

Letter of Authorization Application – Addendum to G&G Permit Application

Long Form – Assumes proprietary materials of BOEM G&G application are not provided to NMFS

BOEM CONTROL NUMBER: L21-024

A. Type of Survey:

Please indicate which type of survey will be used in the proposed activity
<input checked="" type="checkbox"/> Deep Penetration Seismic (greater than 1,500 in³ total airgun array volume) <ul style="list-style-type: none">• 2D Seismic-towed Streamer• 2D Seismic-Sea-floor Cable or Nodes• 3D Seismic-towed Streamer• 3D Seismic-Sea-floor Cable or Nodes• NAZ• WAZ• 4D (Time Lapse)• Vertical Cable• Borehole Seismic (VSP)
<input type="checkbox"/> Shallow Penetration Seismic (less than 1,500 in³ total airgun array volume) <ul style="list-style-type: none">• Surface Vessel• Surface Vessel and AUV/ROV• Borehole Seismic (VSP)
<input type="checkbox"/> HRG Surveys (no airguns used) <ul style="list-style-type: none">• Surface vessel• AUV/ROV• Both
<input type="checkbox"/> Other <u>Describe (if Other):</u>

Proxy used : Coil

WesternGeco is applying for an LOA to acquire a long offset sparse OBN survey.

The Coil proxy option has been used in the Exposure Estimation Tool because it most closely resembles sparse OBN. Both Coil and sparse OBN use efficient acquisition methodology to acquire Full Azimuth (FAZ) and long offset data to enable better imaging of the sub-surface geological structures in both production/development and exploration settings. Both acquisition methods use multiple sources, towed from different vessels to achieve the Full Azimuth and Long Offset data set. Long offsets being 30 Km for sparse OBN and 18-20 Km for

Coil. Full Azimuth (FAZ) means each receiver collects data from a full range of azimuths, i.e. 0° - 360°, thereby “illuminating” the sub-surface geological structures from different directions and therefore providing a clearer image of potential drilling prospects.

In contrast, 3D NAZ is narrow azimuth and short offset, typically 8-10 Km, with a source towed by a single vessel, the same vessel that tows the receiver array. Narrow Azimuth means each receiver collects data from a limited range of azimuths, i.e. 150° - 210° relative to the source and therefore there is a limitation on this technology’s ability to image the deep geological structures.

B. Survey Area and Operational Plan:

Question:	Response
Location: (Lease Block(s), Facility or Prospect Name, Lat/Lon, etc.)	Engagement 2 Located wholly in the Green Canyon protraction area.
Overall Duration of the Activity (days):	58 days
Areal extent of the survey area: (in OCS lease blocks or km ²) (Attach GIS file(s) of survey lines and/or survey area perimeter)	106 OCS blocks for the node area 132 OCS blocks for the source area Survey perimeter shape files attached
G&G ITR/PEIS Modeling Zone(s) in which the activity will occur (1-7):	5 (100%)
Number of days during the overall activity period on which the sound source(s) listed in Section C will operate: (If the activity will occur in more than one Modeling Zone, provide the number of operating days within each modeling zone.)	48 days – the other 10 days will be used for final node recovery
Water depth range	600 m to 2,000 m

C. Sound Sources:

- List all survey-related instruments that emit acoustic energy into the water column, including but not limited to airgun or airgun arrays, sub-bottom profilers, bubble pulsers, sparkers, side scan sonars, multi-beam sonars, single-beam echosounders, ultra-short baseline (USBL) position systems, pressure inverted echosounder (PIES), etc.
- For airgun arrays, please attach a diagram showing the layout (geometry) of the array and list of airgun sizes. See diagrams in Appendix A

