days
	Chronic PNEC >0.4 mg/kg	soil, plants	-
tert-butyl methyl ether	Acute EC50 472 mg/l Fresh water	Daphnia	48 hours
	Acute LC50 200 mg/l Marine water	Crustaceans	96 hours
	Acute LC50 672 mg/l Fresh water	Fish	96 hours
	Acute LC50 574 mg/l Marine water	Fish	96 hours
	Chronic NOEC 26 mg/l Marine water	Crustaceans	28 days
	Chronic NOEC 51 mg/l Fresh water	Daphnia	21 days

Section 12. Ecological information

Conclusion/Summary Toxic to aquatic life with long lasting effects.

Persistence and degradability

Expected to be biodegradable. Non-persistent per IMO criteria

Product/ingredient name	Test	Result	Dose	Inoculum
tert-butyl methyl ether	not guideline	100 % - 1.25 days	-	-
	Modelled data	61 to 69 % - 151 days	-	-
	OECD 301 D	9.24 % - Not readily - 28 days	-	-
	OECD 301 D	1.8 % - Not readily - 28 days	-	-
	OECD 301 D	0 % - Not readily - 28 days	-	-
	Modelled data	0 % - 250 days	-	-

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Gasoline	-	-	Inherent

Bioaccumulative potential

This product is not expected to bioaccumulate through food chains in the environment.

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Gasoline	2 to 7	-	high
Benzene	2.13	11	low
diisopropyl ether	2.4	-	low
2-methylpropan-2-ol	0.317	-	low
tert-butyl methyl ether	1.04	1.5	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) Not available.

Mobility Spillages may penetrate the soil causing ground water contamination.

Other ecological information Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

Section 13. Disposal considerations

Disposal methods The generation of waste should be avoided or minimised wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapour from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Special Precautions for Landfill or Incineration No additional special precautions identified.

Section 14. Transport information

	ADG	IMDG	IATA
UN number	UN1203	UN1203	UN1203
UN proper shipping name	MOTOR SPIRIT or GASOLINE or PETROL	MOTOR SPIRIT or GASOLINE or PETROL. Marine pollutant	MOTOR SPIRIT or GASOLINE or PETROL
Transport hazard class(es)	3 	3 	3 
Packing group	II	II	II
Environmental hazards	No.	Yes.	Yes. The environmentally hazardous substance mark is not required.
Additional information	**Hazchem code** 3YE **Initial emergency response guide** 14	The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg. **Emergency schedules** F-E, S-E	The environmentally hazardous substance mark may appear if required by other transportation regulations.

Special precautions for user Not available.

Transport in bulk according to IMO instruments **Proper shipping name** MARPOL Annex 1 rules apply for bulk shipments by sea.
Category: gasoline and spirits

Section 15. Regulatory information

Standard for the Uniform Scheduling of Medicines and Poisons

Not scheduled. When packed in containers having capacity of greater than 20 litres.

S5. When packed in containers having capacity of less than 20 litres.

Model Work Health and Safety Regulations - Scheduled Substances

Ingredient name	Schedule
Benzene	Restricted carcinogen [All uses involving benzene as a feedstock containing more than 50% of benzene by volume; Restricted use - Genuine research or analysis; For spray painting if the substance contains more than 1% by volume]

Montreal Protocol

Ingredient name	List name	Status
Not listed.		

Stockholm Convention on Persistent Organic Pollutants

Ingredient name	List name	Status
Not listed.		

Rotterdam Convention on Prior Informed Consent (PIC)

Section 15. Regulatory information

Ingredient name	List name	Status
Not listed.		

International lists

National inventory

REACH Status	For the REACH status of this product please consult your company contact, as identified in Section 1.
Australia inventory (AICS)	Contact local supplier or distributor.
Canada inventory	Not determined.
China inventory (IECSC)	Not determined.
Japan inventory (ENCS)	Not determined.
Korea inventory (KECI)	At least one component is not listed.
Philippines inventory (PICCS)	Not determined.
Taiwan Chemical Substances Inventory (TCSI)	Not determined.
United States inventory (TSCA 8b)	Not determined.

Section 16. Any other relevant information

History

Date of printing	5/26/2021
Date of issue/Date of revision	5/26/2021
Date of previous issue	5/25/2021
Version	4.01
Prepared by	Product Stewardship
Key to abbreviations	ADG = Australian Dangerous Goods ATE = Acute Toxicity Estimate BCF = Bioconcentration Factor GHS = Globally Harmonized System of Classification and Labelling of Chemicals IATA = International Air Transport Association IBC = Intermediate Bulk Container IMDG = International Maritime Dangerous Goods LogPow = logarithm of the octanol/water partition coefficient MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) NOHSC = National Occupational Health and Safety Commission REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006] STEL = Short term exposure limit SUSMP = Standard Uniform Schedule of Medicine and Poisons UN = United Nations TWA = Time weighted average VOC = Volatile Organic Compound SADT = Self-Accelerating Decomposition Temperature Varies = may contain one or more of the following 64741-88-4, 64741-89-5, 64741-95-3, 64741-96-4, 64742-01-4, 64742-44-5, 64742-45-6, 64742-52-5, 64742-53-6, 64742-54-7, 64742-55-8, 64742-56-9, 64742-57-0, 64742-58-1, 64742-62-7, 64742-63-8, 64742-65-0, 64742-70-7, 72623-85-9, 72623-86-0, 72623-87-1

Procedure used to derive the classification

Section 16. Any other relevant information

Classification	Justification
FLAMMABLE LIQUIDS - Category 1	On basis of test data
SKIN CORROSION/IRRITATION - Category 2	Calculation method
GERM CELL MUTAGENICITY - Category 1B	Expert judgment
CARCINOGENICITY - Category 1B	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY - SINGLE EXPOSURE (Narcotic effects) - Category 3	Calculation method
ASPIRATION HAZARD - Category 1	Calculation method

Indicates information that has changed from previously issued version.

Notice to reader

All reasonably practicable steps have been taken to ensure this data sheet and the health, safety and environmental information contained in it is accurate as of the date specified below. No warranty or representation, express or implied is made as to the accuracy or completeness of the data and information in this data sheet.

The data and advice given apply when the product is sold for the stated application or applications. You should not use the product other than for the stated application or applications without seeking advice from BP Group.

It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. The BP Group shall not be responsible for any damage or injury resulting from use, other than the stated product use of the material, from any failure to adhere to recommendations, or from any hazards inherent in the nature of the material. Purchasers of the product for supply to a third party for use at work, have a duty to take all necessary steps to ensure that any person handling or using the product is provided with the information in this sheet. Employers have a duty to tell employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken. You can contact the BP Group to ensure that this document is the most current available. Alteration of this document is strictly prohibited.

4+ Polar Max

Safety Data Sheet

According to the Hazard Communication Standard (CFR29 1910.1200) HazCom 2012 and the Hazardous Products Regulations (HPR) WHMIS 2015

Date of issue: 08/03/2016 Revision date: 07/19/2019 Version: 2.0

SECTION 1: Identification

1.1. Identification

Product form : Mixture

Product name : 4+ Polar Max

Product code : Not available

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Premium fuel enhancer

1.3. Details of the supplier of the safety data sheet

Manufacturer
DSG Power Systems Inc.
230 29th Street East
Saskatoon, SK S7L 6Y6 - Canada
T 1-800-667-6879

Distributor
Innospec Fuel Specialties LLC
8375 South Willow Street
Littleton, Colorado 80124
T 1-800-441-9547

1.4. Emergency telephone number

Emergency number : CANUTEC: 613-996-6666 (24hr) (Transport only)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS classification

Flam. Liq. 4
Skin Irrit. 2
Eye Irrit. 2A
Carc. 2
Asp. Tox. 1

2.2. Label elements

GHS labelling

Hazard pictograms (GHS) :

GHS07 GHS08

Signal word (GHS) : Danger

Hazard statements (GHS) : Combustible liquid. Causes skin irritation. Causes serious eye irritation. Suspected of causing cancer. May be fatal if swallowed and enters airways.

Precautionary statements (GHS) : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Wash hands, forearms and face thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection. If exposed or concerned: Get medical advice/attention. If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If on skin: Wash with plenty of water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. Store in a well-ventilated place. Keep cool. Store locked up. Dispose of contents/container to hazardous or special waste collection point, in accordance with local, regional, national and/or international regulation

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%
Benzene, ethylenated, residues, distillation lights	(CAS-No.) 178535-25-6	30 - 60
Petroleum distillates, hydrotreated light	(CAS-No.) 64742-47-8	10 - 30
2-Ethylhexanol	(CAS-No.) 104-76-7	7 - 13
Benzene, 1,3,5-triethyl-	(CAS-No.) 102-25-0	5 - 10
Naphthalene	(CAS-No.) 91-20-3	0.5 – 1.5
Ethylene oxide	(CAS-No.) 75-21-8	< 0.01

***Chemical name, CAS number and/or exact concentration have been withheld as a trade secret**

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical advice/attention if you feel unwell.

First-aid measures after skin contact : IF ON SKIN: Wash with plenty of water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.

First-aid measures after eye contact : IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

First-aid measures after ingestion : IF SWALLOWED: Immediately call a POISON CENTER/doctor. Do NOT induce vomiting. Never give anything by mouth to an unconscious person.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/effects after inhalation : May cause irritation to the respiratory tract.

Symptoms/effects after skin contact : Causes skin irritation. Symptoms may include redness, drying, defatting and cracking of the skin.

Symptoms/effects after eye contact : Causes serious eye irritation. Symptoms may include discomfort or pain, excess blinking and tear production, with marked redness and swelling of the conjunctiva.

Symptoms/effects after ingestion : May be fatal if swallowed and enters airways. May result in aspiration into the lungs, causing chemical pneumonia. May cause stomach distress, nausea or vomiting.

4.3. Indication of any immediate medical attention and special treatment needed

Symptoms may be delayed. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

SECTION 5: Fire-fighting measures

5.1. Extinguishing media

Suitable extinguishing media : Powder, water spray, foam, carbon dioxide.

Unsuitable extinguishing media : None known.

5.2. Special hazards arising from the substance or mixture

Fire hazard : Combustible liquid. Products of combustion may include, and are not limited to: oxides of carbon.

5.3. Advice for firefighters

Protection during firefighting : Keep upwind of fire. Wear full fire fighting turn-out gear (full Bunker gear) and respiratory protection (SCBA).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Use personal protection recommended in Section 8. Isolate the hazard area and deny entry to unnecessary and unprotected personnel. Eliminate sources of ignition. Use special care to avoid static electric charges. Use only non-sparking tools.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent entry to sewers and public waters.

6.3. Methods and material for containment and cleaning up

For containment : Contain and/or absorb spill with inert material (e.g. sand, vermiculite), then place in a suitable container. Do not flush to sewer or allow to enter waterways. Use appropriate Personal Protective Equipment (PPE).

Methods for cleaning up : Sweep or shovel spills into appropriate container for disposal. Provide ventilation.

6.4. Reference to other sections

For further information refer to section 8: "Exposure controls/personal protection"

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not get in eyes, on skin, or on clothing. Avoid breathing dust/fume/gas/mist/vapors/spray. Do not swallow. Handle and open container with care. When using do not eat, drink or smoke. Ethylene Oxide is subject to the standard 29 CFR 1910.1047, which may contain specific requirements for handling including protective equipment, regulated areas, monitoring and medical surveillance. The employer should review the standard and assure compliance with applicable requirements.

Hygiene measures : Take off contaminated clothing and wash it before reuse. Wash hands, forearms and face thoroughly after handling.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Proper grounding procedures to avoid static electricity should be followed.

Storage conditions : Keep out of the reach of children. Keep container tightly closed and in a well-ventilated place. Protect from sunlight. Do not store at temperatures above 49 °C / 120 °F. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Store locked up.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Petroleum distillates, hydrotreated light (64742-47-8)
Not applicable

Ethylene oxide (75-21-8)		
ACGIH	ACGIH TWA (ppm)	1 ppm
OSHA	OSHA PEL (TWA) (ppm)	1 ppm
OSHA	OSHA PEL (STEL) (ppm)	5 ppm (see 29 CFR 1910.1047)
IDLH	US IDLH (ppm)	800 ppm
NIOSH	NIOSH REL (TWA) (mg/m³)	0.18 mg/m³ (less than stated value)
NIOSH	NIOSH REL (TWA) (ppm)	0.1 ppm (less than stated value)
NIOSH	NIOSH REL (ceiling) (mg/m³)	9 mg/m³
NIOSH	NIOSH REL (ceiling) (ppm)	5 ppm

Benzene, ethylenated, residues, distillation lights (178535-25-6)
Not applicable

Benzene, 1,3,5-triethyl- (102-25-0)
Not applicable

Naphthalene (91-20-3)		
ACGIH	ACGIH TWA (ppm)	10 ppm
OSHA	OSHA PEL (TWA) (mg/m³)	50 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	10 ppm
IDLH	US IDLH (ppm)	250 ppm
NIOSH	NIOSH REL (TWA) (mg/m³)	50 mg/m³

Naphthalene (91-20-3)		
NIOSH	NIOSH REL (TWA) (ppm)	10 ppm
NIOSH	NIOSH REL (STEL) (mg/m³)	75 mg/m³
NIOSH	NIOSH REL (STEL) (ppm)	15 ppm

2-Ethylhexanol (104-76-7)
Not applicable

8.2. Exposure controls

Appropriate engineering controls : Use ventilation adequate to keep exposures (airborne levels of dust, fume, vapor, etc.) below recommended exposure limits.

Hand protection : Wear suitable gloves resistant to chemical penetration.

Eye protection : Wear eye/face protection.

Skin and body protection : Wear suitable protective clothing.

Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Environmental exposure controls : Avoid release to the environment.

Other information : Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Appearance : Clear.

Colour : Colourless

Odour : Aromatic

Odour threshold : No data available

pH : No data available

Melting point : -51.5 °C (-60.7 °F)

Freezing point : No data available

Boiling point : 218.8 °C (425.8 °F)

Flash point : 70 °C (158 °F) (CC)

Relative evaporation rate (butylacetate=1) : No data available

Flammability (solid, gas) : Combustible liquid

Vapour pressure : 0.01 kPa /0.08 mmHg @20 °C (68 °F)

Relative vapour density at 20 °C : 5.49

Relative density : 0.91

Solubility : Partially soluble.

Partition coefficient n-octanol/water : No data available

Auto-ignition temperature : 400 °C (752 °F)

Decomposition temperature : No data available

Viscosity, kinematic : No data available

Viscosity, dynamic : No data available

Explosive limits : Lower explosive limit (LEL): 0.6 vol %
Upper explosive limit (UEL): 7 vol %

Explosive properties : No data available

Oxidising properties : No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No dangerous reactions known under normal conditions of use.

10.2. Chemical stability

Stable under normal conditions. May form flammable/explosive vapour-air mixture.

10.3. Possibility of hazardous reactions

No dangerous reactions known under normal conditions of use.

10.4. Conditions to avoid

Heat. Sources of ignition. Incompatible materials.

10.5. Incompatible materials

Oxidizing agents. Fluorine.

10.6. Hazardous decomposition products

May include, and are not limited to: oxides of carbon. May release flammable gases.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral) : Not classified.
Acute toxicity (dermal) : Not classified.
Acute toxicity (inhalation) : Not classified.

Petroleum distillates, hydrotreated light (64742-47-8)	
LD50 oral rat	> 5000 mg/kg
LD50 dermal rabbit	> 2000 mg/kg
LC50 inhalation rat	> 5.2 mg/l/4h

Ethylene oxide (75-21-8)	
LD50 oral rat	72 mg/kg
LD50 oral	72 mg/kg
LC50 inhalation rat	800 ppm
ATE CA (oral)	72 mg/kg bodyweight
ATE CA (Gases)	700 ppmv/4h
ATE CA (vapours)	3 mg/l/4h
ATE CA (dust,mist)	0.5 mg/l/4h

Naphthalene (91-20-3)	
LD50 oral rat	1780 mg/kg
LD50 dermal rabbit	10000 mg/kg
LC50 inhalation rat	> 340 mg/m³ (Exposure time: 1 h)
ATE CA (oral)	1780 mg/kg bodyweight
ATE CA (Dermal)	10000 mg/kg bodyweight

2-Ethylhexanol (104-76-7)	
LD50 oral rat	3730 mg/kg
LD50 dermal rabbit	1980 mg/kg
LC50 inhalation rat	> 227 ppm (Exposure time: 6 h)
ATE CA (oral)	3730 mg/kg bodyweight
ATE CA (Dermal)	1980 mg/kg bodyweight
ATE CA (Gases)	4500 ppmv/4h
ATE CA (vapours)	11 mg/l/4h
ATE CA (dust,mist)	1.5 mg/l/4h

Skin corrosion/irritation : Causes skin irritation.
Serious eye damage/irritation : Causes serious eye irritation.
Respiratory or skin sensitisation : Not classified.
Germ cell mutagenicity : Not classified.
Carcinogenicity : Suspected of causing cancer.

Ethylene oxide (75-21-8)	
IARC group	1 - Carcinogenic to humans
National Toxicology Program (NTP) Status	2 - Known Human Carcinogens

Ethylene oxide (75-21-8)	
In OSHA Hazard Communication Carcinogen list	Yes
In OSHA Specifically Regulated Carcinogen list	Yes

Naphthalene (91-20-3)	
IARC group	2B - Possibly carcinogenic to humans
National Toxicology Program (NTP) Status	1 - Evidence of Carcinogenicity, 3 - Reasonably anticipated to be Human Carcinogen
In OSHA Hazard Communication Carcinogen list	Yes

Reproductive toxicity : Not classified.

STOT-single exposure : Not classified.

Ethylene oxide (75-21-8)	
STOT-single exposure	May cause respiratory irritation.

2-Ethylhexanol (104-76-7)	
STOT-single exposure	May cause respiratory irritation.

STOT-repeated exposure : Not classified.

Ethylene oxide (75-21-8)	
STOT-repeated exposure	Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard : May be fatal if swallowed and enters airways.

Symptoms/effects after inhalation : May cause irritation to the respiratory tract.

Symptoms/effects after skin contact : Causes skin irritation. Symptoms may include redness, drying, defatting and cracking of the skin.

Symptoms/effects after eye contact : Causes serious eye irritation. Symptoms may include discomfort or pain, excess blinking and tear production, with marked redness and swelling of the conjunctiva.

Symptoms/effects after ingestion : May be fatal if swallowed and enters airways. May result in aspiration into the lungs, causing chemical pneumonia. May cause stomach distress, nausea or vomiting.

Other information : Likely routes of exposure: ingestion, inhalation, skin and eye.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : May cause long-term adverse effects in the aquatic environment.

Petroleum distillates, hydrotreated light (64742-47-8)	
LC50 fish 1	45 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
LC50 fish 2	2.2 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [static])

Ethylene oxide (75-21-8)	
LC50 fish 1	84 mg/l
EC50 Daphnia 1	137 - 300 mg/l (Exposure time: 48 h - Species: Daphnia magna)

Naphthalene (91-20-3)	
LC50 fish 1	5.74 - 6.44 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
EC50 Daphnia 1	2.16 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 fish 2	1.6 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [flow-through])
EC50 Daphnia 2	1.96 mg/l (Exposure time: 48 h - Species: Daphnia magna [Flow through])

2-Ethylhexanol (104-76-7)	
LC50 fish 1	32 - 37 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [static])
EC50 Daphnia 1	39 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 fish 2	> 7.5 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss)

12.2. Persistence and degradability

4+ Polar Max	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

4+ Polar Max	
Bioaccumulative potential	Not established.

Petroleum distillates, hydrotreated light (64742-47-8)	
BCF fish 1	61 - 159

Ethylene oxide (75-21-8)	
Partition coefficient n-octanol/water	-0.3 (at 25 °C)

Naphthalene (91-20-3)	
BCF fish 1	30 - 430
Partition coefficient n-octanol/water	3.6

2-Ethylhexanol (104-76-7)	
Partition coefficient n-octanol/water	3.1

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Other information : No other effects known.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product/Packaging disposal recommendations : Dispose of contents/container to hazardous or special waste collection point, in accordance with local, regional, national and/or international regulation.

Additional information : Handle empty containers with care because residual vapours are flammable.

SECTION 14: Transport information

Department of Transportation (DOT) and Transportation of Dangerous Goods (TDG)

In accordance with DOT/TDG

UN-No.(DOT/TDG) : UN3082

Proper Shipping Name (DOT/TDG) : Environmentally hazardous substance, liquid, n.o.s. (2-Ethylhexyl nitrate, Light ends of polyethylbenzene residue)

Class (DOT/TDG) : Class 9 - Miscellaneous hazardous material 49 CFR 173.140

Packing group (DOT/TDG) : III

Hazard labels (DOT/TDG) :

SECTION 15: Regulatory information

15.1. Federal regulations

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory.

All components of this product are listed, or excluded from listing, on the Canadian DSL (Domestic Substances List) and NDSL (Non-Domestic Substances List) inventories.

15.2. International regulations

No additional information available

15.3. US State regulations

WARNING: This product can expose you to Ethylene oxide, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

SECTION 16: Other information

Revision date : 07/19/2019

Other information : None.

Prepared by : Nexreg Compliance Inc.
www.Nexreg.com

Indication of changes:
Modified. Regulatory information.

SDS HazCom 2012 - WHMIS 2015 (NexReg)

AMC BIO DEGRADABLE ROD GREASE

AMC

Chemwatch Hazard Alert Code: **1**

Chemwatch: **5202-38**
Version No: **7.1**
Safety Data Sheet according to WHMIS 2015 requirements

Issue Date: **12/23/2022**
Print Date: **02/14/2023**
L.GHS.CAN.EN.E

SECTION 1 Identification

Product Identifier

Product name	AMC BIO DEGRADABLE ROD GREASE
Chemical Name	Not Applicable
Synonyms	Not Available
Chemical formula	Not Applicable
Other means of identification	Not Available

Recommended use of the chemical and restrictions on use

Relevant identified uses	Grease.

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Registered company name	**AMC**
Address	1220 N. 2200 W. Suite# 600, Salt Lake City UT 84116 United States
Telephone	801-364-0233
Fax	801-364-0278
Website	www.amcmud.com
Email	amc@imdexlimited.com

Emergency phone number

Association / Organisation	**AMC**	**CHEMWATCH EMERGENCY RESPONSE (24/7)**
Emergency telephone numbers	**Chemwatch - (1) 877 715 9305**	**+1 867 670 2867**
Other emergency telephone numbers	**-**	**+61 3 9573 3188**

Once connected and if the message is not in your preferred language then please dial 01

Une fois connecté et si le message n'est pas dans votre langue préférée alors s'il vous plaît cadran 07

SECTION 2 Hazard(s) identification

Classification of the substance or mixture

NFPA 704 diamond

Note: The hazard category numbers found in GHS classification in section 2 of this SDSs are NOT to be used to fill in the NFPA 704 diamond. Blue = Health Red = Fire Yellow = Reactivity White = Special (Oxidizer or water reactive substances)

Canadian WHMIS Symbols

Classification	Not Applicable

Page 1 continued...

Label elements

Hazard pictogram(s)	Not Applicable
Signal word	**Not Applicable**

Hazard statement(s)

Not Applicable

Physical and Health hazard(s) not otherwise classified

Not Applicable

Precautionary statement(s) General

P101	If medical advice is needed, have product container or label at hand.
P102	Keep out of reach of children.

Precautionary statement(s) Prevention

Not Applicable

Precautionary statement(s) Response

Not Applicable

Precautionary statement(s) Storage

Not Applicable

Precautionary statement(s) Disposal

Not Applicable

SECTION 3 Composition / information on ingredients

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
Not Available	>60	Ingredients determined not to be hazardous

The specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret.

SECTION 4 First-aid measures

Description of first aid measures

Eye Contact	If this product comes in contact with the eyes: ▸ Wash out immediately with fresh running water. ▸ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. ▸ Seek medical attention without delay; if pain persists or recurs seek medical attention. ▸ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	If skin contact occurs: ▸ Immediately remove all contaminated clothing, including footwear. ▸ Flush skin and hair with running water (and soap if available). ▸ Seek medical attention in event of irritation.
Inhalation	▸ If fumes or combustion products are inhaled remove from contaminated area. ▸ Lay patient down. Keep warm and rested. ▸ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. ▸ Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary. ▸ Transport to hospital, or doctor.
Ingestion	▸ If swallowed do **NOT** induce vomiting. ▸ If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.

Continued...

	▸ Observe the patient carefully. ▸ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. ▸ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. ▸ Seek medical advice.

Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5 Fire-fighting measures

Extinguishing media

- Foam.
- Dry chemical powder.

Do not use water jets.

Special hazards arising from the substrate or mixture

Fire Incompatibility	▸ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Special protective equipment and precautions for fire-fighters

Fire Fighting	▸ Alert Fire Brigade and tell them location and nature of hazard. ▸ Wear breathing apparatus plus protective gloves.
Fire/Explosion Hazard	▸ Combustible. ▸ Slight fire hazard when exposed to heat or flame. Combustion products include: carbon dioxide (CO_2) acrolein other pyrolysis products typical of burning organic material.

SECTION 6 Accidental release measures

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills	Slippery when spilt. ▸ Clean up all spills immediately. ▸ Avoid contact with skin and eyes.
Major Spills	Slippery when spilt. ▸ Clear area of personnel and move upwind. ▸ Alert Fire Brigade and tell them location and nature of hazard.

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 Handling and storage

Precautions for safe handling

Safe handling	Rags wet / soaked with unsaturated hydrocarbons / drying oils may auto-oxidise; generate heat and, in-time, smoulder and ignite. This is especially the case where oil-soaked materials are folded, bunched, compressed, or piled together - this allows the heat to accumulate or even accelerate the reaction Oily cleaning rags should be collected regularly and immersed in water, or spread to dry in safe-place away from direct sunlight or stored, immersed, in solvents in suitably closed containers. ▸ Limit all unnecessary personal contact. ▸ Wear protective clothing when risk of exposure occurs.
Other information	▸ Store in original containers. ▸ Keep containers securely sealed.

Continued...

Conditions for safe storage, including any incompatibilities

Suitable container	▸ Metal can or drum ▸ Packaging as recommended by manufacturer. ▸ Check all containers are clearly labelled and free from leaks.
Storage incompatibility	▸ Avoid reaction with oxidising agents

SECTION 8 Exposure controls / personal protection

Control parameters

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Not Available

Emergency Limits

Ingredient	TEEL-1	TEEL-2	TEEL-3
AMC BIO DEGRADABLE ROD GREASE	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
AMC BIO DEGRADABLE ROD GREASE	Not Available	Not Available

MATERIAL DATA

Exposure limit to the mist = 5 mg/m3 (TLV/TWA, ACCIH)

Exposure controls

Appropriate engineering controls	Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.
Personal protection	
Eye and face protection	▸ Safety glasses with side shields ▸ Chemical goggles. ▸ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants.
Skin protection	See Hand protection below
Hands/feet protection	Wear general protective gloves, eg. light weight rubber gloves.
Body protection	See Other protection below
Other protection	No special equipment needed when handling small quantities. **OTHERWISE:** ▸ Overalls.

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the:
"Forsberg Clothing Performance Index".
The effect(s) of the following substance(s) are taken into account in the ***computer-generated*** selection:
AMC BIO DEGRADABLE ROD GREASE

Material	CPI
PVC	A

* CPI - Chemwatch Performance Index
A: Best Selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to Dangerous Choice for other than short term immersion
NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

Respiratory protection

- Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content.
- The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- Cartridge performance is affected by humidity. Cartridges should be changed after 2 hr of continuous use unless it is determined that the humidity is less than 75%, in which case, cartridges can be used for 4 hr. Used cartridges should be discarded daily, regardless of the length of time used

Continued...

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

SECTION 9 Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Dark green to black semi-solid with characteristic vegetable oil odour; does not mix with water.

Physical state	Non Slump Paste	**Relative density (Water = 1)**	0.92
Odour	Not Available	**Partition coefficient n-octanol / water**	Not Available
Odour threshold	Not Available	**Auto-ignition temperature (°C)**	Not Available
pH (as supplied)	Not Applicable	**Decomposition temperature (°C)**	Not Available
Melting point / freezing point (°C)	Not Available	**Viscosity (cSt)**	Not Available
Initial boiling point and boiling range (°C)	Not Available	**Molecular weight (g/mol)**	Not Applicable
Flash point (°C)	Not Available	**Taste**	Not Available
Evaporation rate	<1 BuAC = 1	**Explosive properties**	Not Available
Flammability	Not Available	**Oxidising properties**	Not Available
Upper Explosive Limit (%)	Not Available	**Surface Tension (dyn/cm or mN/m)**	Not Available
Lower Explosive Limit (%)	Not Available	**Volatile Component (%vol)**	Negligible
Vapour pressure (kPa)	<0.1 @20C	**Gas group**	Not Available
Solubility in water	Immiscible	**pH as a solution (1%)**	Not Applicable
Vapour density (Air = 1)	>1	**VOC g/L**	Not Available

SECTION 10 Stability and reactivity

Reactivity	See section 7
Chemical stability	‣ Unstable in the presence of incompatible materials. ‣ Product is considered stable.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 Toxicological information

Information on toxicological effects

Inhaled	Not normally a hazard due to non-volatile nature of product Inhalation of oil droplets/ aerosols may cause discomfort and may produce chemical pneumonitis.
Ingestion	The material has **NOT** been classified by EC Directives or other classification systems as "harmful by ingestion". This is because of the lack of corroborating animal or human evidence.
Skin Contact	Excessive use or prolonged contact may lead to defatting, drying and irritation of sensitive skin
Eye	The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Chronic	Long-term exposure to the product is not thought to produce chronic effects adverse to health (as classified by EC Directives using animal models); nevertheless exposure by all routes should be minimised as a matter of course.

AMC BIO DEGRADABLE	**TOXICITY**	**IRRITATION**

Continued...

ROD GREASE	Not Available	Not Available
Legend:	*1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances*	

Acute Toxicity	✗	**Carcinogenicity**	✗
Skin Irritation/Corrosion	✗	**Reproductivity**	✗
Serious Eye Damage/Irritation	✗	**STOT - Single Exposure**	✗
Respiratory or Skin sensitisation	✗	**STOT - Repeated Exposure**	✗
Mutagenicity	✗	**Aspiration Hazard**	✗

Legend: ✗ *– Data either not available or does not fill the criteria for classification*
✔ *– Data available to make classification*

SECTION 12 Ecological information

Toxicity

AMC BIO DEGRADABLE ROD GREASE	**Endpoint**	**Test Duration (hr)**	**Species**	**Value**	**Source**
	Not Available	Not Available	Not Available	Not Available	Not Available
Legend:	*Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data*				

DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
	No Data available for all ingredients	No Data available for all ingredients

Bioaccumulative potential

Ingredient	Bioaccumulation
	No Data available for all ingredients

Mobility in soil

Ingredient	Mobility
	No Data available for all ingredients

SECTION 13 Disposal considerations

Waste treatment methods

Product / Packaging disposal	▸ **DO NOT** allow wash water from cleaning or process equipment to enter drains. ▸ It may be necessary to collect all wash water for treatment before disposal. ▸ Recycle wherever possible or consult manufacturer for recycling options. ▸ Consult State Land Waste Authority for disposal.

SECTION 14 Transport information

Labels Required

Marine Pollutant	NO

Land transport (TDG): NOT REGULATED FOR TRANSPORT OF DANGEROUS GOODS

Air transport (ICAO-IATA / DGR): NOT REGULATED FOR TRANSPORT OF DANGEROUS GOODS

Continued...

Sea transport (IMDG-Code / GGVSee): NOT REGULATED FOR TRANSPORT OF DANGEROUS GOODS

Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

Transport in bulk in accordance with MARPOL Annex V and the IMSBC Code

Product name	Group

Transport in bulk in accordance with the IGC Code

Product name	Ship Type

SECTION 15 Regulatory information

Safety, health and environmental regulations / legislation specific for the substance or mixture

This product has been classified in accordance with the hazard criteria of the Hazardous Products Regulations and the SDS contains all the information required by the Hazardous Products Regulations.

National Inventory Status

National Inventory	Status
Australia - AIIC / Australia Non-Industrial Use	Not Available
Canada - DSL	Not Available
Canada - NDSL	Not Available
China - IECSC	Not Available
Europe - EINEC / ELINCS / NLP	Not Available
Japan - ENCS	Not Available
Korea - KECI	Not Available
New Zealand - NZIoC	Not Available
Philippines - PICCS	Not Available
USA - TSCA	Not Available
Taiwan - TCSI	Not Available
Mexico - INSQ	Not Available
Vietnam - NCI	Not Available
Russia - FBEPH	Not Available
Legend:	*Yes = All CAS declared ingredients are on the inventory* *No = One or more of the CAS listed ingredients are not on the inventory. These ingredients may be exempt or will require registration.*

SECTION 16 Other information

Revision Date	12/23/2022
Initial Date	03/22/2016

SDS Version Summary

Version	Date of Update	Sections Updated
6.1	02/27/2020	Toxicological information - Acute Health (inhaled), Physical and chemical properties - Appearance, Exposure controls / personal protection - Engineering Control, Firefighting measures - Fire Fighter (extinguishing media), Firefighting measures - Fire Fighter (fire/explosion hazard), Composition / information on ingredients - Ingredients, Stability and reactivity - Instability Condition, Physical and chemical properties - Physical Properties, Handling and storage - Storage (storage incompatibility), Handling and storage - Storage (storage requirement), Identification of the substance / mixture and of the company / undertaking - Supplier Information, Toxicological information - Toxicity and Irritation (Other)
7.1	12/23/2022	Classification review due to GHS Revision change.

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch

Continued...

Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings.

Definitions and abbreviations

PC—TWA: Permissible Concentration-Time Weighted Average
PC—STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit。
IDLH: Immediately Dangerous to Life or Health Concentrations
ES: Exposure Standard
OSF: Odour Safety Factor
NOAEL :No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index
AIIC: Australian Inventory of Industrial Chemicals
DSL: Domestic Substances List
NDSL: Non-Domestic Substances List
IECSC: Inventory of Existing Chemical Substance in China
EINECS: European INventory of Existing Commercial chemical Substances
ELINCS: European List of Notified Chemical Substances
NLP: No-Longer Polymers
ENCS: Existing and New Chemical Substances Inventory
KECI: Korea Existing Chemicals Inventory
NZIoC: New Zealand Inventory of Chemicals
PICCS: Philippine Inventory of Chemicals and Chemical Substances
TSCA: Toxic Substances Control Act
TCSI: Taiwan Chemical Substance Inventory
INSQ: Inventario Nacional de Sustancias Químicas
NCI: National Chemical Inventory
FBEPH: Russian Register of Potentially Hazardous Chemical and Biological Substances

SAFETY DATA SHEET

US OSHA Hazard Communication Standard (29 CFR 1910.1200) and Canada WHMIS 2015 which includes the amended Hazardous Products Act (HPA) and the Hazardous Products Regulation (HPR)

Issuing Date 01-Dec-2022 **Revision Date** 01-Dec-2022 **Revision Number** 1

1. Identification

Product identifier

Product Name AMSOIL XL SAE 0W-20, 5W-20, 5W-30, 10W-30, 10W-40 100% Synthetic Motor Oil

Other means of identification

Product Code(s) XLZ, XLM, XLF, XLT, XLO

Synonyms None

Recommended use of the chemical and restrictions on use

Recommended use Engine oil

Restrictions on use Avoid formation of mists

Details of the supplier of the safety data sheet

Initial supplier identifier
AMSOIL INC.
Bay Adelaide Centre, East Tower
22 Adelaide St. W
Toronto, ON, Canada M5H 4E3
T:+1 877-822-5172

Manufacturer Address
AMSOIL INC.
One AMSOIL Center
Superior, WI 54880, USA
T: +1 715-392-7101

E-mail compliance@amsoil.com

Emergency telephone number

Emergency telephone CHEMTREC: Within USA and Canada: 1-800-424-9300
Outside the USA and Canada: +1 703-741-5970
(collect calls accepted) 24/7

2. Hazard(s) identification

Classification

This product is not considered hazardous by either the US 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200) or the Canadian Workplace Hazardous Material Information System (WHMIS 2015)

Label elements

Hazard statements
Not classified.

Other information
No information available.

3. Composition/information on ingredients

Substance

Not applicable.

Mixture

Based on tests performed on the final product, the product is classified as non-hazardous.

