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Sent: Friday, July 12, 2002 3:58 PM
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Subject: WesternGeco Acoustical and Biological Research Test Program



JEK_Test Program IMG_Acoustic and
PS Notificati... Biological Te...

WesternGeco has applied today to the NEB for an approval pursuant to paragraph 5(1)(b) of the Canada Oil and Gas Operations Act for a Research Test Program.

Please find attached:

- NEB's notification and preliminary screening exemption for the subject research test program, and
- IMG-Golder's "Acoustical and Biological Test for the Mackenzie River/Delta"

A signed copy of NEB's letter, WesternGeco's application (including the above IMG-Golder report), and WesternGeco's letter regarding consultation will be forwarded by facsimile on Monday morning.

Please call me if you have any questions regarding this.

Regards,

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File 9180-W730-2

12 July 2002

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WesternGeco Application to Conduct a Mackenzie River Acoustical and Biological Research Test Program - Pursuant to 5(1)(b) of the *Canada Oil and Gas Operations Act* Notification and Preliminary Screening Exemption

Background

By application submitted on 23 April 2002, WesternGeco Canada Limited (WesternGeco) proposed to undertake a 1,800 km seismic acquisition program on the Mackenzie River (the Development). The National Energy Board (NEB), as the designated regulatory agency, initiated a preliminary screening on 2 May 2002. On 25 June 2002, the NEB and the Department of Fisheries and Oceans (DFO) jointly referred the development proposal to the Mackenzie Valley Environmental Impact Review Board (Review Board) for environmental assessment. The NEB and DFO felt that the acoustic effects and proposed mitigation measures of a river seismic program of that magnitude required further study in order adequately evaluate the residual impacts on fish and freshwater mammals. The potential impacts in question related to changes in behaviour and physiology.

Mackenzie River Acoustical and Biological Research Test Program

On 12 July 2002, the NEB received a WesternGeco application for an authorization pursuant to paragraph 5(1)(b) of the *Canada Oil and Gas Operations Act* (COGOA) to conduct a Mackenzie River acoustical and biological research test program (Research Test Program). An Aurora Institute Scientific Research Licence and a DFO Licence to Collect Aquatic Plants, Animals and Fish for Scientific Purpose is also required for the Research Test Program. The Research Test Program would evaluate the effectiveness of mitigation measures proposed for the Development. The results of the Research Test Program would be made available to the Review Board for its environmental assessment of the Development.

The Research Test Program has been designed in consultation with DFO and the Department of Resources, Wildlife and Economic Development (RWED). Further, WesternGeco consulted with the potentially affected communities and groups.

The Research Test Program is proposed for two, 90 km sections of the Mackenzie River: east of, and upriver from Tsiigehtchic in the Gwich'in Settlement Area; and in the vicinity of Norman Wells in the Sahtu Settlement Area. The test sections have been selected to provide channels of different widths, depths, substrates and island configuration. The Research Test Program consists of three components:

acoustic testing, fish effects assessment, and monitoring of effects on, and reactions by, aquatic mammals and fish.

Preliminary Screening Exemption

After examining Western Geco's application for an approval of a research test program, the NEB is of the opinion that the proposal is exempt from preliminary screening pursuant to section 15 of the *Exemption List Regulations*. Section 15 provides an exemption for:

Engineering tests undertaken to define the elements of a development, or alternatives necessary to determine the environmental impact of a development, that

- (a) will not entail the deposit of waste into a water body; and
- (b) do not require a land use permit or a water licence pursuant to the *Mackenzie Valley Resource Management Act*, the *Northwest Territories Waters Act* or the *Territorial Land Use Regulations*.

The NEB is satisfied that the proposed Research Test Program is necessary to help determine the environmental impact of the Development. The proposed Research Test Program will not entail the deposit of waste into a water body and does not require a land use permit or water licence pursuant to the MVRMA.

If you have any questions regarding the above, please contact John Korec at 403-292-6614, or Laura Van Ham at 403-299-2769 after July 15, 2002. Thank you.