Energy Source	Manufacturer	Model	Total Array Volume & Number of Elements (cubic inches or Liters.)	Source Level (SL) in dB re 1µPa@1m in water (RMS)	Source Level (SL) in dB re 1µPa@1m in water (Peak to Peak)	Operating Frequency (Hz, kHz, range)	Pulse Duration (seconds, milli-seconds)	Pulse Rate (or Cycle) (Pulses per second or minute)	Towing Depth of the Source (ft or m)	Towing Depth of the Receiver(s) (ft or m)	Duration of Use (Number of Days or Percent of Active Sound Source Days)
Air gun array	Bolt	Long Life	5200 cu. in.	235	266	0-128 Hz	100 msecs	8 seconds	10 m	OBN receivers on Seabed	48
Pressure Inverted Echo Sounder	Sonardyne	8036	NA	188-200 dB	190-200 dB	14-19 KHz	NA	1 pulse every 15 seconds	Placed on seabed	Placed on seabed	58
Single beam echosounder One per vessel	Simrad	EA600	NA			38 KHz					58
USBL system	Kongsberg	HiPAP 501	NA			21-31 KHz					58

D. Take Estimate:

[Insert the “Summary for NOAA” table here after completing all required inputs on the “Applicant Data Entry” spreadsheet in the Take Calculator Excel file or alternative tool developed with/by NMFS]

Exposures by Metric			
	Summer	Winter	Total
Level A			
Low-Frequency Hearing Group			
Bryde's whale	< 0.01	0.48	0.48
High-Frequency Hearing Group			
Kogia (dwarf, pygmy sperm whale)	< 0.01	25.25	25.25
Level B			
Low-Frequency Hearing Group			
Bryde's whale	< 0.01	20.71	20.71
Mid-Frequency Functional Hearing Group			
Beaked whales (Cuvier/Blainville/Gervais)	< 0.01	5,572.41	5,572.41
Bottlenose dolphin	< 0.01	4,539.87	4,539.87
Short-finned pilot whale	< 0.01	512.39	512.39
Sperm whale	< 0.01	1,251.13	1,251.13
Atlantic spotted dolphin	< 0.01	1,813.40	1,813.40
Clymene dolphin	< 0.01	2,696.12	2,696.12
False killer whale	< 0.01	663.23	663.23
Fraser's dolphin	< 0.01	302.77	302.77
Killer whale	< 0.01	17.86	17.86
Melon-headed whale	< 0.01	1,771.38	1,771.38
Pantropical spotted dolphin	< 0.01	12,234.74	12,234.74
Pygmy killer whale	< 0.01	416.88	416.88
Risso's dolphin	< 0.01	792.15	792.15
Rough-toothed dolphin	< 0.01	958.12	958.12
Spinner dolphin	< 0.01	3,278.34	3,278.34
Striped dolphin	< 0.01	1,053.03	1,053.03
High-Frequency Hearing Group			
Kogia (dwarf, pygmy sperm whale)	< 0.01	451.94	451.94

Level A Color Legend:	
	Level A SEL
	Level A Peak
*If no color highlight, both Level A peak and SEL are <0.01	