Chemical Additions

The classification as a carcinogen does not apply as it can be shown that the substance(s) contain(s) less than 3% DMSO extract as measured by IP 346.

4. First-aid measures

Description of first aid measures

General advice	Get medical attention immediately if symptoms occur. Show this safety data sheet to the doctor in attendance.
Inhalation	Remove person to fresh air and keep comfortable for breathing.
Eye contact	Rinse thoroughly with plenty of water, also under the eyelids. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.
Skin contact	Wash skin with soap and water. Take off contaminated clothing. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Do NOT induce vomiting. Never give anything by mouth to an unconscious person.
Self-protection of the first aider	Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed

Symptoms	May cause temporary eye irritation. May cause gastrointestinal discomfort if consumed in large amounts. Symptoms of overexposure are dizziness, headache, tiredness, nausea, unconsciousness and difficulty breathing. Repeated or prolonged skin contact may cause skin irritation and/or dermatitis and sensitization in susceptible persons.

Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray, carbon dioxide (CO2), dry chemical, alcohol-resistant foam. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards arising from the chemical	Containers can burst or explode when heated, due to excessive pressure build-up. Thermal decomposition can lead to release of irritating gases and vapors.
Hazardous combustion products	Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

Explosion data

Sensitivity to mechanical impact None.

Sensitivity to static discharge	None.
Special protective equipment and precautions for fire-fighters	Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions	Use personal protective equipment as required. See section 8 for more information. Ensure adequate ventilation.
For emergency responders	Use personal protection recommended in Section 8.

Methods and material for containment and cleaning up

Methods for containment	Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	Contain and collect spillage with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see Section 13). Clean contaminated surface thoroughly. After cleaning, flush away traces with water.
Reference to other sections	For additional information see: Section 8: Exposure controls/personal protection; Section 12: Ecological information; Section 13: Disposal considerations.

7. Handling and storage

Precautions for safe handling

Advice on safe handling	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with used product. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling.

Conditions for safe storage, including any incompatibilities

Storage Conditions	Keep containers tightly closed in a dry, cool and well-ventilated place. Do not reuse empty containers. Keep out of the reach of children. Store away from incompatible materials. See section 10 for more information. Store in accordance with local regulations.

8. Exposure controls/personal protection

Control parameters

Exposure Limits	Under conditions which may generate mists, the following exposure limits are recommended: Long-term exposure limit (8-hour TWA): 5 mg/m³. Short-term exposure limit (15-minute): 10 mg/m³.
Biological occupational exposure limits	This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering controls	Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

Eye/face protection	If there is a risk of contact:. Wear safety glasses with side shields (or goggles).

Hand protection	If there is a risk of contact: Wear suitable gloves. Ensure that the breakthrough time of the glove material is not exceeded. Refer to glove supplier for information on breakthrough time for specific gloves.
Skin and body protection	If there is a risk of contact: Wear suitable protective clothing.
Respiratory protection	No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.
Environmental exposure controls	Avoid release to the environment. Local authorities should be advised if significant spillages cannot be contained.
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling the product.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance	
Physical state	Liquid
Color	Amber
Odor	Mild hydrocarbon
Odor threshold	No information available

Property	**Values**	**Remarks • Method**
pH		No data available
Melting point / freezing point		No data available
Initial boiling point and boiling range		No data available
Flash point	210 - 238 °C / 410 - 460.4 °F	Cleveland Open Cup ASTM D 92
Evaporation rate		No data available
Flammability		No data available
Flammability Limit in Air		
Upper flammability or explosive limits		No data available
Lower flammability or explosive limits		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density	0.8468 - 0.8545	No data available
Water solubility		No data available
Solubility(ies)		No data available
Partition coefficient		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity	45.8 - 103.4 cSt at 40 ºC 8.7 - 15.7 cSt at 100 ºC	ASTM D445
Dynamic viscosity		No data available

Other information

Explosive properties	No information available.
Oxidizing properties	No information available.
Softening point	No information available
Pour Point	-48-(-44) ºC [ASTM D 97]
Fire Point	230 - 260 ºC (COC) [ASTM D 92]
Molecular weight	No information available
VOC content	No information available
Liquid Density	No information available
Bulk density	No information available

10. Stability and reactivity

Reactivity None under normal use conditions.

Chemical stability Stable under normal conditions.

Possibility of hazardous reactions None under normal processing.

Conditions to avoid None known based on information supplied.

Incompatible materials None known based on information supplied.

Hazardous decomposition products Thermal decomposition can lead to release of irritating gases and vapors. Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

11. Toxicological information

Information on likely routes of exposure

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Specific test data for the substance or mixture is not available.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms May cause temporary eye irritation. May cause gastrointestinal discomfort if consumed in large amounts. Symptoms of overexposure are dizziness, headache, tiredness, nausea, unconsciousness and difficulty breathing. Repeated or prolonged skin contact may cause skin irritation and/or dermatitis and sensitization in susceptible persons.

Acute toxicity

Numerical measures of toxicity

The following values are calculated based on chapter 3.1 of the GHS document:

Component Information

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity The supplier declares that it can be shown that the substance(s) contain less than 3% DMSO extract as measured by IP 346.

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard Due to the viscosity, this product does not present an aspiration hazard.

12. Ecological information

Ecotoxicity Not considered to be harmful to aquatic life. Large or frequent spills may have hazardous effects on the environment.

Persistence and degradability No information available.

Bioaccumulation

Mobility in soil No information available.

Other adverse effects No information available.

13. Disposal considerations

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations, Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

14. Transport information

DOT Not regulated

TDG Not regulated

IATA Not regulated

IMDG Not regulated

15. Regulatory information

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

International Inventories
Contact supplier for inventory compliance status
*Contact supplier for details. One or more substances in this product are either not listed on the US TSCA inventory, listed on the confidential US TSCA inventory or are otherwise exempted from inventory listing requirements

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any

chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories
Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical name	New Jersey	Massachusetts	Pennsylvania
Phosphorodithioic acid, O,O-di-C1-14-alkyl esters, zinc salts 68649-42-3	X	-	X
Fumaric acid 110-17-8	X	X	X
1,2-Diaminoethane 107-15-3	X	X	X
Hydrogenated base oil 64742-56-9	-	X	-
Diphenylamine 122-39-4	X	X	X

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal

Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Issuing Date	01-Dec-2022
Revision Date	01-Dec-2022
Revision Note	Initial Release.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SAFETY DATA SHEET

3010® ULTRA

Version	Revision Date:	SDS Number:	Date of last issue: 05/06/2020
3.0	11/06/2020	130217-00015	Date of first issue: 05/27/2015

SECTION 1. IDENTIFICATION

Product name : 3010® ULTRA

Other means of identification : No data available

SDS-Identcode : 379G

Manufacturer or supplier's details

Company name of supplier : Bestolife Corporation
Address : 2126 Vanco Drive
Irving TX 75061,
Telephone : 855-243-9164/972-865-8961
Telefax : 214-631-3047
E-mail address : www.bestolife.com

Recommended use of the chemical and restrictions on use

Recommended use : Industrial use
Thread Compound (Pipe Dope) and Jacking grease for use in Offshore industries
Mining, (without offshore industries)
Restrictions on use : Do not use on oxygen lines or in oxygen enriched atmospheres.

SECTION 2. HAZARDS IDENTIFICATION

GHS classification in accordance with the Hazardous Products Regulations

Not a hazardous substance or mixture.

GHS label elements

Not a hazardous substance or mixture.

Other hazards

None known.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Mixture

Components

Chemical name	CAS-No.	Concentration (% w/w)
Graphite	7782-42-5	>= 30 - < 60 *
Distillates (petroleum), hydrotreated light naphthenic	64742-53-6	>= 30 - < 60 *
Talc	14807-96-6	>= 10 - < 30 *
Quartz	14808-60-7	>= 1 - < 5 *
Boric acid	10043-35-3	>= 0.1 - < 1 *

* Actual concentration or concentration range is withheld as a trade secret

SECTION 4. FIRST AID MEASURES

If inhaled : If inhaled, remove to fresh air.

		Get medical attention if symptoms occur.
In case of skin contact	:	Wash with water and soap as a precaution. Get medical attention if symptoms occur.
In case of eye contact	:	Flush eyes with water as a precaution. Get medical attention if irritation develops and persists.
If swallowed	:	If swallowed, DO NOT induce vomiting. Get medical attention if symptoms occur. Rinse mouth thoroughly with water.
Most important symptoms and effects, both acute and delayed	:	None known.
Protection of first-aiders	:	No special precautions are necessary for first aid responders.
Notes to physician	:	Treat symptomatically and supportively.

SECTION 5. FIRE-FIGHTING MEASURES

Suitable extinguishing media	:	Water spray Alcohol-resistant foam Carbon dioxide (CO2) Dry chemical
Unsuitable extinguishing media	:	None known.
Specific hazards during fire fighting	:	Exposure to combustion products may be a hazard to health.
Hazardous combustion products	:	Carbon oxides Metal oxides
Specific extinguishing methods	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water spray to cool unopened containers. Remove undamaged containers from fire area if it is safe to do so. Evacuate area.
Special protective equipment for fire-fighters	:	Wear self-contained breathing apparatus for firefighting if necessary. Use personal protective equipment.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Follow safe handling advice (see section 7) and personal protective equipment recommendations (see section 8).
Environmental precautions	:	Avoid release to the environment. Prevent further leakage or spillage if safe to do so. Retain and dispose of contaminated wash water. Local authorities should be advised if significant spillages cannot be contained.
Methods and materials for containment and cleaning up	:	Sweep up or vacuum up spillage and collect in suitable container for disposal. Local or national regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which regulations are applicable.

Sections 13 and 15 of this SDS provide information regarding certain local or national requirements.

SECTION 7. HANDLING AND STORAGE

Technical measures	:	See Engineering measures under EXPOSURE CONTROLS/PERSONAL PROTECTION section.
Advice on safe handling	:	For outdoor use only Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment Take care to prevent spills, waste and minimize release to the environment.
Conditions for safe storage	:	Keep in properly labeled containers. Store in accordance with the particular national regulations.
Materials to avoid	:	Do not store with the following product types: Strong oxidizing agents

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ingredients with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
Graphite	7782-42-5	TWA (Respirable)	2 mg/m³	CA BC OEL
		TWAEV (respirable dust)	2 mg/m³	CA QC OEL
		TWA (Respirable)	2 mg/m³	CA AB OEL
		TWA (Respirable particulate matter)	2 mg/m³	ACGIH
Distillates (petroleum), hydrotreated light naphthenic	64742-53-6	TWA (Mist)	5 mg/m³	CA AB OEL
		STEL (Mist)	10 mg/m³	CA AB OEL
		TWAEV (Mist)	5 mg/m³	CA QC OEL
		STEV (Mist)	10 mg/m³	CA QC OEL
		TWA (Mist)	1 mg/m³	CA BC OEL
		TWA (Inhalable particulate matter)	5 mg/m³	ACGIH
Talc	14807-96-6	TWAEV (respirable dust)	3 mg/m³	CA QC OEL
		TWA (Respirable particulates)	2 mg/m³	CA AB OEL

		TWA (Respirable)	2 mg/m³	CA BC OEL
		TWA	2 fibres per cubic centimeter	CA ON OEL
		TWA (Respirable fraction)	2 mg/m³	CA ON OEL
		TWA (Respirable particulate matter)	2 mg/m³	ACGIH
Quartz	14808-60-7	TWA (Respirable particulates)	0.025 mg/m³	CA AB OEL
		TWA (Respirable fraction)	0.1 mg/m³	CA ON OEL
		TWAEV (respirable dust)	0.1 mg/m³	CA QC OEL
		TWA (Respirable particulates)	0.025 mg/m³ (Silica)	CA AB OEL
		TWA (Respirable particulate matter)	0.025 mg/m³ (Silica)	ACGIH
Boric acid	10043-35-3	TWA (Inhalable)	2 mg/m³ (Borate)	CA BC OEL
		STEL (Inhalable)	6 mg/m³ (Borate)	CA BC OEL
		TWA (Inhalable particulate matter)	2 mg/m³ (Borate)	ACGIH
		STEL (Inhalable particulate matter)	6 mg/m³ (Borate)	ACGIH

These substance(s) are inextricably bound in the product and therefore do not contribute to a dust inhalation hazard.

Quartz

Engineering measures : Minimize workplace exposure concentrations.
Dust formation may be relevant in the processing of this product. In addition to substance-specific OELs, general limitations of concentrations of particulates in the air at workplaces have to be considered in workplace risk assessment. Relevant limits include: OSHA PEL for Particulates Not Otherwise Regulated of 15 mg/m3 - total dust, 5 mg/m3 - respirable fraction; and ACGIH TWA for Particles (insoluble or poorly soluble) Not Otherwise Specified of 3 mg/m3 - respirable particles, 10 mg/m3 -

inhalable particles.

Personal protective equipment

Respiratory protection	:	If adequate local exhaust ventilation is not available or exposure assessment demonstrates exposures outside the recommended guidelines, use respiratory protection.
Filter type	:	Combined particulates and organic vapor type
Hand protection		
Remarks	:	Wash hands before breaks and at the end of workday.
Eye protection	:	Wear the following personal protective equipment: Safety glasses
Skin and body protection	:	Skin should be washed after contact.
Hygiene measures	:	If exposure to chemical is likely during typical use, provide eye flushing systems and safety showers close to the working place. When using do not eat, drink or smoke. Wash contaminated clothing before re-use.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Viscous semi-solid
Color	:	black
Odor	:	Petroleum
Odor Threshold	:	No data available
pH	:	Not applicable (not an aqueous solution)
Melting point/freezing point	:	No data available
Initial boiling point and boiling range	:	208 °C Method: ASTM D 2887 Distillates (petroleum), hydrotreated light naphthenic
Flash point	:	> 150 °C Method: Cleveland open cup Distillates (petroleum), hydrotreated light naphthenic
Evaporation rate	:	< 1
Flammability (solid, gas)	:	Not classified as a flammability hazard
Upper explosion limit / Upper flammability limit	:	No data available
Lower explosion limit / Lower flammability limit	:	No data available
Vapor pressure	:	Not applicable
Relative vapor density	:	Not applicable

Relative density	:	1.3
Density	:	No data available
Solubility(ies)		
Water solubility	:	negligible
Partition coefficient: n-octanol/water	:	Not applicable
Autoignition temperature	:	407 °C Method: ASTM E 659
Decomposition temperature	:	No data available
Viscosity		
Viscosity, dynamic	:	No data available
Viscosity, kinematic	:	18.17 cSt (40 °C) Distillates (petroleum), hydrotreated light naphthenic 1.817 mm²/s (40 °C) Distillates (petroleum), hydrotreated light naphthenic
Flow time	:	No data available
Explosive properties	:	Not explosive
Oxidizing properties	:	The substance or mixture is not classified as oxidizing.
Molecular weight	:	No data available
Particle size	:	No data available

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	Not classified as a reactivity hazard.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Can react with strong oxidizing agents.
Conditions to avoid	:	None known.
Incompatible materials	:	Oxidizing agents
Hazardous decomposition products	:	No hazardous decomposition products are known.

SECTION 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Skin contact
Ingestion
Eye contact

Acute toxicity

Not classified based on available information.

Components:

Graphite:

Acute oral toxicity	:	LD50 (Rat): > 2,000 mg/kg Method: OECD Test Guideline 423 Assessment: The substance or mixture has no acute oral toxicity
Acute inhalation toxicity	:	LC50 (Rat): > 2 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403

Distillates (petroleum), hydrotreated light naphthenic:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Method: OECD Test Guideline 401
Acute inhalation toxicity	:	LC50 (Rat): > 5.53 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403 Assessment: The substance or mixture has no acute inhalation toxicity
Acute dermal toxicity	:	LD50 (Rabbit): > 2,000 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Talc:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Remarks: Based on data from similar materials

Quartz:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg

Boric acid:

Acute oral toxicity	:	LD50 (Rat): 3,450 mg/kg
Acute inhalation toxicity	:	LC50 (Rat): > 2.03 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403 Assessment: The substance or mixture has no acute inhalation toxicity
Acute dermal toxicity	:	LD50 (Rabbit): > 2,000 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Acute toxicity

Not classified based on available information.

Components:

Graphite:

Acute oral toxicity	:	LD50 (Rat): > 2,000 mg/kg Method: OECD Test Guideline 423 Assessment: The substance or mixture has no acute oral toxicity
Acute inhalation toxicity	:	LC50 (Rat): > 2 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403

Distillates (petroleum), hydrotreated light naphthenic:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Method: OECD Test Guideline 401
Acute inhalation toxicity	:	LC50 (Rat): > 5.53 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403 Assessment: The substance or mixture has no acute inhalation toxicity
Acute dermal toxicity	:	LD50 (Rabbit): > 2,000 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Talc:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg Remarks: Based on data from similar materials

Quartz:

Acute oral toxicity	:	LD50 (Rat): > 5,000 mg/kg

Boric acid:

Acute oral toxicity	:	LD50 (Rat): 3,450 mg/kg
Acute inhalation toxicity	:	LC50 (Rat): > 2.03 mg/l Exposure time: 4 h Test atmosphere: dust/mist Method: OECD Test Guideline 403 Assessment: The substance or mixture has no acute inhalation toxicity
Acute dermal toxicity	:	LD50 (Rabbit): > 2,000 mg/kg Assessment: The substance or mixture has no acute dermal toxicity

Skin corrosion/irritation

Not classified based on available information.

Components:

Graphite:

Species	:	Rabbit
Method	:	OECD Test Guideline 404
Result	:	No skin irritation

Distillates (petroleum), hydrotreated light naphthenic:

Species	:	Rabbit
Result	:	No skin irritation

Talc:

Species	:	Rabbit
Result	:	No skin irritation

Boric acid:

Species	:	Rabbit
Result	:	No skin irritation

Serious eye damage/eye irritation

Not classified based on available information.

Components:

Graphite:

Species	:	Rabbit
Result	:	No eye irritation
Method	:	OECD Test Guideline 405

Distillates (petroleum), hydrotreated light naphthenic:

Species	:	Rabbit
Result	:	No eye irritation

Talc:

Species	:	Rabbit
Result	:	No eye irritation

Boric acid:

Species	:	Rabbit
Result	:	No eye irritation

Respiratory or skin sensitization

Skin sensitization

Not classified based on available information.

Respiratory sensitization

Not classified based on available information.

Components:

Graphite:

Test Type	:	Local lymph node assay (LLNA)
Routes of exposure	:	Skin contact
Species	:	Mouse
Result	:	negative

Distillates (petroleum), hydrotreated light naphthenic:

Test Type	:	Buehler Test
Routes of exposure	:	Skin contact
Species	:	Guinea pig
Method	:	OECD Test Guideline 406
Result	:	negative

Talc:

Routes of exposure	:	Skin contact
Species	:	Humans
Result	:	negative

Boric acid:

Test Type	:	Buehler Test
Routes of exposure	:	Skin contact
Species	:	Guinea pig
Method	:	OECD Test Guideline 406
Result	:	negative

Germ cell mutagenicity

Not classified based on available information.

Components:

Graphite:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Method: OECD Test Guideline 471 Result: negative Test Type: In vitro mammalian cell gene mutation test Method: OECD Test Guideline 476 Result: negative Test Type: Chromosome aberration test in vitro Method: OECD Test Guideline 473 Result: negative

Distillates (petroleum), hydrotreated light naphthenic:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Method: OECD Test Guideline 476 Result: negative

Genotoxicity in vivo	:	Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Mouse Application Route: Intraperitoneal injection Method: OECD Test Guideline 474 Result: negative

Talc:

Genotoxicity in vitro	:	Test Type: DNA damage and repair, unscheduled DNA synthesis in mammalian cells (in vitro) Result: negative
Genotoxicity in vivo	:	Test Type: Chromosome aberration test in vitro Species: Rat Application Route: Ingestion Result: negative

Boric acid:

Genotoxicity in vitro	:	Test Type: Bacterial reverse mutation assay (AMES) Result: negative Test Type: In vitro mammalian cell gene mutation test Result: equivocal Test Type: Chromosome aberration test in vitro Result: negative
Genotoxicity in vivo	:	Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Mouse Application Route: Ingestion Result: negative

Carcinogenicity

Not classified based on available information.

Product:

Carcinogenicity - Assessment	:	Petroleum distillates have been classified as not carcinogenic based on DMSO extract content < 3% (Regulation (EC) 1272/2008, Annex VI, Part 3, Note L).

Components:

Distillates (petroleum), hydrotreated light naphthenic:

Species	:	Mouse
Application Route	:	Skin contact
Exposure time	:	78 weeks
Result	:	negative

Talc:

Species	:	Mouse

Full Synthetic Diesel Engine Oil
SAFETY DATA SHEET

Section 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Full Synthetic Diesel Engine Oil 0W30, 0W40, 5W40, 15W40; Euro 5W40 Synthetic
COMMON NAME: Full Synthetic Diesel Engine Oil**,** Euro 5W40 Synthetic
CHEMICAL FORMULA: Mixture
CHEMICAL NAME: Lubricating Oil
CHEMICAL FAMILY: Hydrocarbon

SUPPLIER:
Boss Lubricants
112, 6303 30 St. SE
Calgary, AB
T2C 1R4

Emergency Phone Number(s)
Business: (800) 844-9457
Fax #: **(**403) 279-2272

CHEMTREC: +1 (800) 424-9300
Issue Date: January 24, 2018
Supersedes Issue: January 1, 2015

Section 2: HAZARDS IDENTIFICATION

Classification of the substance or mixture: Not classified under GHS

Other hazards

Hazards not otherwise classified: Avoid prolonged or repeated contact with used motor oil. Used motor oil has been shown to cause skin cancer in laboratory animals.

Unknown acute toxicity (GHS-US)

Unknown Acute Toxicity (Gas): 24.987922 % of the mixture consists of ingredient(s) of unknown toxicity.
Unknown Acute Toxicity (Dust/Mist): 24.987922

Section 3: COMPOSITION AND INFORMATION ON INGREDIENTS

Chemical Name	%	CAS #	GHS Classification
Lubricating oils (petroleum), C20-50, hydrotreated neutral oil-based	5 - 10	72623-87-1	Acute Tox. 4; H332 Acute Tox. 3; H331
Solvent-refined light paraffinic distillate	1 - 5	64741-89-5	Acute Tox. 4; H332 Acute Tox. 3; H331
Petroleum distillates, solvent-refined heavy paraffinic	1 - 5	64741-88-4	Not applicable
Solvent dewaxed light paraffinic distillate (petroleum)	1 - 5	64742-56-9	Acute Tox. 4; H332 Acute Tox. 3; H331

Section 4: FIRST AID MEASURES

EMERGENCY AND FIRST AID PROCEDURES:

Eye Contact: If material comes in contact with the eyes, immediately wash the eyes with large amounts of water for 15 minutes, occasionally lifting the lower and upper lids. Get medical attention.

Skin Contact: If the material comes in contact with the skin, wash the contaminated skin with soap and water promptly. If the material penetrates through clothing, remove the clothing and wash the skin with soap and water promptly. If irritation persists after washing, get medical attention immediately.

Inhalation: If person breathes in large amounts of material, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the person warm and at rest. Get medical attention as soon as possible.

Ingestion: If material has been swallowed, do not induce vomiting. Get medical attention immediately.

Section 5: FIRE - FIGHTING MEASURES

FLASH POINT: 224°C (435.2°F) **AUTO IGNITION TEMP:** >260°C (>500°F)

FLAMMABLE LIMITS IN AIR	**LOWER**	**UPPER**
% BY VOLUME	N/A	N/A

EXTINGUISHING MEDIA: Use water spray to cool fire exposed surfaces and to protect personnel. Use foam, dry chemical or water spray (fog) to extinguish fire.

SPECIAL FIRE FIGHTING PROCEDURES: When fighting fires wear full turnout gear and self-contained breathing apparatus. Water may cause splattering. Material floats on water.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Toxic fumes gases or vapors may evolve on burning.

HAZARD RATINGS

NFPA 704:	Health: 1	Fire: 1	Reactivity: 0
HMIS:	Health: 1	Fire: 1	Reactivity: 0

Section 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

General Measures: No health affects expected from the clean up of this material if contact can be avoided. Follow personal protective equipment recommendations found in Section 8 of this SDS.

Environmental precautions: Remove from water surface by skimming or with suitable absorbents. Do not use dispersants. Avoid runoff into storm sewers and ditches that lead to waterways. Do not flush to sewer. Avoid runoff into storm sewers and ditches that lead to waterways.

Methods and material for containment and cleaning up

Methods for cleaning up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Dispose of according to Federal, State, Local, or Provincial regulations. Used fluid should be disposed of at a recycling center. {EMSFORM_06GHS_CLEAN}

Reference to other sections: Follow all protective equipment recommendations provided in Section 8.

Section 7: HANDLING AND STORAGE

HANDLING AND STORING: Store in closed container away from all ignition sources. Handling temperatures should not exceed 175°F (80°C). Wash thoroughly after handling. Do not store at temperatures exceeding 113°F (45° C). Odorous and toxic fumes may form from the decomposition of this product if stored at excessive temperatures for extended periods of time. Open containers carefully and only in well ventilated areas or use appropriate respiratory protection. Store in well ventilated area.

Section 8: EXPOSURE CONTROL - PERSONAL PROTECTION

Control parameters

Chemical Name	Occupational Exposure Limits	Value
Oil mist, mineral	OSHA PEL	5 mg/m3
Oil mist, mineral	OSHA PEL	5 mg/m3
Lubricating oils (petroleum), C20-50, hydrotreated neutral oil-based	OSHA PEL	5 mg/m3
Distillates (petroleum), solvent-dewaxed light paraffinic	OSHA PEL	5 mg/m3
Oil mist, mineral	OSHA PEL	5 mg/m3
Oil mist, mineral	OSHA PEL	5 mg/m3
None.	OSHA STEL	
Oil mist, mineral	ACGIH TLV-TWA	5 mg/m3
Oil mist, mineral	ACGIH TLV-TWA	5 mg/m3
Lubricating oils (petroleum), C20-50, hydrotreated neutral oil-based	ACGIH TLV-TWA	5 mg/m3
Distillates (petroleum), solvent-dewaxed light paraffinic	ACGIH TLV-TWA	5 mg/m3
Oil mist, mineral	ACGIH TLV-TWA	5 mg/m3
Oil mist, mineral	ACGIH TLV-TWA	5 mg/m3
Oil mist, mineral	ACGIH STEL	10 mg/m3
Oil mist, mineral	ACGIH STEL	10 mg/m3
Lubricating oils (petroleum), C20-50, hydrotreated neutral oil-based	ACGIH STEL	10 mg/m3
Distillates (petroleum), solvent-dewaxed light paraffinic	ACGIH STEL	10 mg/m3
Oil mist, mineral	ACGIH STEL	10 mg/m3
Oil mist, mineral	ACGIH STEL	10 mg/m3
None.	IDLH	
None.	OSHA PEL-Skin Notation	

Exposure controls

Engineering Measures: Local exhaust ventilation or other engineering controls are normally required when handling or using this product to avoid overexposure.

Respiratory Protection Respiratory protection will be required when handling this product. Use respirators only if ventilation cannot be used to eliminate symptoms or reduce the exposure to below acceptable levels.

Respirator Type(s): None required where adequate ventilation is provided. If airborne concentrations are above the applicable exposure limits, use NIOSH/MSHA approved respiratory protection.

Eye Protection: No special requirements under normal industrial use.

Skin Protection: Where use can result in skin contact, practice good personal hygiene and wear impervious gloves. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work.

Gloves: Neoprene, Nitrile

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Amber liquid	**ODOR:**	Mild odor
BOILING POINT:	N/D	**SPECIFIC GRAVITY (water=1):**	0.8400 - 0.8700
VAPOR PRESSURE:	<0.20	**VAPOR DENSITY (air=1):**	N/D
SOLUBLE IN WATER:	Insoluble	**pH:**	N/D
EVAPORATION RATE (ether=1):	**<1**		

Section 10: STABILITY AND REACTIVITY

STABILITY: Stable under moderately elevated temperatures and pressures. See handling and storage section

INCOMPATIBILITY:

CONDITIONS TO AVOID: See handling and storage section.

MATERIALS TO AVOID: Acids, oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Smoke, carbon monoxide, aldehydes, hydrogen sulfide and alkyl mercaptans may be released. Under combustion conditions, oxides of the following elements will be formed: Magnesium, calcium, nitrogen, sulfur, and carbon.

HAZARDOUS POLYMERIZATION: Will not occur.

Section 11: TOXICOLOGY INFORMATION

Information on toxicological effects

Ingestion Toxicity: Although this product has a low order of acute oral toxicity, aspiration of minute amounts into the lungs during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death. Likely to be practically non-toxic by ingestion based on animal data.

Skin Contact: This material is likely to be slightly irritating to skin based on animal data. Can cause minor skin irritation, defatting, and dermatitis.

Absorption: Likely to be practically non-toxic based on animal data.

Inhalation Toxicity: No hazard in normal industrial use. Likely to be practically non-toxic based on animal data.

Eye Contact: This material is estimated to be non-irritating eyes (Draize score <15 [rabbits]). No hazard in normal industrial use.

Sensitization: Non-hazardous under Respiratory Sensitization category.

Mutagenicity: No data available to indicate product or any components present at greater than 0.1% is mutagenic or genotoxic.

Carcinogenicity: Not expected to cause cancer. This product meets the IP-346 criteria of <3% PAH's and is not considered a carcinogen by the International Agency for Research on Cancer.

Reproductive and Developmental Toxicity: No data available to indicate product or any components present at greater than 0.1% may cause birth defects.

Specific target organ Toxicity-Single exposure: Non-hazardous under Specific Target Organ Systemic Toxicity Single Exposure category.

Specific target organ Toxicity-Repeated exposure: Non-hazardous under Specific Target Organ Systemic Toxicity Repeated Exposure category.

Long-Term (Chronic) Health Effects: No data available.

Aspiration toxicity: Non-hazardous under Aspiration category.

Other information: No data available.

Agents Classified by IARC Monographs

IARC Group 1: Benzene

IARC Group 2A: Not applicable

IARC Group 2B: Vinyl acetate

National Toxicity Program (NTP) Status

Known Human Carcinogen: Benzene

Reasonably Anticipated to Be a Human Carcinogen: Not applicable

Section 12: ECOLOGICAL INFORMATION

Toxicity

Acute Aquatic Ecotoxicity: Non-hazardous under Aquatic Acute Environment category.

Chronic Aquatic Ecotoxicity: Non-hazardous under Aquatic Chronic Environment category.

Persistence and degradability: Biodegrades slowly.

Bioaccumulative potential: Bioconcentration may occur.

Mobility in soil: This material is expected to have essentially no mobility in soil. It absorbs strongly to most soil types.

Results of PBT and vPvB assessment: No data available.

Other adverse effects: Not determined

Section 13: DISPOSAL CONSIDERATION

Waste Treatment Methods

Disposal Methods: Dispose of according to Federal, State, Local, or Provincial regulations. Recycle used oil.

Waste Disposal Code(s)

Waste Description for Spent Product: Spent or discarded material is non-hazardous according to environmental regulations.

Contaminated packaging: Recycle containers whenever possible.

Section 14: TRANSPORTATION

Basic Description: Not classified as hazardous for transport (DOT, TDG, IMO/IMDG, IATA/ICAO).

DOT

Proper Shipping Name: No data available.
UN Number: No data available.
Hazard Class: No data available.
Packing Group: No data available.

TDG

Proper Shipping Name: No data available.
UN Number: No data available.
Hazard Class: No data available.
Packing Group: No data available.

IMDG

Proper Shipping Name: No data available.
UN Number: No data available.
Hazard Class: No data available.
Packing Group: No data available.
Marine Pollutant: No data available.

IATA

Proper Shipping Name: No data available.
UN Number: No data available.
Hazard Class: No data available.
Packing Group: No data available.

Section 15: REGULATORY INFORMATION

Chemical Inventories

U.S. State Restrictions: Not applicable
Canadian WHMIS: Uncontrolled product according to WHMIS classification criteria.
Canadian Regulations: Uncontrolled product according to hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all information required by the CPR.

Chemical Name	Regulation	CAS #	%
None.	CERCLA		
None.	SARA 313		
None.	SARA EHS		
None.	SCA 12b		

U.S. State Regulations

Chemical Name	Regulation	CAS #	%
None.	California Prop 65- Cancer		
None.	California Prop 65- Dev. Toxicity		
None.	California Prop 65- Reprod -fem		
None.	California Prop 65- Reprod-male		
Mineral oil, petroleum distillates, solvent-dewaxed light paraffinic	Massachusetts RTK List	64742-56-9	1 - 5
Mineral oil, petroleum distillates, solvent-refined light paraffinic	Massachusetts RTK List	64741-89-5	1 - 5
None.	New Jersey RTK List		
None.	Pennsylvania RTK List		
None.	Rhode Island RTK List		
None.	Minnesota Hazardous Substance List		

HMIS Ratings:		**NFPA Ratings:**	
Health:	1	Health:	1
Fire:	1	Fire:	1
Reactivity:	0	Reactivity:	0
PPE:	B		

KEY: 0 - Least 1 - Slight 2 - Moderate 3 - High 4 – Extreme

Section 16: OTHER INFORMATION

Date: January 24, 2018
Supersedes: January 1, 2015
Revision Information: Update to SDS format

References

ACGIH:	American Conference of Governmental Industrial Hygienists	**NTP:**	National Toxicology Program
AIHA:	American Industrial Hygiene Association	**OSHA:**	Occupational Safety and Health administration
CFR:	Code of Federal Regulations	**PEL:**	Permissible Exposure Limit
DOT:	United States Department of Transportation	**RTK:**	Right-to-Know
GHS:	Globally Harmonized System of Classification and Labeling of Chemicals	**SARA:**	Superfund Amendments and Reauthorization Act
HMIS:	Hazardous Materials Identification System	**STEL:**	Short-term Exposure Limit
IARC:	International Agency for Research on Cancer	**TDG:**	Transportation of Dangerous Goods
IATA:	International Air Transportation Association	**TLV:**	Threshold limit value
IDLH:	Immediately Dangerous to Life or Health	**TSCA:**	Toxic Substances Control Act
IMDG:	International Maritime Dangerous Goods	**TWA:**	Time weighted average
NFPA:	National Fire Protection Association	**UN:**	United Nations
NIOSH:	National Institute for Occupational Safety and Health	**WHMIS:**	Workplace Hazardous Materials Information System

Full Synthetic Diesel Engine Oil

Disclaimer: This safety data sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in the data sheet which we have received from outside sources and we believe the information to be correct, but cannot guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product in a safe manner and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either expressed or implied.

Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Delo ELC Antifreeze/Coolant - Premixed 50/50

Product Use: Heavy Duty Coolant
Product Number(s): 227811
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Rd.
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency & Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@chevron.com
Product Information: 1 (800) 582-3835, LUBETEK@chevron.com

SECTION 2 HAZARDS IDENTIFICATION

CLASSIFICATION:

- Reproductive toxicant (developmental): Category 2.
- Target organ toxicant (repeated exposure): Category 2.

Signal Word: Warning
Health Hazards:
- Suspected of damaging the unborn child.
- May cause damage to organs (Kidney) through prolonged or repeated exposure.

PRECAUTIONARY STATEMENTS:
Prevention:
- Obtain special instructions before use.

- Do not handle until all safety precautions have been read and understood.
- Do not breathe dust/fume/gas/mist/vapours/spray.
- Use personal protective equipment as required.

Response:
- IF exposed or concerned: Get medical advice/attention.
- Get medical advice/attention if you feel unwell.

Storage:
- Store locked up.

Disposal:
- Dispose of contents/container in accordance with applicable local/regional/national/international regulations.

HAZARDS NOT OTHERWISE CLASSIFIED: Not Applicable

SECTION 3 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Ethylene glycol	107-21-1	45 - 50 %weight
Sodium 2-ethylhexanoate	19766-89-3	1 - 5 %weight
Tolyltriazole	29385-43-1	0.1 - < 1 %weight

SECTION 4 FIRST AID MEASURES

Description of first aid measures

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.

Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.

Ingestion: If swallowed, get immediate medical attention. Do not induce vomiting. Never give anything by mouth to an unconscious person.

Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

Most important symptoms and effects, both acute and delayed

IMMEDIATE HEALTH EFFECTS

Eye: Not expected to cause prolonged or significant eye irritation.

Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.

Ingestion: May be harmful if swallowed.

