Fisheries and Oceans / Pêches et Océans

Canada

5625

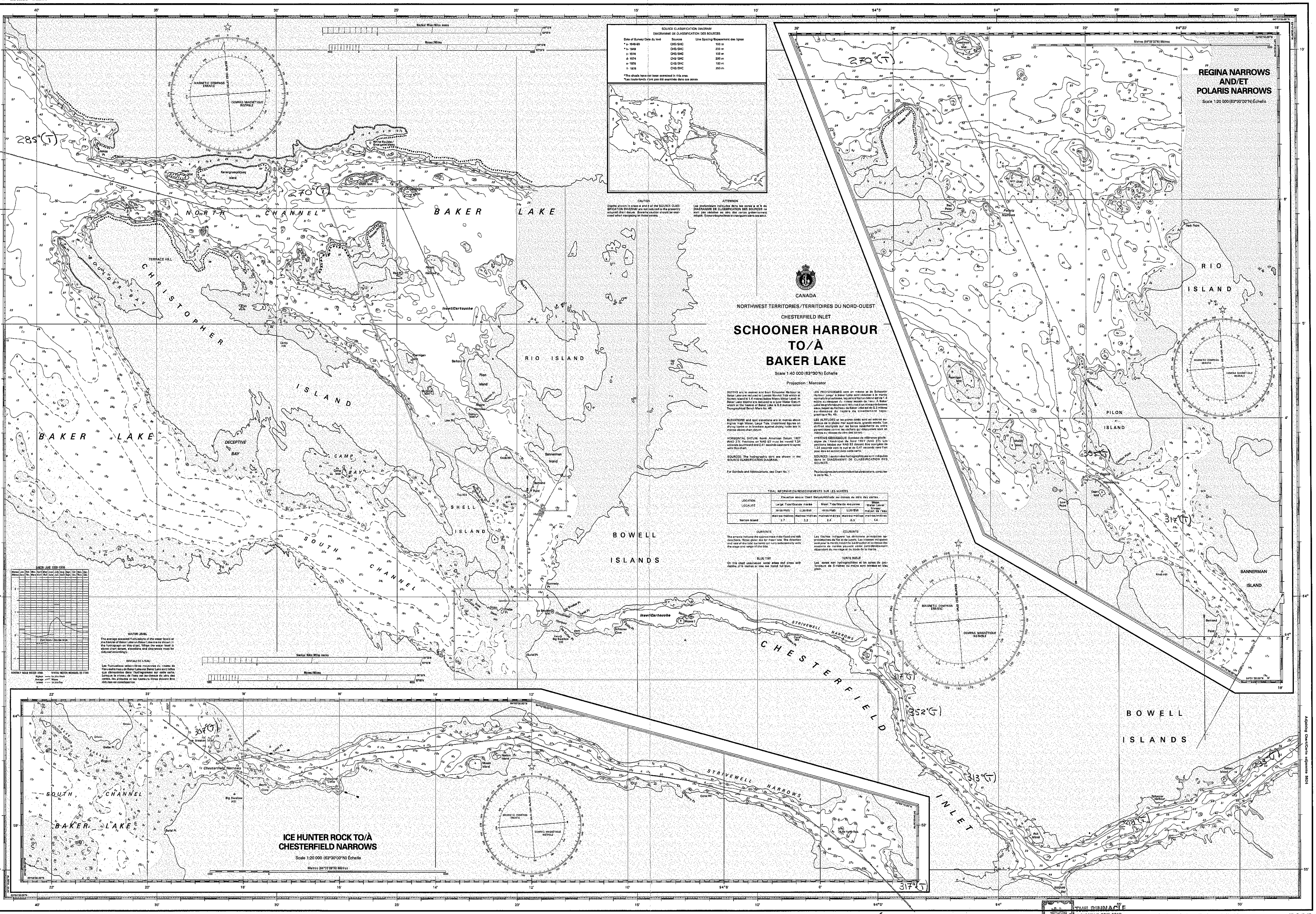

Table	Columns	Columns	Columns
Date of Survey/Date du levé	Sources	Line Spacing/Espacement des lignes
* a- 1949-50	CHS/SHC	150 m
* b- 1949	CHS/SHC	200 m
c- 1974	CHS/SHC	100 m
d- 1974	CHS/SHC	200 m
e- 1976	CHS/SHC	100 m
f- 1978	CHS/SHC	250 m

TIDAL INFORMATION/RENSEIGNEMENTS SUR LES MARÉES

LOCATION / LOCALITÉ	Large Tide/Grande marée HHW/PMS	Large Tide/Grande marée LLW/BMI	Mean Tide/Marée moyenne HHW/PMS	Mean Tide/Marée moyenne LLW/BMI	Mean Water Level / Niveau moyen de l'eau
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Norton Island	2.7	0.2	2.4	0.3	1.4

Adjoining Chart/Carte adjacente 5626

Adjoining Chart/Carte adjacente 5624

Cruise the Net / Naviguez dans Internet
www.charts.gc.ca www.cartes.gc.ca

PREVIOUS EDITIONS/ÉDITIONS ANTÉRIEURES 1975
NEW EDITION/NOUVELLE ÉDITION JULY/JUIL 10 1992
NOTICE TO MARINERS/AVIS AUX NAVIGATEURS 2004-09-03