Yours truly,

T.M. Baker
Chief Conservation Officer

Jek/Attachment

c.c. Marty Swagar, WesternGeco, facsimile 403-509-4217
Pete Cott, DFO, facsimile 867-777-7501
Jane McMullen, RWED, facsimile 867-873-0114

**ACOUSTIC AND BIOLOGICAL TEST
FOR THE MACKENZIE RIVER/DELTA**

Submitted by:

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DISTRIBUTION:

1 Copy	WesternGeco Calgary, AB
1 Copy	IMG-Golder Inuvik, NT and Calgary, AB

July 2002

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1. INTRODUCTION

Initially, testing and monitoring programs were included as components of both the Delta and Mackenzie River 2D Seismic Projects. However, in response to questions concerning the potential effects on fish raised by regulatory agencies, WesternGeco is now prepared to undertake an expanded test program (the "Test") in advance of the full seismic program to evaluate and research the effectiveness of proposed mitigation. A Test will be completed in the Delta (one Test area of 90 km), and a Test will be completed within the Mackenzie River (two test areas, totaling 180 km). These test areas are discussed in further detail in following sections.

WesternGeco understands the concerns stemming from lack of information on the effects of airguns in a riverine system. Furthermore, WesternGeco is sensitive to the importance of the Mackenzie River and the Delta to the traditional land use and cultural and spiritual value of the aboriginal people, as well as their significance to environmental diversity.

However, WesternGeco remains confident that the seismic tests will not result in adverse environmental effects. This is primarily due to recent advances in the technology being used, WesternGeco's experience in using this technology and in working in the north, and the proactive mitigation measures that have been incorporated into the tests. Nevertheless, the Tests described in the following sections has been developed to alleviate the concern and collect data to answer questions raised by the National Energy Board (NEB), Department of Fisheries and Oceans (DFO), Fisheries Joint Management Committee (FJMC), and Resources, Wildlife and Economic Development (RWED). It is understood that a Scientific Research Licence and Licence to Collect Aquatic Plants, Animal and Fish for Scientific Purpose will be required from the Aurora Institute and DFO, respectively, before the test program can proceed. RWED (Ray Case, email to D. Melton, IMG-Golder, dated July 5, 2002) has determined that the monitoring of aquatic mammals as proposed for the Test will not require a Wildlife Research Permit.

1.1 Test Outline

The Test has the following components:

Acoustic Testing

- The source/level\Maximum necessary source level;
- Test and record ambient noise in the Mackenzie Delta/River; and
- Produce Sound Attenuation Data.

Fish Effects Assessment

- Vertical acoustic monitoring to determine distribution of fish species before and after airgun activity;
- Horizontal acoustic monitoring to determine distribution of fish species before and after airgun activity;
- Caged fish assessment; and
- Radio-telemetry to estimate fish response to airgun seismic array (contingency).

Monitoring

- Aquatic mammals; and
- Fish injury/mortality.

Mitigation

The proposed Test is intended to conduct research that provides information related to air gun seismic sound characteristics and environmental effects within a riverine system, namely the Mackenzie River (i.e., main channel and a Delta channel). This Test is designed to evaluate the effectiveness of the mitigation proposed for the full scale seismic program, as it relates to fish and wildlife. In the event that a given portion of the Test is deemed inadequate, WesternGeco would contact DFO (Pete Cott, Inuvik) immediately, to discuss appropriate options.

1.2 Test Locations

Three Test locations (i.e., 90 km each or 270 km total) are proposed to be implemented: two within the main channel of the Mackenzie River in the vicinity of Norman Wells and east of Tsiigehtchic, and one within the Reindeer Channel and adjacent portions of the Mackenzie River within the Delta, as described in detail in the following paragraphs. These Test areas have been proposed, as they would provide channels of different widths, depths, substrates, and island configurations that would be required to analyse the sound propagation under the diverse situations present within the Delta and the Mackenzie River. The Test has been modified with input from FJMC, RWED and DFO (e.g., the Tests have been shortened from 150 km, down to 90 km within that 150 km reach).