Inhalation: Not expected to be harmful if inhaled. Breathing this material at concentrations above the recommended exposure limits may cause central nervous system effects. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death.

DELAYED OR OTHER HEALTH EFFECTS:

Reproduction and Birth Defects: Contains material that may cause harm to the unborn child if swallowed based on animal data.

Target Organs: Contains material that may cause damage to the following organ(s) following repeated inhalation at concentrations above the recommended exposure limit: Kidney See Section 11 for

additional information. Risk depends on duration and level of exposure.

Indication of any immediate medical attention and special treatment needed Not Applicable

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Dry Chemical, CO2, Aqueous Film Forming Foam (AFFF) or alcohol resistant foam.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. See Section 7 for proper handling and storage. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion. Combustion may form oxides of: Sodium.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

General Handling Information: Do not taste or swallow antifreeze or solution. Keep out of the reach of children and animals.
Precautionary Measures: Do not get in eyes, on skin, or on clothing. Do not taste or swallow. Do not breathe vapor or fumes. Wash thoroughly after handling. Keep out of the reach of children.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

General Storage Information: Do not store in open or unlabeled containers.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 2), applicable exposure limits, job activities, and other substances in the workplace when designing engineering controls and selecting personal protective equipment (PPE). If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, refer to PPE information below.

Factors that affect PPE include, but are not limited to: properties of the chemical, other chemicals which may contact the same PPE, physical requirements (fit & sizing, cut/puncture protection, dexterity, thermal protection, etc.), and potential allergic reactions to the PPE material. It is the responsibility of the user to read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances. Refer to appropriate CEN standards.

ENGINEERING CONTROLS:
Use general ventilation, local exhaust ventilation, or a combination of both.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: Wear protective equipment to prevent eye contact. Selection of protective equipment may include safety glasses, chemical goggles, face shields, or a combination depending on the work operations conducted.
Skin Protection: Wear chemical personal protective equipment (PPE) to prevent skin contact. Selection of chemical protective clothing should be performed by an Occupational Hygienist or Safety Professional and be based upon applicable standards (ASTM F739 or EN 374). Using chemical PPE depends upon operations conducted and may include chemical gloves, boots, chemical apron, chemical suit, and complete facial protection. Refer to PPE manufacturers to obtain breakthrough time information to determine how long PPE can be used before it needs to be replaced. Unless specific glove manufacturer data indicates otherwise, the below table is based upon available industry data to assist in the glove selection process and is intended to be used as reference only.

Chemical Glove Material	Thickness (mm)	Typical Breakthrough Time (minutes)
Butyl	0.7	120
Neoprene	0.61	120
Nitrile	0.8	120
Polyvinyl Chloride (PVC)	1.1	120
Viton Butyl	0.3	120

Respiratory Protection: Determine if airborne concentrations are below the recommended occupational exposure limits for jurisdiction of use. If airborne concentrations are above the acceptable limits, wear an approved respirator that provides adequate protection from this material, such as: Air-Purifying Respirator for Organic Vapors, Dusts and Mists.

Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Agency	Form	TWA	STEL	Ceiling	Notation
Ethylene glycol	ACGIH	Inhalable aerosol	--	10 mg/m3	--	--
Ethylene glycol	ACGIH	Vapor fraction	25 ppm	50 ppm	--	--
Ethylene glycol	ACGIH	--	0.01 ppm	--	--	Skin

Consult local authorities for appropriate values.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Red
Physical State: Liquid
Odor: Faint or Mild
Odor Threshold: No data available
pH: 8 - 8.6; 67%volume @ 20°C (solution in water)
Vapor Pressure: No data available
Vapor Density (Air = 1): 2.10
Initial Boiling Point: 109°C (228.2°F)
Solubility: Soluble in water.
Freezing Point: -37°C (-34.6°F) (Max)
Melting Point: Not Applicable
Specific Gravity: 1.06 - 1.09
Density: 1.071 kg/l @ 15°C (59°F) (Min)
Viscosity: No data available
Coefficient of Therm. Expansion / °F: No data available
Evaporation Rate: No data available
Decomposition temperature: No data available
Octanol/Water Partition Coefficient: No data available

FLAMMABLE PROPERTIES:
Flammability (solid, gas): Not Applicable

Flashpoint: Not Applicable
Autoignition: No data available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

SECTION 10 STABILITY AND REACTIVITY

Reactivity: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: Not applicable
Hazardous Decomposition Products: Ketones (Elevated temperatures), Aldehydes (Elevated temperatures)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects
Serious Eye Damage/Irritation: The material is not considered an eye irritant. The product has not been tested. The statement is based on evaluation of data for product components.

Skin Corrosion/Irritation: The material is not considered a skin irritant. The product has not been tested. The statement is based on evaluation of data for product components.

Skin Sensitization: The material is not considered a skin sensitizer. The product has not been tested. The statement is based on evaluation of data for similar materials.

Acute Dermal Toxicity: The material is not considered a dermal toxicant. The product has not been tested. The statement is based on evaluation of data for product components.

Acute Oral Toxicity: The material is not considered an oral toxicant. The product has not been tested. The statement is based on evaluation of data for product components.

Acute Inhalation Toxicity: The material is not considered an inhalation toxicant. The product has not been tested. The statement is based on evaluation of data for product components.
Acute Toxicity Estimate: Not Determined

Germ Cell Mutagenicity: The material is not considered a mutagen. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Carcinogenicity: The material is not considered a carcinogen. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Reproductive Toxicity: This material is suspected of damaging the unborn child. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Specific Target Organ Toxicity - Single Exposure: The material is not considered a target organ toxicant (single exposure). The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Specific Target Organ Toxicity - Repeated Exposure: This material may cause damage to organs through prolonged or repeated exposure. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Aspiration Hazard: The material is not considered an aspiration hazard.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains ethylene glycol (EG). The toxicity of EG via inhalation or skin contact is expected to be slight at room temperature. The estimated oral lethal dose is about 100 cc (3.3 oz.) for an adult human. Ethylene glycol is oxidized to oxalic acid which results in the deposition of calcium oxalate crystals mainly in the brain and kidneys. Early signs and symptoms of EG poisoning may resemble those of alcohol intoxication. Later, the victim may experience nausea, vomiting, weakness, abdominal and muscle pain, difficulty in breathing and decreased urine output. When EG was heated above the boiling point of water, vapors formed which reportedly caused unconsciousness, increased lymphocyte count, and a rapid, jerky movement of the eyes in persons chronically exposed. When EG was administered orally to pregnant rats and mice, there was an increase in fetal deaths and birth defects. Some of these effects occurred at doses that had no toxic effects on the mothers. We are not aware of any reports that EG causes reproductive toxicity in human beings.

2-Ethylhexanoic acid (2-EXA) caused an increase in liver size and enzyme levels when repeatedly administered to rats via the diet. When administered to pregnant rats by gavage or in drinking water, 2-EXA caused teratogenicity (birth defects) and delayed postnatal development of the pups. Additionally, 2-EXA impaired female fertility in rats. Birth defects were seen in the offspring of mice who were administered sodium 2-ethylhexanoate via intraperitoneal injection during pregnancy.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
This material is not expected to be harmful to aquatic organisms.
The product has not been tested. The statement has been derived from products of a similar structure and composition.

MOBILITY
No data available.

PERSISTENCE AND DEGRADABILITY
This material is expected to be readily biodegradable. The biodegradability of this material is based on an evaluation of data for the components or a similar material.
The product has not been tested. The statement has been derived from the properties of the individual components.

POTENTIAL TO BIOACCUMULATE
Bioconcentration Factor: No data available.
Octanol/Water Partition Coefficient: No data available

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by international, country, or local laws and regulations.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: PROPRIETARY ANTIFREEZE PREPARATION IN NON-BULK PACKAGING; NOT REGULATED FOR TRANSPORT UNDER 49 CFR
Additional Information: Bulk shipments containing a reportable quantity (RQ, 5000 pounds or more) of ethylene glycol in a single packaging are transported as hazardous material. The shipping description is: UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (ETHYLENE GLYCOL CONTAINS BITTERANT), 9, III, RQ (ETHYLENE GLYCOL)

IMO/IMDG Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORTATION UNDER THE IMDG CODE

ICAO/IATA Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORTATION UNDER ICAO TI OR IATA DGR

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code:
Not applicable

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES:
Reproductive toxicity
Specific target organ toxicity (single or repeated exposure)

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	05=MA RTK
01-2A=IARC Group 2A	06=NJ RTK
01-2B=IARC Group 2B	07=PA RTK
02=NTP Carcinogen	08-1=TSCA 5(e)
03=EPCRA 313	08-2=TSCA 12(b)
04=CA Proposition 65	

The following components of this material are found on the regulatory lists indicated.
Ethylene glycol 03, 04, 05, 07

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AIIC (Australia), DSL (Canada), EINECS (European Union), ENCS (Japan), IECSC (China), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (United States).

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: Refer to components listed in Section 3.

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 1 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 1* Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

REVISION STATEMENT: SECTION 02 - Hazard Statements information was modified.
SECTION 02 - Health Classification information was modified.
SECTION 02 - Precautionary Statements information was modified.
SECTION 03 - Composition information was modified.
SECTION 04 - Delayed Health Effects - Target Organ(s) information was modified.
SECTION 08 - Engineering Control Measures information was modified.
SECTION 08 - Eye/Face Protection information was modified.
SECTION 08 - General Considerations information was modified.
SECTION 08 - Occupational Exposure Limit Table information was modified.
SECTION 08 - Personal Protective Equipment List information was deleted.
SECTION 08 - Personal Protective Equipment information was added.
SECTION 08 - Skin Protection information was modified.
SECTION 11 - Carcinogenicity information was added.
SECTION 11 - Germ Cell Mutagenicity information was added.
SECTION 11 - Reproductive Toxicity information was added.
SECTION 11 - Specific Target Organ Toxicity - Repeated Exposure information was added.
SECTION 11 - Specific Target Organ Toxicity - Single Exposure information was added.
SECTION 11 - Toxicological Information information was added.
SECTION 11 - Toxicological Information information was modified.
SECTION 15 - Regulatory Information information was modified.

Revision Date: February 23, 2023

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
GHS - Globally Harmonized System	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Governmental Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	SDS - Safety Data Sheet
HMIS - Hazardous Materials Information System	NFPA - National Fire Protection Association (USA)

DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration
NCEL - New Chemical Exposure Limit	EPA - Environmental Protection Agency
SCBA - Self-Contained Breathing Apparatus	

Prepared according to the 29 CFR 1910.1200 (2012) by Chevron Technical Center, 6001 Bollinger Canyon Road, San Ramon, CA 94583.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Clarity Hydraulic Oil AW 32, 46, 68, 100

Product Use: Hydraulic Oil
Product Number(s): 219612, 230340, 230341, 230342, 255702, 278022, 278023, 278024
Synonyms: Clarity Hydraulic Oil AW 32 ISOCLEAN Certified; Clarity Hydraulic Oil AW 46 ISOCLEAN Certified; Clarity Hydraulic Oil AW 68 ISOCLEAN Certified
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Rd.
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency & Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@chevron.com
Product Information: 1 (800) 582-3835, LUBETEK@chevron.com

SECTION 2 HAZARDS IDENTIFICATION

CLASSIFICATION:

- Reproductive toxicant (fertility): Category 2.

Signal Word: Warning
Health Hazards:
- Suspected of damaging fertility.

PRECAUTIONARY STATEMENTS:
Prevention:
- Obtain special instructions before use.

- Do not handle until all safety precautions have been read and understood.
- Use personal protective equipment as required.

Response:
- IF exposed or concerned: Get medical advice/attention.

Storage:
- Store locked up.

Disposal:
- Dispose of contents/container in accordance with applicable local/regional/national/international regulations.

HAZARDS NOT OTHERWISE CLASSIFIED: Not Applicable

SECTION 3 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Highly refined mineral oil (C15 - C50)	Mixture	70 - 99 %weight
N-Phenylbenzenamine, reaction products with 2,4,4-trimethylpentene	68411-46-1	0.1 - < 1 %weight

SECTION 4 FIRST AID MEASURES

Description of first aid measures

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.

Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.

Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.

Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

Most important symptoms and effects, both acute and delayed

IMMEDIATE HEALTH EFFECTS

Eye: Not expected to cause prolonged or significant eye irritation.

Skin: High-Pressure Equipment Information: Accidental high-velocity injection under the skin of materials of this type may result in serious injury. Seek medical attention at once should an accident like this occur. The initial wound at the injection site may not appear to be serious at first; but, if left untreated, could result in disfigurement or amputation of the affected part.

Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.

Ingestion: Not expected to be harmful if swallowed.

Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

DELAYED OR OTHER HEALTH EFFECTS:

Reproduction and Birth Defects: Swallowing this material may cause adverse reproductive effects based on animal data. See Section 11 for additional information. Risk depends on duration and level of exposure.

Indication of any immediate medical attention and special treatment needed
Note to Physicians: In an accident involving high-pressure equipment, this product may be injected under the skin. Such an accident may result in a small, sometimes bloodless, puncture wound. However, because of its driving force, material injected into a fingertip can be deposited into the palm of the hand. Within 24 hours, there is usually a great deal of swelling, discoloration, and intense throbbing pain. Immediate treatment at a surgical emergency center is recommended.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.
Unusual Fire Hazards: Leaks/ruptures in high pressure system using materials of this type can create a fire hazard when in the vicinity of ignition sources (eg. open flame, pilot lights, sparks, or electric arcs).

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. See Section 7 for proper handling and storage. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Precautionary Measures: DO NOT USE IN HIGH PRESSURE SYSTEMS in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed. Do not get in eyes, on skin, or on clothing. Do not taste or swallow. Wash thoroughly after handling.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 2), applicable exposure limits, job activities, and other substances in the workplace when designing engineering controls and selecting personal protective equipment (PPE). If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, refer to PPE information below.

Factors that affect PPE include, but are not limited to: properties of the chemical, other chemicals which may contact the same PPE, physical requirements (fit & sizing, cut/puncture protection, dexterity, thermal protection, etc.), and potential allergic reactions to the PPE material. It is the responsibility of the user to read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances. Refer to appropriate CEN standards.

ENGINEERING CONTROLS:
Use general ventilation, local exhaust ventilation, or a combination of both.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: Wear protective equipment to prevent eye contact. Selection of protective equipment may include safety glasses, chemical goggles, face shields, or a combination depending on the work operations conducted.
Skin Protection: Wear chemical personal protective equipment (PPE) to prevent skin contact. Selection of chemical protective clothing should be performed by an Occupational Hygienist or Safety Professional and be based upon applicable standards (ASTM F739 or EN 374). Using chemical PPE depends upon operations conducted and may include chemical gloves, boots, chemical apron, chemical suit, and complete facial protection. Refer to PPE manufacturers to obtain breakthrough time information to determine how long PPE can be used before it needs to be replaced. Unless specific glove manufacturer data indicates otherwise, the below table is based upon available industry data to assist in the glove selection process and is intended to be used as reference only.

Chemical Glove Material	Thickness (mm)	Typical Breakthrough Time (minutes)
Butyl	0.7	120
Neoprene	0.61	120
Nitrile	0.8	120
Polyvinyl Chloride (PVC)	1.1	120
Viton Butyl	0.3	120

Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge.
Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Agency	Form	TWA	STEL	Ceiling	Notation
Highly refined mineral oil (C15 - C50)	ACGIH	--	5 mg/m3	10 mg/m3	--	--
Highly refined mineral oil (C15 - C50)	OSHA Z-1	--	5 mg/m3	--	--	--

Consult local authorities for appropriate values.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Colorless to yellow
Physical State: Liquid
Odor: Petroleum odor
Odor Threshold: No data available
pH: Not Applicable
Vapor Pressure: No data available
Vapor Density (Air = 1): No data available
Initial Boiling Point: No data available
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: No data available
Density: 0.8618 kg/l - 0.8694 kg/l @ 15°C (59°F) (Typical)
Viscosity: 32 mm2/s - 110 mm2/s @ 40°C (104°F)
Evaporation Rate: No data available
Decomposition temperature: No data available
Octanol/Water Partition Coefficient: No data available

FLAMMABLE PROPERTIES:
Flammability (solid, gas): Not Applicable

Flashpoint: (Cleveland Open Cup) 190 °C (374 °F) (Minimum)
Autoignition: No data available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

SECTION 10 STABILITY AND REACTIVITY

Reactivity: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: Not applicable
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects
Serious Eye Damage/Irritation: The material is not considered an eye irritant. The product has not been tested. The statement is based on evaluation of data for product components.

Skin Corrosion/Irritation: The material is not considered a skin irritant. The product has not been tested. The statement is based on evaluation of data for product components.

Skin Sensitization: The material is not considered a skin sensitizer. The product has not been tested. The statement is based on evaluation of data for product components.

Acute Dermal Toxicity: The material is not considered a dermal toxicant. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Acute Oral Toxicity: The material is not considered an oral toxicant. The product has not been tested. The statement is based on evaluation of data for product components.

Acute Inhalation Toxicity: The material is not considered an inhalation toxicant. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.
Acute Toxicity Estimate: Not Determined

Germ Cell Mutagenicity: The material is not considered a mutagen. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Carcinogenicity: The material is not considered a carcinogen. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Reproductive Toxicity: This material is suspected of damaging fertility. The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Specific Target Organ Toxicity - Single Exposure: The material is not considered a target organ toxicant (single exposure). The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Specific Target Organ Toxicity - Repeated Exposure: The material is not considered a target organ toxicant (repeated exposure). The product has not been tested. The statement is based on evaluation of data for similar materials or product components.

Aspiration Hazard: The material is not considered an aspiration hazard.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B).
These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3).

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
This material is not expected to be harmful to aquatic organisms.
The product has not been tested. The statement has been derived from the properties of the individual components.

MOBILITY
No data available.

PERSISTENCE AND DEGRADABILITY
This material is not expected to be readily biodegradable. The product has not been tested. The statement has been derived from the properties of the individual components.

POTENTIAL TO BIOACCUMULATE
Bioconcentration Factor: No data available.
Octanol/Water Partition Coefficient: No data available

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: NOT REGULATED AS HAZARDOUS MATERIAL UNDER 49 CFR

IMO/IMDG Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code:
Not applicable

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES:
Reproductive toxicity

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	05=MA RTK
01-2A=IARC Group 2A	06=NJ RTK
01-2B=IARC Group 2B	07=PA RTK
02=NTP Carcinogen	08-1=TSCA 5(e)
03=EPCRA 313	08-2=TSCA 12(b)
04=CA Proposition 65	

No components of this material were found on the regulatory lists above.

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AIIC (Australia), DSL (Canada), ENCS (Japan), IECSC (China), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (United States).

One or more components is listed on ELINCS (European Union). All other components are listed or exempted from listing on EINECS.

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: PETROLEUM OIL (Hydraulic oil)

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 0* Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

REVISION STATEMENT: SECTION 02 - Hazard Statements information was added.
SECTION 02 - Health Classification information was added.
SECTION 02 - Pictogram information was added.
SECTION 02 - Precautionary Statements information was added.
SECTION 02 - Signal Word information was added.
SECTION 03 - Composition information was modified.
SECTION 04 - Delayed Health Effects - Reproductive Toxicity information was modified.
SECTION 07 - Precautionary Measures information was modified.
SECTION 08 - Engineering Control Measures information was modified.
SECTION 08 - Personal Protective Equipment information was modified.
SECTION 11 - Reproductive Toxicity information was modified.
SECTION 12 - Ecological Information information was added.
SECTION 12 - Ecological Information information was deleted.
SECTION 15 - Chemical Inventories information was modified.
SECTION 15 - SARA 311 EPCRA Score information was added.
SECTION 15 - SARA 311 EPCRA Score information was deleted.
SECTION 16 - HMIS Rating information was modified.

Revision Date: November 04, 2022

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
GHS - Globally Harmonized System	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Governmental Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	SDS - Safety Data Sheet
HMIS - Hazardous Materials Information System	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration
NCEL - New Chemical Exposure Limit	EPA - Environmental Protection Agency
SCBA - Self-Contained Breathing Apparatus	

Prepared according to the 29 CFR 1910.1200 (2012) by Chevron Technical Center, 6001 Bollinger Canyon Road, San Ramon, CA 94583.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **XANTHAN GUM (P)**

Synonyms NEWZAN D ● VISCO XC 84 ● XANTHAN GUM (BIOPOLYMER)

1.2 Uses and uses advised against

Uses DRILLING FLUID ADDITIVE ● VISCOSITY MODIFIER

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

2.2 GHS Label elements

No signal word, pictograms, hazard or precautionary statements have been allocated.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
XANTHAN GUM	11138-66-2	234-394-2	>87%
WATER	7732-18-5	231-791-2	<13%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting. Ingestion is considered unlikely due to product form.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Adverse effects not expected from this product under normal conditions of use.

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Dry agent, carbon dioxide, foam or water fog. Prevent contamination of drains or waterways.

5.2 Special hazards arising from the substance or mixture

Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition. Finely divided dust may form explosive mixtures with air.

5.3 Advice for firefighters

Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS. Clear area of all unprotected personnel. Contact emergency services where appropriate.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Contain spillage, then collect and place in suitable containers for reuse or disposal. Avoid generating dust.

6.4 Reference to other sections

See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure containers are adequately labelled and tightly closed when not in use.

7.3 Specific end uses

No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Exposure standards

No exposure standards have been entered for this product.

Biological limits

No biological limit values have been entered for this product.

8.2 Exposure controls

Engineering controls Avoid inhalation. Use in well ventilated areas.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Wear a Class P1 (Particulate) respirator. Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	LIGHT BEIGE POWDER
Odour	SLIGHT ODOUR
Flammability	COMBUSTIBLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	NOT AVAILABLE
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Relative density	1.5
Solubility (water)	MISCIBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT
Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT AVAILABLE
Oxidising properties	NOT AVAILABLE
Odour threshold	NOT AVAILABLE

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials
Incompatible with oxidising agents (e.g. hypochlorites) and acids (e.g. nitric acid).

10.6 Hazardous decomposition products
May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity	This product is expected to be of low acute toxicity. Under normal conditions of use, adverse health effects are not anticipated. LD50 (oral) > 1000 mg/kg (mouse) LD50 (oral) > 45,000 mg/kg (rat) LD50 (oral) > 20,000 mg/kg (dog) LD50 (intraperitoneal): > 50 mg/kg (mouse) LD50 (intravenous): 100-250 mg/kg (mouse)
Skin	Not classified as a skin irritant. Contact may result in mild irritation.
Eye	Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.
Sensitisation	Not classified as causing skin or respiratory sensitisation.
Mutagenicity	No evidence of mutagenic effects.
Carcinogenicity	No evidence of carcinogenic effects.
Reproductive	No relevant or reliable studies were identified.
STOT - single exposure	Not classified as causing organ damage from single exposure.
STOT - repeated exposure	Not classified as causing organ damage from repeated exposure.
Aspiration	This product does not present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
This product is not anticipated to cause adverse effects to animal or plant life if released to the environment in small quantities.

12.2 Persistence and degradability
No information provided.

12.3 Bioaccumulative potential
Not expected to bioaccumulate.

12.4 Mobility in soil
No information provided.

12.5 Other adverse effects
No information provided.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal	Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer/supplier for additional information (if required).
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared by

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[End of SDS]

NEWPARK DRILLING FLUIDS

SAFETY DATA SHEET

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

1.1 Product identifier

Product name **BENTONITE POWDER**

Synonyms AVAGEL ● BENTONIL HR ● HISWELL ● MAXIGEL ● NATURALGEL ● NEWGEL ● RHEOBEN ● RHEOBEN NT ● SODIUM BENTONITE ● SODIUM MONTMORILLONITE

1.2 Uses and uses advised against

Uses DRILLING FLUID

1.3 Details of the supplier of the product

Supplier name **NEWPARK DRILLING FLUIDS (AUSTRALIA) LTD**

Address 11 Alacrity Place, Henderson, WA, 6166, AUSTRALIA

Telephone +61 8 9410 8200

Fax +61 8 9410 8299

Website http://www.newpark.com

1.4 Emergency telephone numbers

Emergency 1800 127 406 (Australia); +64 4 917 9888 (International)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

Physical Hazards

Not classified as a Physical Hazard

Health Hazards

Specific Target Organ Toxicity (Repeated Exposure): Category 2

Environmental Hazards

Not classified as an Environmental Hazard

2.2 GHS Label elements

Signal word **WARNING**

Pictograms

Hazard statements

H373 May cause damage to organs through prolonged or repeated exposure.

Prevention statements

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

Response statements

P314 Get medical advice/attention if you feel unwell.

Storage statements

None allocated.

Disposal statements

P501 Dispose of contents/container in accordance with relevant regulations.

2.3 Other hazards

No information provided.

3. COMPOSITION/ INFORMATION ON INGREDIENTS

3.1 Substances / Mixtures

Ingredient	CAS Number	EC Number	Content
BENTONITE	1302-78-9	215-108-5	90 to 98%
QUARTZ (CRYSTALLINE SILICA)	14808-60-7	238-878-4	2 to 10%
SODA ASH	-	-	2 to 4%

4. FIRST AID MEASURES

4.1 Description of first aid measures

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). Due to product form and application, ingestion is considered unlikely.

First aid facilities Eye wash facilities and safety shower should be available.

4.2 Most important symptoms and effects, both acute and delayed

Repeated exposure to crystalline silica may result in lung fibrosis (silicosis). Principal symptoms of silicosis are coughing and breathlessness. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

4.3 Immediate medical attention and special treatment needed

Treat symptomatically.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Use an extinguishing agent suitable for the surrounding fire.

5.2 Special hazards arising from the substance or mixture

Non flammable. May evolve toxic gases if strongly heated.

5.3 Advice for firefighters

Treat as per requirements for surrounding fires. Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

5.4 Hazchem code

None allocated.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear Personal Protective Equipment (PPE) as detailed in section 8 of the SDS.

6.2 Environmental precautions

Prevent product from entering drains and waterways.

6.3 Methods of cleaning up

Moisten with water to prevent a dust hazard and place in sealable containers for disposal.

6.4 Reference to other sections
See Sections 8 and 13 for exposure controls and disposal.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

7.2 Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well ventilated area, removed from incompatible substances and foodstuffs. Ensure packaging are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

7.3 Specific end uses
No information provided.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters
Exposure standards

Ingredient	Reference	TWA		STEL	
		ppm	mg/m³	ppm	mg/m³
Quartz (respirable dust)	SWA [AUS]	--	0.05	--	--
Quartz (respirable dust) (Precautionary advice)	WorkSafe VIC	--	0.02	--	--

Biological limits No Biological Limit Value allocated.

8.2 Exposure controls
Engineering controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE

Eye / Face	Wear dust-proof goggles.
Hands	Wear PVC or rubber gloves.
Body	When using large quantities or where heavy contamination is likely, wear coveralls.
Respiratory	Where an inhalation risk exists, wear a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	BROWN POWDER
Odour	SLIGHT ODOUR
Flammability	NON FLAMMABLE
Flash point	NOT RELEVANT
Boiling point	NOT AVAILABLE
Melting point	1100°C to 1200°C (Fusion Point)
Evaporation rate	NOT AVAILABLE
pH	NOT AVAILABLE
Vapour density	NOT AVAILABLE
Relative density	2.7
Solubility (water)	INSOLUBLE
Vapour pressure	NOT AVAILABLE
Upper explosion limit	NOT RELEVANT
Lower explosion limit	NOT RELEVANT

9.1 Information on basic physical and chemical properties

Partition coefficient	NOT AVAILABLE
Autoignition temperature	NOT AVAILABLE
Decomposition temperature	NOT AVAILABLE
Viscosity	NOT AVAILABLE
Explosive properties	NOT EXPLOSIVE
Oxidising properties	NON OXIDISING
Odour threshold	NOT AVAILABLE

9.2 Other information

Bulk density	~ 0.9 kg/L

10. STABILITY AND REACTIVITY

10.1 Reactivity

Carefully review all information provided in sections 10.2 to 10.6.

10.2 Chemical stability

Stable under recommended conditions of storage.

10.3 Possibility of hazardous reactions

Polymerization is not expected to occur.

10.4 Conditions to avoid

Avoid heat, sparks, open flames and other ignition sources.

10.5 Incompatible materials

Incompatible with acids (e.g. nitric acid) and alkalis (e.g. sodium hydroxide).

10.6 Hazardous decomposition products

May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Toxicity Data available for the ingredients:
QUARTZ (SILICA CRYSTALLINE) (14808-60-7):
LCLo (inhalation) = 300 ug/m³/10 years (human)
TCLo (inhalation) = 16 000 000 particles/ft3/8 hours/17.9 years (human-fibrosis)
BENTONITE (1302-78-9):
LD50 (intravenous) = 35 mg/kg (rat)
LD50 (oral): > 2000mg/kg (rat)
LDLo (intravenous) = 10 mg/kg (dog)
Inhalation LC 50: > 5.27 mg/L, 4hr (rat)

Additional ingredient toxicity values:

BENTONITE (1302-78-9)

LD50 (intravenous)	35 mg/kg (rat)
LDLo (intravenous)	10 mg/kg (dog)

Skin

Not classified as a skin irritant. Contact may result in mild irritation and dermatitis.

Eye

Not classified as an eye irritant. Contact may cause discomfort, lacrimation and redness.

Sensitisation

Not classified as causing skin or respiratory sensitisation.

Mutagenicity

Insufficient data available to classify as a mutagen.

Carcinogenicity

This product contains crystalline silica which is classified as carcinogenic to humans (IARC Group 1). However, there is sufficient information to conclude that the relative risk of lung cancer is increased in persons with silicosis. Therefore, preventing the onset of silicosis will also reduce the cancer risk.

Reproductive

Insufficient data available to classify as a reproductive toxin.

STOT - single exposure

Not classified as causing organ damage from single exposure.

STOT - repeated exposure

Repeated exposure to respirable silica may result in pulmonary fibrosis (silicosis). Silicosis is a fibronodular lung disease caused by deposition in the lungs of fine respirable particles of crystalline silica. Principal symptoms of silicosis are coughing and breathlessness.

Aspiration

Not expected to present an aspiration hazard.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Bentonite (1302-78-9):
EC50 Daphnia > 100 mg/l, 48 hours
EC50 Freshwater algae > 100 mg/l, 72 hours
LC50 Freshwater fish = 16000 mg/l, 96 hours
LC50 Marine water fish = 2800 - 3200 mg/l, 24 hours
EC50 Coon stripe shrimp (Pandalus danae) = 24.8 mg/l, 96 hours
EC50 Dungeness or edible crab (Cancer magister) = 81.6 mg/l, 96 hours
LC50 Rainbow trout, donaldson trout (Oncorhynchus mykiss) = 19000 mg/l, 96 hours

12.2 Persistence and degradability

Not relevant for inorganic substances.

12.3 Bioaccumulative potential

Will not bioaccumulate.

12.4 Mobility in soil

Low water solubility, expected to sink and migrate into the sediment. Expected to partition to sediment and wastewater solids.

12.5 Other adverse effects

The main component/s of this product are not anticipated to cause any adverse effects to plants or animals.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Waste disposal Reuse where possible. No special precautions are normally required when handling this product.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

	LAND TRANSPORT (ADG)	SEA TRANSPORT (IMDG / IMO)	AIR TRANSPORT (IATA / ICAO)
14.1 UN Number	None allocated.	None allocated.	None allocated.
14.2 Proper Shipping Name	None allocated.	None allocated.	None allocated.
14.3 Transport hazard class	None allocated.	None allocated.	None allocated.
14.4 Packing Group	None allocated.	None allocated.	None allocated.

14.5 Environmental hazards

No information provided.

14.6 Special precautions for user

Hazchem code None allocated.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Poison schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

Classifications Safe Work Australia criteria is based on the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals (GHS Revision 7).

Inventory listings **AUSTRALIA: AIIC (Australian Inventory of Industrial Chemicals)**
All components are listed on AIIC, or are exempt.

16. OTHER INFORMATION

Additional information

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this report is provided as a guide only. Factors such as form of product, method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: form of product; frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS #	Chemical Abstract Service number - used to uniquely identify chemical compounds
CNS	Central Nervous System
EC No.	EC No - European Community Number
EMS	Emergency Schedules (Emergency Procedures for Ships Carrying Dangerous Goods)
GHS	Globally Harmonized System
GTEPG	Group Text Emergency Procedure Guide
IARC	International Agency for Research on Cancer
LC50	Lethal Concentration, 50% / Median Lethal Concentration
LD50	Lethal Dose, 50% / Median Lethal Dose
mg/m³	Milligrams per Cubic Metre
OEL	Occupational Exposure Limit
pH	relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm	Parts Per Million
STEL	Short-Term Exposure Limit
STOT-RE	Specific target organ toxicity (repeated exposure)
STOT-SE	Specific target organ toxicity (single exposure)
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
SWA	Safe Work Australia
TLV	Threshold Limit Value
TWA	Time Weighted Average

Report status

This document has been compiled by RMT on behalf of the manufacturer, importer or supplier of the product and serves as their Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer, importer or supplier or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer, importer or supplier.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared by

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[End of SDS]

1501253 B.C. LTD.

Waste Management Plan

Coppermine Project

Coppermine River area, Kugluktuk

20/03/2025

Contents

REVISION HISTORY

The table below is a revision history table that outlines the revisions made by 1501253 B.C. Ltd to this document.

Version	Date	Section	Summary of Changes
1.2	04/03/2025	Intro	Updated diamond drilling to 'drilling'.
1.3	20/03/2025	3.0	Updated waste management station section.

1.0 Introduction

The Coppermine Project is an early-stage mineral exploration program that will likely include a small drilling program for approximately 10-20 holes, geological mapping and prospecting, rock chip and soil sampling, small ground-based non-invasive geophysical surveys, and possibly airborne geophysical surveys. Staff will be based out of Kugluktuk and fly to site via helicopter or fixed wing. Activities will cease during the Bluenose East caribou herd calving and post calving form from 28th may to 3rd July.

Diesel fuel will be used for the drill rig, and aviation fuel (A1) will be used for the helicopter. Small fuel caches up to 3,800l of combined diesel and aviation fuel will be created at the drill site and possibly other locations in the project area to support geological mapping, rock chip sampling and prospecting. Fuel will be stored on a flat area in 205l barrels, and in sit in a secondary pop-up containment bund that is sealed to prevent any spillage or leakage from seeping into the underlying soil. Fuel caches will be stored at least 31 metres away from the ordinary high-water mark of any water body.

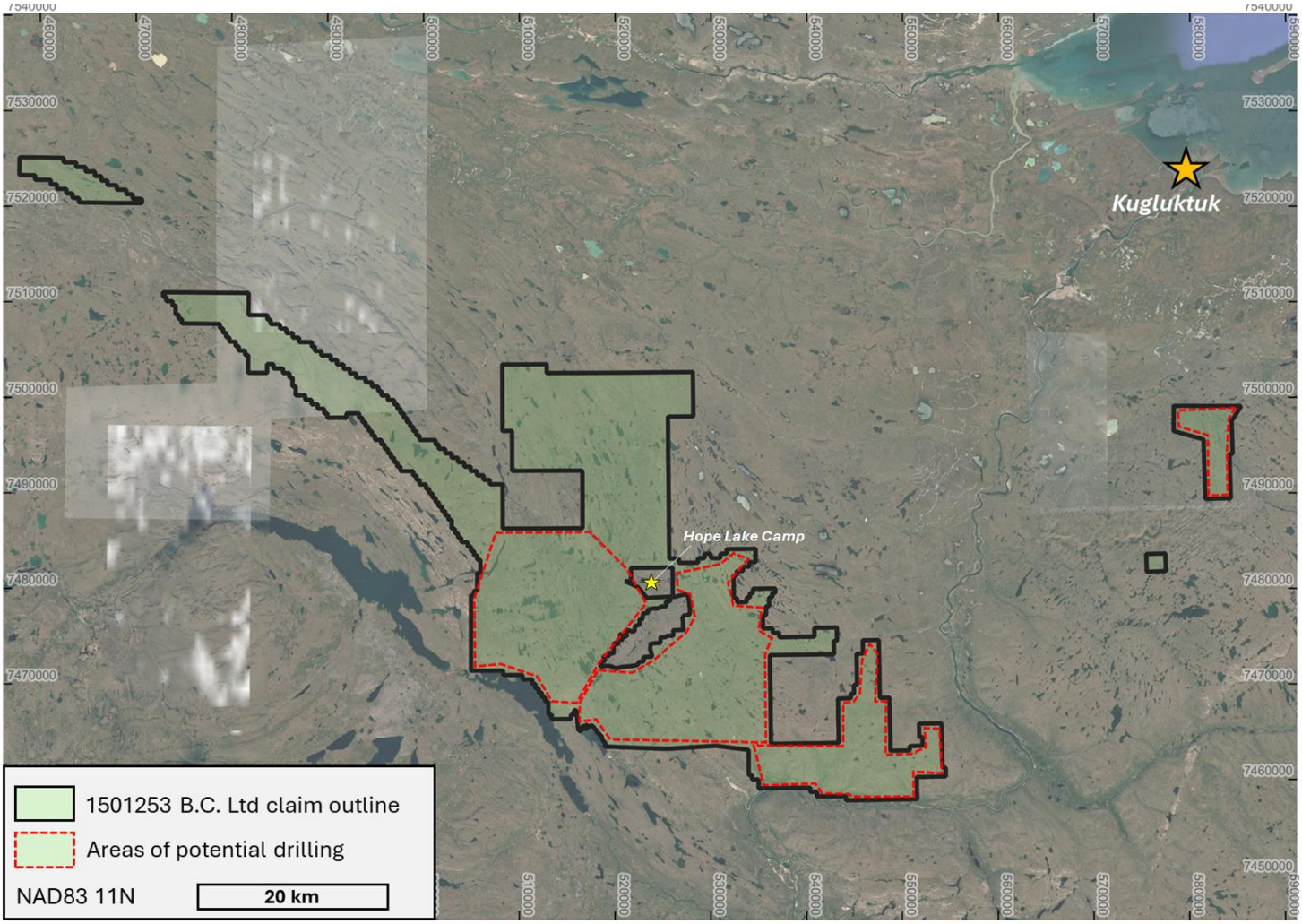
Spill kits will be located at each cache, and at the drill rig. Kits will contain fuel absorbent pads, heavy duty plastic bags, tarps, and empty drums or buckets, and hand tools.