METRES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MÈTRES
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	PIEDS														
FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	BRASSES														

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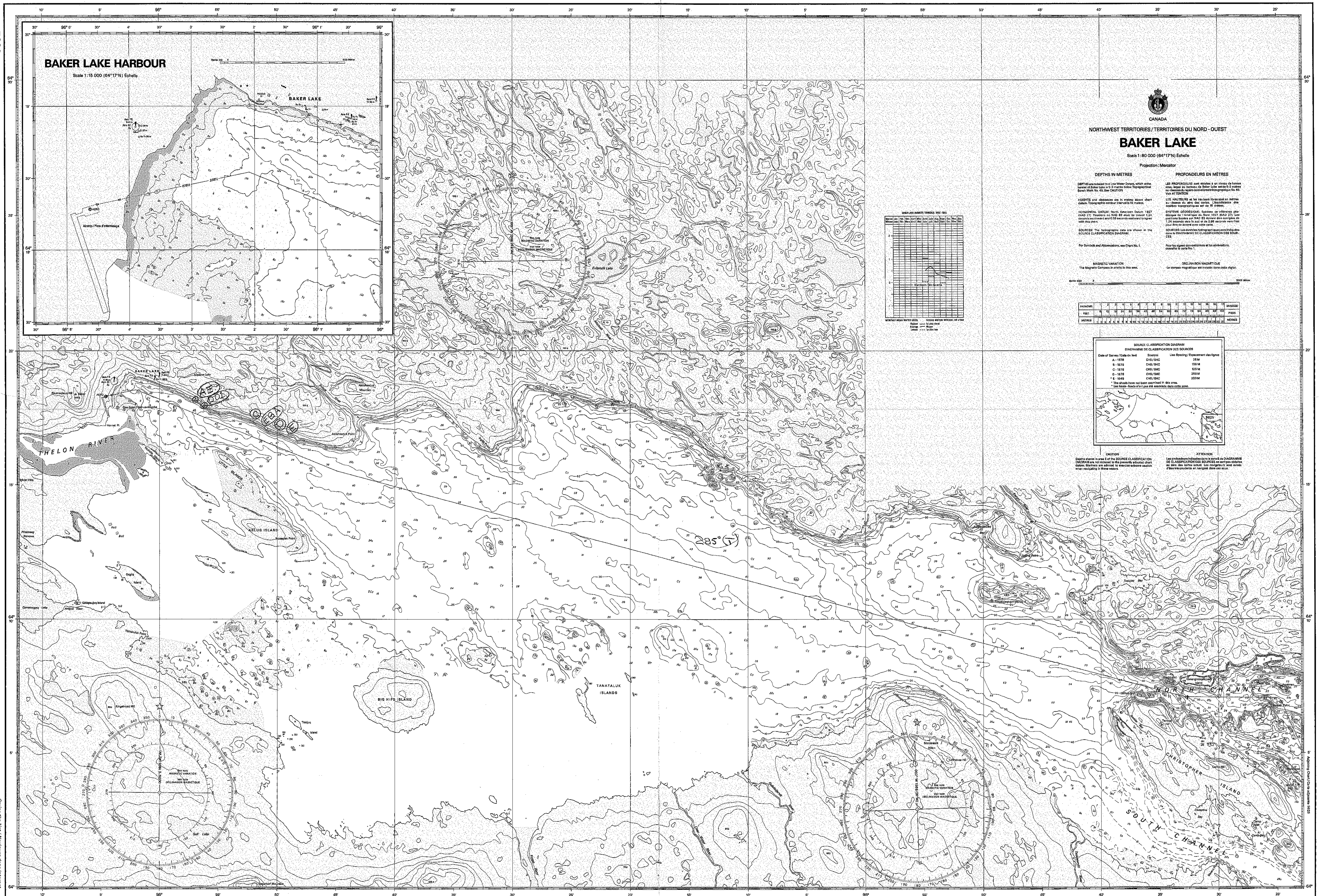
METRIC/MÉTRIQUE



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NEW CHART / CARTE NOUVELLE AUG. / AOÛT 8 1986
NOTICES TO MARINERS / AVIS AUX NAVIGATEURS 1993 849

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METRIC / MÉTRIQUE

Attachment B Risk Assessment Methodology

1. **Hazard/Risk Definition**

    - **Hazard:** A condition with the potential to cause personal injury or death, property damage or mission degradation
    - **Risk:** An expression of possible loss in terms of severity and probability.

2. **Operations Analysis**

    - The Study of Marine Transportation Options for the High Volume Sealift was used as a basis for the risk screening.
    - Marine operations were broken down into various scenarios based on the logistics plan.

