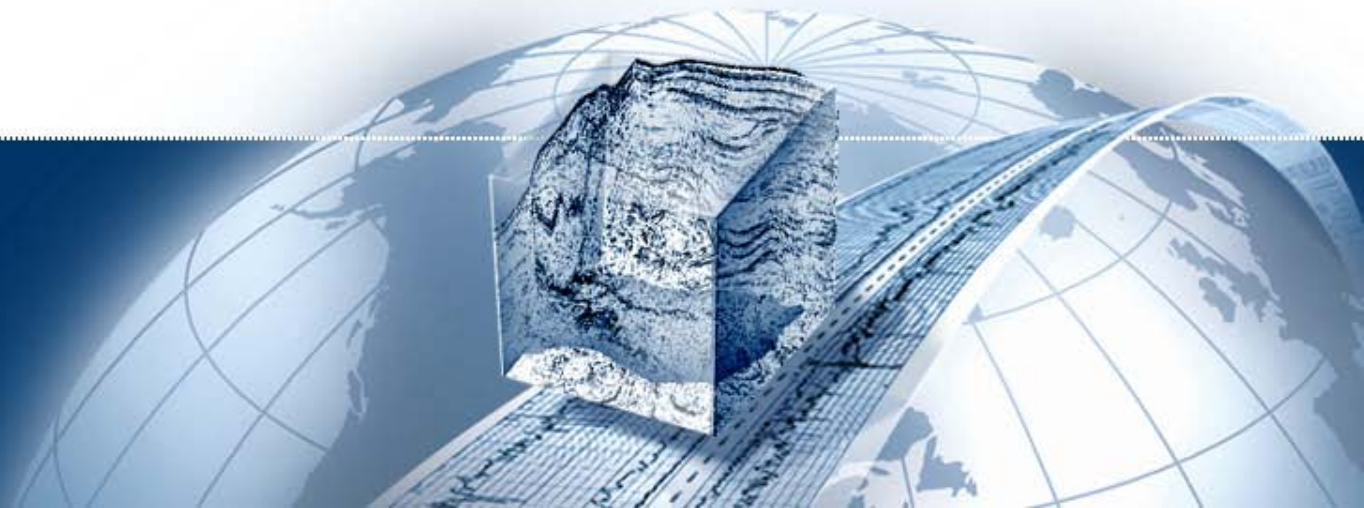


TGS 2010 Operations and Monitoring Plans Chukchi Sea 2D Seismic Survey

Open Water Meeting
Anchorage, AK
3/22/2010



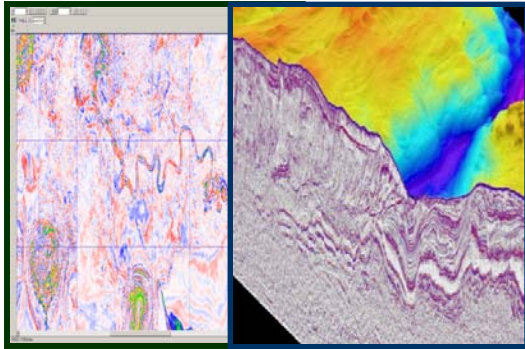
TGS' Profile

A leading provider of multi-client seismic data and related geoscientific products to the oil & gas industry.

- **Main offices:** Houston (USA) and Asker (Norway)
Regional offices: London, Stavanger, Perth, Moscow
- **Approximately 630 employees**
- **Traded on Oslo Stock Exchange, in OBX Index (25 most liquid shares at the OSE).**

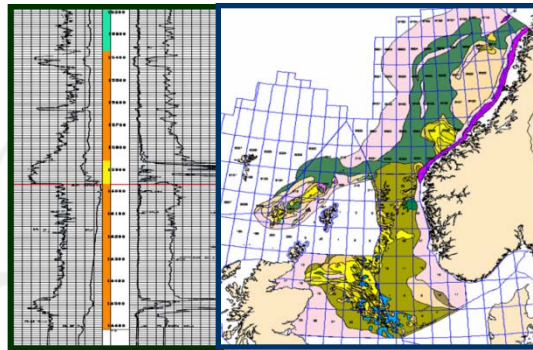
TGS' Core Businesses

Geophysical



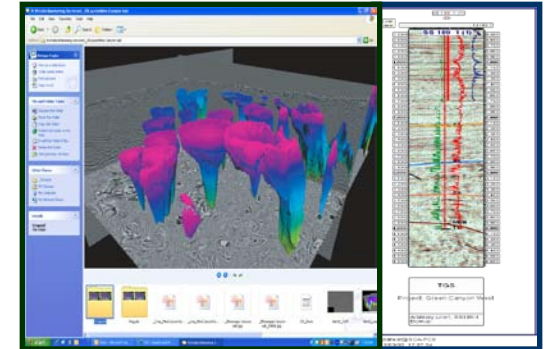
- 2D Seismic
- 3D Seismic
- Wide Azimuth Seismic
- Aeromagnetics
- Gravity
- Electromag (CSEM)
- Multi-beam

Geological



- Digital well data
- Production data
- Core data
- Regional geologic interpretation
- Facies Map Browser
- Interpretive services

Imaging Services



- Seismic processing
- High end depth imaging
- Proprietary technology
- Ongoing R&D investment
- Contract business model

TGS' Values

- **Responsibility to Clients & Customers**
 - We promise to provide quality and service
- **Responsibility to Employees**
 - Our #1 asset
- **Responsibility to Communities and Environment**
 - This is where we live and work
- **Responsibility to Shareholders**
 - We strive to provide profit and growth

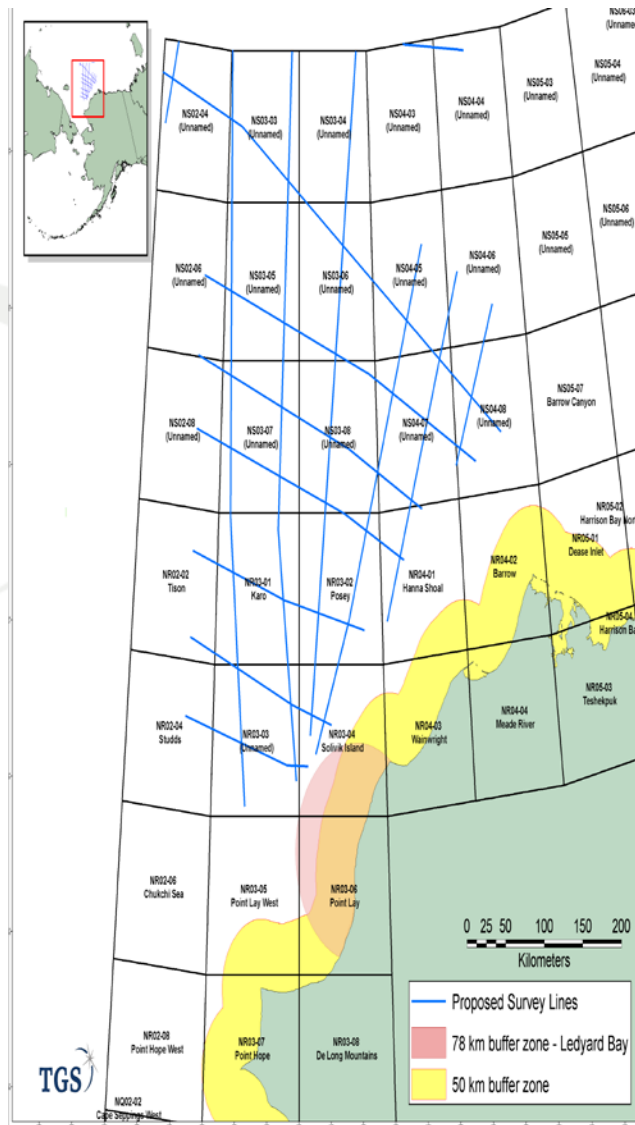
Solid data from a solid company.