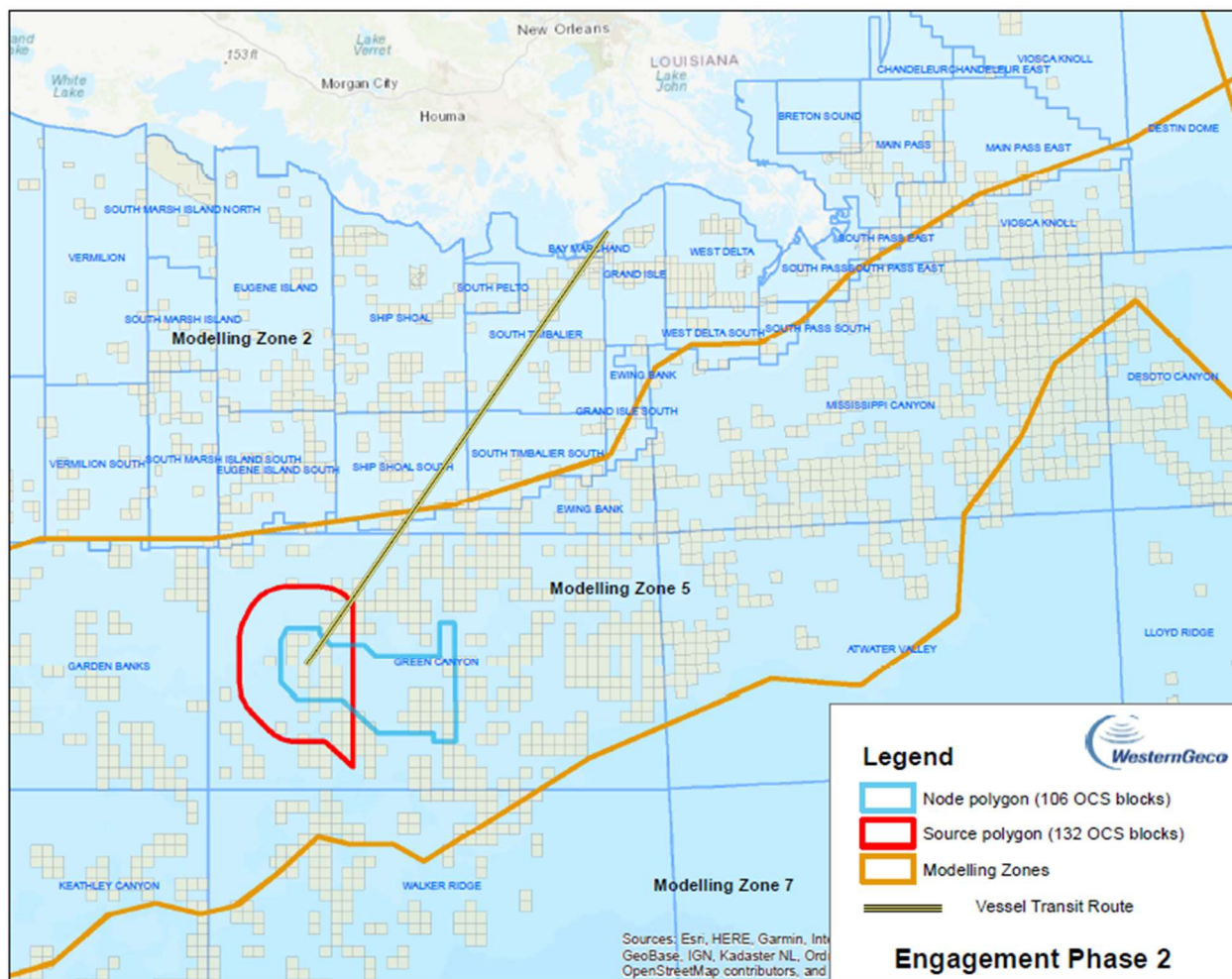
Total take, including Level B Scaling (where appropriate)			
	Summer	Winter	Total
	< 0.01	4.39144534	4.39
	< 0.01	562.81	562.81
	< 0.01	1302.94	1302.94
	< 0.01	151.15	151.15
	< 0.01	529.23	529.23
	< 0.01	520.45	520.45
	< 0.01	773.79	773.79
	< 0.01	195.65	195.65
	< 0.01	86.90	86.90
	< 0.01	5.27	5.27
	< 0.01	522.56	522.56
	< 0.01	3511.37	3511.37
	< 0.01	122.98	122.98
	< 0.01	233.68	233.68
	< 0.01	274.98	274.98
	< 0.01	940.88	940.88
	< 0.01	302.22	302.22
	< 0.01	170.32	170.32

E. Mitigation and Monitoring Efforts:

Question:	Response:
<p>Please indicate which set of monitoring and mitigation measures from the ITR's apply to the planned activity:</p>	<p>All monitoring and mitigation measures in the ITRs applicable to Airgun Surveys with a total volume >1500 cu in will be followed. See attached file "Mitigation Measures.pdf" for a list of applicable monitoring and mitigation measures.</p>
<p>Confirm that you will apply this set of monitoring and mitigation measures during the activity:</p>	<p>Yes, we will apply these measures during the 3D OBN survey.</p>