3. **Hazard Identification**

    - A tug master, with experience in the Chesterfield Inlet/Baker Lake tug barge operation participated in the hazard identification and risk rating
    - Free input technique was used to identify and evaluate hazards

4. **Root Causal Analysis of Hazards**

    - Preliminary Hazard Analysis (PHA)
    - Root causes were targeted versus symptoms

5. **Hazard Severity Rating**

    - **Severity 1 -** Probably will not cause injury to personnel or harm to the environment. Commercial loss is less than $10,000.
    - **Severity 2 –** Exposes personnel to minor reportable injury less not requiring lost time. Mitigated by the use of control procedures, Personal Protection Equipment and training. Minor exposure to environmental damage mitigated by procedures and Emergency Response Plans. Commercial loss exposure of $10,000 to $50,000.
    - **Severity 3 –** Exposes personnel to modest injury including lost time of 3 days or over. Mitigated by the use of control procedures, Personal Protection Equipment and training.

Modest exposure to environmental damage mitigated by the use of procedures and Emergency Response Plans. Commercial loss exposure of $50,000 to $250,000.

- **Severity 4 -** Exposes personnel to serious injury, serious harm to the environment or commercial loss of $250,000 to $1,000,000.
- **Severity 5 –** Exposes personnel to severe injury or death, severe harm to the environment or commercial loss of $1,000,000 or greater**.**

6. **Probability Ranking**

- **Highly Unlikely –**Improbable or remote under any circumstances. 0 - 10% chance of happening.
- **Unlikely –** Unlikely under normal conditions. Has been planned for and may be possible. 11 - 40% chance of happening
- **Possible –** Known to have occurred in the past. 41 - 60% chance of happening.
- **Likely –** Likely the risk will occur. 61 – 90% chance of happening.
- **Probable –** Very likely to happen. 91 – 100% chance of happening.

Severity	Probability of Occurrence				
	Highly Unlikely	Unlikely	Possible	Likely	Probable
	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25
	Risk levels				

7. **Risk Levels**

- Level 1 – 3. Low Risk. Acceptable Risk no controls required. Negligible potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigation controls not required.

- Level 4 – 6. Low to Moderate Risk. Acceptable Risk with controls. Minor potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigated by providing hazard specific training and by investigating engineering controls to minimize reliance on procedures and Personal Protection Equipment.
- **Level 8 – 10. Moderate Risk. Acceptable Risk with Stringent Controls.** Moderate potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Mitigation measures include the examination the areas of exposure in the process. Agree on a mitigation plan and implementation time table.
- **Level 12 - 25 Unacceptable Risk.** High potential for harm to the well being of people, the environment and/or the commercial interests of Areva. Work must be stopped and immediate action must be taken to reduce the risk to an acceptable level. Mitigation Controls are mandatory.

8. **Assess Probability**

- Probability is expressed in descriptive or quantitative terms
- Experience data was used wherever possible
- Uncertainty is acknowledged where appropriate

9. **Complete Hazard/Risk Assessment**

- Potential Mitigation Measures are listed for each risk
- An experienced Tug Master provided operator input
- Mitigation measures were examined for conflict
- Mitigation effects were examined and risks were re-evaluated after mitigation

Attachment C Risk Assessment Results

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO									
Scenario "A": One standard tug tows two standard single hull barges. Load containers in southern port and mobilise direct to Baker Lake									
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**			
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**	
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**	
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**	
3	Barges get delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**	
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**	
5	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**	
6	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**	
7	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4*	**16**	• See Mitigation Controls Hazard Item 5	4	3	**12****	
8	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**	
9	Tug/ Barge collides or grounds due to conflicting traffic	4	4*	**16**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**	
10	Tug encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**	
11	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**	
12	Tow lines foul Tandem tow	4***	3	**12**	• Secure barges together for Chesterfield Inlet passage, not recommended for Narrows passage	4	3	**12****	

* Note: A standard tug towing two barges is less manoeuvrable than an ATB Tug pushing one barge and towing the second barge.
**Note: Mitigation Controls do not reduce Risk level to an acceptable level. Passage of tug with two barges in tow through the Chesterfield Narrows is considered to carry unacceptable risk.
***Note High severity level if incident occurs in Chesterfield Inlet or the Narrows

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO									
Scenario "B": One standard tug tows two standard single hull barges. Load containers in southern port and mobilises to Helicopter Island. One Barge is dropped at an anchorage at Helicopter Island and the tug then proceeds through the Chesterfield Narrows with one barge to Baker Lake.									
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**			
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**	
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**	
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**	
3	Barges delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**	
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**	
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**	
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**	
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**	
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**	
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**	
10	Tug/ Barge collides or grounds due to conflicting traffic	4	4*	**16**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**	
11	Tug encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**	
12	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**	
13	Tow lines foul Tandem tow	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, drop one barge for Narrows passage	4	2	**8**	

ACTIVITY: 1. BARGE MOBILISATION DRY CARGO								
Scenario "C": One Articulating tug with two ATB double hull barges, one barge being pushed in the notch and the second barge is towed. Load containers in southern port and mobilise direct to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	3	**9**	• Confirm labour status prior to loading • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	0	0	**0**	• Integrated Tug Barge (ITB) system provides sufficient manoeuvrability to move two barges safely through Narrows	0	0	**0**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	3	2	**6**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Tug encounters ice and is severely damaged or sinks	2	1**	**2**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	2	1	**2**
12	Barge encounters ice and is severely damaged or sinks	4	2	**8**	• Sail tugs/barges to arrive in open water • Slow speed to avoid damage	3	1	**3**