Proposed 2D Seismic Survey

A regional, baseline survey for the Chukchi Sea

- **One seismic vessel, one source array, one streamer**
 - Source = 3400 cu in
 - Streamer = 6 – 8 km (~3-4 miles) **ice dependent
- **~5,000 km of seismic lines (~3,100 miles)**
- **Data belongs to TGS to license to multiple customers**



CONFIDENTIAL

Operational Time Line

- **Start Date:** **July 22/August 1
- **Calculated Length: 30 – 35 days**

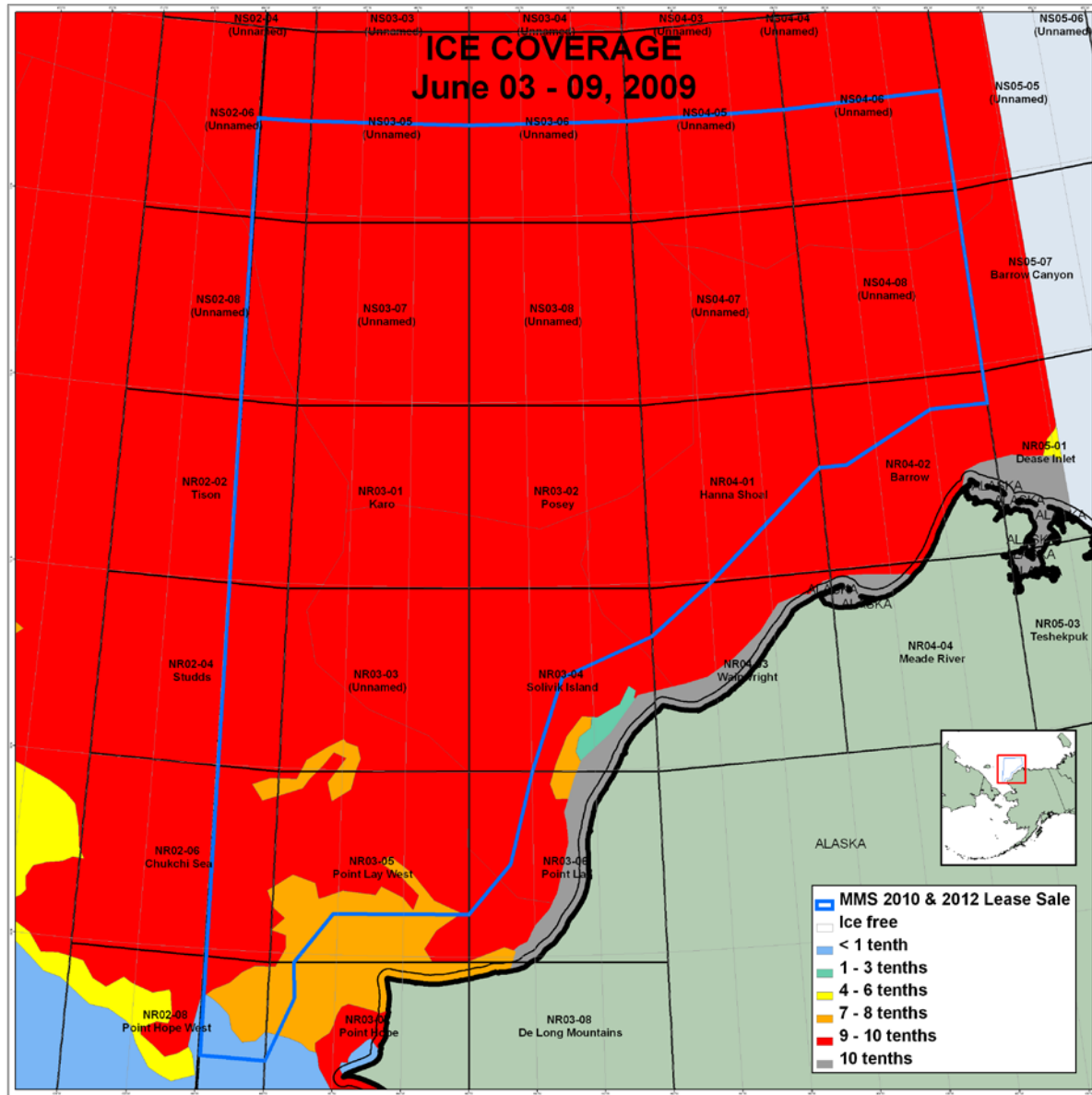
Variables:

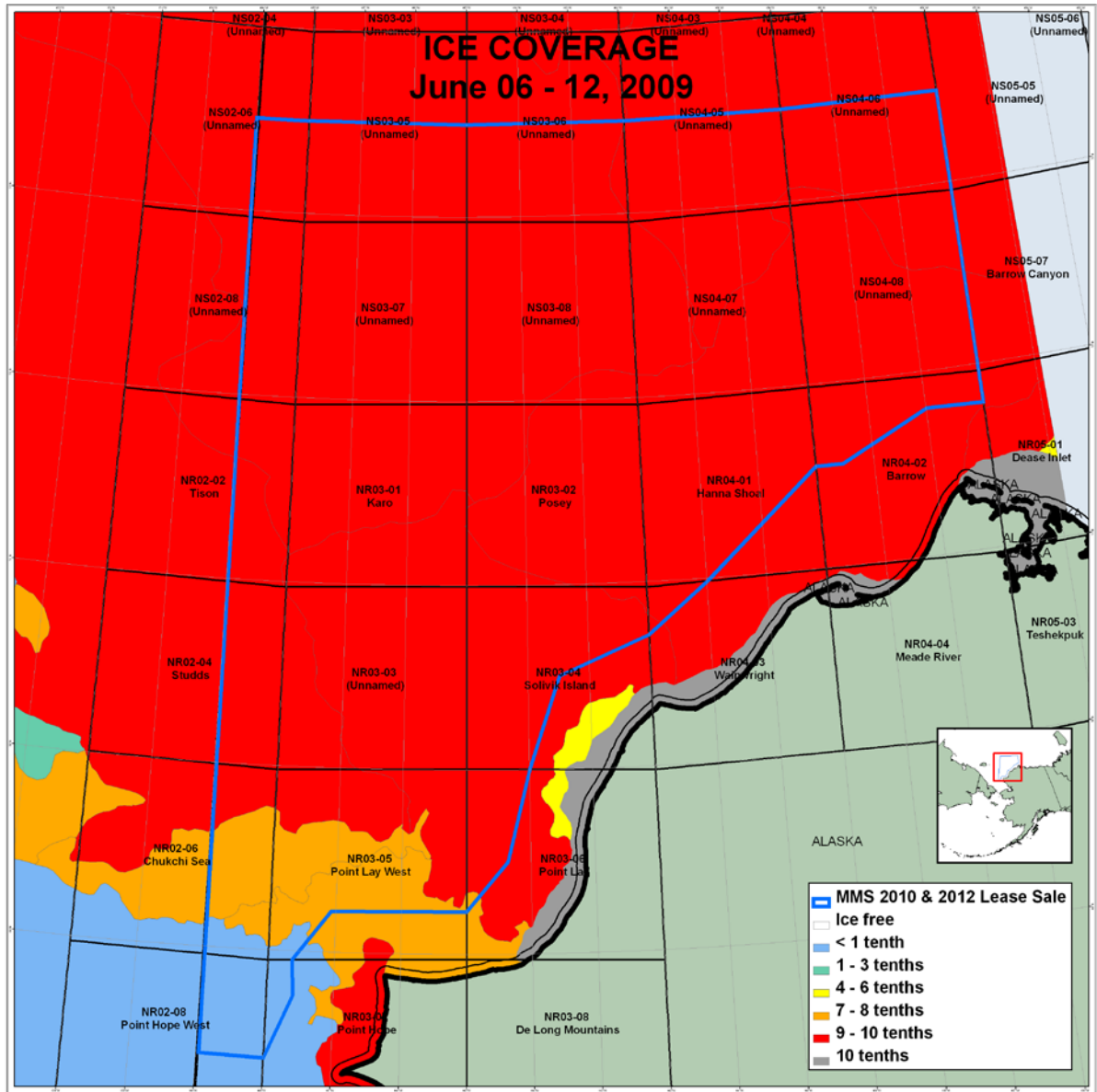
- Ice
- Marine mammals
- SIMOPS
- Weather
- Equipment