After drilling is complete and the site is remediated, 1501253 B.C Ltd will conduct a thorough inspection of each drill location area to check for:

- Hydrocarbon staining
- Fire and safety hazards
- Debris or litter

1501253 B.C Ltd commits to taking a series of photographs of the drill site locations after the activities are complete, for recording and reporting purposes. All items, waste, and fuel barrels will be removed upon completion of each hole.

Figure 1. Project Location



2.0 Waste Types

Given the limited scope of activities proposed for the 2025 field season, a limited amount of waste types will be generated at the project site. See Table 1 below for a list of waste the project will generate and potential environmental impacts of each.

Table 1. Project Waste Types

Waste Type	Source of Generation	Estimated Waste Generated	Potential Environmental Impacts
Inert construction debris	Drill rig shelter	1 m^3	Litter on the tundra or nearby watercourses
Contaminated soils	Fuel leaks and spills	< 0.1 m^3	Contaminant release to the surrounding environment
Sewage	Drill staff	0.5 m^3	Release to nearby water courses Wildlife attractant
Used oil, fuels, lubricants, greases, and solvents	Equipment maintenance	30 L	Potential to leak or spill onto the tundra
Chemical wastes – liquids or solids	Cleaning solutions	< 1 L / day	Potential to leak or spill onto the tundra
Food containers or leftovers	Staff	0.1 m^3	Wildlife attractant, litter on the tundra
Drilling debris from consumables	Drill rig	1m^3	Litter on the tundra or nearby watercourses

2.1 Management of Each Waste Type

All waste generated at the Coppermine Project will be managed in accordance with applicable territorial and federal laws, regulations, guidelines, and project authorizations such as the land use permit and Nunavut Water Board Authorization.

1501253 B.C. Ltd will use the Waste Management Hierarchy to guide waste management practices at the Coppermine Project. Waste prevention and reduction is the preferred approach to waste management. 1501253 B.C. Ltd will make every reasonable attempt to reduce the amount of materials flown into site in the first instance, and to avoid generating waste during operations. 1501253 B.C. Ltd will reuse construction materials and recycle items such as aluminum cans and plastics where possible.

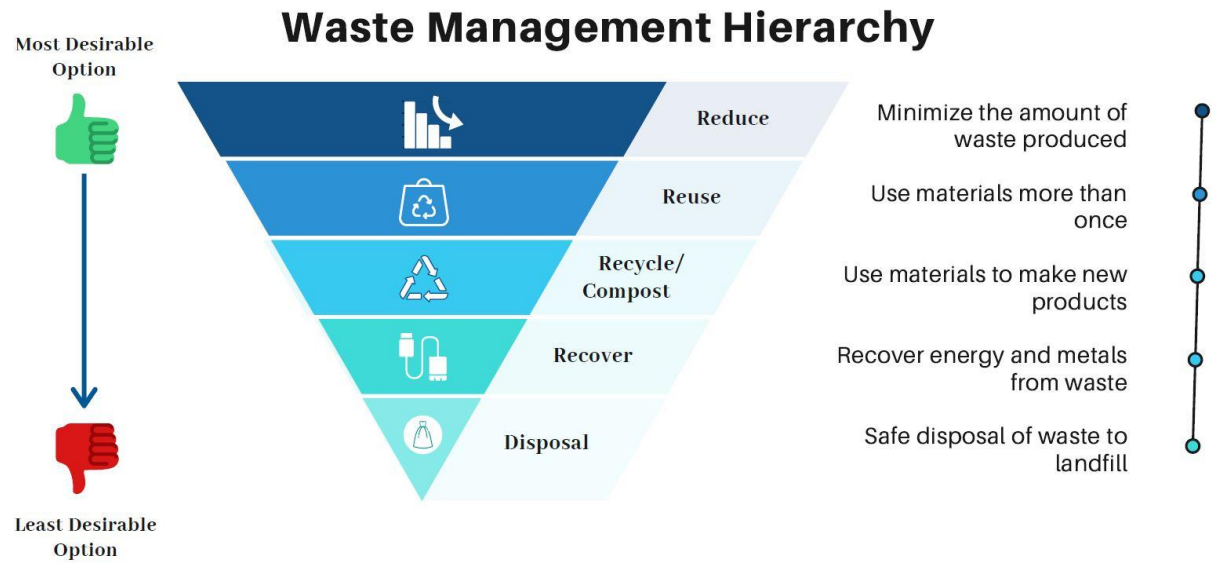


Figure 2. Waste Management

Hierarchy

Below is a list of waste streams generated at the Coppermine Project and how 1501253 B.C. Ltd proposes to manage the various waste types.

Recyclables

Recyclable items such as aluminum cans and clean plastics will be crushed and collected in a designated bin at transported to Kugluktuk for proper disposal.

Construction and Set up waste

1501253 B.C. Ltd, will only fly in the construction materials necessary for drilling and maintenance during the field season. All unused materials will be stored for repurposing opportunities, and then flown off site at the end of the field season. Where possible, 1501253 B.C. Ltd will store and reuse construction materials offsite for further field season

and avoid creating waste during construction.

Sewage

Pacto toilets will be used to manage human waste generated at the Project. The toilets will be located more than 31 metres away from the Ordinary High-Water Mark of any water course. Waste collected from the Pacto toilets will be stored in sealed vessels to eliminate the possible animal attractants and transported offsite routinely throughout the program.

Used Fuels and Chemicals

Contaminated or expired fuels will either remain in their original containers or be placed inside an empty fuel drum. The drums will be clearly labelled and segregated as hazardous waste. The drums will be shipped offsite for disposal with a registered hazardous waste receiver.

Waste chemicals will be packaged in clearly labelled, tightly sealed containers and stored for eventual backhaul.

Contaminated soil and water

As per 1501253 B.C Ltd's Spill Contingency Plan, contaminated soil will be cleaned up immediately and placed within sealed 205 L metal drums. Similarly, any contaminated water, snow, or ice will be cleaned up immediately and placed within sealed 205 metal drums for shipment off site.

3.0 Waste Management Infrastructure

Sump

Hand dug sumps will be used to dispose of any muddy water produced from drilling, and filled in afterwards. Pursuant to the *Nunavut Waters Regulations*, 1501253 B.C Ltd's will not deposit waste to surface water or within thirty-one (31) metres of the Ordinary High-Water Mark of any water body. No waste with a visible hydrocarbon sheen, or suspicion of hydrocarbon contamination, will be deposited to the sump.

Waste management station

A waste staging area will be set up at the drill rig, with barrels or containers available for different types of rubbish. Waste types will be separated by their varying disposal methods, clearly labelled and sealed to avoid attracting wildlife. Any waste containers that contain hazardous (such as spill-contaminated material) will have a spill kit available nearby at the drill rig, and sit within

a secondary bund.

Drums of waste will be clearly labelled and staged for shipment off site by air to Kugluktuk or Yellowknife depending on the recycling and waste disposal facilities available and the type of waste.

4.0 Roles and Responsibilities

1501253 B.C. Ltd Senior Management - Responsible for ensuring that the site supervisor is aware of the Waste Management Hierarchy, as well as proper waste management procedures on site. The Senior Management team will ensure that management plans are properly implemented and that the site supervisor is familiar with the conditions of site authorizations such as the land use permit.

Site Supervisor – Responsible for ensuring employees and contractors on site are aware of waste management procedures. The site supervisor is responsible for implementing management plans such as the Waste Management Plan to minimize environmental impacts and wildlife interaction with the Project. The site supervisor will ensure that waste is properly packaged, labelled, and shipped off site during routine backhauls or in bulk at the end of the field season.

Staff and Contractors – All personnel working on site must be familiar with the Waste Management Plan and understand how to properly manage waste generated on site. Staff and contractors must adhere to the Waste Management Plan to help minimize wildlife attractants and environmental risks created by the Project.

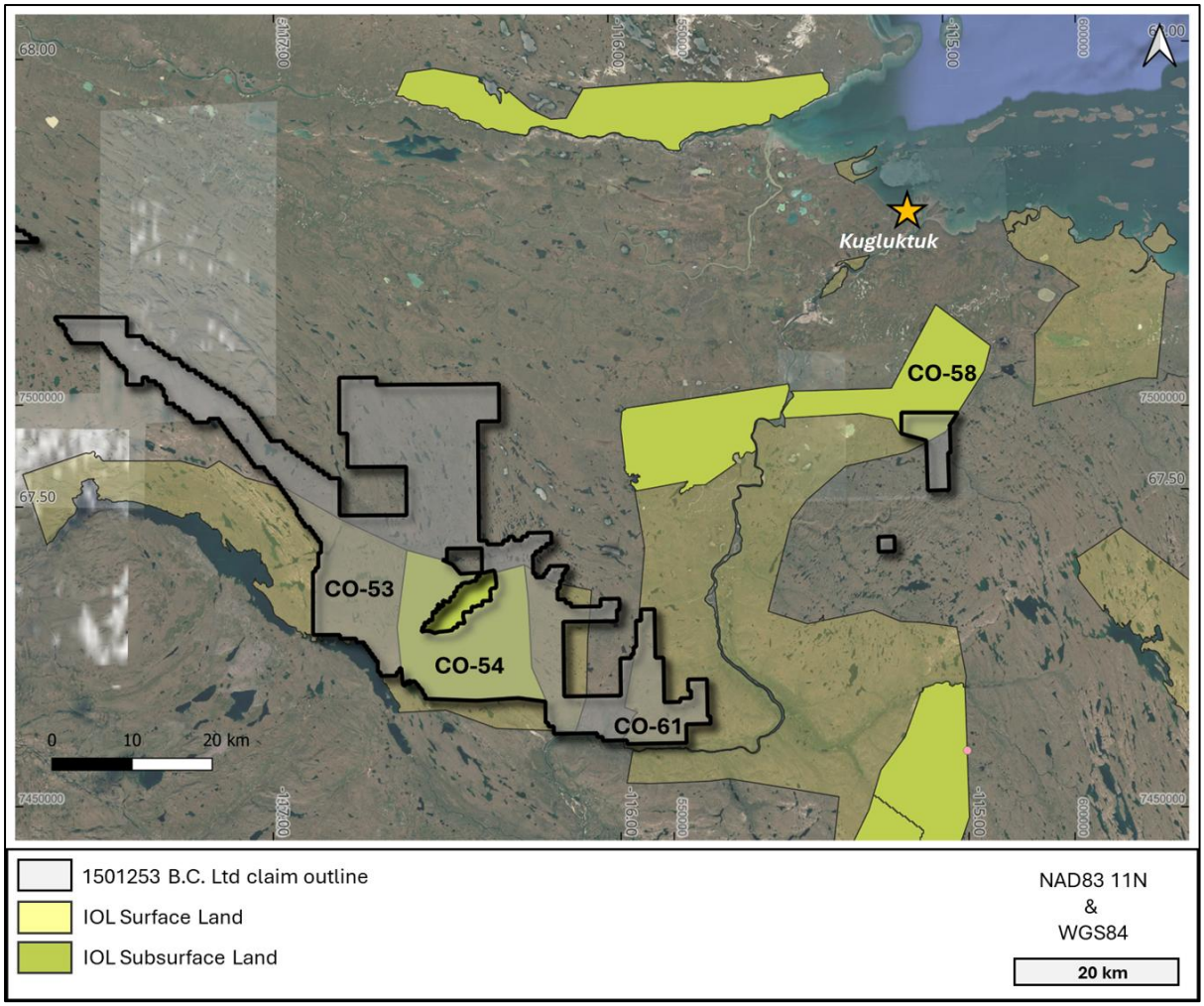


Image 1.1501253 B.C. Ltd claims over Inuit owned land.

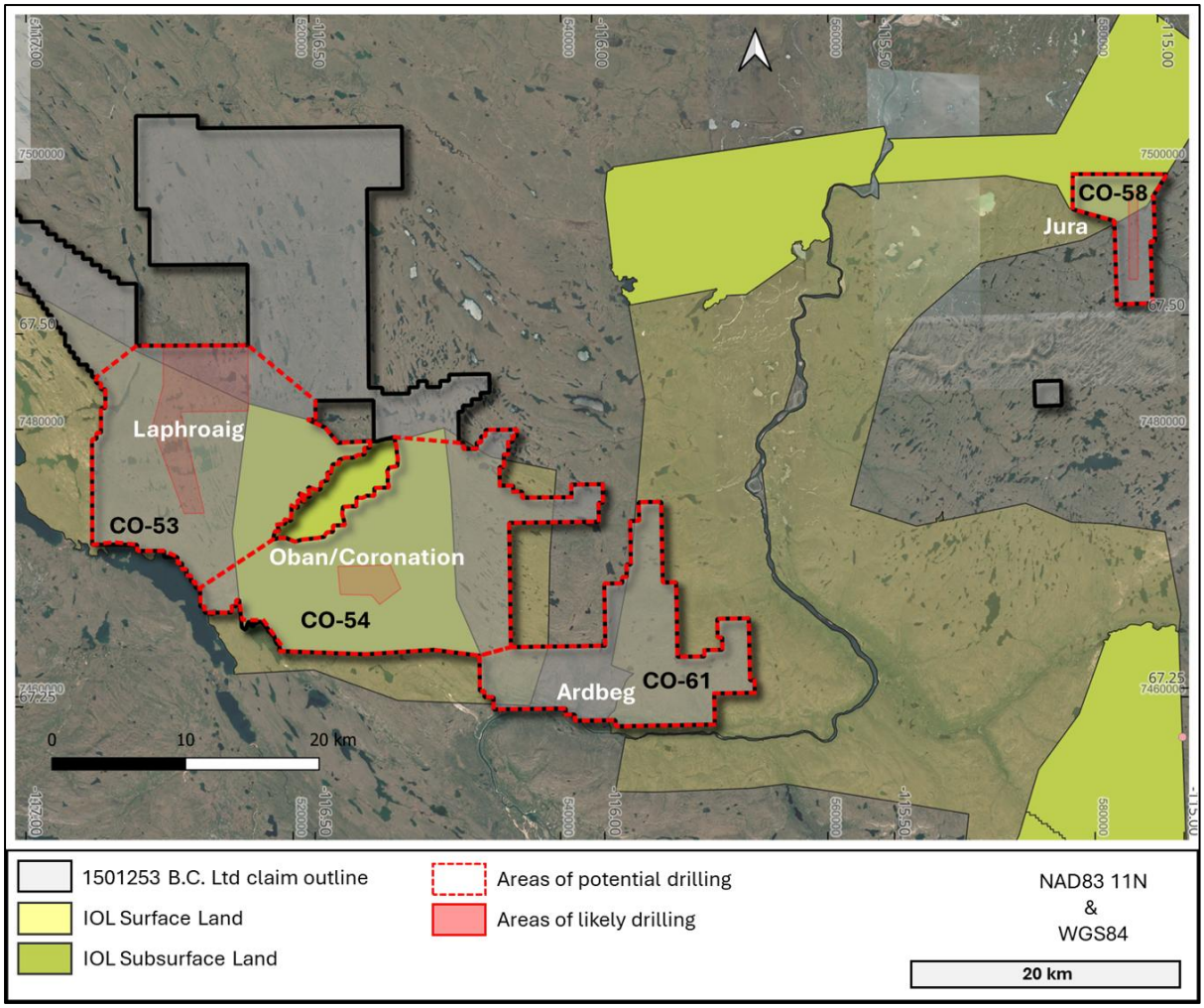


Image 2. Overview of 1501253 B.C. Ltd claims and Inuit owned land, with areas of likely drilling outlined in red.

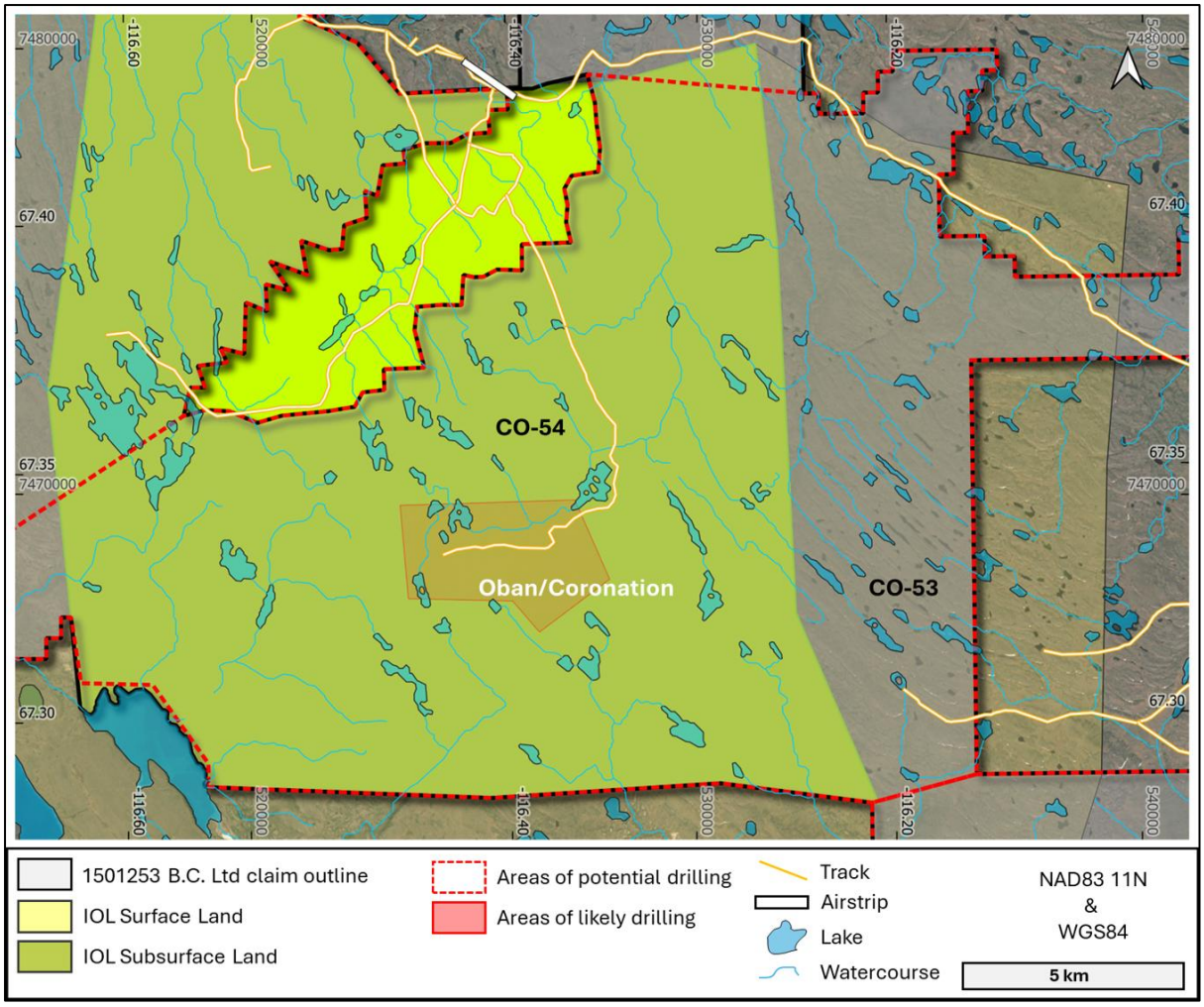


Image 3. Oban district showing the Coronation prospect. This sits on Inuit owned land parcels CO-54 and CO-53. The Company has an Exploration and Mining agreement in place for CO-54.

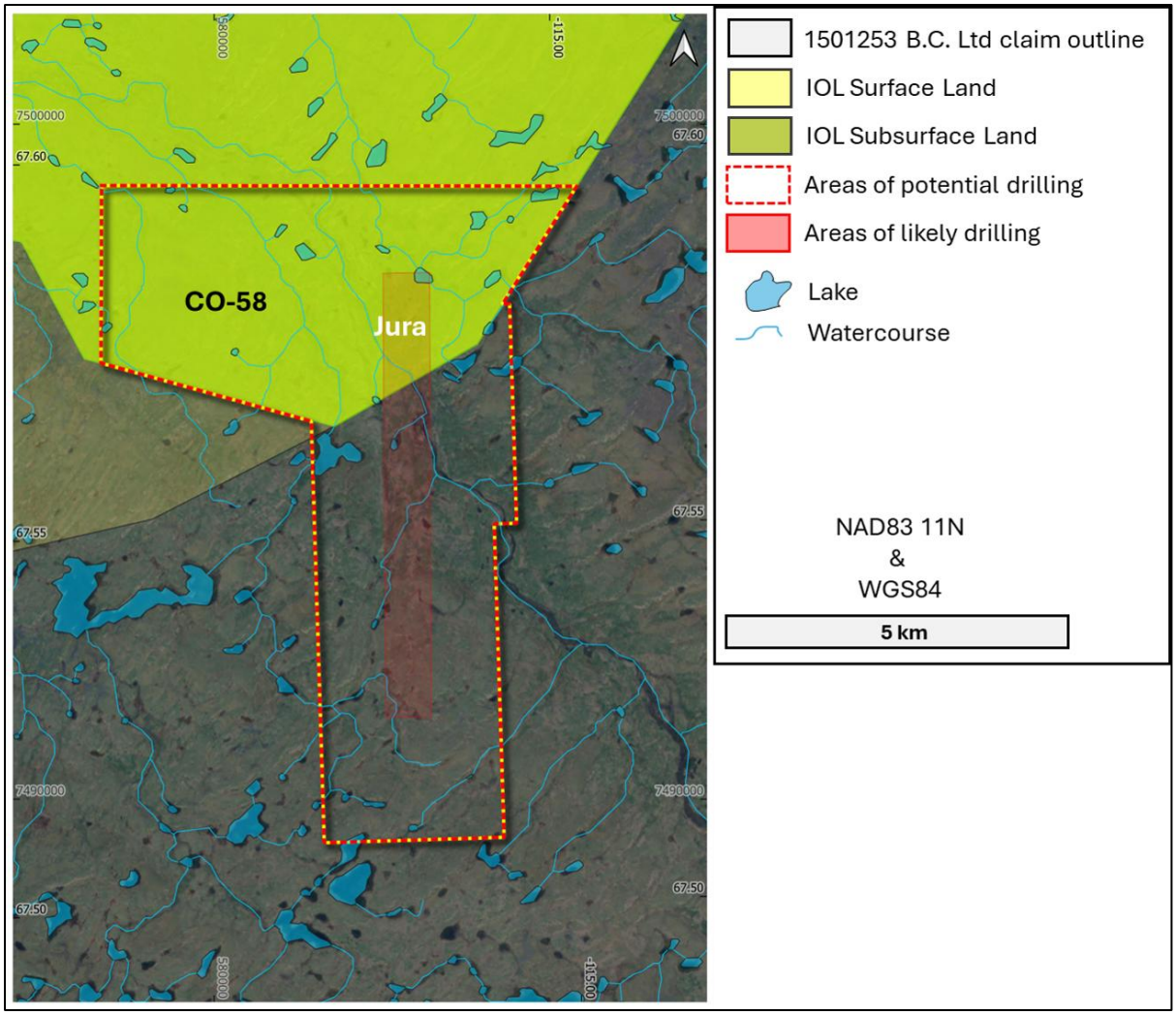


Image 4. Jura district.

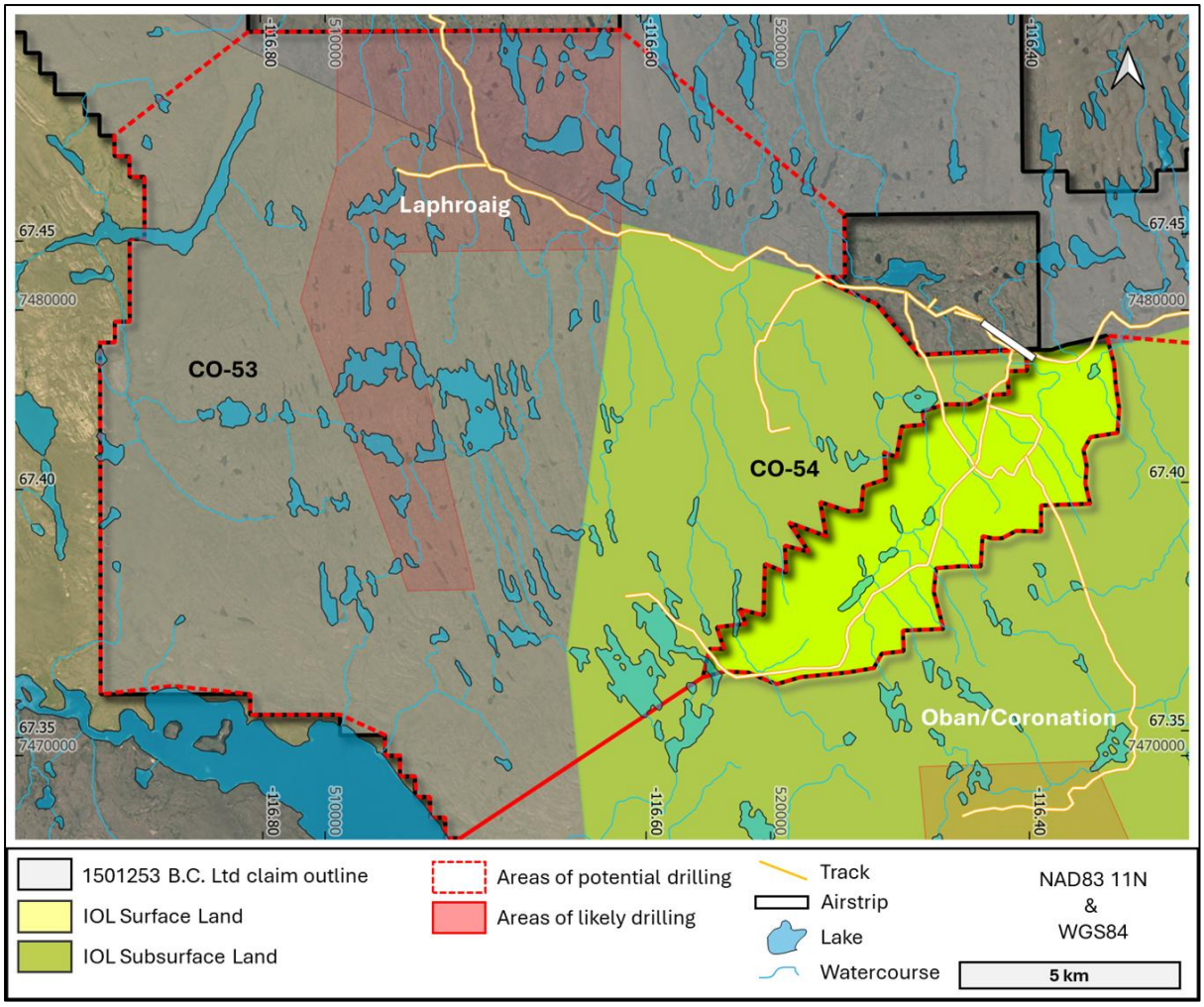


Image 5. Laphroaig district.

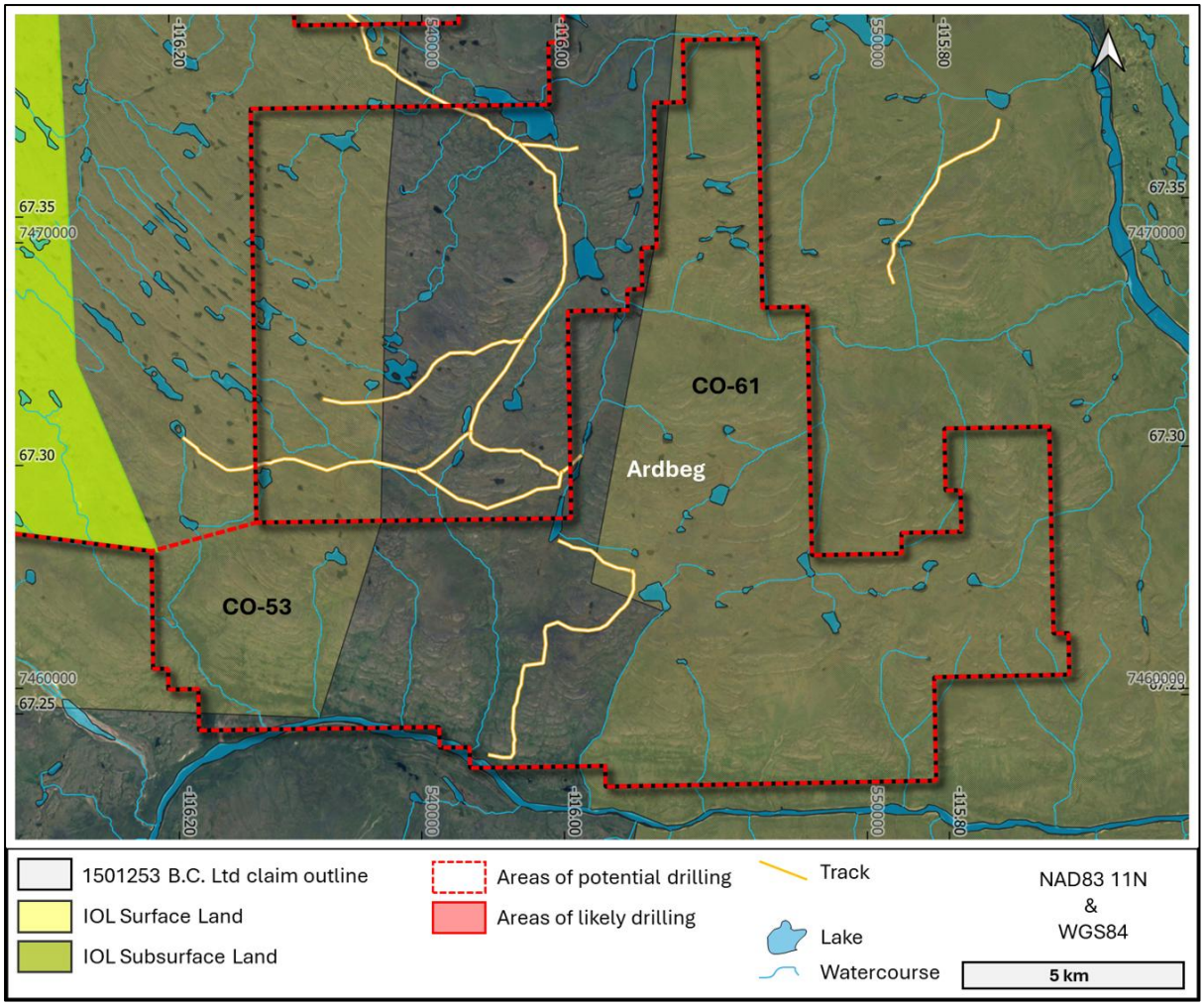


Image 6. Ardbeg district.

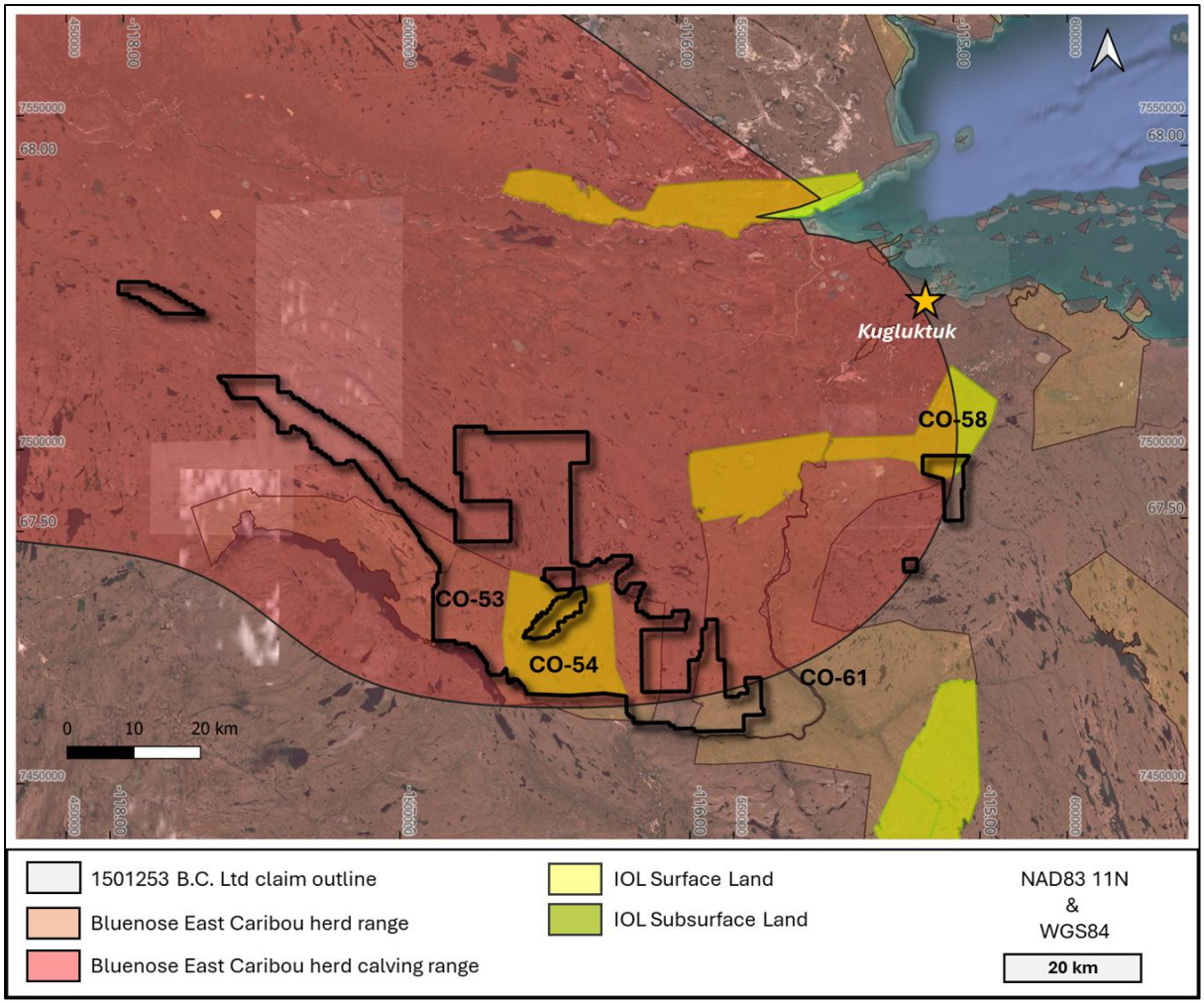


Image 7. Bluenose East Caribou herd calving grounds, in relation to the Company's claims. The Company will stop all exploration activities during calving and post-calving, which will be 28th May – 3rd July, or other dates as agreed upon with the local HTO. Aircraft will avoid wildlife at all times and fly at a height as to not disturb bears/muskox/caribou, or fly around them.