* Note ATB system provides high degree of manoeuvrability
**Note: ATB tug is protected by barge

ACTIVITY: 2. CONTAINER SHIP TO CHURCHILL									
Scenario "A": Load Container ship at Southern Port and deliver containers to Churchill									
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**			
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**	
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**	
2	Containership runs aground in Churchill due to Navigation or Manoeuvring error	3	2	**6**	• Use Marine Simulator Training for Pilots	3	1	**3**	
3	Stevedores injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**	
4	Containership catches fire in Churchill	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**	
5	Containership delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**	
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**	
7	Canadian Container ship not available	5	5	**25**	• Import Foreign Flagged vessel • Load cargo in foreign port use foreign flag vessel • Use rail system to move freight	2	1	**2**	
8	Containers damaged by heavy weather in transit	3	3	**9**	• Critical cargo loaded in protected area on vessel	3	1	**3**	
9	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Do not sail vessel until route is ice free	5	1	**5**	
10	Delays due to insufficient number of pilots to navigate ships in and out of Churchill	3	4*	12	• Train Additional Pilots • Obtain exemptions for Tugs and barges	3	1	**3**	
11	Mooring Lines Part	3	3	9	• Watch procedures to include close attention to line tension	3	1	**3**	

*Note: Currently there is only one pilot stationed at the port of Churchill. Due to sensitive environment, compulsory pilotage may be required for barges.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "A": One standard tug tows two standard single hull barges. Load containers in Churchill and deliver to Baker Lake								
		Before controls				**After controls**		
Hazard Id No.	**Hazard**	**Severity**	**Probability**	**Risk Level**	**Mitigation Controls**	**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**
3	Barges delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4*	**16**	• See Mitigation Controls Hazard Item 6	4	3	**12****
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
10	Tug/Barge collides or grounds due to conflicting traffic	4	4*	**16**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tug sinks after collision	5	1	**5**	• Develop Emergency Response plan to rescue survivors and limit environmental damage	5	1	**5**
12	Barge sinks after collision	5	2	**10**	• Develop Emergency Response plan to limit environmental damage	5	2	**10*****
13	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, not practical for Narrows passage	4	3	**12*****
14	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

* Note: A standard tug towing two barges is less manoeuvrable than an ATB Tug pushing one barge and towing the second barge.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "B": One standard tug tows two standard single hull barges. Load containers in Churchill and mobilises to Helicopter Island. One Barge is dropped at an anchorage at Helicopter Island and the tug then proceeds through the Chesterfield Narrows with one barge to Baker Lake.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS cover for this area	4	2	**8**
7	Tug or Barge grounds in Chesterfield inlet passage due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides or grounds due to conflicting traffic	4	3*	**12**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped before Narrows passage	4	2	**8**
12	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

* Note: A standard tug towing one similar in manoeuvrability to an ATB Tug pushing one barge and towing the second barge.

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "C": One standard tug tows one single hull barge, load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed in heavy weather	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed in heavy weather	2	2	**4**
5	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
6	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
7	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
9	Tug/ Barge collides with conflicting traffic	4	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
10	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
11	Tug has mechanical failure/accident lost for season	4	3	**12**	• Have additional tug for back up • Charter in replacement	2	3	**6**
12	Barge is damaged and lost for season	4	3	**12**	• Additional barge as back up • Barge repair facility in Baker Lake area	2	3	**6**

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "D": One Articulating tug with two ATB double hull barges, one barge being pushed in the notch and the second barge is towed. Load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	2	3	**6**	• Make allowance for delays in estimate	2	2	**4**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	0	0	**0**	• Integrated Tug Barge (ITB) system provides sufficient manoeuvrability to move two barges safely through Narrows	0	0	**0**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

* Note ATB system provides high degree of ship-like manoeuvrability and sea keeping

ACTIVITY: 3. BARGE CONTAINERS FROM CHURCHILL TO BAKER LAKE								
Scenario "E": One Articulating tug with one ATB double hull barge being pushed in the notch. Load containers in Churchill and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	2	**6**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	1	**3**
3	Barges get delayed due to weather	2	2	**4**	• Make allowance for delays in estimate	2	2	**4**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2*	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2**	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	2*	**8**	• See Mitigation Controls Hazard Item 7	4	1	**4**
10	Tug/ Barge collides with conflicting traffic	4	2*	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
12	Tug has mechanical failure/accident lost for season	4	3	**15**	• Have additional ATB tug for back up	2	3	**6**
13	Barge is damaged and lost for season	4	3	**15**	• Use landing craft type vessels as back up • Additional ATB barge as back up • Barge repair facility in Baker Lake area	2	3	**6**

*Note: The probability of mechanical failure is reduced due to the limited time exposure

**Note: The ATB Tug with one barge is very manoeuvrable

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "A": One standard tug tows two standard towed single hull barges. Load empty containers in Baker Lake and delivers them to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	4	**16**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	3*	**12***
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
7	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, not recommended for Narrows passage	4	3	**12***

*Note: Mitigation Controls do not reduce Risk level to an acceptable level. Passage of tug with two barges in tow through the Chesterfield Narrows is considered to carry unacceptable risk.