Delta Test

Inuvialuit Settlement Region (ISR) – The Delta Test would be 90 km in length, located within a 150 km long reach that originates near the mouth of Reindeer Channel into Shallow Bay and proceeds upstream and turns south into the main channel. The approximate start location of this reach of river is 481,560 E 7,644,607 N and the approximate end location is near 523,710 E and 7,567,990 N.

Mackenzie River Test

Gwich'in Settlement Area (GSA) – The North River Test reach would commence on the Mackenzie River, southeast of Tsiigehtchic at approximately 582,200 E and 7,456,500 N, and traveling upstream for approximately 150 km to a point near the Sahtu border, at 694,500 E and 7,476,000 N. The Test would be 90 km in length, within this reach.

Sahtu Settlement Area (SSA) – The South River Test reach would commence on the Mackenzie River near Norman Wells, and proceed 150 km upstream. The approximate start location is 573,447 E and 7,253,859 N and the approximate end location is 685,529 E and 7,183,487 N. The Test would be conducted on 90 km of river within this reach.

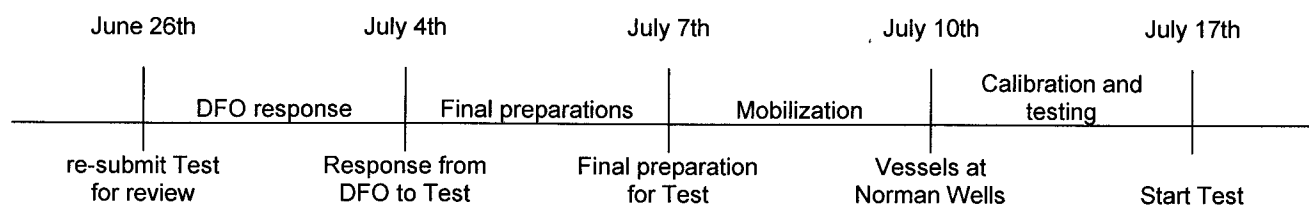
The 90 km of the Test within the above described 150 km long river reaches may be continuous, or it may be broken up into approximately 20 km segments to facilitate the Test under different river conditions (e.g., width, depth, substrate).

1.3 Timing

The time line for the initial start-up, calibration, testing and initial Test is outlined in Figure 1.

WesternGeco proposes to continue onto the other Test areas on completion of the first Test, scheduled to begin near Norman Wells, on or about July 17, 2002. It is expected that the DFO will be present to monitor the calibration of equipment and to verify that the test is being conducted to the DFO's satisfaction (please see time line). In addition, WesternGeco invites FJMC and RWED representatives to be present during a portion of the Test so that first hand observations can be made. WesternGeco will contact DFO, FJMC and RWED to determine an appropriate time and location for this participation.

Figure 1. Test Time Line



1.4 Test Chronology

Upon reaching the Test area, the two seismic vessels (e.g., tugs and barges) will position themselves, one in front of the other, after the streamer has been deployed. The scout boats and local monitoring boats will then take up positions in front and behind the vessels, monitoring for wildlife and other local traffic as they maneuver into position. The vessels will then ramp up while they are in close proximity to each other, and move apart once the ramp-up procedure is complete. This is so that fish will not be "trapped" between the vessels. Radio contact will be established so that the scout boats stay the appropriate distance (e.g., up to 2 km) ahead of, and behind the seismic vessels.

Details of the Test are provided in the following sections. The first tests to be completed within each of the Test areas will be the source level investigations. This will entail operating for 10 km using 1500 in³ source, then continuing for another 10 km using a 1250 in³, and finally 10 km using 1000 in³. This will use 30 km of the 90 km proposed at each Test location. The horizontal acoustic monitoring would be completed during the ramp-up procedure in at least four locations within each Test area. The vertical acoustic monitoring would be completed on four transects located within the 90 km Test area. Final locations of these transects would be determined based on final placement of the 90 km Test. If required, the seismic vessels will hold their position to allow the vertical acoustic monitoring team time to gather the appropriate fisheries information prior to the initiation of this component of the Test.