SEASONAL RANGES OF THE CAPE BATHURST, BLUENOSE-WEST, AND BLUENOSE-EAST BARREN-GROUND CARIBOU HERDS

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ABSTRACT

Satellite tracking data obtained for Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou during March 1996 to May 2004 were analyzed to define the seasonal and cumulative ranges of each of these herds. Location data were grouped into the following 8 seasons: calving/post calving (1-25 June), early summer (26 June-15 July), mid summer (16 July-7 August), late summer (8 August-7 October), fall/rut (8-31 October), fall/post rut (1-30 November), winter (1 December-31 March), and spring, spring migration, and pre-calving (1 April-31 May). Seasons used were similar to those defined for the Porcupine caribou herd. Maps showing the geographic extent of the seasonal and cumulative ranges used by each herd are provided.

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INTRODUCTION

In 1950, Banfield (1954) described two herds of barren-ground caribou (*Rangifer tarandus groenlandicus*) in the area north of Great Bear Lake in the Northwest Territories (NT) and Nunavut (NU). Based on various historic accounts, reconnaissance aerial surveys, and where these caribou wintered, he named these herds the Great Bear Lake and Colville Lake herds (Banfield 1954). Thomas (1969) introduced the name Bluenose herd for caribou that wintered northwest of Great Bear Lake; these animals included Banfield's Great Bear Lake and Colville Lake herds. Based on aerial surveys in March and April 1967, Thomas (1969) assumed that these caribou migrated toward the Arctic coast and Bluenose Lake. The area around Bluenose Lake was recognized as the calving area of the Bluenose herd (Thomas 1969), although a small portion of the herd was later thought to calve on the Cape Bathurst Peninsula (Hawley *et al*. 1979). The latter calving area was reported to have been permanently abandoned by 1979 (Brackett *et al*. 1979, Gunn & Miller 1986). Thomas (1969) also found caribou wintering northeast of Great Bear Lake (i.e. Caribou Point and Dease Arm), an area that Banfield (1950, 1954) had associated with his Great Bear Lake herd. However, based on aerial surveys in April and May 1967, Thomas (1969) described these caribou as migrating toward Bathurst Inlet, and he designated them as being part of the Bathurst herd.

By the mid 1980s the range of the 'Bluenose caribou herd' was considered to include the area south of the Arctic coast from the Mackenzie Delta east to Kugluktuk, and north of Great Bear Lake in the Northwest Territories (NT) and Nunavut (NU). Caribou within this area were managed as a single unit. The range of the 'Bluenose caribou herd' includes portions of the Inuvialuit, Gwich'in, Sahtu, and Nunavut land claim areas, 14 user communities on the mainland (12 communities) and on the Arctic islands (2 communities), and four regions of the Governments of the NWT and Nunavut. Currently, wildlife co-management boards established under land claim agreements have primary responsibility for managing caribou within this area. From 1994 to 1999, these groups worked together to develop a comprehensive co-management plan for the 'Bluenose caribou herd' (Nagy et al. 1999).

In 1994, as part of this planning process, distribution data obtained during population and telemetry surveys done between 1966 and 1993 were analyzed using a computer geographic information system (GIS) to define the seasonal ranges of the 'Bluenose caribou herd'. Analysis indicated there were three calving and two rutting areas within this area. Caribou management has been based on the herd concept, where herds are identified based on their use of traditional calving grounds (Thomas 1969, Gunn & Miller 1986). Applying this approach we hypothesized that there were two, and possibly three, herds within the range of 'Bluenose caribou'.

In March 1996, satellite tracking and genetic studies similar to those done to define polar bear populations (Paetkau *et al*. 1995, Bethke *et al*. 1996) were initiated to identify the number of caribou herds within the 'Bluenose' range (Figure 1). Samples were also collected for genetic comparisons from the two well defined herds to the west and east of the Bluenose range, the Porcupine (*R. t. granti*) and Bathurst herds (*R. t. groenlandicus*), respectively, and the reindeer herd on the Tuktoyaktuk Peninsula. The results of these studies strongly support the hypothesis that there are three herds of barren-ground caribou within the range previously ascribed to the 'Bluenose caribou herd' (Nagy *et al*. in prep). These data show that the herds use different seasonal ranges (especially calving) and are genetically different (Nagy *et al.* in prep.). For convenience we have referred to these herds as the Cape Bathurst, Bluenose-West, and Bluenose-East herds.

Barren-ground caribou use different geographic areas to meet their seasonal requirements. These are referred to as 'seasonal ranges'. Given current and proposed levels of development activities within the ranges of these herds, knowledge of the geographic boundaries and relative importance of seasonal ranges to Cape Bathurst, Bluenose-West, and Bluenose-East caribou herds is important for management purposes. The movement data obtained for adult female caribou tracked with satellite collars during the period March 1996 to May 2004 were analyzed to define these seasonal ranges. The geographic distributions of these ranges are presented.

METHODS

The movements of 60 adult female caribou of the Cape Bathurst (n = 18), Bluenose-West (n = 26), and Bluenose-East (n = 16) barren-ground caribou herds were tracked with satellite collars during March 1996 to May 2004. Satellite collars (Telonics Inc., Mesa, Arizona, USA) were deployed on adult female caribou of these herds (Table 1).

Table 1. Distribution of 60 collars deployed on adult female caribou of the Cape Bathurst, Bluenose-West, and Bluenose-East herds between 1996 and 2003

Herd	Dates of collar deployment	Number deployed (n)
Cape Bathurst	16-30 March 1996	4
	13-16 April 1999	2
	31 March-16 April 1999	2
	31 March-2 April 2002	10
Bluenose-West	21-30 March 1996	6
	28 March 1997	2

	13-28 April 1999	12
	28 March-1 April 2002	6
Bluenose-East	23 March 1996	5
	19 March 1997	3
	7 May 1999	5
	23 March 2003	3

The data obtained for these animals were grouped into 8 seasons (Table 2). Seasons were defined in a manner similar to those defined for the Porcupine caribou herd (Porcupine Caribou Technical Committee 1993).

Table 2. Date range of each of the eight defined seasons

Season	Date range
Calving/post calving	1 - 25 June
Early summer	26 June -15 July
Mid summer	16 July - 7 August
Late summer	8 August - 7 October
Full/rut	8 - 31 October
Fall/post rut	1 - 30 November
Winter	1 December - 31 March
Spring, spring migration, and pre-calving	1 April - 31 May

Satellite collared caribou were assigned to herds based on calving ground use and subsequent movements. Herd assignments were verified using cluster analyses in SPSS (Nagy *et al*. in prep). Some caribou were harvested or died after being collared but before we obtained sufficient data to assign them to a herd. In addition, the satellite collars on some caribou failed before we obtained sufficient data to assign them to a herd. Data for these animals were excluded from the final analyses.

The duty cycle for deployed collars varied among years. As a result, the number of locations obtained each season varied among caribou tracked. To reduce the potential bias resulting from different sample sizes, the location data for each caribou were selected every 4 - 5 days during the calving/post calving, early summer, mid summer, late summer, and rut/fall periods; and every 10 days during the post rut, winter, and spring migration periods.

Locations for individual caribou were included in the analyses if $\geq$ ⅔ of the possible locations for a season were obtained and these locations were distributed throughout the season.

We estimated the extent of the seasonal ranges by pooling the location data obtained for each herd for each season among years. The boundaries of the seasonal ranges were estimated by analyzing location data using the fixed kernel home range option with the least squares cross validation smoothing factor of the Animal Movement Program extension (Hooge *et al*. 1999) of ArcView GIS 3.2a (ESRI 2000). The 50, 60, 70, 80, 90, and 95 percent utilization distributions for each season were generated and mapped for each herd. We used the 95 percent utilization distribution for the pooled data to define the boundaries of each seasonal range and to calculate the area (km^2) of each seasonal range. The utilization distribution describes the relative frequency distribution for the location data, and calculates boundaries based on the complete distribution of locations (Millsspaugh and Marzluff 2001). Because unusual movements of animals or outlier locations can dramatically affect the estimates of boundaries and the size of "normal" seasonal ranges, we excluded animals from the analyses that made long-range movements out of the "normal" seasonal distribution of locations for each herd. The movements of caribou were overlaid on each seasonal range to provide information on the direction of movement or migration.

The boundaries of the ranges of each herd were estimated by analyzing the location data obtained for each herd, each season and each year, using the fixed kernel home range option with the least squares cross validation smoothing factor of the Animal Movement Program extension (Hooge *et al*. 1999) of ArcView GIS 3.2a (ESRI 2000). We then overlaid all of the resulting 95 percent seasonal utilization distributions for each herd to estimate the boundary of its range. We determined the frequency of use of areas within the range of each herd by determining the frequency of overlap of the 95 percent seasonal utilization distributions. The maximum number of utilization distributions was 64 (8 seasons for 8 years). We then classified and mapped the frequency of use of areas within the range of each herd as: high use, or areas where $\geq$ 8 seasonal ranges overlapped; moderate use, or areas where 4 to 7 seasonal ranges overlapped; or low use, or areas where 1 to 3 seasonal ranges overlapped.

Caribou use ranged between 1 season for 8 years and 8 seasons for 1 year in areas mapped as high frequency of use. Use ranged between 1 season for 4 to 7 years and 4 to 7 seasons for 1 year in areas mapped as moderate frequency of use. Similarly, use ranged between 1 season for 1 to 3 years and 1 to 3 seasons during 1 year in areas mapped as low frequency of use.

There was overlap among some of the seasonal ranges of the three herds. We overlaid all of the 95 percent seasonal utilization distributions obtained for these three herds to estimate the cumulative range used. We then determined the frequency of overlap of 95 percent seasonal utilization distributions in areas within the cumulative range of the herds. We classified and mapped the frequency of use of areas within the cumulative range of the three herds as follows: high use, or areas where $\geq$ 8 seasonal ranges overlapped; moderate

use, or areas where 4 to 7 seasonal ranges overlapped; or low use, or areas where 1 to 3 seasonal ranges overlapped.

RESULTS

The number of individual caribou for which location data were obtained by season between March 1996 and May 2004 varied from 13 to 16 for the Bluenose-East herd, 18 to 24 for the Bluenose-West herd, and 14 to 16 for the Cape Bathurst herd (Table 3). The number of caribou seasons of location obtained by year, during March 1996 to May 2004 for the Cape Bathurst, Bluenose-West, and Bluenose-East herds are given in Tables 4, 5, and 6. The number of locations used to generate each seasonal range is given in Table 7. The sizes of the seasonal ranges (km^2) for each herd are given in Table 8. Areas of the 50 to 95 percent utilization distributions by season are given for each herd (Tables 9, 10, and 11).

The seasonal ranges and movements of caribou within those ranges are given in Figures 1 through 16. Unusual movements were documented for some caribou. In 1999 and 2000 one Bluenose-East caribou was within the range of the Bathurst caribou herd during the 1999 fall/rut to 2000 calving period (Figure 17). Similarly two Cape Bathurst caribou were within the range of the Bluenose-West herd during the 2003 fall/rut to 2004 spring migration period (Figure 18). The data for these animals were excluded from analyses for these periods.

The frequencies of use of areas within the ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds are shown in Figures 19, 20, and 21. The frequencies of use of areas within the cumulative range of the Cape Bathurst, Bluenose-West, and Bluenose-East herds (data pooled among herds) is shown in Figure 22.

DISCUSSION

Adult female caribou of the Cape Bathurst, Bluenose-West and Bluenose-East herds were tracked using satellite collars during March 1996 to May 2004. The primary objective of this paper was to present results of analyses completed to define the seasonal ranges of these herds. Maps showing the seasonal ranges of these herds are presented (Figures 1 to 22). The following paragraphs describe some of the limitations of the data used to generate these maps.

The distribution maps presented in this document were generated using satellite location data obtained for adult female caribou. Information was not available on the distribution of adult males in these herds and, as a result, the full extent of

some seasonal ranges of these herds may be underestimated. Satellite tracking work should be undertaken to document the distribution of males in these herds.

With the exception of a few years, the number of satellite-collared animals tracked each year in each herd was relatively small. As a result, the seasonal ranges presented here may be under estimated. Additionally, we were not able to determine how the seasonal ranges for these herds varied among years. The seasonal ranges presented in this document incorporate variation in ranges used by satellite-collared adult female caribou among years in each herd. A minimum of 20 satellite collars should be maintained each year on adult female caribou in all herds so that annual variations in seasonal range use can be assessed.

We documented what we believed were 'unusual' movements of caribou in the Bluenose-East and Cape Bathurst herds. Because the number of satellite-collared animals tracked each year in each herd was relatively small, we do not know the extent or frequency with which these types of movements occur. The 'unusual' movements of the Cape Bathurst animals occurred after freezing rains fell along northern coastal areas within the range of this, and the Bluenose-West, herd during fall 2003. These conditions may have precipitated the movement of caribou out of the normal northern portion of their fall and winter ranges. The Department of Resources, Wildlife, and Economic Development completed a range wide caribou survey during late March/early April 2004 (D'Hont *et al*. in prep). Very few caribou were observed within the northern portion of the normal winter range of the Bluenose-West or Cape Bathurst herds. The absence of caribou in the areas where people from Paulatuk harvest caribou was notable during winter 2003-2004. Insights into the frequency and magnitude of these types of movements may be obtained by monitoring the movements of a larger number of satellite-collared caribou in each herd and monitoring climatic and snow conditions on the fall/early winter ranges of these herds. The frequency of these types of 'unusual' movements may increase if current trends in climate change persist.

The relative importance of each seasonal range to Cape Bathurst, Bluenose-West, and Bluenose-East caribou herds has not been investigated specifically, however, relevant research has been completed to define the importance of seasonal ranges of similar caribou in the Porcupine caribou herd (Porcupine Caribou Technical Committee 1993). Additional work is required to make assessments for the seasonal ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East herds. This work is particularly important given existing and proposed levels of oil and gas development activities on their winter ranges. Development activities, in combination with wild fires, may have significant impacts on the availability and use of herd ranges.

ACKNOWLEDGEMENTS

This project could not have been completed without the support of a number of community organizations, co-management boards, government agencies, and biologists.

The following hunters and trappers organizations contributed traditional knowledge and supported this project:

- Aklavik Hunters and Trappers Committee, Aklavik, NT
- Behdzi Ahda Renewable Resources Council, Colville Lake, NT
- Deline Renewable Resource Council, Deline, NT
- Ehdiitat Renewable Resource Council, Aklavik, NT
- Fort Good Hope Renewable Resources Council, Fort Good Hope, NT
- Gwichya Renewable Resource Council, Tsiigehtchic, NT
- Inuvik Hunters and Trappers Committee, Inuvik, NT
- Kugluktuk Hunters and Trappers Organization, Kugluktuk, NU
- Nihtat Gwich'in Renewable Resource Council, Inuvik, NT
- Norman Wells Renewable Resources Council, Norman Wells, NT
- Paulatuk Hunters and Trappers Committee, Paulatuk, NT
- Tetlit Gwich'in Renewable Resource Council, Fort McPherson, NT
- Tuktoyaktuk Hunters and Trappers Committee, Tuktoyaktuk, NT
- Tulita Renewable Resources Council, Tulita, NT

The following agencies and organizations provided funding for this project (in alphabetic order):

- Department of Resources, Wildlife, and Economic Development, Government of Northwest Territories, Inuvik, NT
- Department of Resources, Wildlife, and Economic Development, Government of Northwest Territories, Norman Wells, NT
- Department of Resources, Wildlife, and Economic Development, Government of Northwest Territories, Yellowknife, NT
- Gwich'in Renewable Resource Board, Inuvik, NT
- Inuvialuit Final Agreement Wildlife Research Implementation Funds, NT
- Inuvialuit Game Council, Inuvik, NT
- Nunavut Wildlife Management Board, Iqaluit, NU
- Parks Canada Agency, Inuvik, NT
- Sahtu Renewable Resources Board, Tulita, NT
- Tuktut Nogait National Park, Paulatuk, NT
- Wildlife Management Advisory Council (NWT), Inuvik, NT

Anne Gunn contributed data for the Bluenose-East herd. Richard Popko, Nic Larter, John Nishi, and Ian Ellsworth assisted with the deployment of satellite collars. Anne Gunn and Boyan Tracz reviewed and provided comments on the manuscript. Jesse Davidson and Marsha Branigan assisted with processing of satellite location data.

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Table 3. Number of individual caribou for which location data were obtained during March 1996 to May 2004 and used to define the seasonal ranges of each herd.

	Herd		
Season	**Bluenose-East**	**Bluenose-West**	**Cape Bathurst**
Calving/Post Calving	16	24	15
Early Summer	15	24	15
Mid Summer	16	23	15
Late Summer	14	21	15
Fall/Rut	13	19	16
Fall/Post Rut	14	20	15
Winter	13	18	14
Spring and Spring Migration	16	24	16

Table 4. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Cape Bathurst barren-ground caribou herd.

	Number Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	4	3	5	3	1	9	9	38
Early Summer	-	4	4	3	4	3	1	10	9	38
Mid Summer	-	4	3	3	4	1	1	10	9	35
Late Summer	-	4	3	3	3	1	1	10	6	31
Fall/Rut	-	4	3	3	4	1	1	10	6	32
Fall/Post Rut	-	4	3	3	2	1	-	10	6	29
Winter	-	4	3	3	2	1	1	9	3	26
Spring and Spring Migration	4	4	3	5	2	1	10	9	2	40

Table 5. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Bluenose-West barren-ground caribou herd.

	Number of Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	5	5	12	9	3	8	4	50
Early Summer	-	5	5	5	13	8	3	9	4	52
Mid Summer	-	5	5	5	14	7	4	9	4	53
Late Summer	-	4	5	3	12	6	3	9	4	46
Fall/Rut	-	4	5	3	10	4	3	9	3	41
Fall/Post Rut	-	3	5	3	12	6	3	8	4	44
Winter	-	3	5	3	12	5	2	5	2	37
Spring and Spring Migration	5	5	5	14	10	5	9	5	2	60

Table 6. Number of caribou seasons of location data obtained by caribou year during March 1996 to May 2004 and used to define the seasonal ranges of the Bluenose-East barren-ground caribou herd.

	Number of Caribou Seasons of Location Data by Caribou Year (1 June – 31 May)									
Season	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**Total**
Calving/Post Calving	-	4	5	10	9	5	1	-	3	37
Early Summer	-	4	5	6	8	5	1	-	3	32
Mid Summer	-	4	5	8	8	4	1	-	3	33
Late Summer	-	4	5	7	7	3	1	-	3	30
Fall/Rut	-	3	5	8	6	2	1	-	3	28
Fall/Post Rut	-	3	5	9	6	2	1	-	3	29
Winter	-	2	5	9	6	2	-	-	3	27
Spring and Spring Migration	5	5	5	9	5	2	-	3	3	37

Table 7. Number of locations used to generate seasonal ranges for the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

	Number of locations by Herd		
Season	**Bluenose-East**	**Bluenose-West**	**Cape Bathurst**
Calving/Post Calving	200	276	217
Early Summer	148	223	184
Mid Summer	162	259	165
Late Summer	372	520	352
Fall/Rut	138	198	149
Fall/Post Rut	86	127	84
Winter	324	442	311
Spring and Spring Migration	252	351	238

Table 8. The size of seasonal ranges used by the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

	Size of Seasonal Range (km^2) by Herd		
Season	**Cape Bathurst**	**Bluenose-West**	**Bluenose-East**
Calving/Post Calving	3,894	15,350	14,119
Early Summer	2,285	18,668	21,639
Mid Summer	11,627	44,112	51,877
Late Summer	7,965	43,167	31,677
Fall/Rut	12,557	111,481	81,461
Fall/Post Rut	7,820	99,524	113,174
Winter	7,339	78,151	83,479
Spring and Spring Migration	18,986	95,364	27,312

Table 9. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Bluenose-East herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	14,119	9,678	5,298	3,511	2,528	1,811
Early Summer	21,639	15,950	9,343	5,325	3,361	2,370
Mid Summer	51,877	39,465	21,800	11,807	6,501	4,385
Late Summer	31,677	22,861	10,849	5,743	2,978	1,802
Fall/Rut	81,461	62,221	37,463	24,232	17,066	11,437
Fall/Post Rut	113,174	87,693	61,146	45,800	34,338	23,949
Winter	83,479	49,190	23,450	15,197	10,726	7,610
Spring and Spring Migration	27,312	13,427	8,474	6,346	4,895	3,769

Table 10. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Bluenose-West herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	15,350	9,480	4,518	2,917	1,960	1,303
Early Summer	18,668	13,542	8,290	4,709	2,808	1,633
Mid Summer	44,112	35,601	25,119	15,816	9,193	4,847
Late Summer	43,167	31,747	18,753	10,383	7,059	5,061
Fall/Rut	111,481	87,446	58,550	38,465	21,757	12,945
Fall/Post Rut	99,524	79,876	52,756	33,063	19,968	10,866
Winter	78,151	61,827	37,486	23,250	16,453	11,459
Spring and Spring Migration	95,364	69,276	35,098	20,391	12,858	7,730

Table 11. Areas (km^2) of the 50 to 95 percent utilization distributions by season for the Cape Bathurst herd.

	Area (km^2) by Percent Utilization Distribution					
Season	**95**	**90**	**80**	**70**	**60**	**50**
Calving/Post Calving	3,894	2,779	1,937	1,428	1,067	709
Early Summer	2,285	1,959	1,484	1,210	1,012	836
Mid Summer	11,627	9,869	6,620	4,156	2,679	1,866
Late Summer	7,965	6,490	4,472	2,996	2,119	1,562
Fall/Rut	12,557	10,557	6,866	4,821	2,673	1,601
Fall/Post Rut	7,820	6,585	4,552	3,156	2,208	1,445
Winter	7,339	5,544	2,924	1,547	813	506
Spring and Spring Migration	18,986	15,590	9,758	6,792	4,746	3,275

Figure 1. Calving/post calving ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

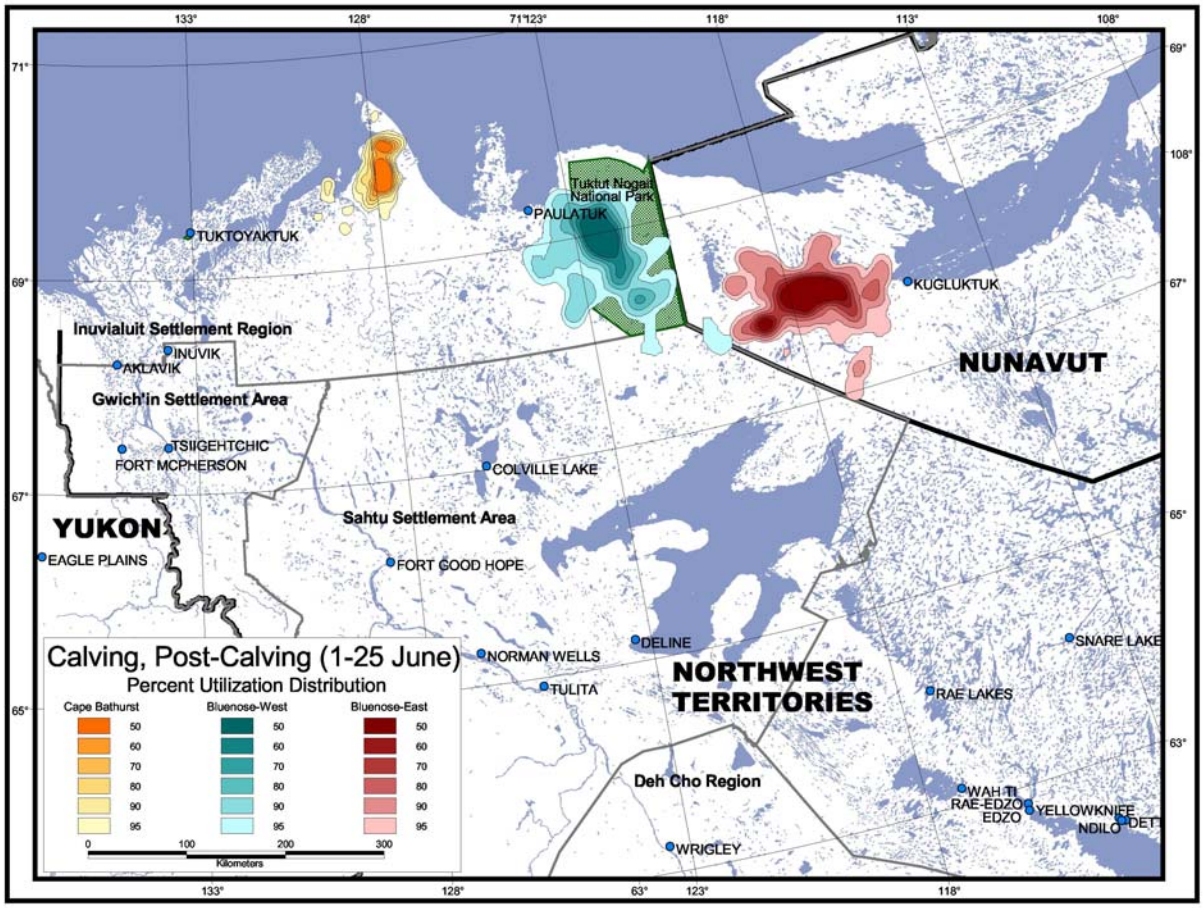


Figure 2. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the calving/post calving season.

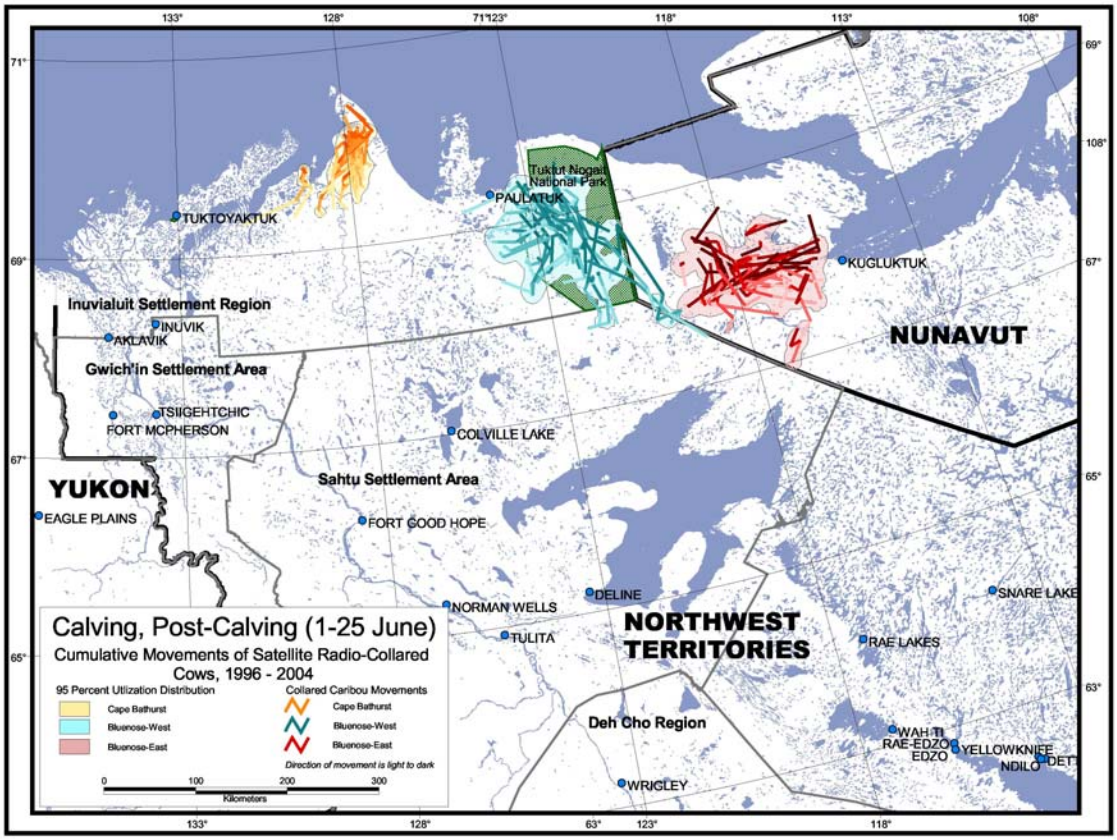


Figure 3. Early summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

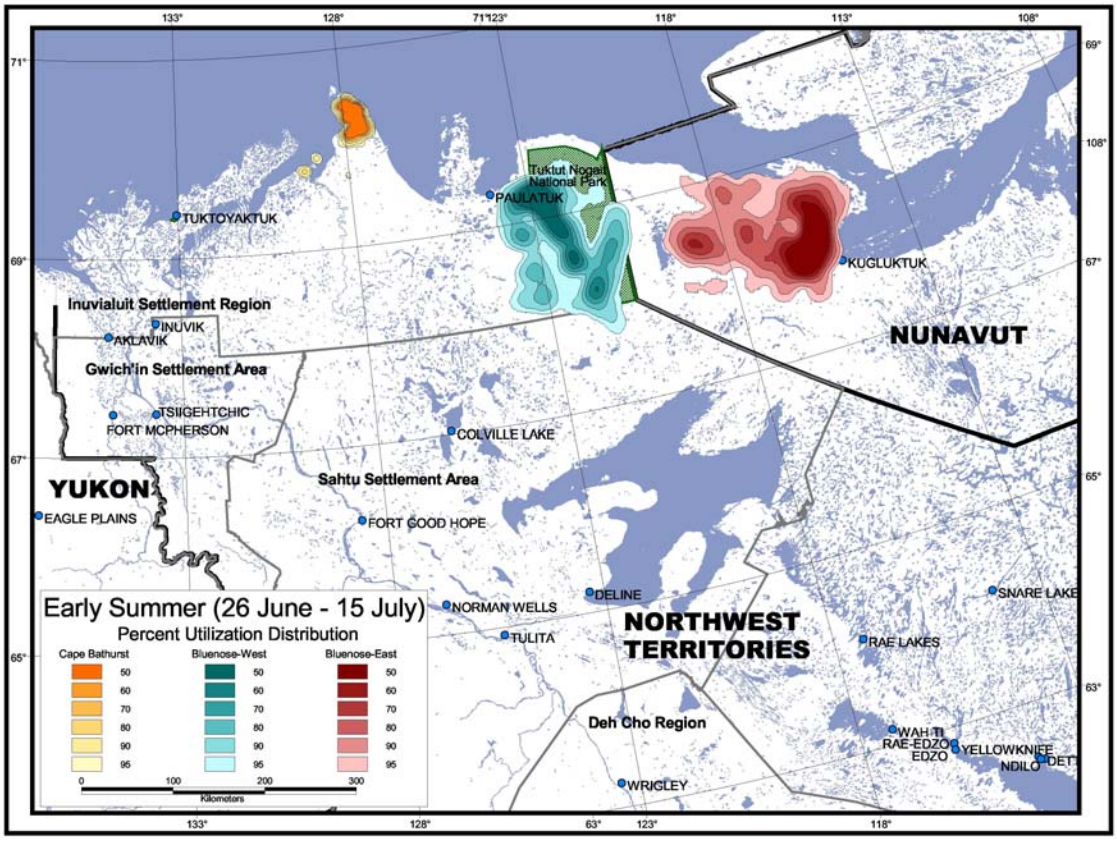


Figure 4. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the early summer season.

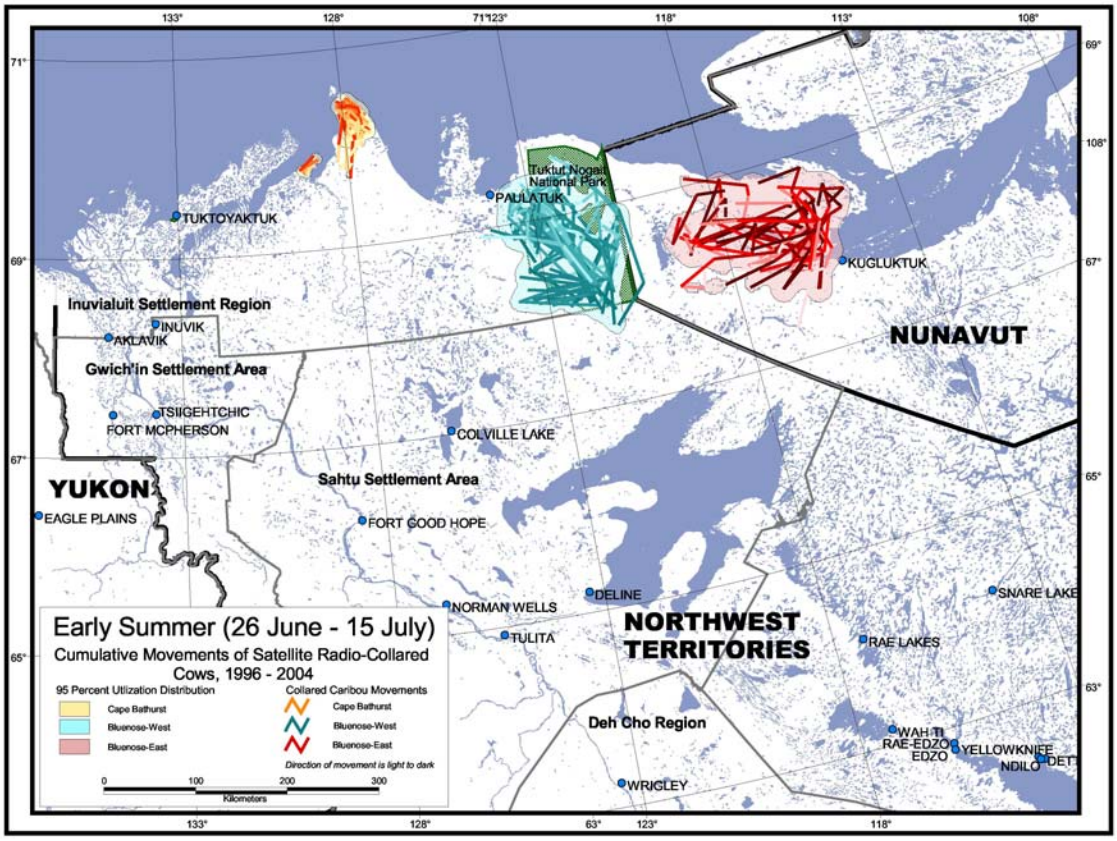


Figure 5. Mid summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

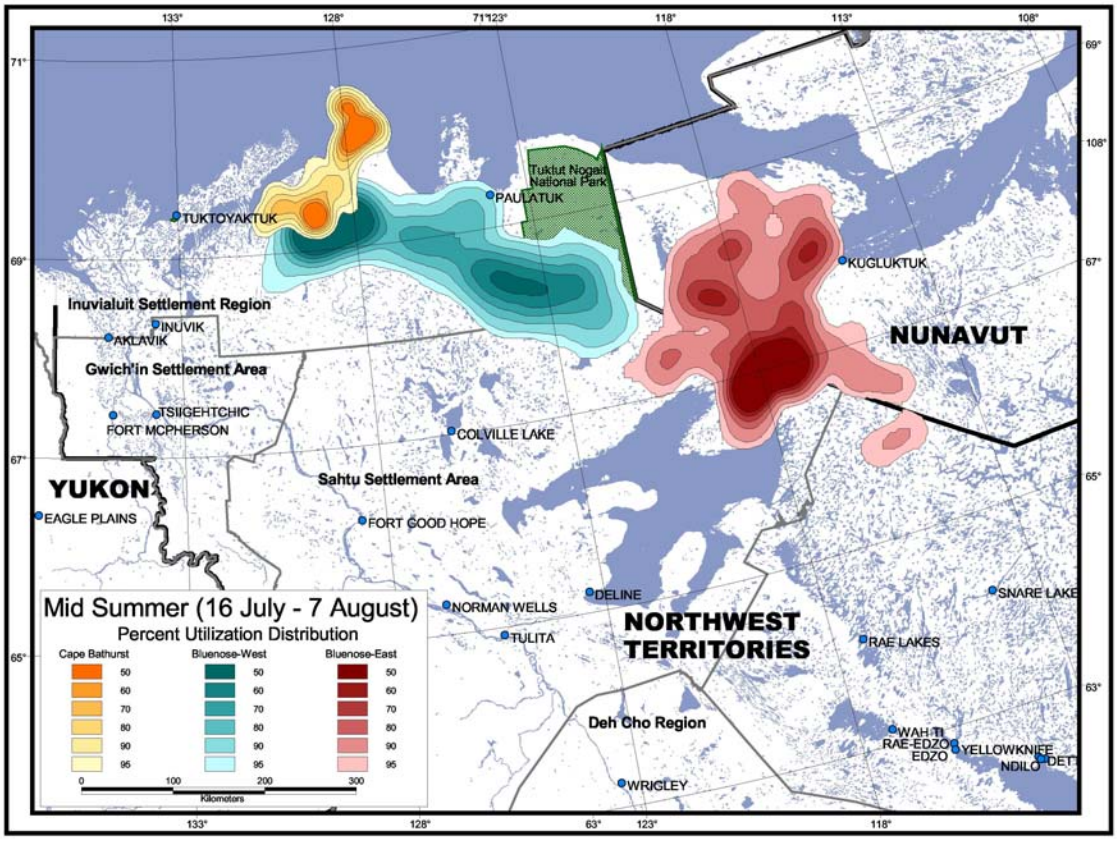


Figure 6. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the mid summer season.