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "B": One standard tug and one standard towed single hull barge loads empty containers at Baker Lake and delivers to Churchill. *								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines • Install emergency tow line	3	1	**3**

***** Note: There are no anchorages identified on the west side of the Chesterfield Narrows

ACTIVITY: 4. BARGE EMPTY CONTAINERS FROM BAKER LAKE TO CHURCHILL								
Scenario "C": One ATB tug tows two ATB double hull barges. Load empty containers in Baker Lake and delivers them to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	2	**4**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed in heavy weather	2	1	**2**
2	Tug or Barge grounds in Chesterfield inlet or Narrows due to Navigation or manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
4	Tug has mechanical failure/accident lost for season	5	2	**10**	• Use landing craft type vessels as back up • Have additional tug for back up	5	1	**5**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo • Use double hull barges	5	1	**5**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "A": Scenario "A": Geared cargo vessels load containers in southern ports and proceed to lightering anchorage at Helicopter Island at the western end of Chesterfield Inlet.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**
2	Cargo ship runs aground in Chesterfield Inlet due to navigation error	3	2	**6**	• Use Marine Simulator Training for Navigators • Two navigators on bridge	3	1	**3**
3	Seamen injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**
4	Cargo ship catches fire at Helicopter Island	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**
5	Cargo ship delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**
7	Containers damaged by heavy weather in transit	5	3	**9**	• Critical cargo loaded in protected area	3	1	**3**
8	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Sail in open water season only • Use ice class vessels	5	1	**5**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "B": Load containers on standard barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	3	**9**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges Slow tow speed	3	2	**6**
3	Barges get delayed due to weather	3	4	**12**	• Make allowance for delays in estimate	2	4	**8**
4	Barge tow line parts due to bad weather	2	3	**6**	• Install emergency tow line on barges • Slow tow speed	2	2	**4**
5	Crew members injured during anchor operation at Helo Island	3	4	**12**	• Use PPE and safe work procedures • Use pre installed anchor systems	3	3	**9**
6	Tug/ Barge grounds in Chesterfield inlet due to Navigation error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide differential GPS cover for this area	4	2	**8**
7	Tug/ Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation error	4	3*	**12**	• See Mitigation Controls Hazard Item 6	4	2	**8**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	3	**12**	• See Mitigation Controls Hazard Item 7 •	4	2	**8**
10	Tug/ Barge collides with conflicting traffic	4	3*	**12**	• Install AIS on all tugs • Establish notification protocol and vessel scheduling information for all operators	4	2	**8**
11	Tug sinks after collision	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped before Narrows passage	4	2	**8**
12	Barge sinks after collision	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
13	Tow lines get fowled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, not practical for Narrows passage	4	3	**12*** **
14	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "C": Load containers on ATB barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour Unrest delays loading/discharging	3	2	**6**	• Confirm labour status prior to loading	3	1	**3**
2	Containers get damaged or washed overboard in heavy weather	3	2	**6**	• Fit Container locks to barges • Reduce stacking by one level for ocean voyage • Fit side frames on barges • Slow tow speed	3	1	**3**
3	Barges get delayed due to weather	2	2	**4**	• Make allowance for delays in estimate	2	2	**4**
6	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	2	**8**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation, i.e. lighted range markers • Install channel buoys • Use Electronic Charts • Use Marine Simulator Model of passage to design operating procedures • Monitor adherence to procedures and performance. • Provide DGPS coverage for this area	4	1	**4**
7	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
8	Tug/ Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	2	**8**	• See Mitigation Controls Hazard Item 6	4	1	**4**
9	Tug/ Barge grounds in Chesterfield Narrows due to mechanical failure	4	2	**8**	• See Mitigation Controls Hazard Item 7 •	4	1	**4**
10	Tug/ Barge collides with conflicting traffic	4	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators	4	1	**4**
11	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**
12	Tug has mechanical failure/accident lost for season	4	3	**15**	• Have additional ATB tug for back up	2	3	**6**
13	Barge is damaged and lost for season	4	3	**15**	• Use landing craft type vessels as back up • Additional ATB barge as back up • Barge repair facility in Baker Lake area	2	3	**6**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "D": Load empty containers on ATB barges in Baker Lake and deliver them to cargo vessels at Helicopter Island								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	2	**4**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed in heavy weather	2	1	**2**
2	Tug or Barge grounds in Chesterfield inlet or Narrows due to Navigation or manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
4	Tug has mechanical failure/accident lost for season	5	2	**10**	• Use landing craft type vessels as back up • Have additional tug for back up	5	1	**5**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo • Use double hull barges	5	1	**5**
					•			