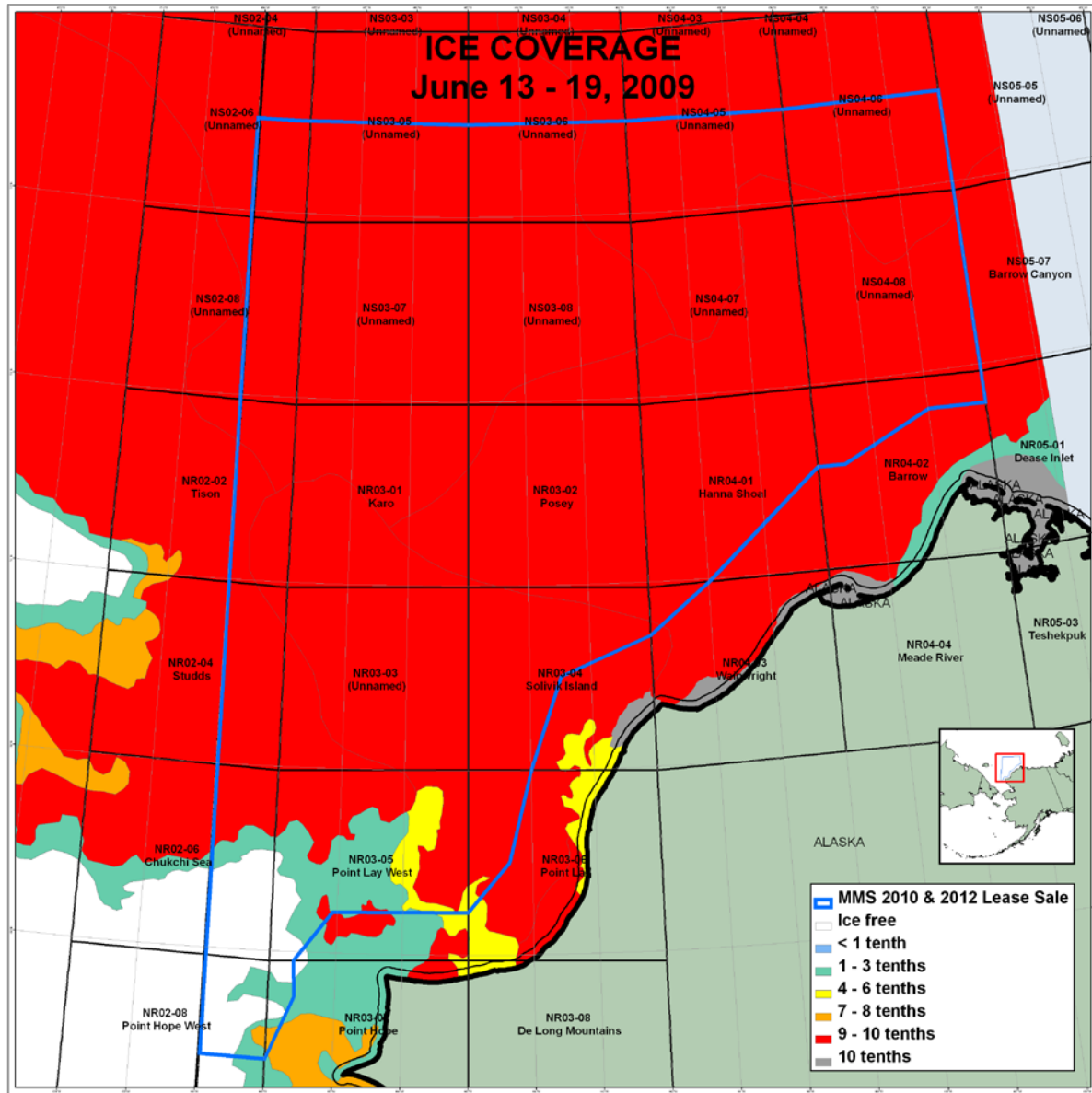
ACTIVITY	DURATION	DATE
Acquisition (planned)	5-7 weeks	August - Mid-September
Acquisition (permitted)	3 months	August-October