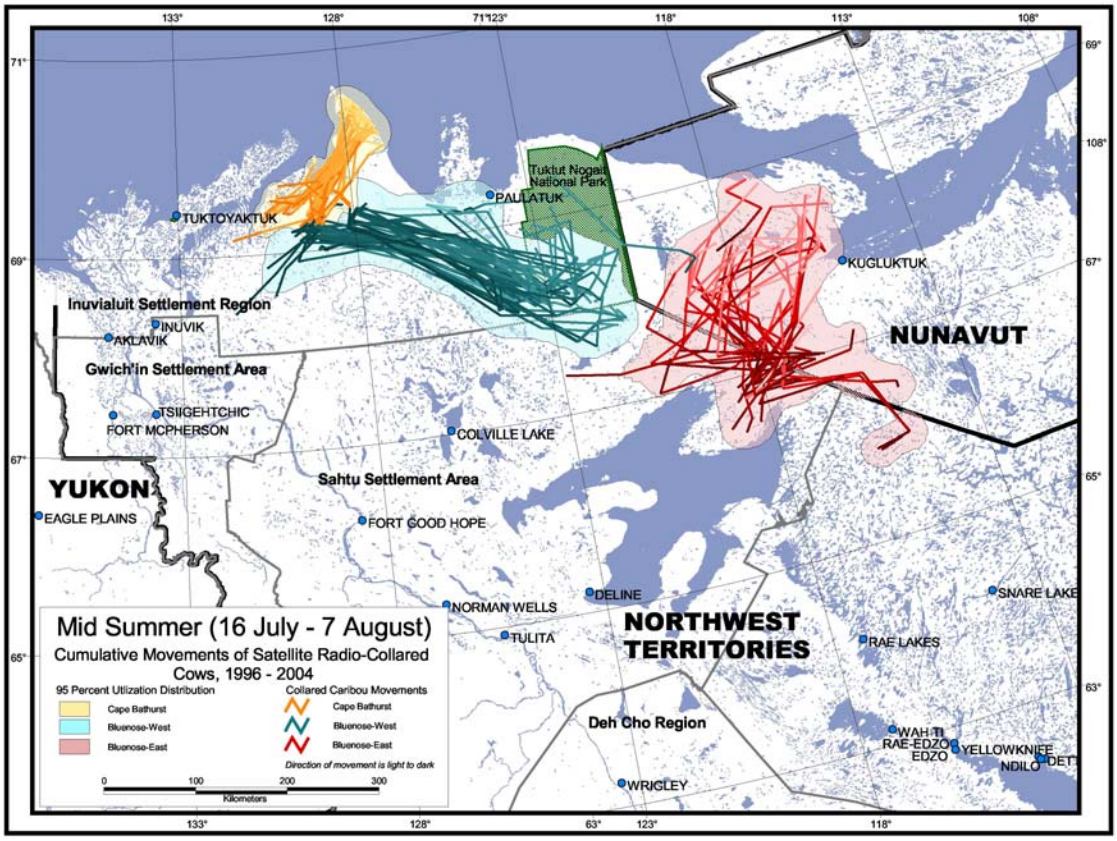


Figure 7. Late summer ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

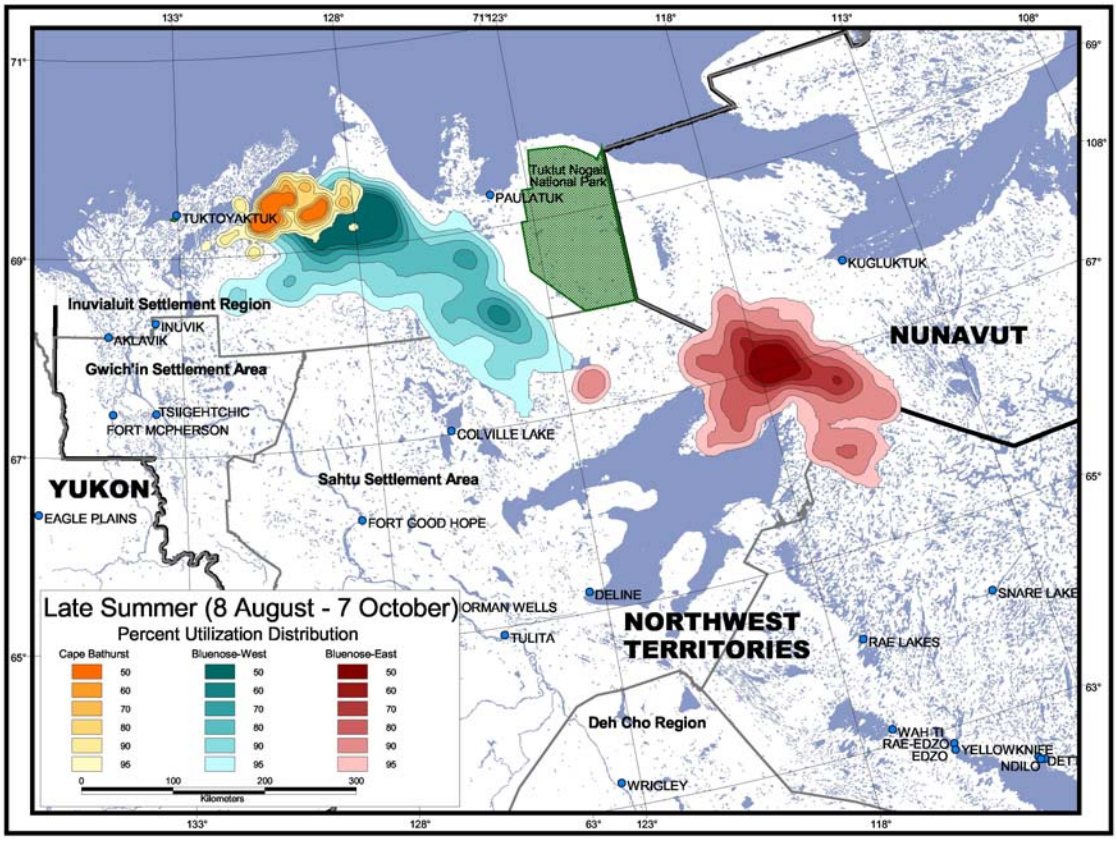


Figure 8. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the late summer season.

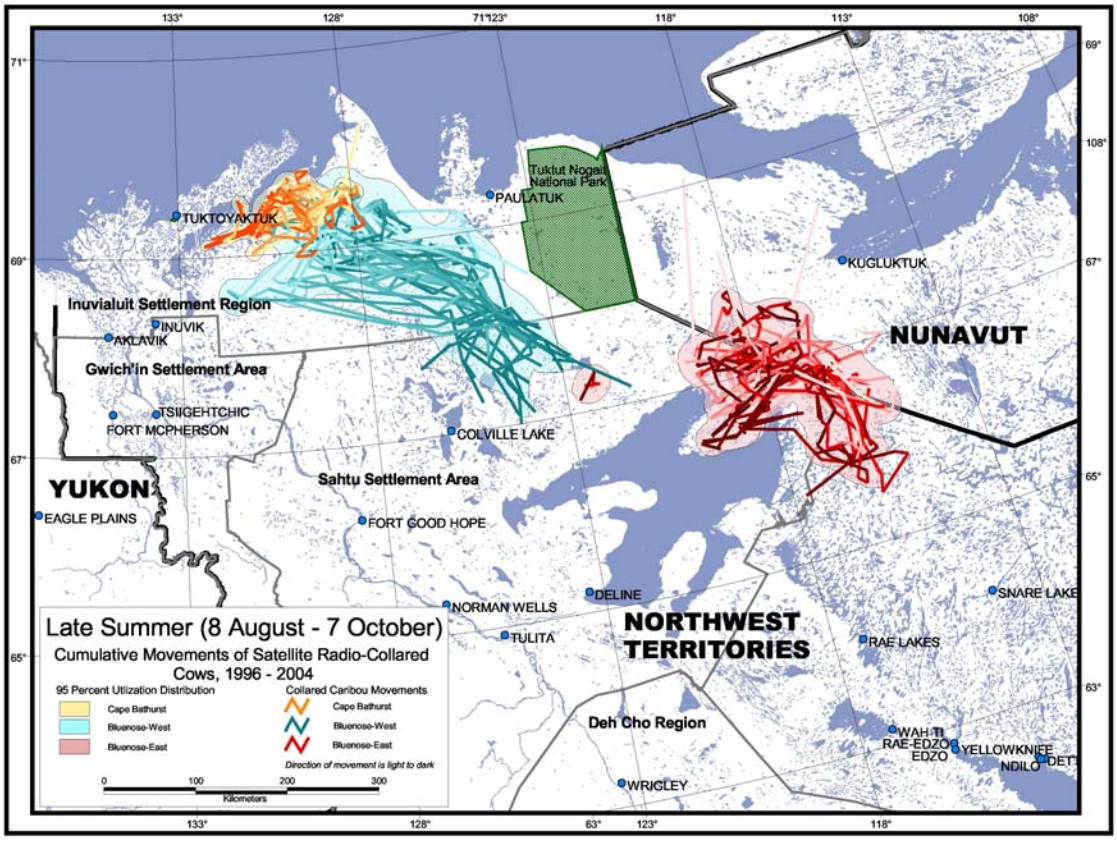


Figure 9. Fall/rutting ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

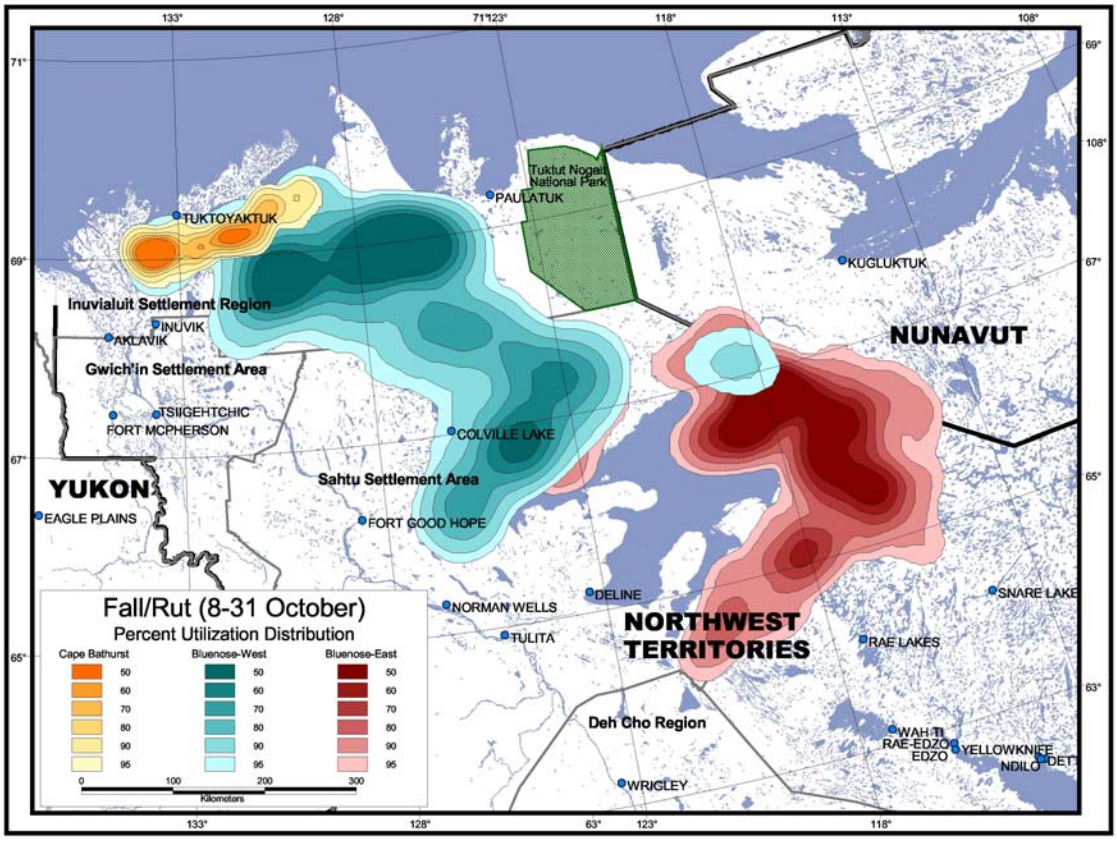


Figure 10. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the fall/rutting season.

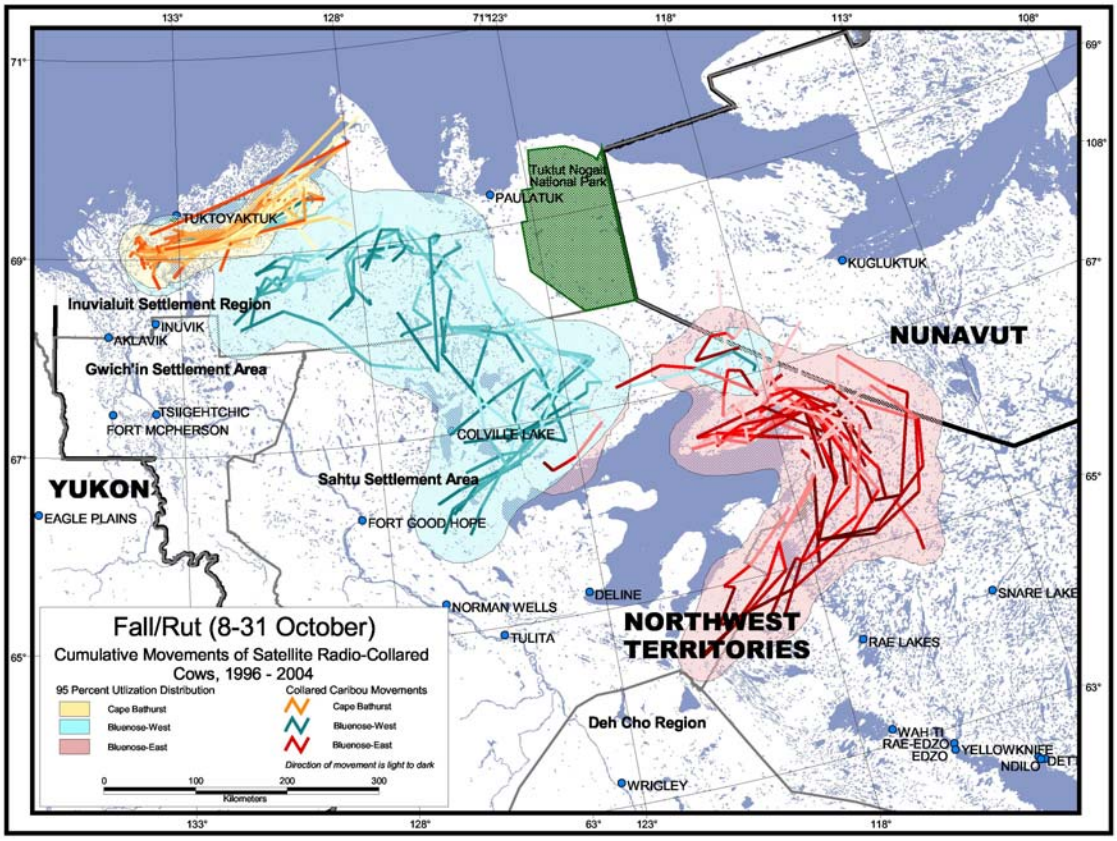


Figure 11. Fall/post rutting ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

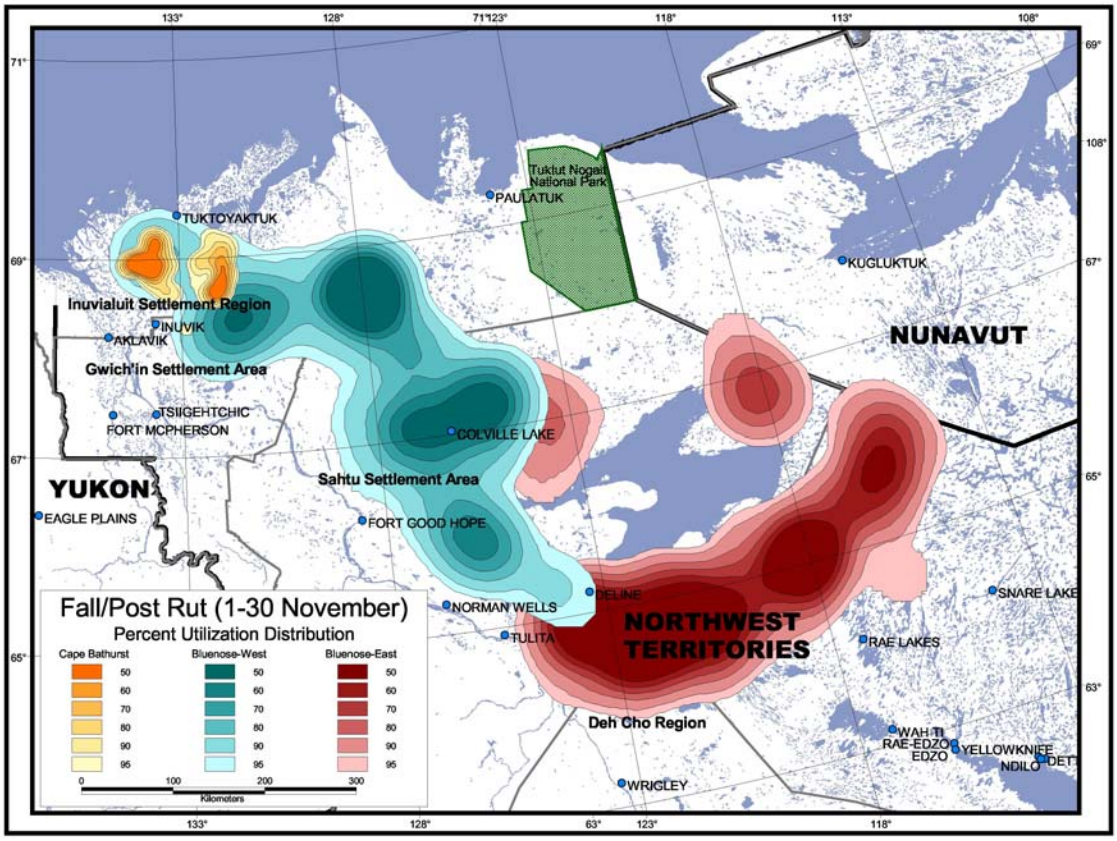


Figure 12. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the fall/post rutting season.

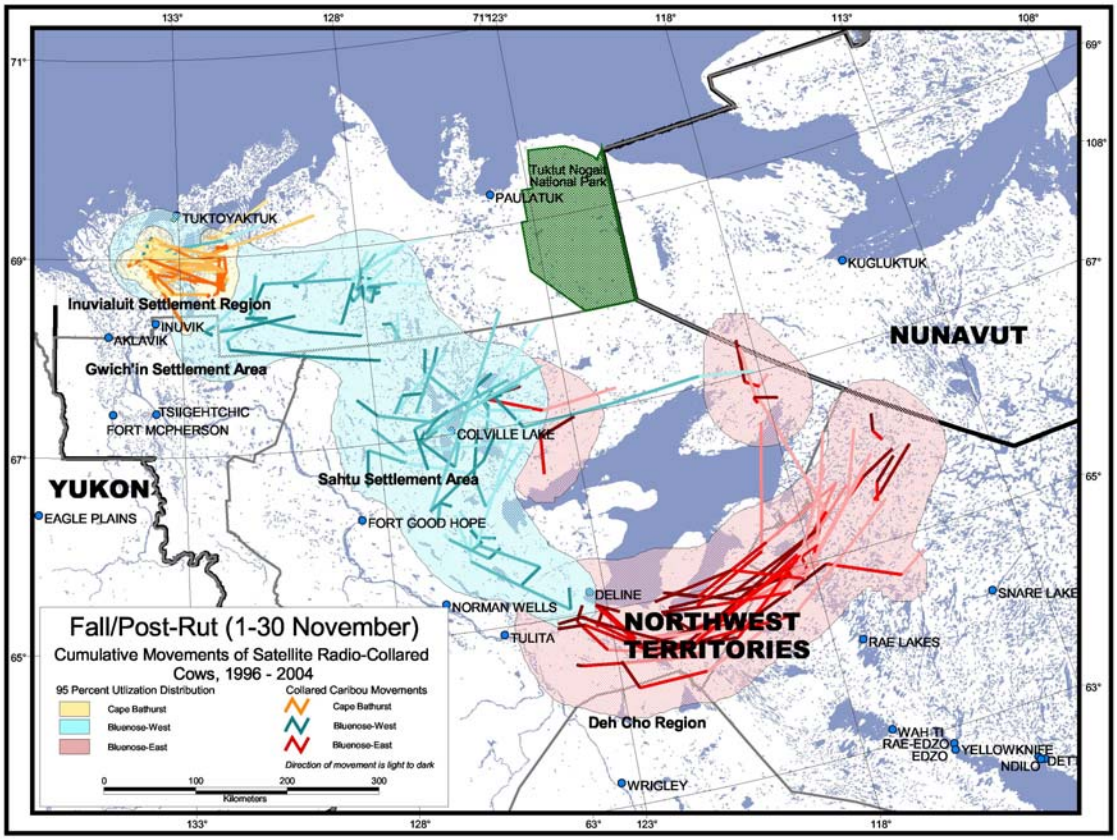


Figure 13. Winter ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

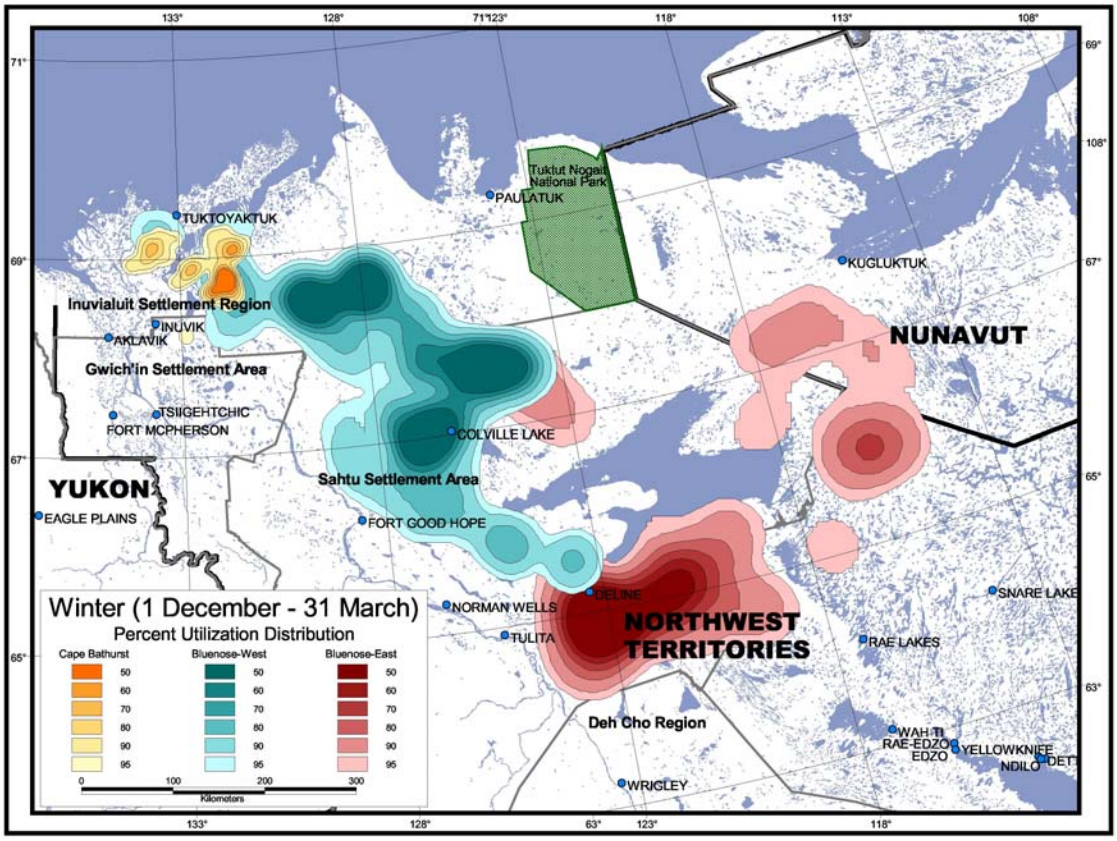


Figure 14. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the winter season.

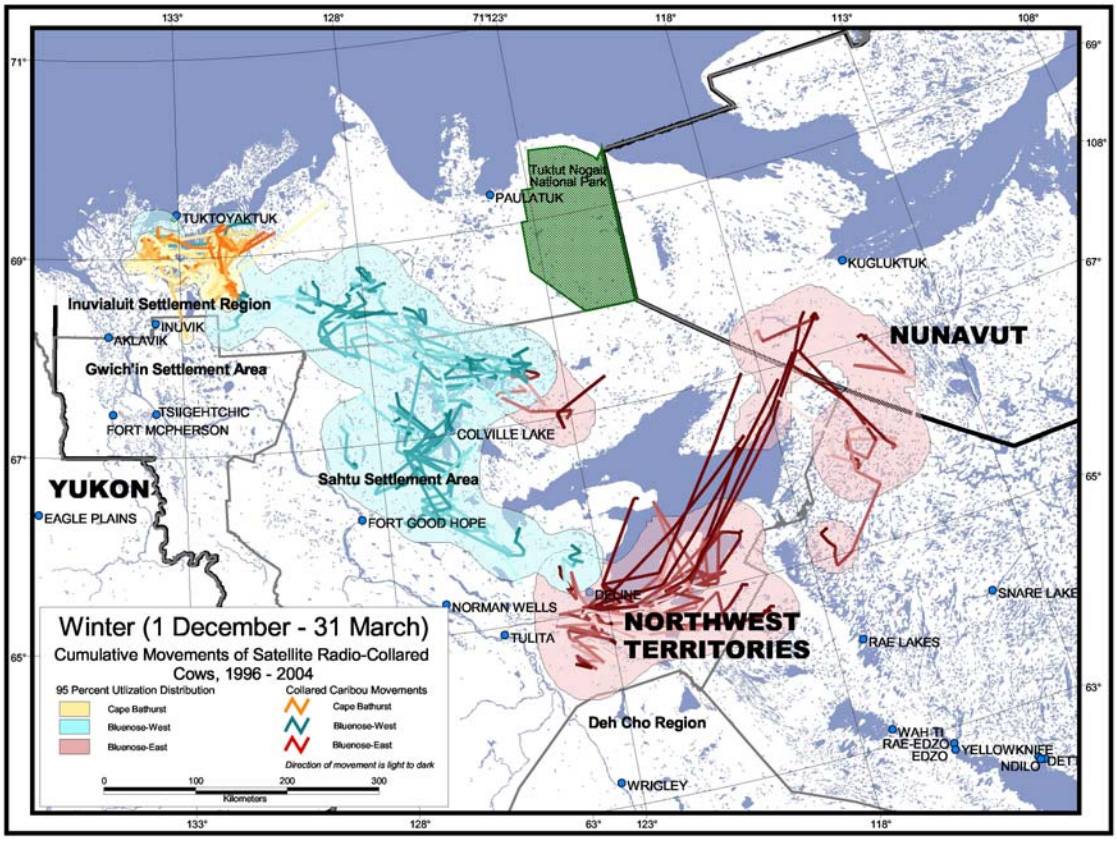


Figure 15. Spring, spring migration, and pre-calving ranges of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds.

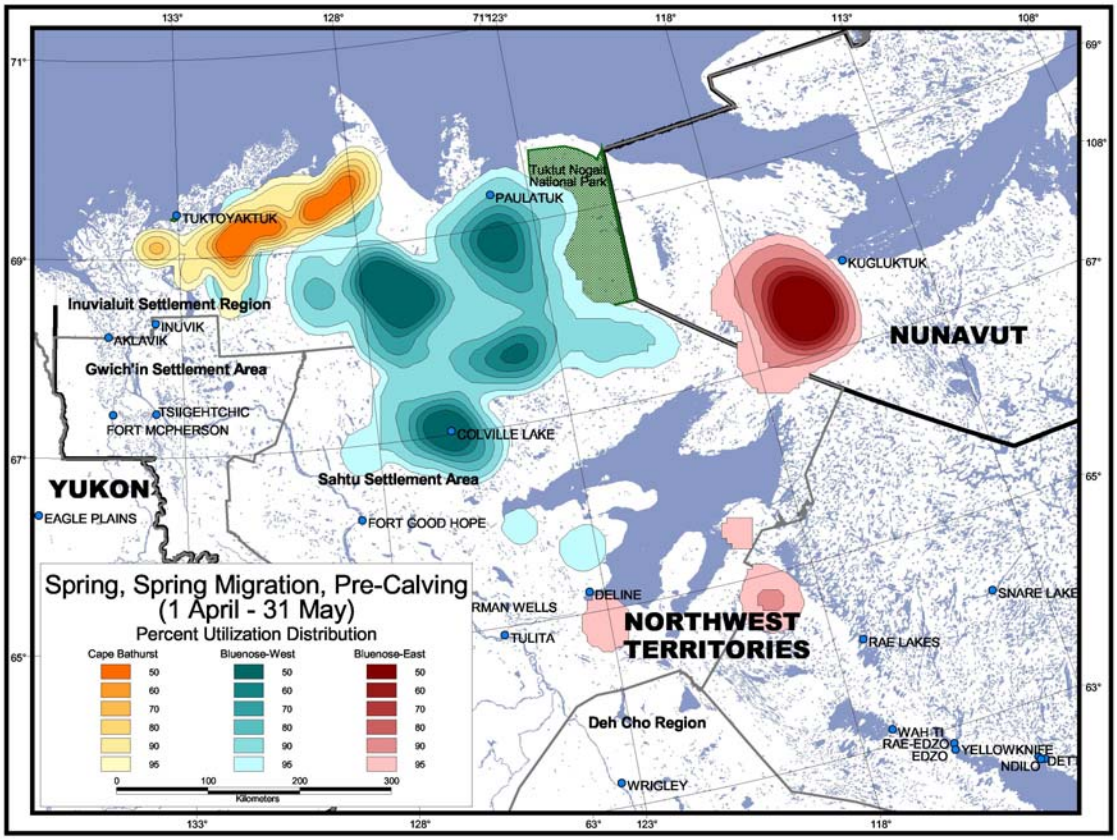


Figure 16. Movements of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herds during the spring, spring migration, and pre-calving season.

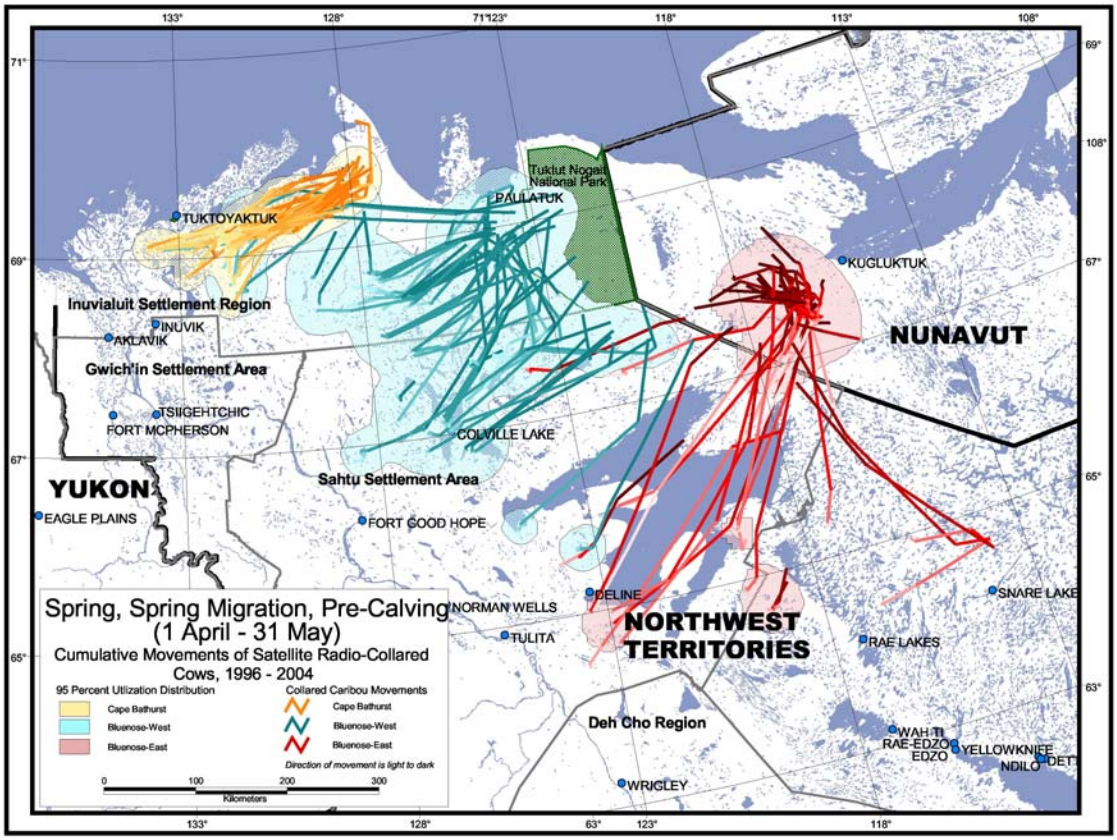


Figure 17. One satellite collared Bluenose-East caribou wintered with the Bathurst herd near Yellowknife during winter 1999-2000, but returned to its normal early summer range by late June 2000.

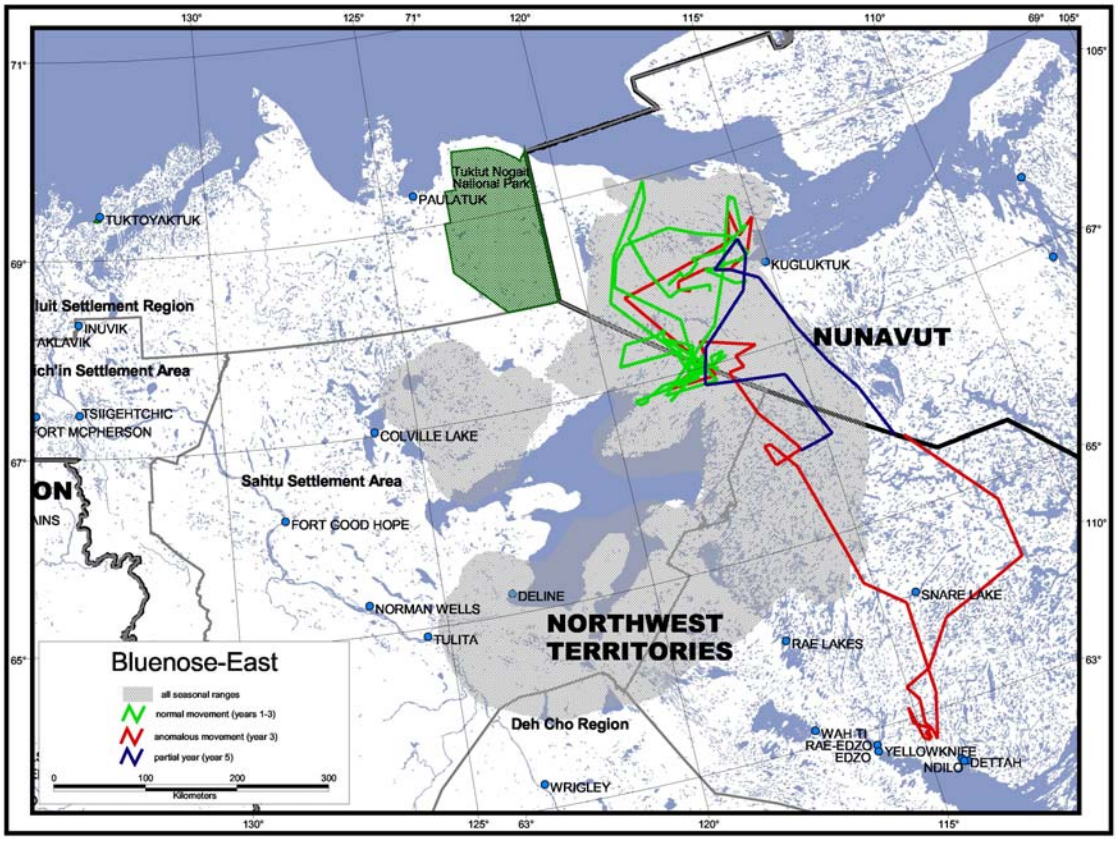


Figure 18. Two satellite collared Cape Bathurst caribou wintered on the Bluenose-West winter range near Colville Lake during winter 2003-2004.