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "E": Load empty containers on standard barges in Baker Lake and deliver them to cargo vessels at Helicopter Island								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Containers get damaged or washed overboard in heavy weather	2	3	**6**	• Fit Container locks to barges • Reduce stacking by one level for bad weather • Fit side frames on barges • Slow tow speed	2	1	**3**
2	Tug or Barge grounds in Chesterfield inlet due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training including bridge resource management • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures Monitor adherence to procedures and performance.	4	2	**8**
3	Tug or Barge grounds in Chesterfield Narrows due to Navigation or Manoeuvring error	4	3	**12**	• Provide marine simulator training • Improve fixed aids to Navigation • Use Electronic Charts • Use Marine Simulator Model of passage plan to design operating procedures • Monitor adherence to procedures and performance.	4	2	**8**
4	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4	3	**12**	• Design tug with 100% redundancy for critical systems • Provide Marine Simulator Training for Contingencies • Use Marine Simulator to design operating procedures • Use predictive maintenance systems	4	2	**8**
5	Grounded Barge blocks channel at narrows	5	3	**15**	• Emergency response plan to recover barge and cargo	3	3	**9**
6	Mooring lines part	3	3	**9**	• Assign watchman to tend lines	3	1	**3**

ACTIVITY: 5. GEARED CARGO VESSEL DELIVERS DRY CARGO TO HELICOPTER ISLAND								
Scenario "F": Load containers on ATB barges at Helicopter Island and deliver to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest delays loading or discharging	3	3	**9**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	3	2	**6**
2	Containership runs aground in Churchill due to Navigation or Manoeuvring error	3	2	**6**	Use Marine Simulator Training for Pilots	3	1	**3**
3	Stevedores injured during unloading process	2	3	**6**	• Implement formal Safety Management System • Use trained personnel • Use correct PPE	2	2	**4**
4	Containership catches fire in Churchill	4	2	**8**	• Use IACS Classed vessels • Carry out pre contract inspections of vessels	4	1	**4**
5	Containership delayed due to weather	2	3	**6**	• Use weather routing • Allow for weather delays in contingency planning	2	2	**4**
6	Mechanical breakdown of unloading equipment	2	3	**6**	• Implement Planned maintenance system	2	2	**4**
7	Containers damaged by heavy weather in transit	5	3	**9**	• Critical cargo loaded in protected area	3	1	**3**
8	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Sail in open water season only • Use ice class vessels	5	1	**5**

ACTIVITY: 6. TANKER DELIVERS FUEL TO CHURCHILL								
Scenario "A": Double Hull Tanker Loads fuel in southern port and delivers fuel to Churchill								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest at ports delays loading or discharging	2	2	**4**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	2	1	**2**
2	Tanker runs aground in Churchill due to Navigation error	4	2	**8**	• Use Marine Simulator to confirm viability of Tanker harbour entrance plans • Engage harbour pilots and tanker operator in preparing close approach procedures • Use escort tugs as required • Review suitability of existing fixed navigation aids in Churchill • Establish minimum navigation aids requirement for tanker • Monitor compliance with procedures	4	1	**4**
3	Tanker runs aground in Churchill due to mechanical failure	4	3	**12**	• Use escort tugs • Tanker uses adequate close quarter critical equipment set up • Use only IACS Classed vessels	4	1	**4**
4	Tanker catches fire in Churchill	4	2	**8**	• Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
5	Tanker delayed due to weather	2	3	**6**	• Use weather routing service • Allow for weather delays in contingency planning	2	2	**4**
6	Tanker encounters heavy ice and is severely damaged or sinks	5	2	**10**	• Do not sail tanker until route is ice free	5	1	**5**
7	Tanker collides with vessel entering or leaving Churchill due to conflicting traffic	5	3	**15**	• Tanker uses AIS system • Review Churchill Marine Traffic Control measures	5	1	**5**
8	Tanker spills cargo in Churchill	4	3	**12**	• Tanker is double hull which limits severity and probability • Emergency response plan is devised to match anticipated potential fuel spill • Oil Spill clean up equipment staged at Churchill • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**
9	Tanker Sinks	5	2	10	• Use IACS Class tankers • Inspect tanker prior to loading	5	1	5
10	Tanker Loads off Spec fuel	5	2	10	• Provide detailed Spec to refinery • Analyse fuel sample for compliance with spec. prior to loading	5	1	5

ACTIVITY: 6. TANKER DELIVERS FUEL TO CHURCHILL								
Scenario "B": Tanker discharges fuel to Churchill tank farm								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Mechanical breakdown of unloading pumps on tanker	2	1*	**2**	• No mitigation required tanker has adequate back up pumps	2	1	**3**
2	Tanker has discharge hose/connection failure	2	3	**6**	• Install boom between dock and ship • Have adequate emergency oil spill procedures and equipment on hand • Insure that hose/connection maintenance and testing procedures are adequate • Monitor compliance with procedures • Use dry break couplings	2	2	**4**
3	Tank farm over flows tank	3**	3	**9**	• Review tank farm loading procedures for compliance with Areva safety guidelines • Review tanker discharge procedures for compliance with Areva and tank farm safety guidelines • Monitor compliance with procedures	3	1	**3**
4	Fuel quantity delivered differs from manifest	2	3	**6**	• Carry out independent cargo survey at load and discharge port	2	1	**2**
5	Tanker delivers off spec or contaminated fuel.	4	2	**8**	• Provide detailed specification for fuel during procurement • Fuel samples taken at loading and analysed for compliance with specification • Fuel Samples taken at discharge port and analysed for compliance with specification • Inspect tanks on vessel prior to loading	4	1	**4**
6	Tanker parts mooring lines at Churchill	3	3	**9**	• Watch procedures to include close attention to line tension	3	1	**3**