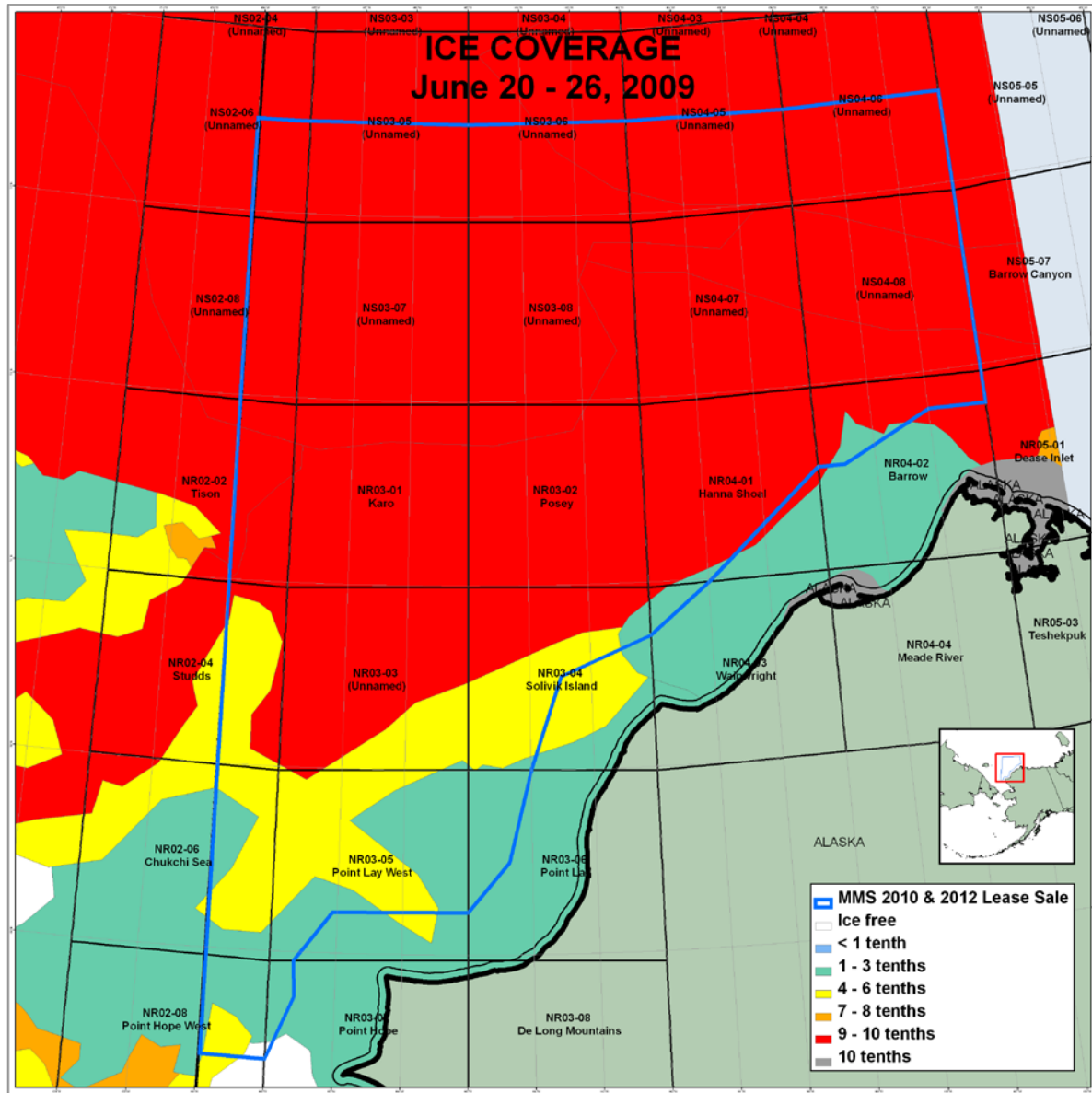
Plan of Operations

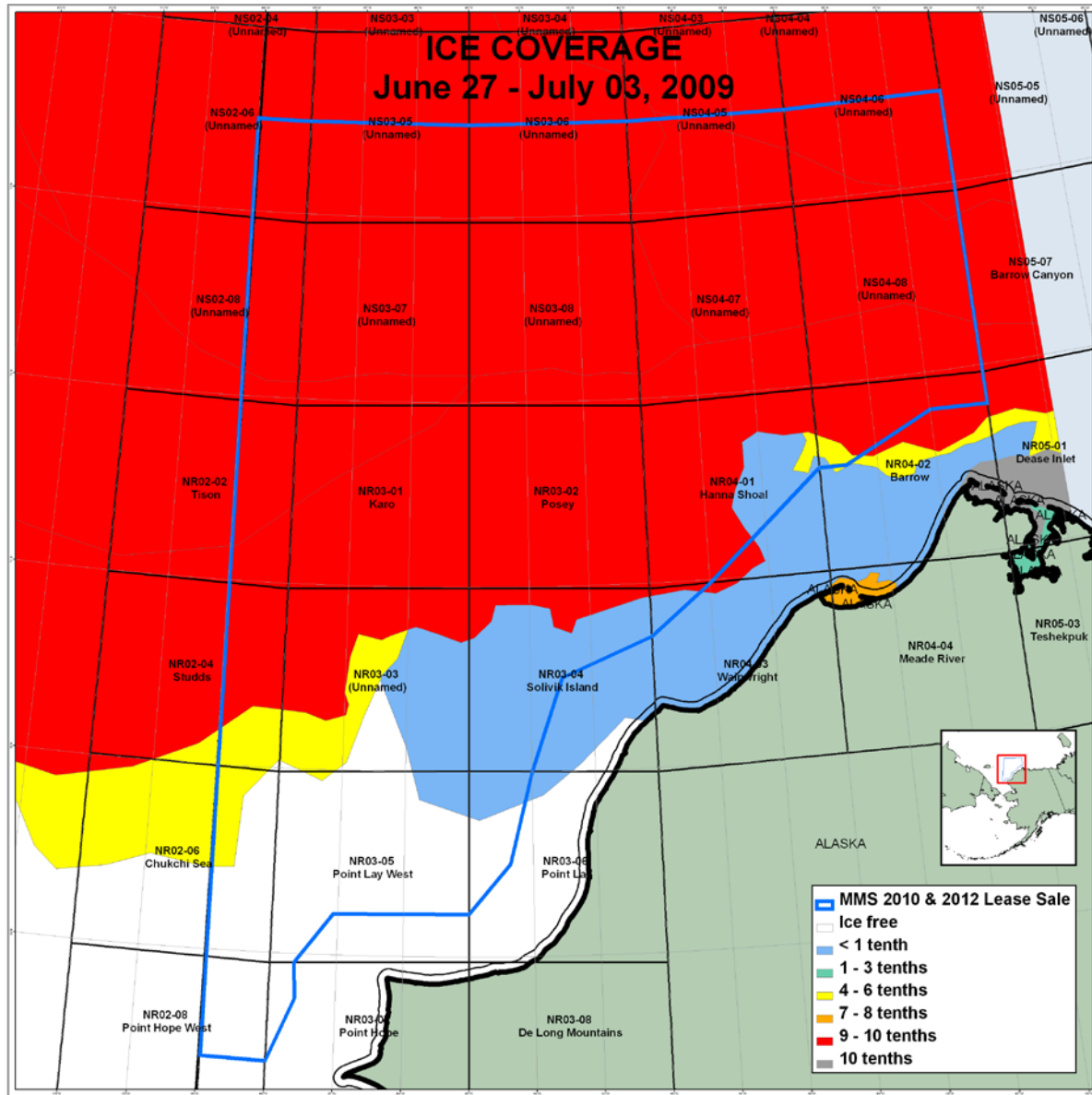
ACTIVITY	LOCATION	DURATION	COMMENTS
Pre-Survey	Nome, AK	1 week	Fuel, supplies, training/start-up meetings
Transit	To Chukchi Sea	2 days	
Acquisition	Chukchi Sea	5-7 weeks	
Transit	To Nome, AK	3 days**	
Crew change	Nome, AK	1 – 3 days	
Transit	TBD	TBD	TBD