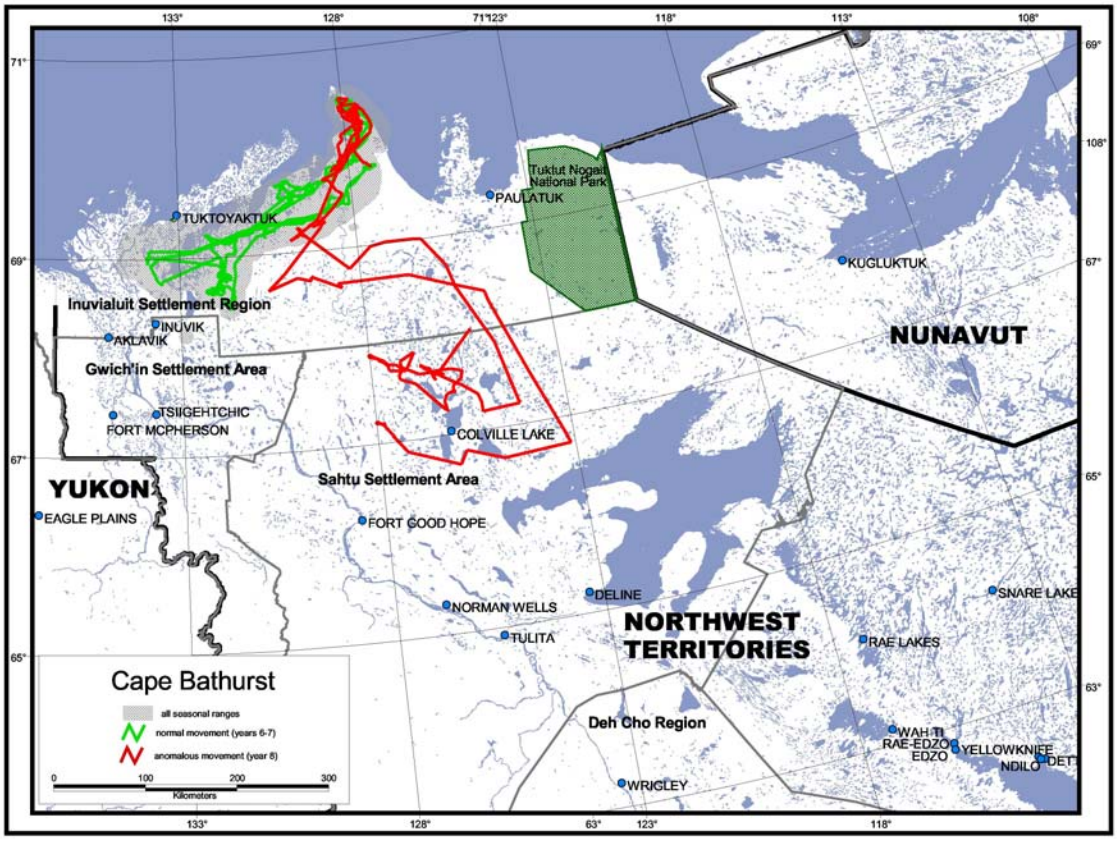


Figure 19. Frequency of caribou use of areas within the range of the Cape Bathurst barren-ground caribou herd.

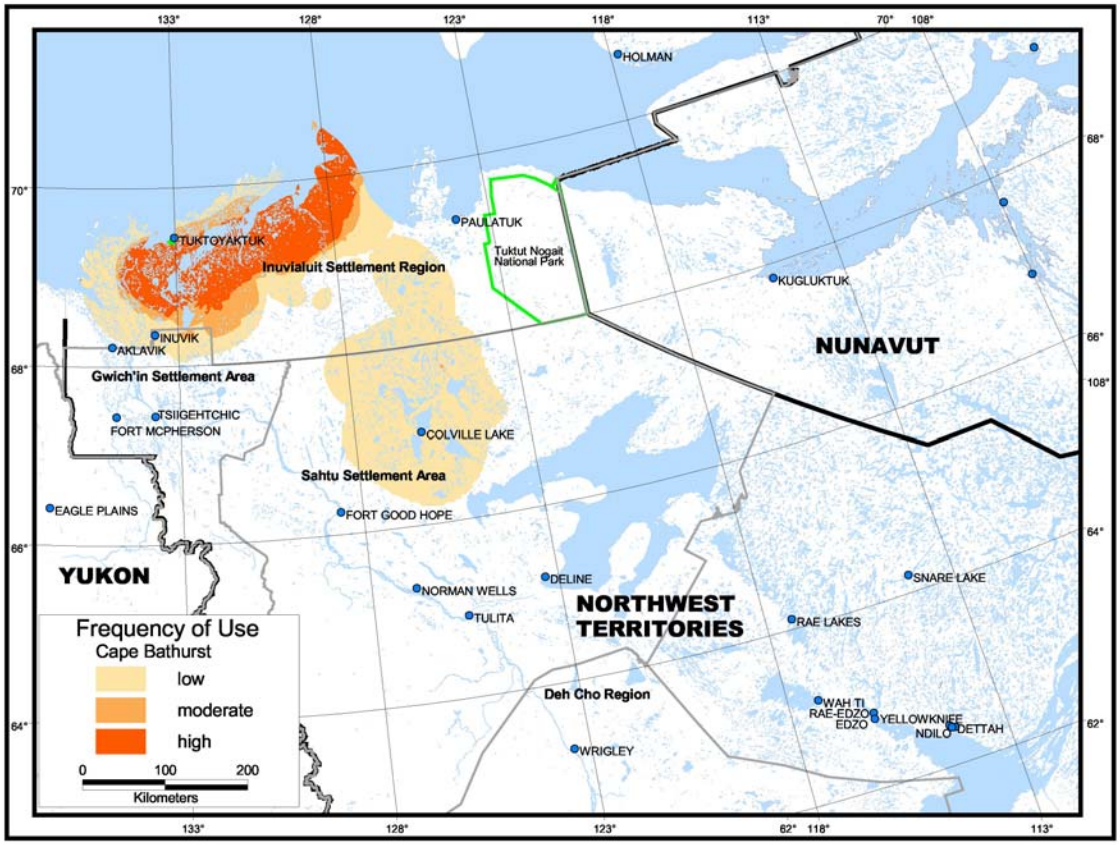


Figure 20. Frequency of caribou use of areas within the range of the Bluenose-West barren-ground caribou herd.

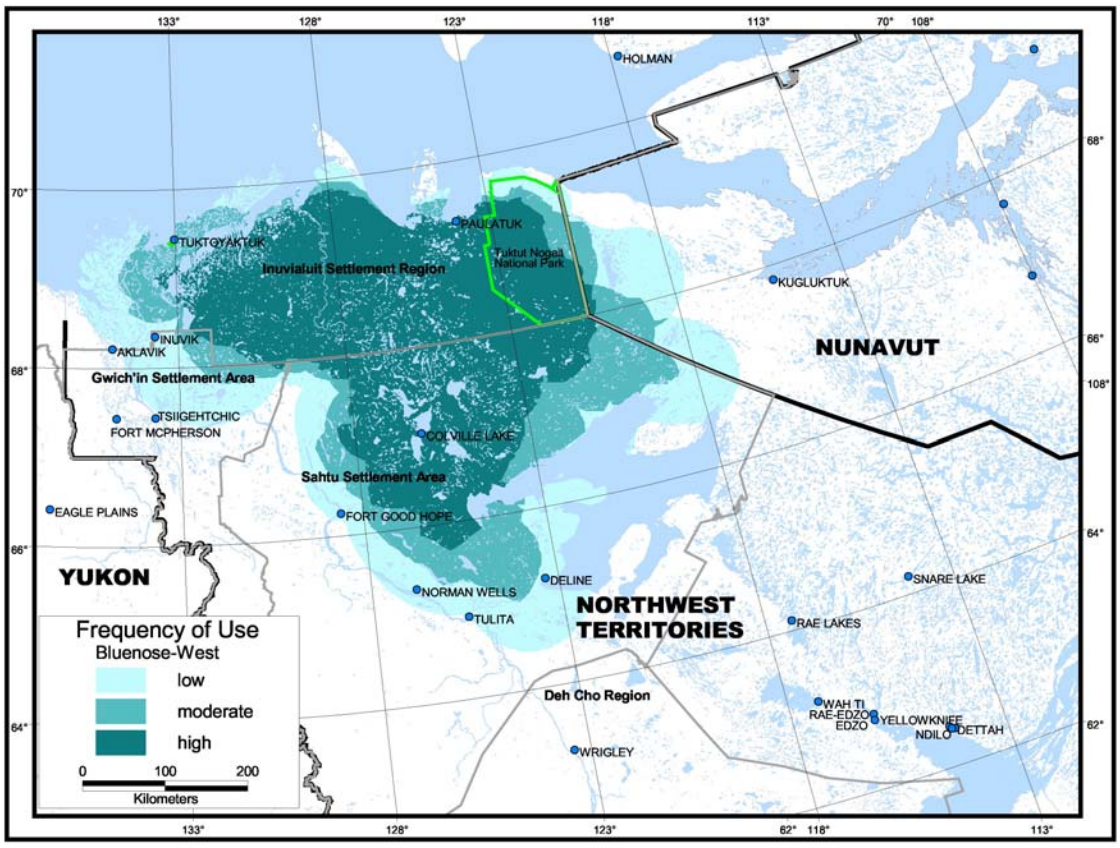


Figure 21. Frequency of caribou use of areas within the range of the Bluenose-East barren-ground caribou herd.

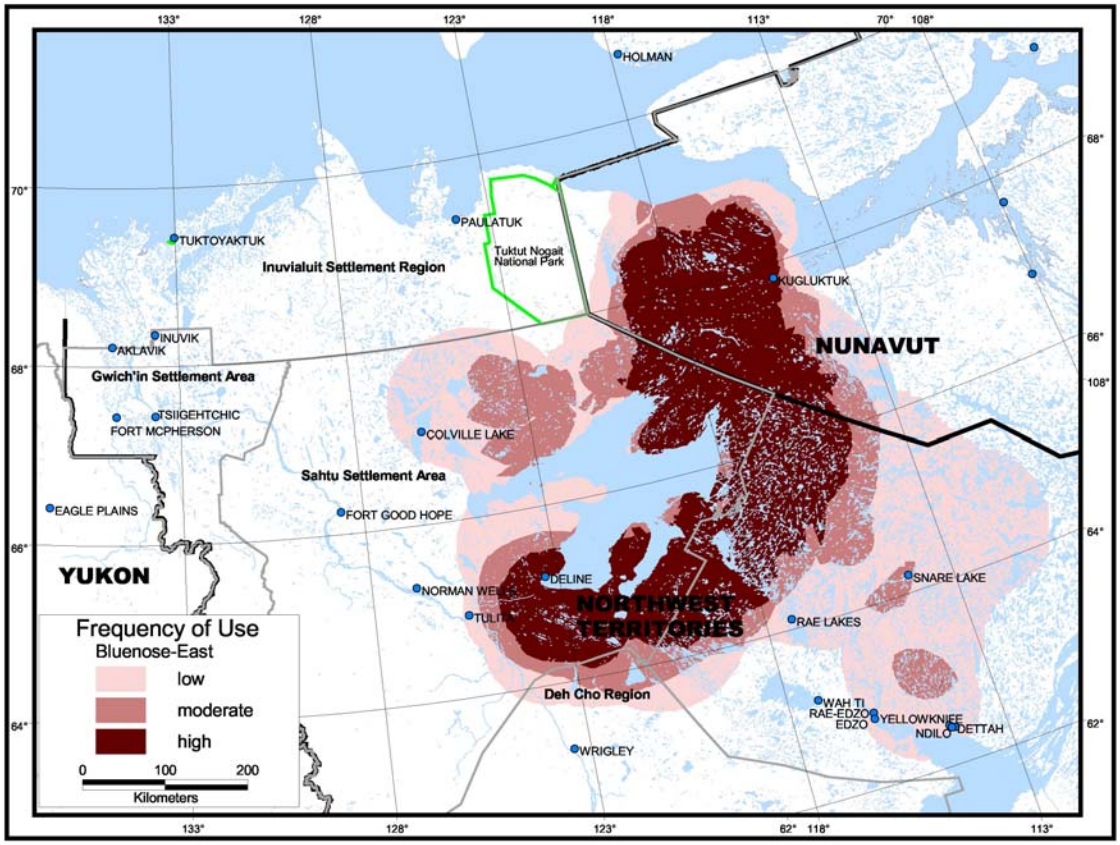
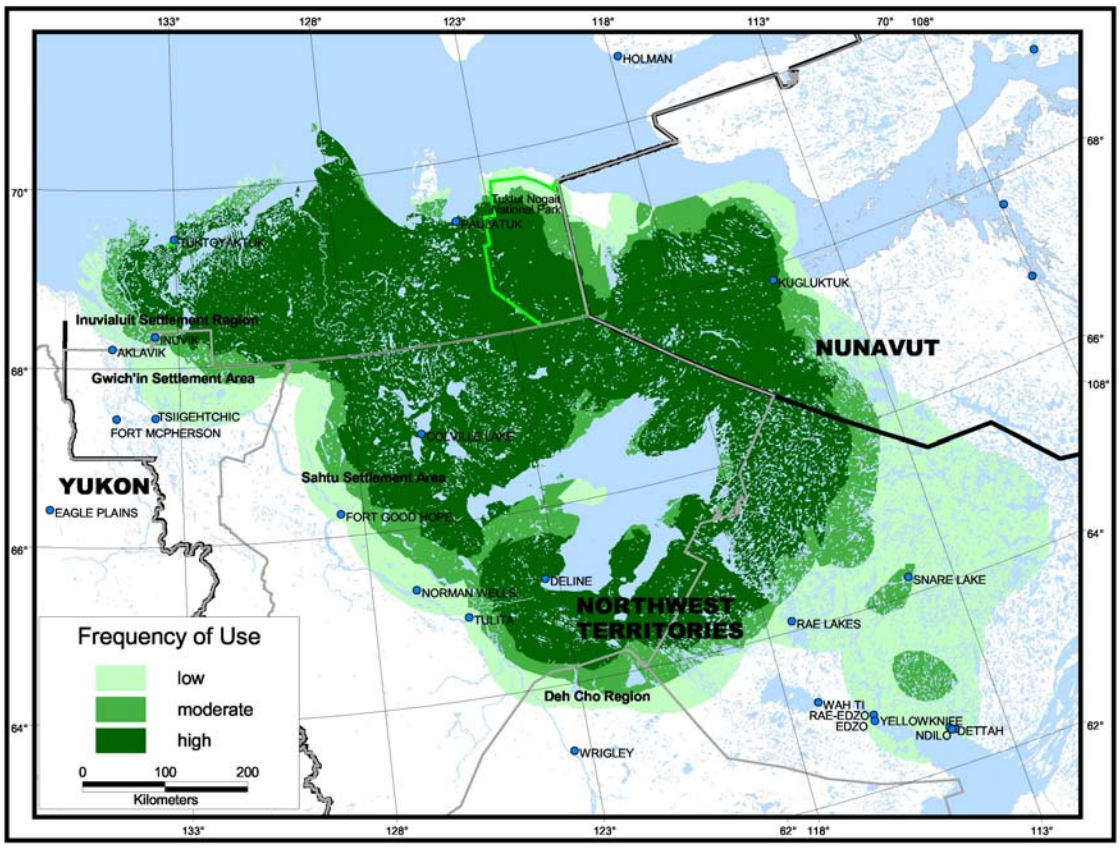


Figure 22. Frequency of caribou use of areas within the cumulative range of the Cape Bathurst, Bluenose-West, and Bluenose-East barren-ground caribou herd.



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Subpopulation structure of caribou (*Rangifer tarandus* L.) in arctic and subarctic Canada

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Abstract. Effective management and conservation of species, subspecies, or ecotypes require an understanding of how populations are structured in space. We used satellite-tracking locations and hierarchical and fuzzy clustering to quantify subpopulations within the behaviorally different barren-ground caribou (*Rangifer tarandus groenlandicus*), Dolphin and Union island caribou (*R. t. groenlandicus* × *pearyi*), and boreal (*R. t. caribou*) caribou ecotypes in the Northwest Territories and Nunavut, Canada. Using a novel approach, we verified that the previously recognized Cape Bathurst, Bluenose-West, Bluenose-East, Bathurst, Beverly, Qamanirjuaq, and Lorillard barren-ground subpopulations were robust and that the Queen Maude Gulf and Wager Bay barren-ground subpopulations were organized as individuals. Dolphin and Union island and boreal caribou formed one and two distinct subpopulation, respectively, and were organized as individuals. Robust subpopulations were structured by strong annual spatial affiliation among females; subpopulations organized as individuals were structured by migratory connectivity, barriers to movement, and/or habitat discontinuity. One barren-ground subpopulation used two calving grounds, and one calving ground was used by two barren-ground subpopulations, indicating that these caribou cannot be reliably assigned to subpopulations solely by calving-ground use. They should be classified by annual spatial affiliation among females. Annual-range size and path lengths varied significantly among ecotypes, including mountain woodland caribou (*R. t. caribou*), and reflected behavioral differences. An east–west cline in annual-range sizes and path lengths among migratory barren-ground subpopulations likely reflected differences in subpopulation size and habitat conditions and further supported the subpopulation structure identified.

Key words: arctic; calving grounds; caribou; clustering; fuzzy clustering; hierarchical linkage; home range; path length; Rangifer tarandus; *space use; subarctic; subpopulation.*

Introduction

Management, conservation, and biodiversity of species, subspecies, or ecotypes can only be addressed effectively if we understand how populations are structured in space. Andrewartha and Birch (1984) concluded that "natural populations" consist of many interbreeding "local populations," and that dispersal among them is almost certain. Little or no dispersal is expected among natural populations because they are isolated by barriers to movement. Wells and Richmond (1995) recommended that when groups of individuals are "spatially, genetically, or demographically" separated from each other the term population should be used, and when they are not, one should use the terms "group, subpopulation, or local population." Berryman (2002), attempting to clarify the terminology, defined a population as "a group of individuals of the same species that live together in an area of sufficient size to permit normal dispersal and/or migration behavior and in which numerical changes are largely determined by birth and death rates." Schaefer (2006), however, argued that Berryman's (2002) definition included vague and ambiguous terms like "together," "sufficient," "normal," and "largely" that are open to interpretation. Further,

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Harwood (2009) argued that "we cannot assign an individual to the population unless we have defined the population and we cannot define the population until we have assigned all of the individuals." Without an unambiguous definition, "we can only sample an area, and our sample cannot be assumed to be representative of more than this" (Harwood 2009).

A number of techniques have been used to identify subpopulations of animals for research and management, including comparing the spatial distribution of individuals with that of a random distribution (Amarasekare 1994), hierarchical and/or fuzzy classification of movement data (Bethke et al. 1996, Schaefer et al. 2001, Klaver et al. 2008), movement and mtDNA data (Calambokidis et al. 2001), DNA data (Barr et al. 2008), and carbon and nitrogen stable isotopes (Witteveen et al. 2009). However, Harwood (2009) argued that populations are composed of a number of individuals whose membership in a population is determined by a "relevant degree of interaction" or connectivity to the rest of the population. Thus he argues that populations are defined by the "relationship between individuals" and not by "an externally imposed classification."

Social relationships determine the degree of interaction or connectivity expected among individuals within a species, subspecies, or ecotype. As a result, behaviors such as spatial tenure (e.g., territories or overlapping home ranges), degree of sociality (e.g., solitary or gregarious), and movement ecology (e.g., migratory or nonmigratory) determine, in part, how populations are structured. It is reasonable to hypothesize that populations of solitary or gregarious and migratory or nonmigratory species may be structured differently. It is also reasonable to assume that populations are structured by area fidelity, habitat discontinuity, resource distribution in continuous habitats, and barriers to movement.

The objective of our study was to quantify the subpopulation structure of four behaviorally different ecotypes of caribou, including migratory and tundra-wintering barren-ground (*Rangifer tarandus groenlandicus*), Dolphin and Union island (*R. t. groenlandicus* × *pearyi*), and boreal (*R. t. caribou*) caribou in northern Canada using satellite telemetry data. Although we had insufficient location data to assess the subpopulation structure of the mountain woodland ecotype (*R. t. caribou*), we included information about their use of annual ranges for comparison. Migratory barren-ground caribou are usually found in large groups, and females collectively migrate annually between winter ranges near or below tree line and calving grounds on the tundra (Banfield 1954). Tundra-wintering barren-ground caribou remain above tree line year round (Calef and Heard 1981), but little is known about their ecology. Seasonal movements and activities are synchronized among female barren-ground caribou (Maier and White 1998). Dolphin and Union island caribou also remain above tree line throughout the year. They collectively migrate over the sea ice between calving to autumn ranges on Victoria Island, where they are geographically isolated from barren-ground caribou, and their winter ranges on mainland Nunavut (NU). Boreal caribou are sedentary and remain largely within the boreal forest throughout the year. Females are solitary (i.e., cows, cow–calf pairs) during precalving to late summer, and form mixed-sex groups of 3–8 or more caribou the rest of the year (Stuart-Smith et al. 1997, Metsaranta and Mallory 2007). Activities of female boreal caribou are coordinated in time but not in space, and are thus more independent of conspecifics than female barren-ground caribou. Mountain woodland caribou occur in small groups most of the year and migrate annually to calving grounds in the mountains. Barren-ground caribou females have been assigned to subpopulations based on the belief that they aggregate on and maintain fidelity to specific calving grounds (Skoog 1968, Miller 1982). In contrast, boreal and Dolphin and Union island caribou disperse to calve (Bergerud et al. 2008).

We hypothesized that subpopulations of caribou within these ecotypes are largely structured by the degree of spatial affiliation that exists among individuals, migratory connectivity, habitat discontinuity, and/or barriers to movement, and that these structures and behaviors could be quantified using hierarchical and fuzzy clustering. Because there are nine barren-ground caribou calving grounds in the Northwest Territories (NT) and Nunavut (Fig. 1), we hypothesized that there should be nine subpopulations that are organized around the annual movements of females that used them. Because association during calving represents only a brief period in an annual cycle, we extended the definition of subpopulation to a more inclusive perspective that includes individuals that are spatially affiliated throughout most or all of the year. Female Dolphin and Union island caribou are most strongly affiliated during spring and fall migrations, so we hypothesized that there should be one subpopulation that is organized as individuals and is structured by migratory connectivity and barriers to movement. Because boreal caribou are dispersed over the landscape and are weakly affiliated during much of the year, we hypothesized that there should be one subpopulation organized as individuals, and, if subpopulations exist, they are primarily structured by habitat discontinuity. Because the behaviors of ecotypes and the distribution of resources within their subpopulation ranges vary, we hypothesized that this variation should be manifested in two ecologically important factors: annual home range size and path length.

Methods

Satellite-tracking studies undertaken in the Northwest Territories and Nunavut have varied over time with study objectives (Appendix A). Caribou were captured and handled according to standard operating procedures of the

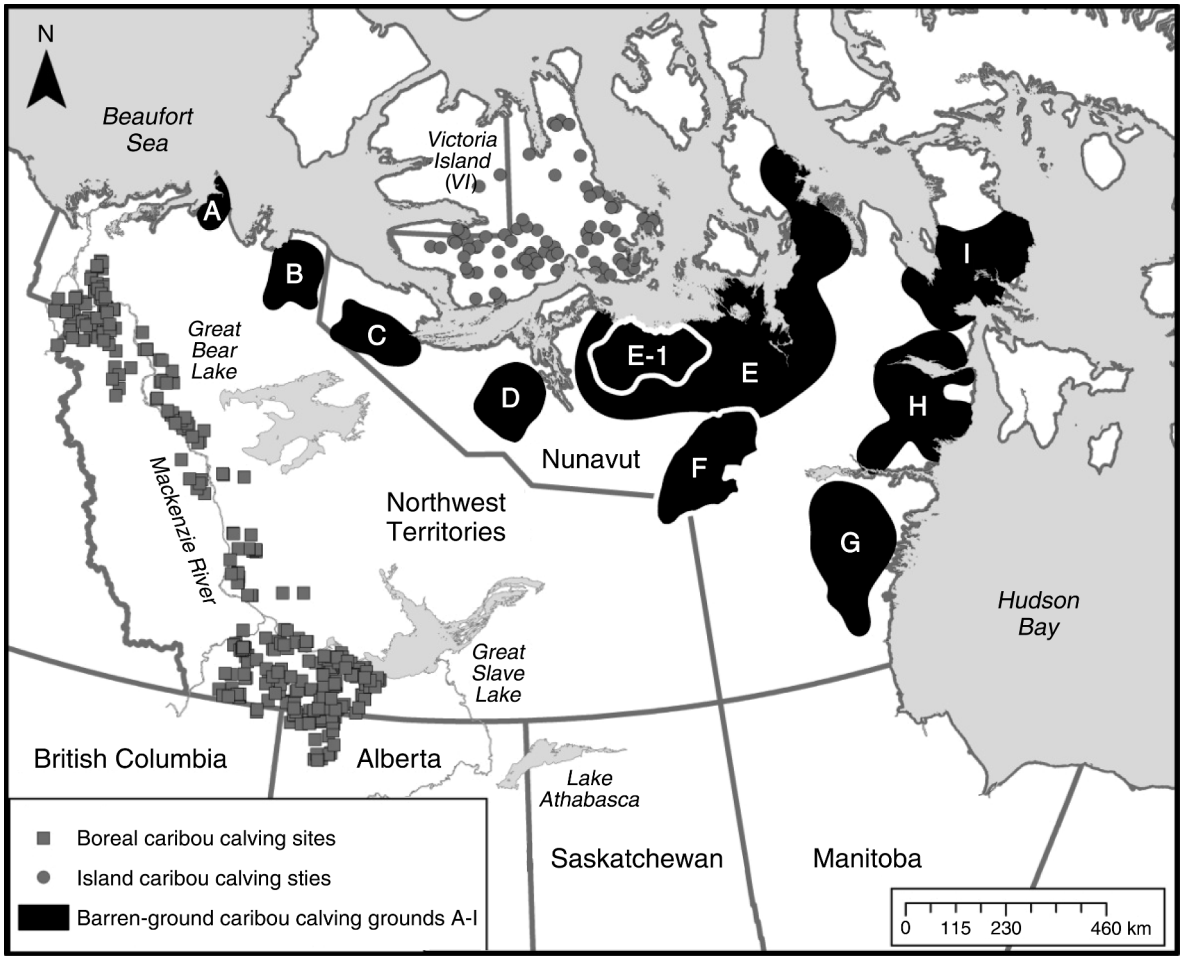

FIG. 1. Barren-ground, Dolphin and Union island, and boreal caribou calving grounds or calving sites in the Northwest Territories, Nunavut, and northern Alberta (J .A. Nagy, *unpublished data*). See *Methods* and Table 3 for the individual calving grounds.

Northwest Territories Wildlife Care Committee or Nunavut Wildlife Live-capture Protocols (Campbell 2002) following methods in compliance with the Canadian Council on Animal Care. Animals were equipped with either ARGOS Doppler shift (DS) or Global Positioning System (GPS) satellite collars (Telonics, Mesa, Arizona, USA and Service Argos, Landover, Maryland, USA). DS and GPS collars provided locations on 1–10 day and 0.33–1 day intervals, respectively, although most DS collars provided locations on 1–5 day intervals. Locations were recorded as longitude and latitude coordinates and projected to the NAD 1983 projection datum of the North America Lambert Conformal Conic coordinate system. We convert longitude and latitude data to x, y coordinates using Hawth's Tools (Beyer 2007). All geographic information system (GIS) analyses used ArcMap 9.3 (Environmental Systems Research Institute, Redlands, California, USA).

We used sums-of-squares agglomerative hierarchical linkage (Ward's [Bethke et al. 1996]) and fuzzy c-means clustering methods (Schaefer et al. 2001) to identify and validate caribou subpopulations (Kos and Psenicka 2000). We conducted hierarchical clustering using PC-ORD 5 (MjM Software Design, Gleneden Beach, Oregon, USA) and STATA 9 (STATCORP, College Station, Texas, USA), with the number of distinct subpopulations indicated by a sharp rise in the values of the post-hierarchical clustering Duda-Hart pseudo test (Rabe-Hesketh and Everett 2007). We conducted fuzzy c-means clustering using the program FUZME 2.0 (Minasny and McBratney 2002), with the diagonal distance transformation option to standardize measurements to equal variance and prevent y-coordinates from dominating x-coordinates (McBratney and Moore 1985, Klaver et al. 2008). We specified fuzzy exponents (m) in increments of 0.1 from 1.5 to 3.0 (Odeh et al. 1992*b*,) and 2–15 potential subpopulations for barren-ground caribou and 2–99 potential subpopulations for boreal and Dolphin and Union island caribou. A maximum of 99 potential subpopulations can be specified in FUZME 2.0. The fuzzy performance index (FPI) and normalized classification entropy (NCE) validity functions were

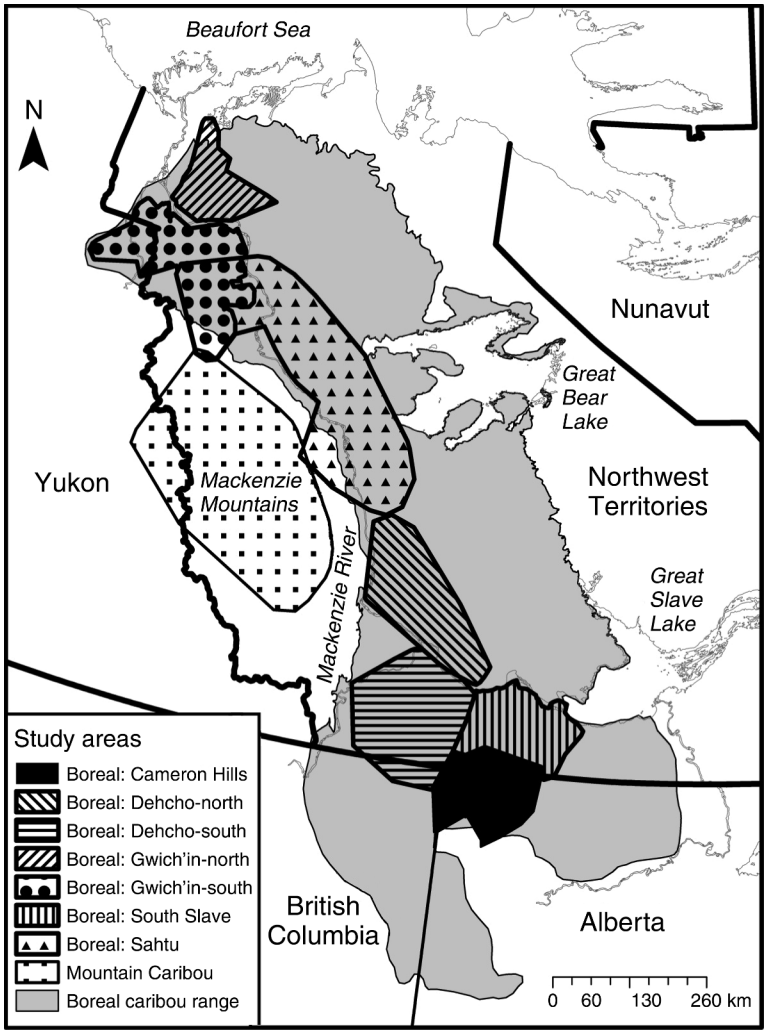

FIG. 2. Location of the boreal and mountain (Mackenzie Mountains) caribou study areas in the Northwest Territories and northern Alberta, Canada.

used to identify the optimal number of subpopulations (Odeh et al. 1992*a*).

Fuzzy clustering is sensitive to data configuration (Ohashi 1984). Our data spanned ~2400 km east–west, with the north–south span increasing from ~500 km in the west to 1600 km in the east. Fuzzy cluster analyses of all caribou data combined were affected by the predominantly east–west orientation of the data. For example, with each incremental increase in m from 2.0 to 3.0, more Dolphin and Union island caribou were assigned to adjacent barren-ground caribou subpopulations. We resolved configuration issues by analyzing data for (1) migratory barren-ground caribou using calving grounds A, B, C, D, E-1, and F (west-central); (2) migratory barren-ground caribou using calving grounds C, D, E-1, and F, and Dolphin and Union island caribou (central); (3) migratory and tundra-wintering barren-ground caribou using calving grounds E including area E-1, F, G, H, and I (east-central; Fig. 1); and (4) boreal caribou separately (Fig. 2). Females using calving grounds E-1 and F provided continuity between the classifications of western and eastern migratory barren-ground caribou.

For cluster analyses, we subsampled the data to a 5-day interval because interlocation intervals varied among studies, and included individuals with four or more locations per month and full years of data in our analyses to reduce sampling bias. We used matrices of median monthly interval x, y coordinates for west-central, central, and boreal caribou (24 variables), and 14-day interval x, y coordinates for east-central caribou (52 variables [Bethke et al. 1996]). We used the median location to account for data asymmetries (Sokal and Rohlf 1995). We used higher-resolution x, y coordinate data for the east-central area to increase the probability of separating migratory and tundra-wintering caribou subpopulations.

We used stepwise analyses (1) to identify distinct well-organized (distinct) subpopulations (Triantafilis et al. 2001), and (2) to determine if they were robust or organized as individuals. For distinct subpopulations (step one), the Duda-Hart pseudo t test and the validity functions had to indicate the same number of subpopulations (Schaefer et al. 2001), $\geq$90% of individuals had to be assigned to the same subpopulations by hierarchical and fuzzy ($m = 2.0$) clustering, and $\geq$90% of the individual had to be consistently assigned to the same subpopulation by fuzzy clustering for most values of m. We determined assignment consistency by comparing each individual's subpopulation assignment at $m = 2.0$ (moderate level of fuzziness) with those at $m = 1.5$–1.9 (less fuzzy) and m = 2.1–3.0 (more fuzzy).

To determine if distinct subpopulations were robust or organized as individuals (step two), we conducted fuzzy clustering on the data for individuals that were assigned to each subpopulation for $m = 2.0$ in step one. We only used fuzzy clustering because hierarchical clustering will generate group structures even when none exist (Pillar 1999). For robust subpopulations, the fuzzy clustering validity functions had to be $\geq$0.90 for most $m \geq 2.0$, indicating that there were no significant substructures in the data and females were strongly spatial affiliated. For distinct subpopulations that were not robust, the validity functions either indicated that (1) there were significant substructures in the data, or (2) females were organized as individuals. If significant substructures were indicated and sample sizes were adequate, we repeated step two until analyses indicated subpopulations were robust or were organized as individuals. Subpopulations were organized as individuals if the validity functions approached 0 when the specified number of potential subpopulations equaled n. Individuals in these subpopulations were spatially independent of each other and were primarily structured by migratory connectivity, habitat discontinuity, and/or barriers to movement.

Utilization distributions

We used the GIS program Home Range Tool (HRT [Rodgers et al. 2007]) to generate fixed-kernel utilization distributions (50, 60, 70, 80, 90, and 95% UD) for each barren-ground, island, and boreal caribou. We used the reference bandwidth, a raster cell size of 1000 m, and minimized the extent of each UD. We calculated mean 90% UD for barren-ground caribou that were assigned to each subpopulation by hierarchical and fuzzy clustering (excluding females that used multiple calving grounds) and island caribou. We considered the mean 90% UD as the core range of barren-ground and island caribou subpopulations, but where appropriate, we clipped them to the coastline to exclude marine areas that were not used. We mapped boreal caribou subpopulation core ranges by merging all individual 90% UD. Each caribou contributed equally to the delineation of subpopulation core ranges.