*Note: Tanker has multiple discharge pumps
**Note: Tank Farm has bermed area to contain leakage from each tank

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "A": One standard tug and two standard double hull barges transport fuel from Churchill to Baker Lake. Tug drops one barge at Helicopter Island and proceeds through Narrows towing one barge.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	8
5	Tug Barge collides with dock Baker Lake	2	4	**8**	• Provide additional tug to assist with docking	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

9	Tug Barge does not complete supply program in weather window	5	3	**15**	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	**8**
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
11	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**
12	Tow lines get fouled	4	3	**12**	• Secure barges together for Chesterfield Inlet passage, one barge dropped at Helicopter Island , navigate Chesterfield Narrows with one barge	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE

Scenario "B": One standard tug and one standard double hull barge transport fuel from Churchill to Baker Lake. Tug drops one barge at Helicopter Island and proceeds through Narrows towing one barge.

Hazard Id No.	Hazard	Before controls			Mitigation Controls	After controls		
		Severity	Probability	Risk Level		Severity	Probability	Risk Level
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	**8**
5	Tug Barge collides with dock Baker Lake	2	4	**8**	• Provide additional tug to assist with docking	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Tug Barge does not complete supply program in weather window	5	3	**15**	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	**8**
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake	3	2	**6**

					• Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability			
11	Barge Spills fuel at Baker Lake	4	3	**12**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "C": One ATB tug and two ATB double hull barges transport fuel from Churchill to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	8
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Tug barge cannot find work outside of Arctic	4	2	**8**	• Design the tug barges so that they are commercially viable in southern markets • Partner with Tug Barge operator that is knowledgeable with Arctic and southern operations	3	1	**3**
10	Tug barge tied up due to labour unrest	4	2	**8**	• Secure labour agreements that exclude work stoppages	4	1	**4**

11	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
12	Barge Spills fuel at Baker Lake	4	2	**8**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	1	**5**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "D: One ATB tug and one ATB double hull barge transports fuel from Churchill to Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	1	**4**
4	Tug or Barge grounds in Chesterfield Narrows due to mechanical failure	4*	2	**8**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	1	**4**
5	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	2	**8**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	4
6	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
7	Tug barge crew injured during docking and undocking operation	2	2	**2**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
8	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**2**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
9	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
11	Barge Spills fuel at Baker Lake	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**

*Note: The double hull barge design significantly reduces the severity level of the hazard

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "E": One ATB tug and two ATB double hull barges transport fuel from Churchill to Helicopter Island. Tug drops one barge at Helicopter Island anchorage then proceeds to Baker Lake through Narrows with one barge in the notch.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	**4**
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Barge Spills fuel at the Narrows or in Chesterfield inlet	3**	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation	3	2	**6**

					controls to reduce probability			
10	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**

*Note: Severity level based on anticipated damage to tug or barge
**Note: Reduced severity level due to double hull construction of barge

ACTIVITY: 7. BARGES LOAD FUEL IN CHURCHILL AND DELIVER TO BAKER LAKE								
Scenario "F": ATB or Standard tug/double hull barge discharges fuel into storage tanks at Baker Lake								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Mechanical breakdown of unloading pumps on barge	2	3	**6**	• Design barge with back up discharge pump • Carry out planned maintenance plan • Monitor adherence to maintenance plan. • Carry spare discharge pump for barges	2	2	**4**
2	Barge has discharge hose/connection failure	2	3	**6**	• Install boom between barge and dock • Have adequate emergency oil spill procedures and equipment on hand • Insure that hose/connection maintenance and testing procedures are adequate • Monitor compliance with procedures • Use dry break couplings	2	2	**4**
3	Tank farm over flows tank	4	2	**8**	• Design tank farm loading procedures in compliance with Areva safety guidelines • Tank farm design includes overflow berm protection • Design tank level alarm in tank farm and integrate with Emergency Shutdown ESD on barge. • Design barge discharge procedures in compliance with Areva and tank farm safety guidelines • Monitor compliance with procedures	4	1	**4**
4	Fuel quantity delivered differs from manifest	2	1	**2**	• Tug Master verifies quantities at load and discharge port	2	1	**2**
5	Barge delivers fuel with Microbiological/ other contamination.	4	3	**12**	• Fuel samples taken from barge and tested for MBC • Keep barge tanks clean and free of moisture • Inspect tanks annually	4	1	**4**
6	Personnel injury due to fall into water	2	2	**4**	• Use PPE • Use approved gangways	2	1	**2**
7	Damage to barge due to ranging	2	4	**8**	• Use fenders to protect docks and barges • Use harbour tug to shift barges if necessary	2	2	**4**
8	Barge Spills fuel at Baker Lake	5	2	**10**	• Locate first response oil spill equipment on each barge and tug • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	1	**5**