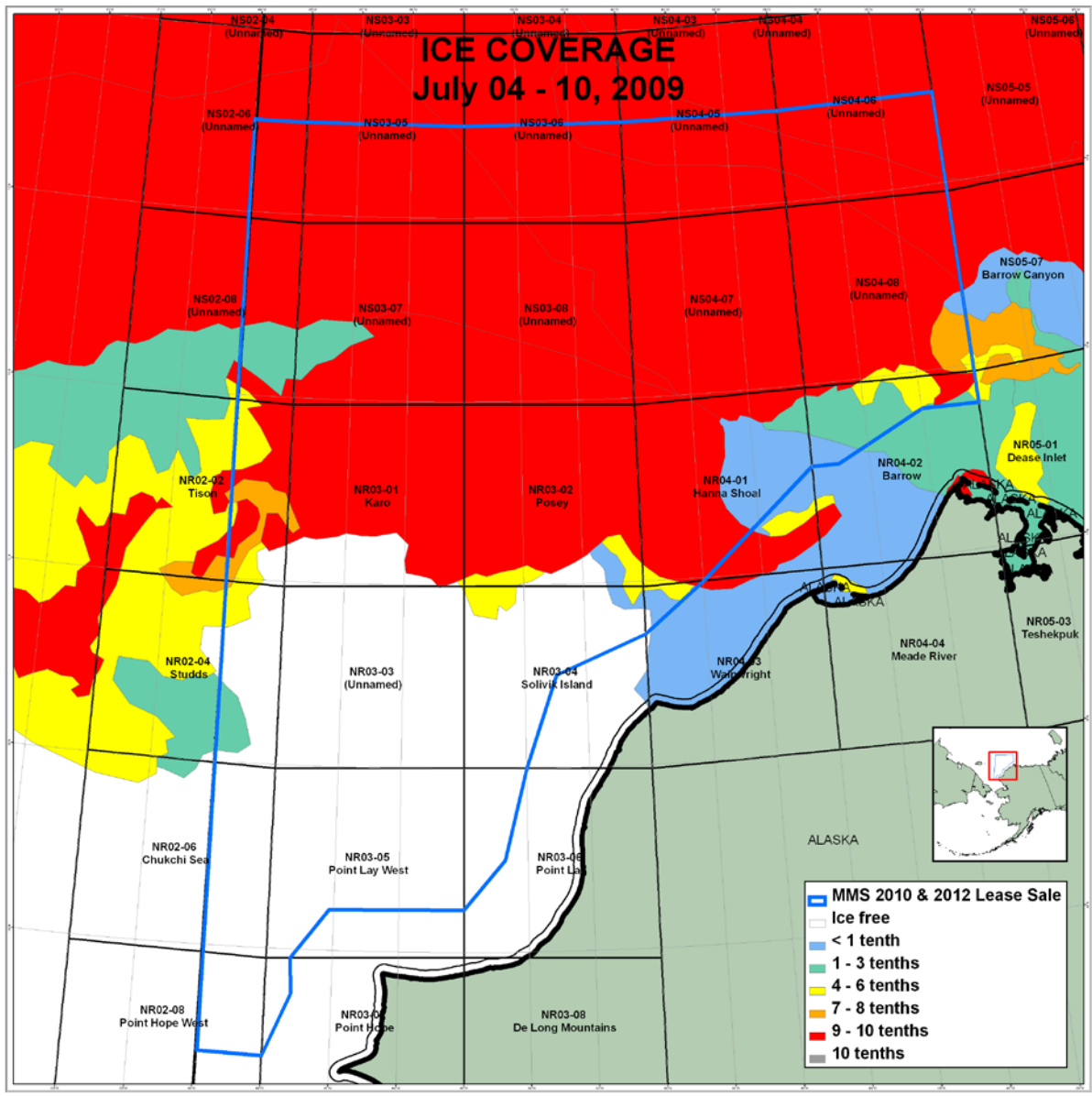




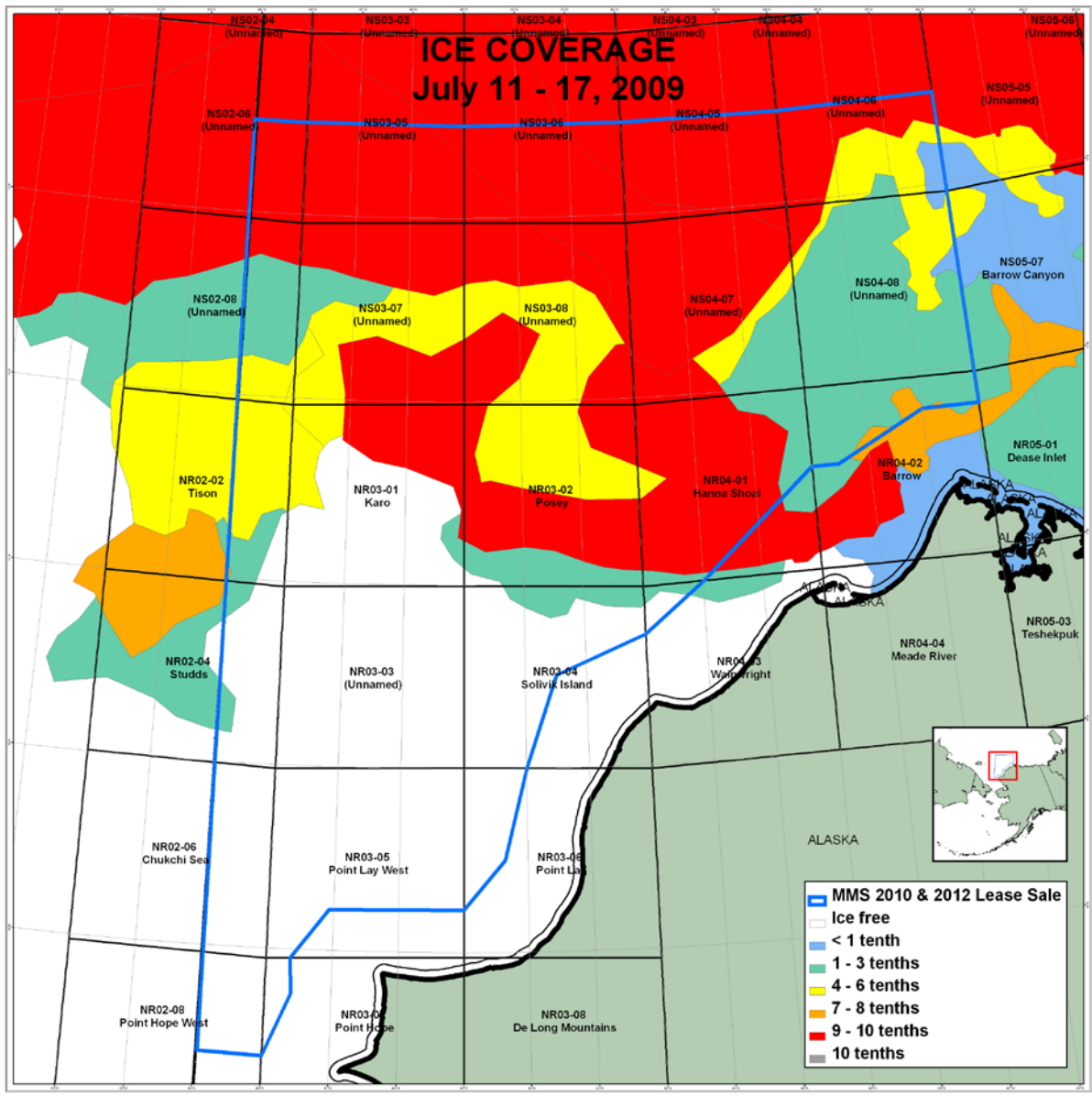




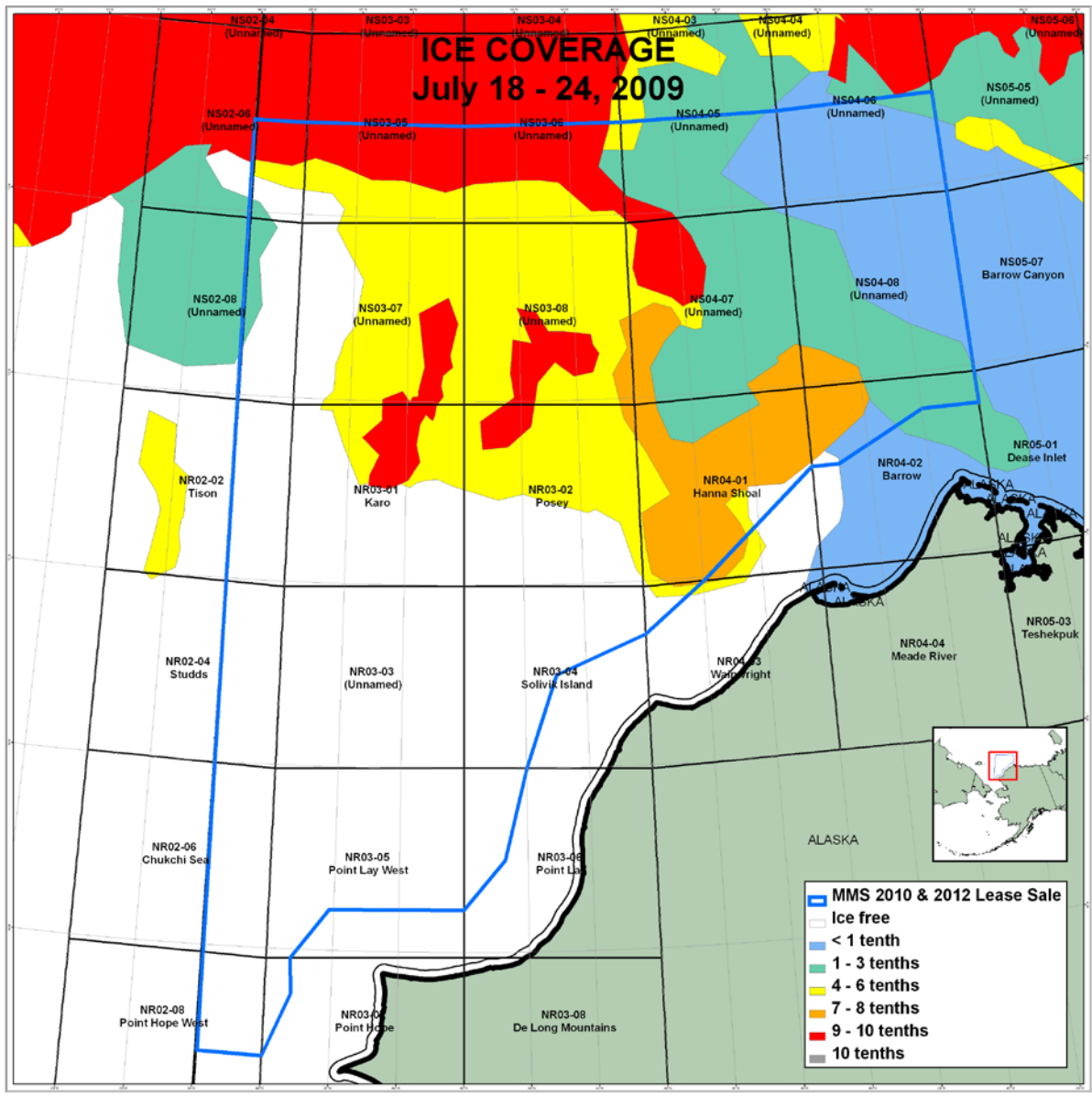
ICE COVERAGE July 04 - 10, 2009

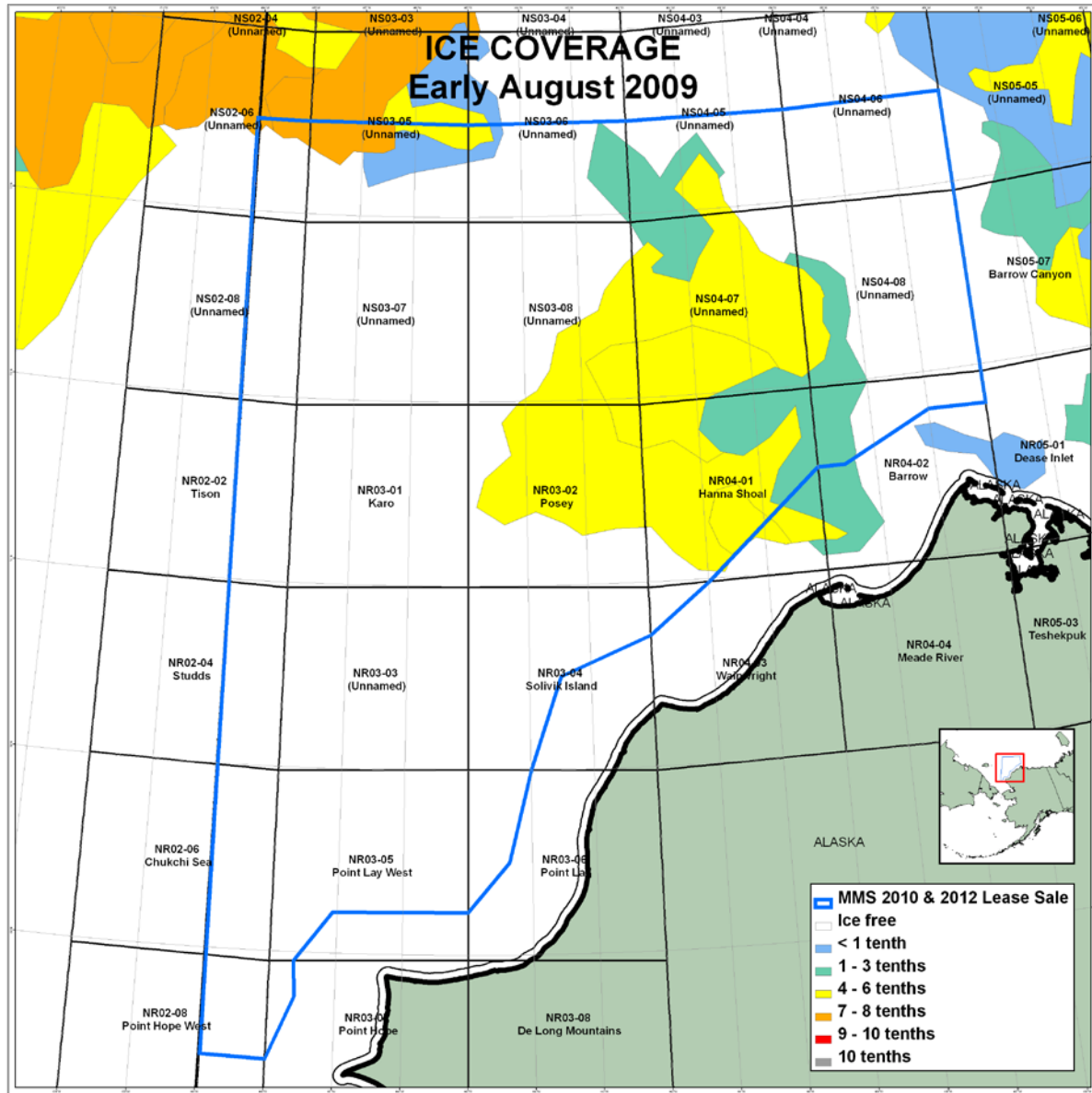


ICE COVERAGE July 11 - 17, 2009

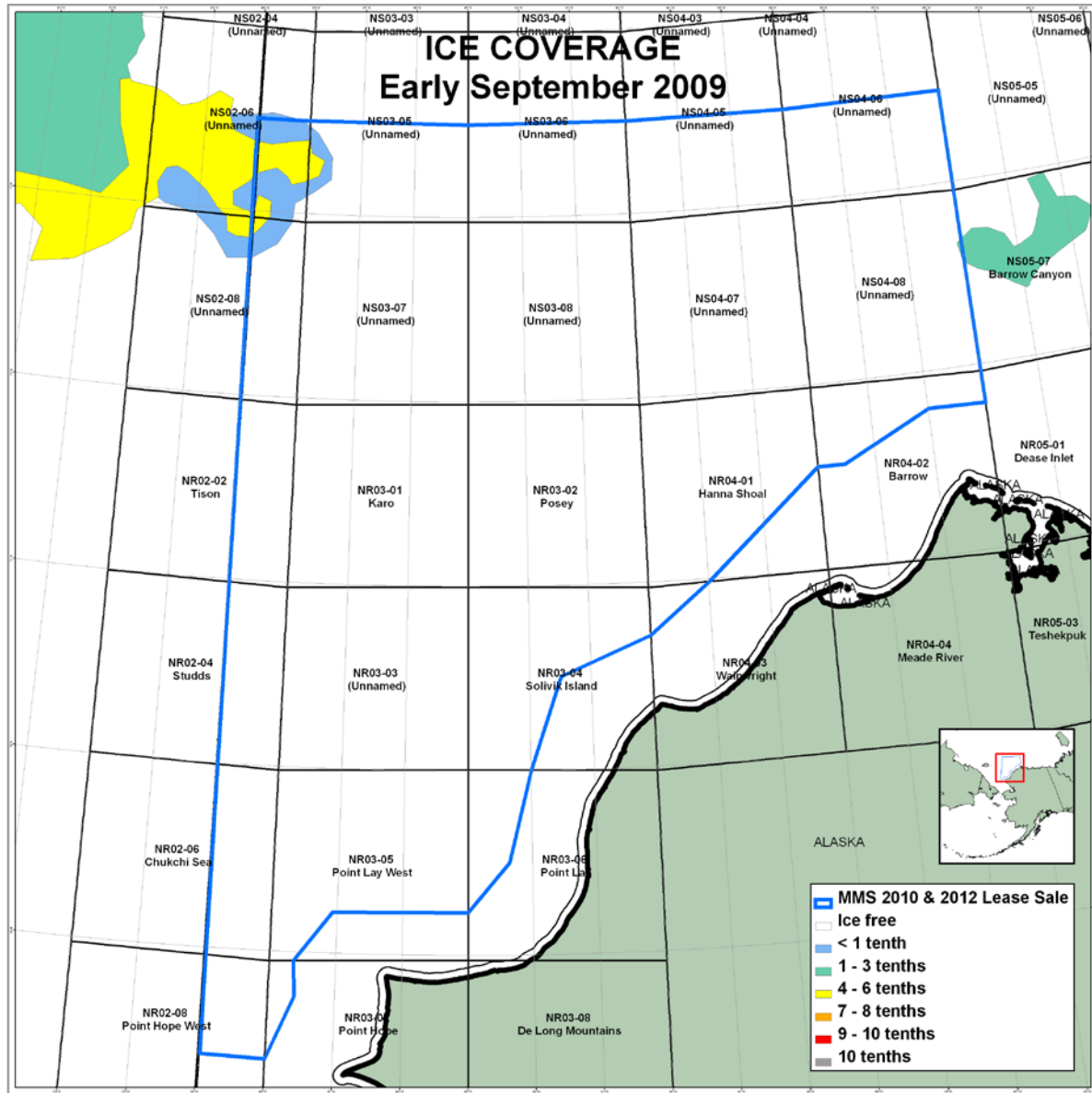


ICE COVERAGE July 18 - 24, 2009

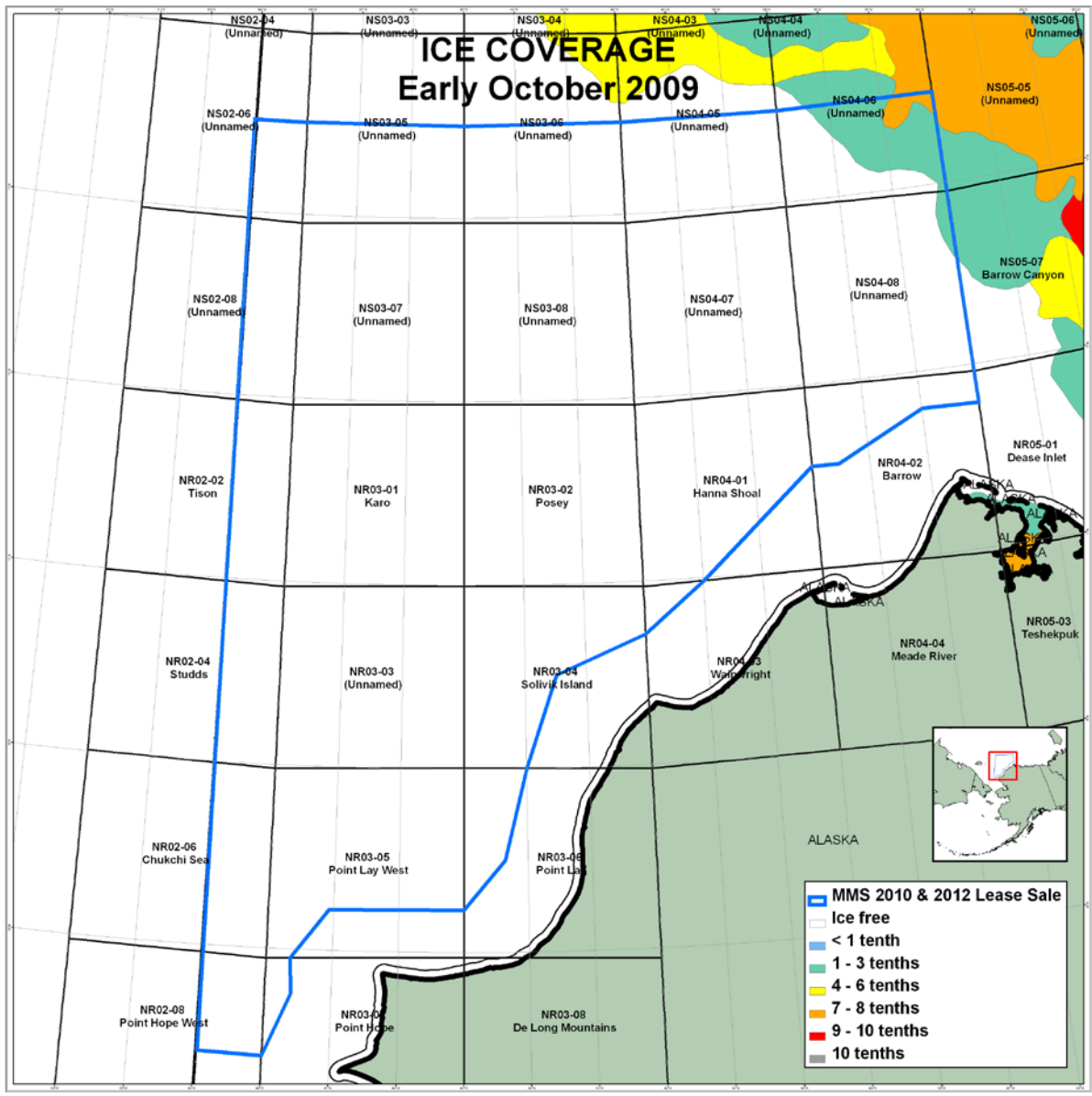




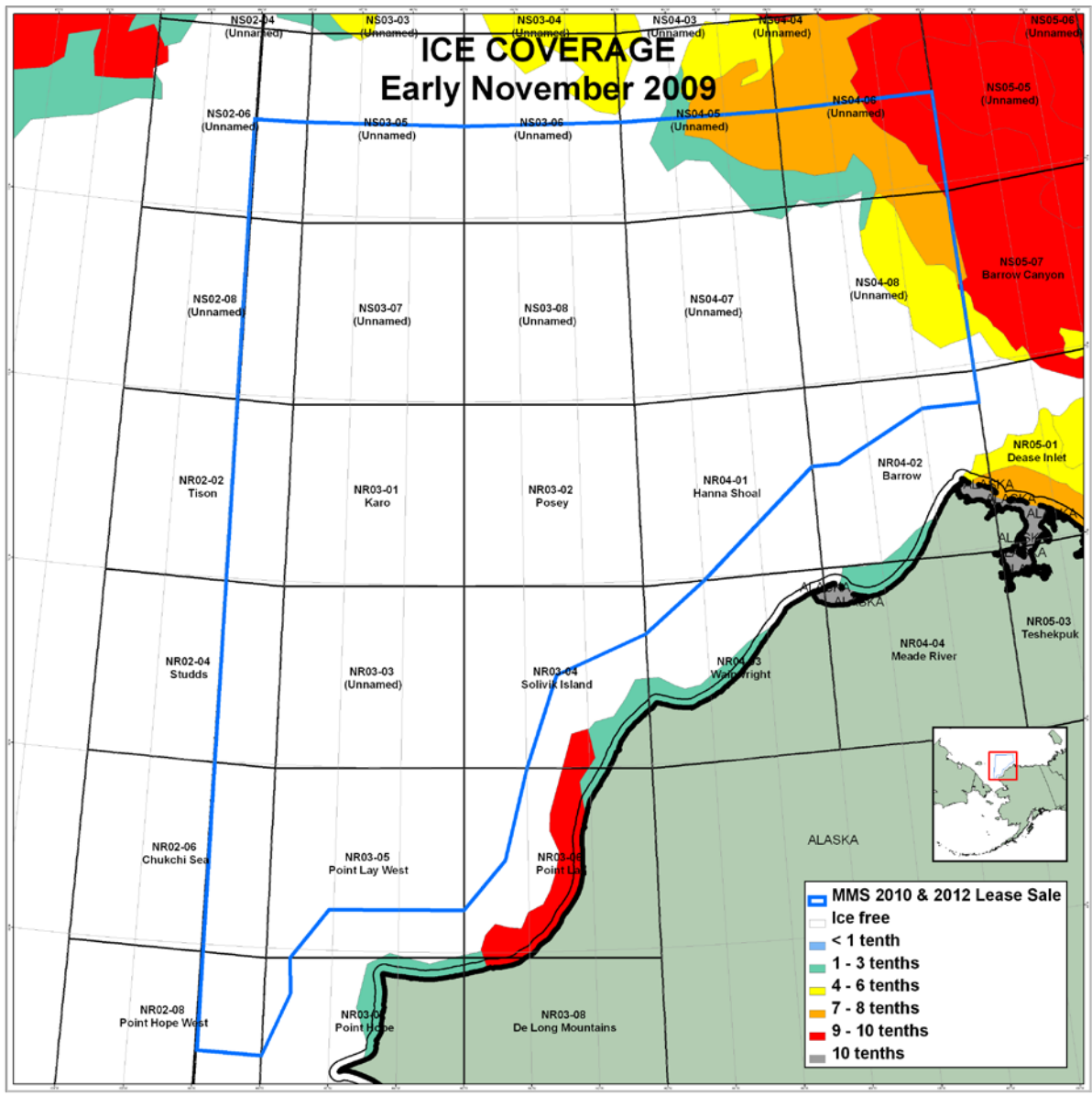
ICE COVERAGE Early September 2009



ICE COVERAGE Early October 2009

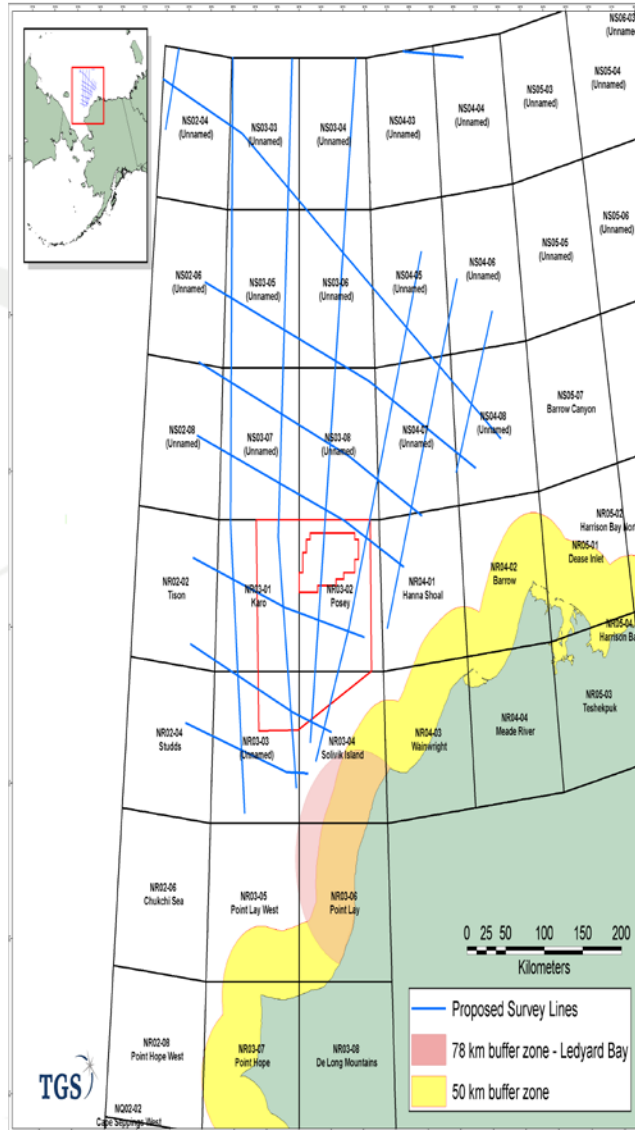


ICE COVERAGE Early November 2009



SIMOPS (Simultaneous Operations)

- **Common practice**
- **Coordinate with other operators**
 - Prevent interference
 - Maintain safe distances
- **Resolve conflict**
 - Time sharing
 - Strategic planning in acquisition timing



CONFIDENTIAL

4MP

- **Objectives:**

- Minimize impacts
- Collect data on distribution and abundance of marine animals in the survey area