Home range size and migratory path length

We generated annual (calculated from the date of capture) minimum convex polygons (MCPs) and paths (straight-line distances between sequential locations) for each caribou using Hawth's Tools (Beyer 2007). To ensure an unbiased sample, we included data for GPS- and DS-collared individuals with $\geq$329 locations each year (90% of possible locations for one-day interlocation interval collars) and $\geq$66 locations each year (90% of possible locations for a five-day interlocation interval collar), respectively. We measured MCP areas and path lengths, standardized these to 365 days (areas or length divided by number of days tracked $\times$ 365), and normalized them using a $\log_{10}$ transformation. We used ANOVA and Tukey's honestly significant difference (hsd) pairwise comparisons (SPSS 11.5, Chicago, Illinois, USA [Maier and White 1998]) to determine if MCP areas and path lengths varied significantly among ecotypes, study areas (boreal caribou), and subpopulations (migratory and tundra-wintering barren-ground caribou). We analyzed DS and GPS collar data separately, because MCP areas and path lengths are influenced by sample size (Borger et al. 2006).

Results

We obtained full years of data for 360 barren-ground, 140 boreal, 10 mountain woodland, and 25 island caribou (Tables 1 and 2 and Appendix B). We excluded 11 barren-ground caribou from analyses: seven because they remained on late winter ranges during the calving period, three had insufficient data, and one because its activity areas were located between but overlapped the distribution of the Beverly and Qamanirjuaq barren-ground subpopulations. Cluster analyses produced unusable results when this animal was included. For barren-ground caribou with $\geq$1.95 years of data, 91.4% (180/197), 8.1% (16/197), and 0.5% (1/197) used one, two, and three calving grounds, respectively. A tundra-wintering barren-ground caribou used three calving grounds.

Migratory barren-ground caribou formed six distinct and robust subpopulations including the Cape Bathurst, Bluenose-West, Bluenose-East, Bathurst, Beverly, and Qamanirjuaq (Table 3). Tundra-wintering barren-ground caribou formed three distinct subpopulations: the Lorillard was robust, and the Queen Maude Gulf and Wager Bay were organized as individuals (Table 3). Dolphin and Union island caribou formed one distinct subpopulation that was organized as individuals. Boreal caribou formed two distinct subpopulations that were organized as individuals.

Two factors influenced analyses of east-central caribou data: (1) ranges of migratory and tundra-wintering caribou overlapped in this area, and (2) the Beverly subpopulation was changing use of calving grounds. By using a two-step analytical approach we separated individuals belonging to these ecotypes. Step one indicated three distinct subpopulations dominated

TABLE 1. Numbers of female caribou tracked with satellite collars for full years and included in hierarchical and fuzzy cluster analyses, by matrix interval, ecotype, subpopulation, and calendar years tracked, in the Northwest Territories, Nunavut, and northern Alberta, Canada (1993–2009).

Caribou ecotype and subpopulation†	Number of caribou tracked by calendar year‡																
	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total
A) Matrix interval: 12-month (x, y) coordinates (24 variables)																	
Migratory barren-ground																	
Cape Bathurst				5	5	4	6	5	1	8	8	4	6	14	21	23	39
Bluenose-West				2	4	5	11	9	4	5	4	2	8	13	20	25	44
Bluenose-East				3	5	9	8	7	2		3	3	17	20	22	28	51
Bathurst				7	7	18	15	14	13	7	11	13	17	16	22	18	52
Beverly			1	4	3	3		1	4	8	5	3	7	19	24	42	62
Total			1	21	24	39	40	36	24	28	31	25	55	82	109	136	248
Boreal										2	10	15	49	62	73	85	140
Dolphin and Union island							16	16	14	11	14	9	1				25
B) Matrix interval: 26 two-week (x, y) coordinates (52 variables)																	
Migratory and tundra-wintering barren-ground																	
Beverly			2	3	3	2			4	5	3	2	7	18	25	42	53
Quanmanirjuaq	4	5	7	5	9	8	8	8	8	7	6	13	10	22	22	29	61
Queen Maude Gulf				2	2	2			1	2	4	3	3	3	3	9	15
Lorillard						2	9	12	11	13	13	13	9	6	1		21
Wager Bay								4	4	3	8	7	4	2			11
Total	4	5	9	10	14	14	17	24	28	30	34	38	33	51	51	80	161

† Assignment of caribou to subpopulations was based on hierarchical and fuzzy classification (fuzzy exponent $m = 2$).
‡ Years when individuals were tracked for all or a portion of a calendar year (93 = 1993, . . . , 08 = 2008).

by Qamanirjuaq, Beverly, and tundra-wintering caribou (Table 3). Step two indicated the Qamanirjuaq-dominated subpopulation was robust (Table 3). For the Beverly-dominated subpopulation, the validity functions for $m = 1.8$–2.2 (moderate level of fuzziness) indicated three distinct subpopulations dominated by (1) females that used calving ground F but included some that used E-1 or both (Beverly A), (2) females that used calving ground E-1 but included some that used F or both (Beverly B), and (3) females that only used calving ground E including area E-1 (Queen Maude Gulf A; Table 3). Validity functions for the pooled Beverly A

TABLE 2. Numbers of full years that female caribou were tracked using satellite collars and included in hierarchical and fuzzy cluster analyses, by matrix interval, ecotype, and subpopulation, in the Northwest Territories, Nunavut, and northern Alberta, Canada (1993–2009).

Caribou ecotype and subpopulation†	Number of years caribou tracked							Total
	1	2	3	4	5	6	7	
A) Matrix interval: 12-month (x, y) coordinates (24 variables)								
Migratory barren-ground								
Cape Bathurst	13	11	8	6	1			39
Bluenose-West	22	11	6	4		1		44
Bluenose-East	25	9	8	9				51
Bathurst	12	17	11	8	4			52
Beverly	32	16	9	4	1			62
Total	104	64	42	31	6	1		248
Boreal	58	57	21	4				140
Dolphin and Union island	9	5	6	5				25
B) Matrix interval: 26 two-week (x, y) coordinates (52 variables)								
Migratory and tundra-wintering barren-ground								
Beverly	26	13	9	4	1			53
Qamanirjuaq	22	12	21	5		1		61
Queen Maude Gulf	8	5	1	1				15
Lorillard	3	6	5	1	3	2	1	21
Wager Bay	4	3	3	1				11
Total	63	39	39	12	4	3	1	161

† Assignment of caribou to subpopulations was based on hierarchical and fuzzy classification (fuzzy exponent $m = 2$).

TABLE 3. Results of hierarchical and fuzzy cluster analyses used to identify distinct and robust subpopulations of barren-ground, Dolphin and Union island, and boreal caribou in the Northwest Territories, Nunavut, and northern Alberta, Canada.

Areas and subpopulations (subpopulation calving ground)	Tests for distinct subpopulations†				
	Concordant classification			Assignment consistency (fuzzy clustering)	
	No. subpopulations	Range of m when no. subpopulations concordant	No. caribou assigned to same classes by both cluster methods	No. caribou classified consistently	Range of m
1) West-central area	5	1.9–2.9	244/248 (98.4%)	247/248 (99.5%)	$1.8 \leq m \leq 2.9$
Cape Bathurst (A)					
Bluenose-West (B)					
Bluenose-East (C)					
Bathurst (D)					
Beverly (E, F)					
2) Central area§	4	1.5–3.0	188/191 (98.4%)	190/191 (99.5%)	$1.5 \leq m \leq 3.0$
Dolphin and Union island					
3) East-central area	3	1.5–3.0	158/161 (98.0%)	160/161 (99.4%)	$1.5 \leq m \leq 3.0$
Qamanirjuaq (G)					
Beverly (E and F)	3	1.8–2.2	52/64 (82.4%)	61/64 (95.3%)	$1.2 \leq m \leq 2.2$
Beverly A					
Beverly B					
Beverly A and B					
QMG A (E)¶					
Tundra-wintering	3	$2.0 \leq m \leq 2.4$	33/36 (91.7%)	33/36 (92%)	$1.5 \leq m \leq 3.0$
QMG B (E)					
Lorillard (H)					
Wager Bay (I)					
QMG A and B (E)					
4) Boreal	2	1.5–3.0	140/140 (100%)	131/140 (93.6%)	$1.5 \leq m \leq 3.0$
Northern					
Southern					

† For subpopulations to be distinct, the post-hierarchical clustering Duda-Hart pseudo t test and both fuzzy clustering validity functions had to indicate the same number of subpopulations (Appendices C and D), ≥90% of individuals had to be assigned to the same subpopulations by hierarchical and fuzzy ($m = 2$) clustering (concordant classification; Appendix E); and ≥90% of individuals had to be consistently assigned to the same subpopulation by fuzzy clustering for most values of m (assignment consistency). Assignment consistency was determined by comparing each individual's subpopulation assignment at $m = 2.0$ (moderate level of fuzziness) with those at $m = 1.5$–1.9 and $m = 2.1$–3.0.

‡ For a subpopulation to be robust, the fuzzy clustering validity functions (fuzzy performance index and normalized classification entropy) had to be ≥0.90 for most $m \geq 2.0$, indicating that females were strongly spatially affiliated.

§ The central area also included the Bluenose-east, Bathurst, and Beverly subpopulations; results of tests for robustness are given under the west-central area.

¶ QMG is Queen Maude Gulf.

and B data indicated that these females formed one of the most robust subpopulations of migratory barren-ground caribou we examined (Table 3). The Queen Maude Gulf A females were organized as individuals (Table 3). For the tundra-wintering caribou-dominated subpopulation, validity functions for $m = 2.0$–2.4 (moderate level of fuzziness) indicated three distinct subpopulations dominated by females that used calving ground H (Lorillard), I (Wager Bay), or E (Queen Maude Gulf B), respectively (Table 3). The Lorillard subpopulation was robust (Table 3). Although Queen Maude Gulf A ($n = 11$) and B ($n = 4$) females may belong to different subpopulations, we pooled them to increase n to test for robustness. The pooled Queen Maude Gulf A and B ($n = 15$) and Wager Bay ($n = 11$) females were organized as individuals (Table 3).

All barren-ground caribou subpopulations were dominated by females that used one calving ground, except the Beverly (Table 3). The Beverly subpopulation included females that used calving ground F or E-1 or changed use from F to E-1 (Fig. 1). The Queen Maude Gulf subpopulation used calving ground E including area E-1. Therefore, we documented the use of two calving grounds by one barren-ground subpopulation and use of one calving ground by two barren-ground subpopulations.

Utilization distributions

Each subpopulation of barren-ground, island, and boreal caribou used distinct core ranges (Fig. 3). The mean area of overlap among core ranges of the robust migratory Cape Bathurst, Bluenose-West, Bluenose-East, and Bathurst barren-ground caribou subpopula-

TABLE 3. Extended.

Test for robust subpopulations (range of m when validity functions were $\geq$0.90 or minimized at individuals)‡	Subpopulation robust	No. caribou and calving grounds used
$2.3 \leq m \leq 3.0$	yes	$n = 39$, A = 36, A and B = 1, B = 2
$2.0 \leq m \leq 3.0$	yes	$n = 44$, B = 42, C = 2
$1.9 \leq m \leq 3.0$	yes	$n = 51$, C = 49, B and C = 1, D = 1
$1.8 \leq m \leq 3.0$	yes	$n = 52$, D = 45, C and D = 2, D and E = 4, E = 1
$2.0 \leq m \leq 3.0$	yes	$n = 62$, E = 46, F = 9, F and E = 7
25 individuals for $1.5 \leq m \leq 3.0$	no	$n = 25$ dispersed calving
$1.7 \leq m \leq 3.0$	yes	$n = 61$ G = 61
		$n = 21$, E = 7, F = 9, F and E = 5
		$n = 32$, E = 29, F = 1, F and E = 2
$1.9 \leq m \leq 3.0$	yes	$n = 53$, E = 36, F = 10, F and E = 7
11 individuals for $1.5 \leq m \leq 3.0$	no	$n = 11$, E = 11
small n	n/a	$n = 4$, E = 3, I = 1
$2.0 \leq m \leq 3.0$	yes	$n = 21$, H = 18, H and I = 2 I = 1
11 individuals for $1.5 \leq m \leq 3.0$	no	$n = 11$, I = 8, H and I = 2, H = 1
15 individuals for $1.5 \leq m \leq 3.0$	no	$n = 15$, E = 14, I = 1
57 individuals for $1.5 \leq m \leq 3.0$	no	$n = 57$ dispersed calving
83 individuals for $1.5 \leq m \leq 3.0$	no	$n = 83$ dispersed calving

tions was 18% (range 5–27%). In comparison, the mean area of overlap among core ranges of Beverly females that used calving grounds F, E-1, or E-1 and F was 63% (range 56–72%) or about three times greater than for other robust migratory subpopulations (Fig. 4). These three ranges reflect the Beverly subpopulations change in calving-ground use.

Annual home range and path length

Mean annual-range areas (DS collars, ANOVA $F_{4, 597} = 466.0$, $P < 0.001$) and path lengths (DS collars, ANOVA $F_{4, 597} = 339.6$, $P < 0.001$) varied significantly among ecotypes (Tables 4 and 5).

Annual ranges used by boreal and migratory barren-ground caribou were significantly smaller and larger, respectively, than those for all other ecotypes (Tukey's hsd pairwise comparisons, $P < 0.05$). For boreal caribou, mean annual-range areas (GPS collars, ANOVA $F_{3, 145} = 9.7$, $P < 0.001$) and path lengths (GPS collars, ANOVA $F_{3, 145} = 4.8$, $P = 0.003$) varied significantly among study areas (Tables 4 and 5). We did not find a clear pattern for these differences. For migratory barren-ground caribou, mean annual-range areas (DS collars, ANOVA $F_{5, 332} = 179.9$, $P < 0.001$) and path lengths (DS collars, ANOVA $F_{5, 332} = 185.4$, $P < 0.001$) varied significantly among subpopulations (Tables 4 and 5). A significant west to east positive cline (Cape Bathurst < Bluenose-West < Bluenose-East < Bathurst < Beverly = Qamanirjuaq subpopulations) was evident in annual-range sizes and path lengths for these caribou (Tukey's hsd pairwise comparisons, $P < 0.05$). For tundra-wintering caribou, mean annual ranges (DS collars, ANOVA $F_{2,74} = 21.5$, $P < 0.001$) and path lengths (DS collars, ANOVA $F_{2,74} = 16.2$, $P < 0.001$) varied significantly among subpopulations (Table 4 and 5). The eastern-most Lorillard and Wager Bay subpopulations had significantly smaller annual ranges and shorter path lengths than the western-most Queen Maude Gulf subpopulation (Tukey's hsd pairwise comparisons, $P < 0.05$).

DISCUSSION

The concept of a population as a group of interbreeding individuals that have little or no contact with other similar groups is different from what really occurs (Caughley 1980). Theoretical and empirical evidence indicates that population types range from "classical closed populations to interacting systems of subpopula-

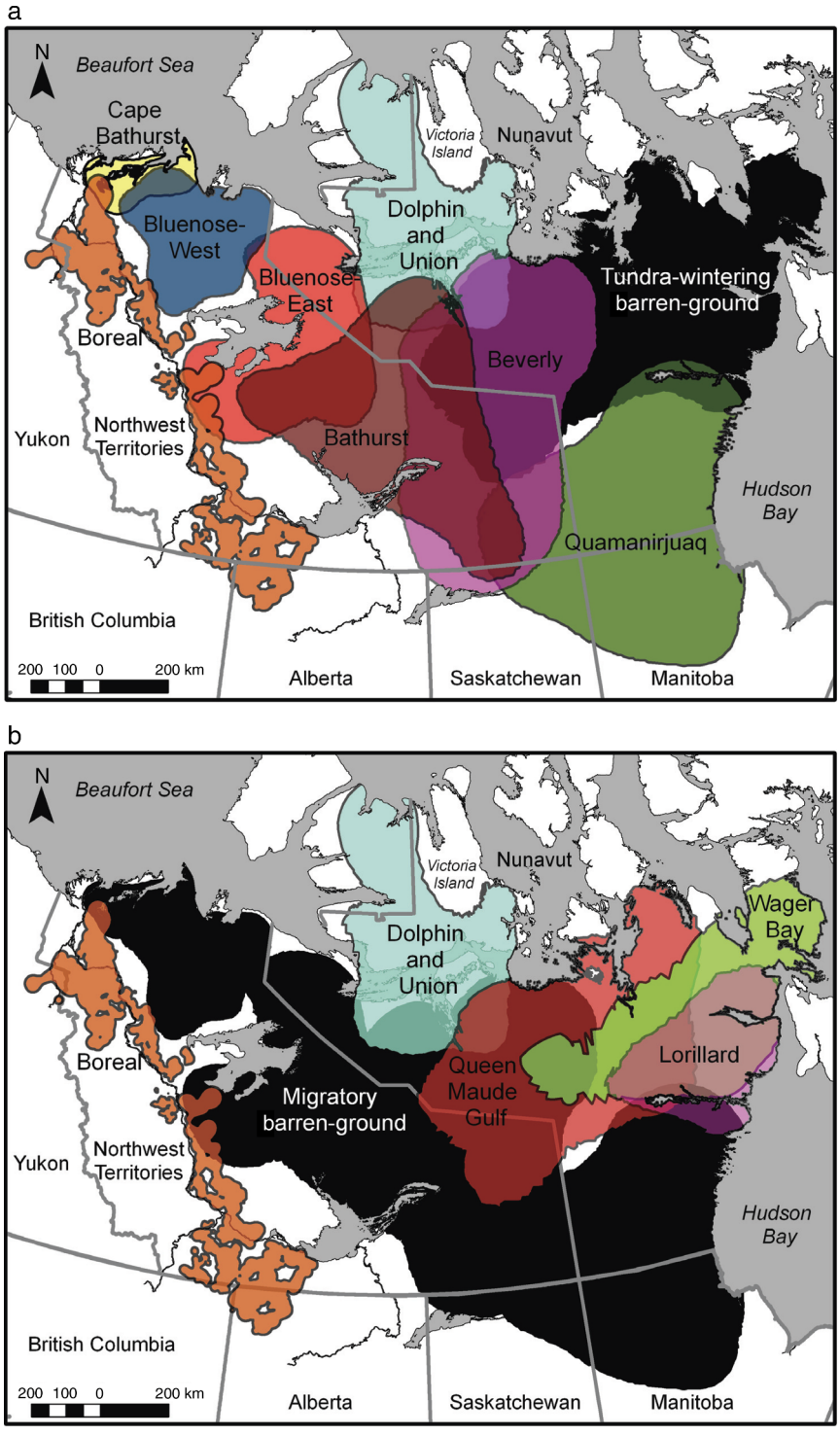

FIG. 3. Core ranges (mean 90% utilization distribution) used by (a) migratory Cape Bathurst, Bluenose-West, Bluenose-East, Bathurst, Beverly, Qamanirjuaq, tundra-wintering barren-ground, boreal, and Dolphin and Union island caribou, and by (b) tundra-wintering Queen Maude Gulf, Wager Bay, and Lorillard and migratory barren-ground, boreal, and Dolphin and Union island caribou subpopulations in the Northwest Territories and Nunavut, Canada (1993–2009). Portions of ranges extending into Yukon Territory, Alberta, Saskatchewan, and Manitoba, Canada, are shown.

tions" (Thomas and Kunin 1999). The population is a central concept for ecology (Berryman 2002), and its complexities must be taken into account for effective management (Schaefer 2006, Harwood 2009). Because population size and distribution will change over time (Harwood 2009), the temporal and spatial characteristics used to define them must be clear to avoid confusion and misunderstanding (Olexa and Gogan 2007).

Space use patterns and affiliations of individuals indicate how populations are structured (Wells and Richmond 1995), and our ability to document these patterns and affiliations has been enhanced by the availability of continuous high-resolution location data acquired through the use of satellite collars. Sufficient numbers of collars must be adequately distributed in the area of interest and tracked long enough at an appropriate resolution so that the resulting observations and conclusions drawn are biologically meaningful and not artifacts of sampling design (Klaver et al. 2008, Harwood 2009). At present, our ability to assess variations in space use patterns among individuals at finer temporal and spatial scales in large subpopulations, e.g., barren-ground caribou, is limited by the proportionately small number of animals that have been tracked annually.

Fuzzy classification has enhanced our ability to assign individuals to groups when their affiliations or the boundaries among groups are uncertain or vague (McBratney and Odeh 1997). Schaefer et al. (2001) and Klaver et al. (2008) used fuzzy clustering to define subpopulations of cervids. Using a novel approach, we used fuzzy clustering to identify distinct subpopulations in four behaviorally different caribou ecotypes and describe how they were structured. We verified that the migratory Cape Bathurst, Bluenose-West, Bluenose-East, Bathurst, Beverly, and Qamanirjuaq barren-ground caribou subpopulations, which were previously recognized using the calving-ground classification system (Banfield 1954, Thomas 1969, Parker 1972, Heard 1983, Nagy et al. 2005), were robust. Data for five of the migratory subpopulations were obtained over 14–17 years, indicating that subpopulation structure and area fidelity were maintained over time. In addition, we verified that the tundra-wintering Queen Maude Gulf, Lorillard, and Wager Bay subpopulations previously described by Calef and Heard (1981) and Heard et al. (1987) were distinct, but only the Lorillard subpopulation was robust. Because the movements of the Queen Maude Gulf and Wager Bay subpopulations were unconstrained by habitat discontinuity or barriers to movement, they may be behaviorally different from other barren-ground caribou, or sample sizes were inadequate to determine spatial affiliation. Additional satellite-tracking studies are required to understand the subpopulation structure of tundra-wintering caribou.

Females in five of the six robust migratory barren-ground caribou subpopulations used one calving ground and supported the concept of calving-ground fidelity.

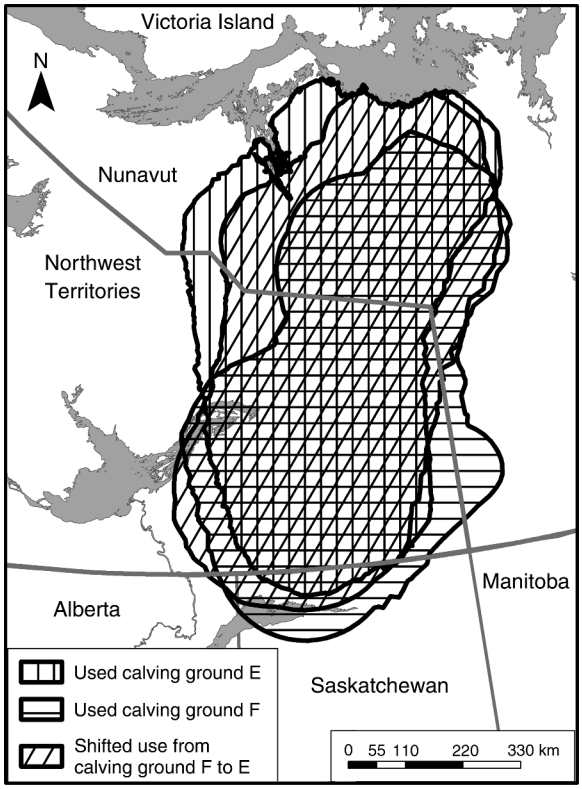

FIG. 4. Core ranges (90% utilization distribution) of migratory female barren-ground caribou that either used calving grounds E-1 or F or switched use from F to E-1 (Beverly subpopulation) in the Northwest Territories and Nunavut, Canada (1993–2009).

However, by 2010, Beverly females had largely abandoned their "traditional" calving ground in favor of one used by the Queen Maude Gulf subpopulation. This shift in use likely began in the mid 1990s. The distance between geographic centers of calving grounds used by Beverly females during 2006 to 2008 is ~245 km. The Bathurst subpopulation made a similar shift in calving-ground use between 1986 and 1996. The distance between geographic centers of calving grounds used by Bathurst females before 1987 and in 1996–2010 is ~250 km. Bathurst females also calved on a number of sites between these two areas over a 10-year transition period (Sutherland and Gunn 1996). In Alaska, Hinkes et al. (2005) documented three patterns of calving-ground use by barren-ground caribou, including subpopulations that maintained annual fidelity to the same calving ground, subpopulations that maintained fidelity to one calving ground for a period, alternated use between this and a new one for a period, and then only used the new one, and subpopulations in which, following the influx of one subpopulation into the winter range of a second, most but not all of the females from the second subpopulation began using the calving ground of the first. These examples indicate that shifts in calving-ground use over time may be common and should be

TABLE 4. Sizes of annual minimum convex polygons (MCPs) for boreal, mountain woodland, Dolphin and Union island, and barren-ground caribou tracked using satellite collars in the Northwest Territories, Nunavut, and northern Alberta (1993–2009).

Ecotype, study area, or subpopulation†	Annual MCPs for GPS satellite-collared caribou‡							Annual MCPs for DS satellite-collared caribou‡						
	Location interval	Caribou (*n*)	MCPs (*n*)	Mean area (km^2)	SD	Min. area (km^2)	Max. area (km^2)	Location interval (days)	Caribou (*n*)	MCPs (*n*)	Mean area (km^2)	SD	Min. area (km^2)	Max Area (km^2)
Ecotypes														
Boreal	8 h	85	149	2478	1512	249	7466	1–5	55	104	2122	1644	206	10 120
Mountain woodland								3	10	31	14 460	9513	7	31 674
Dolphin and Union island								1–20	25	52	36 844	16 409	10 502	83 025
Tundra-wintering barren-ground	1 d	6	6	93 902	33 596	65 636	158 066	1–10	28	66	43 245	29 780	3346	125 312
Migratory barren-ground	8 h	133	218	136 367	85 650	8487	357 389	1–10	154	343	107 574	60 002	1577	306 830
Boreal caribou study areas														
Gwich'in settlement	8 h	26	48	2951	1528	476	7211	1–5	12	22	3227	2044	561	10 120
Sahtu settlement	8 h	18	32	1878	1590	659	7466	1–5	1	4	924	208	738	1157
Cameron Hills/ South Slave	8 h	29	49	2787	1392	434	6217	1–5	16	23	2061	1473	837	8007
Dehcho	8 h	12	20	1549	832	249	3391	1–5	26	55	1792	1388	206	6229
Migratory barren-ground														
Cape Bathurst	8 h	18	33	21 642	8928	8487	64 947	1–10	17	41	19 137	7064	1577	36 959
Bluenose-West	8 h	19	33	47 859	11 654	21 456	68 267	1–10	22	50	60 504	19 563	21 407	105 696
Bluenose-East	8 h	15	19	112 125	24 977	64 721	161 884	1–10	31	61	98 429	42 056	26 837	185 192
Bathurst	8 h	1	1	113 153		113 153	113 153	1–10	38	92	123 220	41 086	47 470	254 009
Beverly	12 h	44	65	172 189	55 391	93 270	355 946	1	13	30	159 693	49 041	72 298	306 830
Qamanirjuaq	1 d	36	67	208 323	60 252	37 797	357 389	1–10	31	64	158 726	48 373	66 769	258 710
Tundra-winter barren-ground														
Lorillard								1–10	18	51	39 717	27 875	3346	123 812
Wager Bay								1–10	9	14	50 235	28 741	8497	97 502
Queen Maude Gulf	1 d	6	6	93 902	33 596	65 636	158 066	1–5	1	1	125 312		125 312	125 312
Total		224	373						272	596				

† Values for migratory and tundra-wintering barren-ground and island caribou are for subpopulations.
‡ Abbreviations are: GPS, Global Positioning System; DS, Doppler Shift.

anticipated to ensure that areas that are suitable for calving but are currently unused, are managed for potential future use. In addition, and contrary to Skoog (1968), barren-ground caribou cannot be reliably assigned to subpopulations based on calving-ground use alone.

We believe that definitions requiring barren-ground caribou subpopulations to consistently use the same "traditional" calving grounds promote a restricted view of the ecology of the species. Changes in calving-ground use over time by subpopulations would, by some definitions, require designation of new subpopulations rather than recognizing the relocation of existing ones. We believe that a more meaningful and robust method of classifying subpopulations of barren-ground caribou is one based on the annual spatial affiliation of females and not just on their calving distribution. Thus we recommend a change in the classification method to one based on our approach. Our definition is consistent with, but is less restrictive than Miller's (1982), in that it allows for (1) distinct subpopulations to have adjacent calving grounds; (2) one subpopulation to use two or more calving grounds over time; or (3) two or more subpopulations to use the same calving ground.

We documented an east–west cline in annual home range sizes and path lengths among migratory barren-ground caribou subpopulations, further supporting the subpopulation structure we identified. This variation may be related to differences in population size, habitat quality, proportions of subpopulation ranges that are above tree line, topography, weather patterns, and predator diversity and density. The more than doubling of annual migratory path lengths between western and eastern migratory subpopulations suggests that the energetic costs to caribou of disturbances that may alter their normal patterns of activity or range use should be considered when effects of petroleum and mineral exploration and development, vehicle traffic, and low-level aircraft overflights are assessed.

Dolphin and Union island caribou were organized as individuals. Because these caribou are migratory and are either geographically or temporally isolated from most other caribou during the year, they are likely structured by migratory connectivity and barriers to movement. These caribou are behaviorally similar to boreal and barren-ground caribou: they are organized as individuals but are structured in part by migratory connectivity.

Boreal caribou formed two subpopulations of females organized as individuals across ranges separated by large areas burned by wildfires in the central NT (Government of the Northwest Territories fire history data). This habitat discontinuity may be temporary if

TABLE 5. Annual-path lengths for caribou tracked using satellite collars in the Northwest Territories, Nunavut, and northern Alberta, Canada (1993–2009).

Ecotype, study area, or subpopulation†	Annual-path lengths for GPS satellite-collared caribou‡							Annual-path lengths for DS satellite-collared caribou‡						
	Location interval	Caribou (*n*)	Path lengths (*n*)	Mean length (km)	SD	Min. length (km)	Max. length (km)	Location interval (days)	Caribou (*n*)	Path lengths (*n*)	Mean length (km)	SD	Min. length (km)	Max. length (km)
Ecotypes														
Boreal	8 h	85	149	1204	245	644	2022	1–5	55	104	620	182	213	1228
Mountain woodland								3	10	31	1140	380	241	1747
Dolphin and Union island								1–20	25	52	1323	285	774	1800
Tundra-wintering barren-ground	1 d	6	6	2461	238	2111	2791	1–10	28	66	1678	427	653	2809
Migratory barren-ground	8 h	133	218	3119	707	1519	4847	1–10	154	343	2249	646	658	4006
Boreal caribou study areas														
Gwich'in Settlement Area	8 h	26	48	1263	278	735	2022	1–5	12	22	744	213	438	1228
Sahtu Settlement Area	8 h	18	32	1180	213	720	1667	1–5	1	4	500	62	422	571
Cameron Hills/South Slave	8 h	29	49	1229	216	684	1659	1–5	16	23	615	145	383	863
Dehcho	8 h	12	20	1038	211	644	1417	1–5	26	55	581	166	213	972
Migratory barren-ground														
Cape Bathurst	8 h	18	33	2041	193	1593	2461	1–10	17	41	1155	242	658	1702
Bluenose-West	8 h	19	33	2488	259	1858	3057	1–10	22	50	1751	276	1113	2284
Bluenose-East	8 h	15	19	3256	258	2757	3725	1–10	31	61	2132	363	1332	2755
Bathurst	8 h	1	1	2865		2865	2865	1–10	38	92	2492	346	1746	3592
Beverly	12 h	44	65	3592	457	2603	4847	1	13	30	2820	363	1889	3592
Qamanirjuaq	1 d	36	67	3466	494	1519	4721	1–10	31	64	2788	502	1849	4006
Tundra-winter barren-ground														
Lorillard								1–10	18	51	1730	411	653	2809
Wager Bay								1–10	9	14	1462	438	679	2489
Queen Maude Gulf	1 d	6	6	2461	238	2111	2791	1–5	1	1	2022		2022	2022
Total		224	373						272	596				

† Values for migratory and tundra-wintering barren-ground and island caribou are for subpopulations.
‡ Abbreviations are: GPS, Global Positioning System; DS, Doppler Shift.

natural habitat regeneration occurs. Our findings are consistent with the observations of Bergerud (1996) that boreal caribou tend to form a near-continuum across a region of favorable calving sites.

Mean annual home ranges for boreal caribou in our study areas were 6–14 times larger than the smallest and up to two times larger than the largest mean annual ranges reported in Alberta (Stuart-Smith et al. 1997) and Saskatchewan (Rettie and Messier 2001). Stuart-Smith et al. (1997) obtained caribou locations about every two weeks, while Rettie and Messier (2001) obtained locations every 2–4 days, and thus differences among home ranges in our areas may in part be a result of sampling frequency (Borger et al. 2006). In many parts of Alberta, forest management practices, agricultural expansion, and oil, gas, and mineral resource exploration and extraction activities have resulted in loss, alteration, and fragmentation of caribou habitat (McLoughlin et al. 2003). In Alberta, boreal caribou currently occupy remnant stands of boreal forest, and their movements may be further constrained by development impacts within these areas (Dyer et al. 2002), thus possibly leading to smaller annual home ranges. In the NT most of the boreal caribou range is comparatively pristine and continuous; thus their movements may not be constrained by human impacts, possibly leading to larger home ranges.

Harwood (2009) posed the question, that "given a group of individual organisms, dispersed over space and/or time, with a variation in their degree of connectivity to the other individuals, can we (1) subdivide these individuals into two or more subgroups, and/or (2) take a sample of these individuals that is representative of the whole group or subgroups?" We show that an externally imposed classification system, i.e., fuzzy clustering, can be used to assign individuals to distinct well-organized subpopulations. Demographic information such as population estimates, pregnancy and parturition rates, and causes and rates of mortality can be obtained by tracking individuals within these subpopulations. The factors structuring these subpopulations, i.e., strong spatial affiliation among its members or environmental conditions, will indicate whether these data are representative of robust subpopulations (e.g., migratory barren-ground caribou) or geographic areas (e.g., boreal caribou).

The only way to understand caribou population ecology without influencing their behavior is by incorporating satellite tracking in study designs. The deployment of satellite collars is initially invasive, but well-designed, long-

PLATE 1. Woodland caribou, early September, Mackenzie Mountains, Northwest Territories, Canada. Photo credit: J. A. Nagy.

term, high-resolution satellite-tracking studies (i.e., using GPS collars), in combination with rigorous analyses of the resulting data using statistical procedures like fuzzy clustering, provide an opportunity to obtain biological information critical for management decisions. Clearly, the benefit of improved technology is that we can define and track changes in population structure and other important ecological processes over time. This is particularly important when considering the potential impacts of natural and anthropogenic disturbances, including climate change, on caribou and their habitats and on the northern people that depend on them.

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APPENDIX A

History of satellite tracking studies undertaken in the Northwest Territories and Nunavut, Canada, 1993–2009 (*Ecological Archives* A021-105-A1).

APPENDIX B

Number of female caribou with full years of satellite tracking data, by ecotype, subpopulation, and years tracked, in the Northwest Territories, Nunavut, and northern Alberta, Canada, 1993–2009 (*Ecological Archives* A021-105-A2).

APPENDIX C

Values of the Duda-Hart *t* test statistic for Ward's hierarchical clustering of movement data for migratory and tundra-wintering barren-ground, Dolphin and Union island, and boreal caribou in the Northwest Territories, Nunavut, and northern Alberta, Canada (*Ecological Archives* A021-105-A3).

APPENDIX D

Values of the validity functions (i.e., fuzziness performance index and normalized classification entropy) for an appropriate number of subpopulations indicated by fuzzy clustering of movement data for migratory and tundra-wintering barren-ground, Dolphin and Union island, and boreal caribou in the Northwest Territories, Nunavut, and northern Alberta, Canada (*Ecological Archives* A021-105-A4).

APPENDIX E

Comparison of assignments by fuzzy (fuzzy *c*-means) and hierarchical (Ward's method) clustering of individual migratory and tundra-wintering barren-ground, Dolphin and Union island, and boreal caribou to subpopulations in the Northwest Territories, Nunavut, and northern Alberta, Canada (*Ecological Archives* A021-105-A5).