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "A": Double Hull Tanker Loads fuel in southern port and delivers to Ellis Island anchorage/lightering location at the Eastern end of Chestrfield Inlet								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Labour unrest at ports delays loading or discharging	2	2	**4**	• Confirm labour status prior to loading or discharging • Prepare contingency plans for alternate load ports	2	1	**2**
2	Tanker runs aground in Chesterfield Inlet due to Navigation error	4	2	**8**	• Use Marine Simulator to confirm viability of Tanker harbour entrance plans • Use escort tugs as required • Establish minimum navigation aids requirement for tanker • Monitor compliance with procedures	4	1	**4**
3	Tanker runs aground in Chesterfield Inlet due to mechanical failure	4	3	**12**	• Use escort tugs • Tanker uses adequate close quarter critical equipment set up • Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
4	Tanker catches fire in Chesterfield Inlet	4	2	**8**	• Use only IACS Classed vessels • Carry out pre hire inspections of vessels for compliance with Areva safety guidelines	4	1	**4**
5	Tanker delayed due to weather	2	3	**6**	• Use weather routing service • Allow for weather delays in contingency planning	2	2	**4**
6	Vessel encounters ice and is severely damaged or sinks	5	2	**10**	• Do not sail tanker until route is ice free	5	1	**5**
7	Tanker collides with vessel entering or leaving Chesterfield Inlet due to conflicting traffic	5	1	**5**	• Tanker uses AIS system • Coordinate traffic in area	5	1	**5**
8	Tanker spills cargo in Chesterfield Inlet	4	3	**12**	• Tanker is double hull which limits severity and probability • Emergency response plan is devised to match anticipated potential fuel spill • Oil Spill clean up equipment staged at Lightering location • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**
9	Tanker Sinks	5	2	10	• Use IACS Class tankers • Inspect tanker prior to loading	5	1	5
10	Tanker Loads off spec fuel	5	2	10	• Provide detailed Spec to refinery • Analyse fuel sample for compliance with spec. prior to loading	5	1	5

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "B": ATB double hull barges load fuel from the tanker in Ellis Island and deliver it to Baker Lake pushed by a tug in a notch.								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	1	4
5	Tug Barge collides with dock Baker Lake	2	1*	**2**	• No mitigation required	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	2	2	**4**	• Use safety managemnt procedures • Personnel use PPE	2	1	**2**
7	Tug barge crew injured during barge tow hook up and disconnect operation	2	2	**4**	• Personnel use PPE	2	1	**2**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**

9	Barge Spills fuel at the Narrows or in Chesterfield inlet	3**	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	3	2	**6**
10	Barge Spills fuel at Baker Lake	5	3	**15**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	5	2	**10**

*Note: Severity level based on anticipated damage to tug or barge
**Note: Reduced severity level due to double hull construction of barge

ACTIVITY: 8. TANKER DELIVERS FUEL TO LIGHTERING POSITION IN CHESTERFIELD INLET								
Scenario "C": Standard double hull barges load fuel from the tanker in Ellis Island and deliver it to Baker Lake towed by a tug								
Hazard Id No.	**Hazard**	**Before controls**			**Mitigation Controls**	**After controls**		
		Severity	**Probability**	**Risk Level**		**Severity**	**Probability**	**Risk Level**
1	Tug or Barge grounds in Chesterfield inlet due to Navigation or manoeuvring error	4*	2	**8**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	1	**4**
2	Tug or Barge grounds in Chesterfield Narrows due to Navigation or manoeuvring error	4*	3	**12**	• Install electronic fixed Nav Aids on waterway • Install electronic charts on tugs • Use Marine simulator to train crews • Use voyage planning and bridge Resource Management procedures • Monitor adherence to procedures	4	2	**8**
3	Tug or Barge grounds in Chesterfield inlet or Narrows due to mechanical failure	4*	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan	4	2	**8**
4	Tug barge involved in collision with conflicting traffic in Narrows or Chesterfield Inlet	4*	3	**12**	• Install AIS on all tugs • Provide notification protocol and scheduling information to all operators • Design additional barge control with ITB system	4	2	**8**
5	Tug Barge collides with dock Baker Lake	2	4	**8**	• Provide additional tug to assist with docking	2	1	**2**
6	Tug barge crew injured during docking and undocking operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
7	Tug barge crew injured during barge tow hook up and disconnect operation	4	3	**12**	• Use safety managemnt procedures • Personnel use PPE	4	2	**8**
8	Tug is damaged by serious season ending fire/mechanical failure	4	3	**12**	• Design tug with duplicate back up on critical systems, including propulsion, navigation, electrical and steering • Use IACS Classed Tugs and Barges • Tugs and Barges to be subject to a comprehensive predictive maintenance plan • Monitor compliance with maintenance plan • Plan for additional tug as back up	4	2	**8**
9	Tug Barge does not complete supply program in weather window	5	3	**15**	• Maintain a conservative estimate of weather window • Use a conservative contingency	4	2	**8**
10	Barge Spills fuel at the Narrows or in Chesterfield inlet	3*	3	**9**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake	3	2	**6**

					• Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability			
11	Barge Spills fuel at Baker Lake	4	3	**12**	• Locate first response oil spill equipment on each barge and tug • Locate secondary Oil Spill response equipment at Helicopter Island and at the east entrance to Chesterfield inlet • Locate another Oil Spill response kit including reaction team at Baker lake • Establish an oil spill response plan and exercise the plan • Root causes of spill addressed in mitigation controls to reduce probability	4	2	**8**

*Note: The double hull barge design significantly reduces the severity level of the hazard