- Document marine mammal occurrence and activity near seismic operations
- Basis for real-time mitigation (power downs and shut downs of the airguns)



4MP

- **Sound Source Verification**
 - Conducted early in the survey
 - Revise safety radii as needed for implementation by MMOs



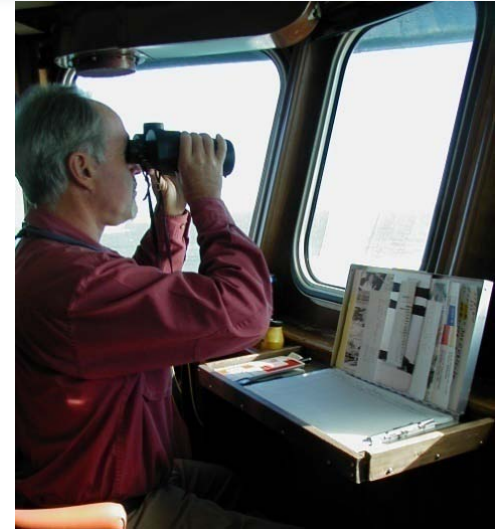
4MP

- **Vessel based observers**

- 5 on source vessel
- 3 on scout vessel**

- **On watch for:**

- all daylight seismic operations
- most daylight non-seismic operations
- 30 min before, and during ramp ups (2 MMOs)



4MP

- **Ensure safety radii are clear of respective marine mammals for 30 minutes prior to and during ramp ups**
 - 180 dB zone for cetaceans and walruses
 - 190 dB zone for pinnipeds and polar bears
 - Start ups only performed when full safety radii are visible during daylight for ≥ 30 min



4MP

- **Continually monitor safety zones during daylight airgun activity**