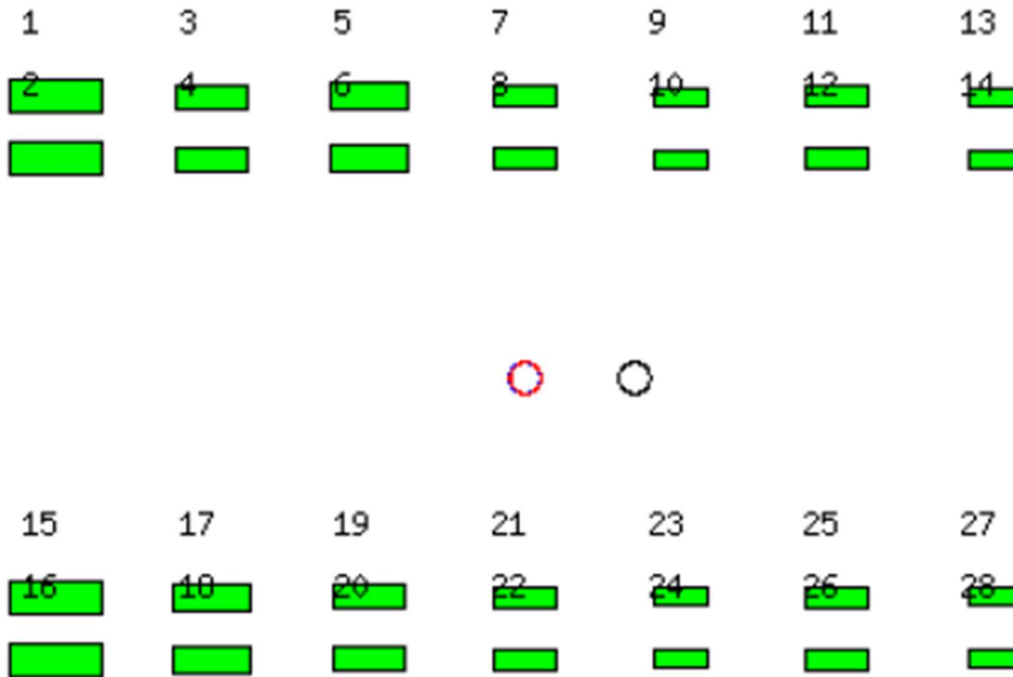
F. Map of Survey Area and Transit Route

[Insert map here or attach as a separate file]



Appendix A – Air gun Array Descriptions

Conventional air gun source using 28 elements per array. Shot interval would be every 50m.



The array described above consists of 28 air guns and has a total volume of 5,200 cubic inches. There will be two source vessels. Each source vessel will tow three of the 5,200 cu. in. arrays at a crossline distance of 100m. Hence, the distance between the outer arrays is 200m. The shot interval for each source is 50m which means that a source will fire every 16.6666m. The source sail line spacing will be 300m, i.e. the distance between each line that the source vessels will traverse.

Currently, on permit L20-027, the two source vessels are averaging 12,500 shots per day – or 6,250 shots per day per vessel. Using this average the source area covered by each source vessel, each day, will be:

$$6,250 \times 16.666 = 104.167 \text{ Km per day per vessel}$$

With a source line spacing of 300m this equates to $104.167 \text{ Km} \times 0.3 \text{ Km} = 31.25 \text{ Km}^2$ per day per vessel, or 62.5 Km^2 total area per day