 - Power down to mitigation gun if a marine mammal is sighted within or likely to enter the full airgun array safety radii
 - Shut down of all airguns if a marine mammal is sighted within or likely to enter the mitigation airgun safety radii




Oil Spill Response

- **On board oil spill response plan (Tier One)**
 - First line of defense
- **Team is assessing the need for a 3rd party contractor**
- **Discussing options with local contractors**

- **No bunkering at sea!**

Next Steps

- **Modify survey lines as necessary**
- **Modify 4MP as necessary**
- **Secure logistics support**
 - Port services
 - Finalize MMO distribution
 - Oil spill response
 - Conflict Avoidance Agreement**



Solid data from a solid company.

Thanks to:

HCG

LGL

ASRC

Citizens of Point Lay

Citizens of Wainwright

Citizens of Barrow

Tom Neugebauer and Erling Frantzen

Bob, Caeser, Christina, and Gabe

Knut and Chris

TGS Executive Team

4MP

- **Modeled Sound Radii**

Received sound level (dB re 1 μ Pa rms)	Water depth (m)	
	<100	>100
190	710	430
180	2600	2400
160	12,000	18,000

	Number of Exposures to Sound Levels ≥ 160 dB					
	Summer		Fall		Total	
	Avg.	Max.	Avg.	Max.	Avg.	Max.
Odontocetes						
<i>Monodontidae</i>						
Beluga	493	985	638	1275	1130	2260
Narwhal	0	1	0	0	0	5
<i>Delphinidae</i>						
Killer whale	11	43	4	14	14	5
<i>Phocoenidae</i>						
Harbor porpoise	118	172	36	47	154	218
Mysticetes						
<i>Bowhead whale</i>	193	386	685	1369	878	1756
<i>Fin whale</i>	11	43	4	14	14	5
Gray whale	869	1739	222	444	1091	2182
<i>Humpback Whale</i>	11	43	4	14	14	5
Minke whale	11	43	4	14	14	5
Total Cetaceans	1716	3455	1594	3192		
Pinnipeds						
Bearded seal	1181	2246	394	749	1575	2994
Ribbon seal	32	129	11	43	43	172
Ringed seal	40682	67373	9086	15047	49767	82419
Spotted seal	814	1347	181	299	994	1647
Total Pinnipeds	42708	71095	9671	16138		