Gun number	Press. (psi)	Volume (cu.in)	Gun Type	x (m.)	y (m.)	z (m.)	Delay (s.)	Sub-array number	Peak to peak contrib. (percent)	Max. bub. rad (m.)
1	2000.00	350.00	1500LL	0.000	-4.500	12.000	0.00000	1	4.0	0.5
2	2000.00	350.00	1500LL	0.000	-3.500	12.000	0.00000	1	3.9	0.5
3	2000.00	200.00	1900LLX T	2.500	-4.500	12.000	0.00000	1	3.4	0.4
4	2000.00	200.00	1900LLX T	2.500	-3.500	12.000	0.00000	1	3.4	0.4
5	2000.00	230.00	1900LLX T	5.000	-4.500	12.000	0.00000	1	3.3	0.4
6	2000.00	230.00	1900LLX T	5.000	-3.500	12.000	0.00000	1	3.2	0.4
7	2000.00	155.00	1900LLX T	7.500	-4.500	12.000	0.00000	1	3.5	0.4
8	2000.00	155.00	1900LLX T	7.500	-3.500	12.000	0.00000	1	3.5	0.4
9	2000.00	120.00	1900LLX T	10.000	-4.500	12.000	0.00000	1	3.6	0.3
10	2000.00	120.00	1900LLX T	10.000	-3.500	12.000	0.00000	1	3.6	0.3
11	2000.00	155.00	1900LLX T	12.500	-4.500	12.000	0.00000	1	3.6	0.4
12	2000.00	155.00	1900LLX T	12.500	-3.500	12.000	0.00000	1	3.6	0.4
13	2000.00	90.00	1900LLX T	15.000	-4.500	12.000	0.00000	1	3.7	0.3
14	2000.00	90.00	1900LLX T	15.000	-3.500	12.000	0.00000	1	3.7	0.3
15	2000.00	350.00	1500LL	0.000	3.500	12.000	0.00000	2	3.9	0.5
16	2000.00	350.00	1500LL	0.000	4.500	12.000	0.00000	2	4.0	0.5
17	2000.00	230.00	1900LLX T	2.500	3.500	12.000	0.00000	2	3.3	0.4
18	2000.00	230.00	1900LLX T	2.500	4.500	12.000	0.00000	2	3.3	0.4
19	2000.00	200.00	1900LLX T	5.000	3.500	12.000	0.00000	2	3.3	0.4
20	2000.00	200.00	1900LLX T	5.000	4.500	12.000	0.00000	2	3.4	0.4
21	2000.00	155.00	1900LLX T	7.500	3.500	12.000	0.00000	2	3.5	0.4
22	2000.00	155.00	1900LLX T	7.500	4.500	12.000	0.00000	2	3.5	0.4
23	2000.00	120.00	1900LLX T	10.000	3.500	12.000	0.00000	2	3.6	0.3
24	2000.00	120.00	1900LLX T	10.000	4.500	12.000	0.00000	2	3.6	0.3
25	2000.00	155.00	1900LLX T	12.500	3.500	12.000	0.00000	2	3.6	0.4
26	2000.00	155.00	1900LLX T	12.500	4.500	12.000	0.00000	2	3.6	0.4
27	2000.00	90.00	1900LLX T	15.000	3.500	12.000	0.00000	2	3.7	0.3
28	2000.00	90.00	1900LLX T	15.000	4.500	12.000	0.00000	2	3.8	0.3

See attached file "5200_10m_array_report.pdf" for source modelling.

Additional Notes for Application:

The Engagement-2 survey is already being acquired under permit L20-027.

This permit, L20-027, will expire on December 31st, 2021.

Due to a late start caused by circumstances beyond our control, we will not be able to complete all acquisition by December 31st, 2021.

Consequently, WesternGeco have submitted an application to BOEM for a new permit to allow acquisition beyond the end of 2021.

This new permit number is L21-024.

Using the current rates of production WesternGeco estimates, at this time, that there will be 48 days of source acquisition remaining, i.e., from January 1st, 2022 until February 17th, 2022.

Note that, as of December 31st, 2021, all nodes will have been deployed and node recovery will have started. Hence, the node polygon as shown in the activity map extends beyond the required source polygon.