Once the acoustic tests are completed in one Test area, the vessels and boats would continue to the next Test area. The first Test area will be the South River Test Area, followed by the North River Test Area, and finally, the Delta Test Area.

2. ACOUSTIC TESTING

2.1 Objective

The objectives of this portion of the Test are to define the following:

- The source level;
- Test and record ambient noise; and
- Record sound attenuation over distance.

2.2 Scope of work

2.2.1 The source level\maximum necessary source level

Differing array volumes will be tested with a view to reducing the maximum proposed production volume, within the constraints of good signal to noise ratios and data quality.

2.2.2 Test and record ambient noise in the Mackenzie Delta/River

Record the ambient and background noise in the Mackenzie Delta/River.

2.2.3 Produce sound attenuation data

Produce sound attenuation data over distance and depth in the Mackenzie Delta and River, and river regions with varying geology near the surface.

2.3 Method

2.3.1 Maximum necessary source level

The maximum tested array volume for test purposes will not exceed, 1500 in³ @ 2000psi. Data will be processed onboard using the WesternGeco Omega ® data quality processing system and test results will be analyzed by WesternGeco personnel. WesternGeco proposes to collect data for 10 km using a 1500 in³ source, then 10 km using a 1250 in³, and, then 10 km using a 1000 in³

source. After this sequence has been completed, WesternGeco will utilize the smallest source gun that will provide the quality of data required. This may require returning to the 1500 in³ source if required to consolidate the data, depending on the energy propagation of the substrate under the river.

A nearfield phone will then be placed at a distance of 5 m below the centre of the array, to test and verify the maximum out-put pressure in bar-m. Far field measurements will be taken at a distance of 250 m from the centre of the source.

2.3.2 Test and record ambient noise in the Mackenzie River

Record the ambient and background noise in the Mackenzie River at 3 locations, with and without “river traffic” noting type and size of noise generator.

2.3.3 Attenuation over distance

During the survey, a hydrophone will be deployed at recorded distances from the source generator, and a set of measurements will be made consisting of a pressure history, water depths and distances from the centre of the array. These dimensions will be measured in water depths in metres, from 1 m below the surface down as far as 1 m above the sub-surface, and a practical minimum linear distance from 50, 100, 200, 500 and 1000 m, and up to 5 km in 1 km increments. If it is logically practical, this will also be done in the perpendicular azimuth. This test will be completed at least 4 times throughout the duration of the Project. Measured positions will be plotted on a map to show distance and bearings from the centre of the source in a time domain, and entered onto a graph in a pressure and distance domain. Plots and graphs will be cross referenced.

We will be considering frequencies between 5Hz and 50kHz. Four areas will be selected with the DFO, and the criteria for selection will include varying geological and geographical conditions.

Background, “human” sources will be the various types of noise generated by river traffic, and industry. We do not envisage being able to catch air traffic noise. We expect that most background noise will be generated within the water column, although we do expect to see some

background noise from pumping equipment on drill islands and around built up areas near the Mackenzie River. This noise should be directional, fairly frequency limited and easy to locate.

We do not expect to see more than maybe 75Hz in the measured nearfield at 5 m, but normally we are considering frequencies from the 5Hz to 50kHz. The near field definition here is somewhat arbitrary. If we are concerned with the coherent sum of acoustic energy from the spatially distributed airgun array elements, then the nearfield extends much further, especially for frequencies with wavelengths much shorter than the array dimensions. This is important here, given the airgun array's total length is 19.1 m.

We propose to make measurements using calibrated Reson TC4034 hydrophones having sensitivity -218 dB/V/uPa and unity-gain preamplifiers. While we will endeavor to make absolute pressure measurements within 5m of the individual airguns, we are aware of the possibility of GTB saturating the hydrophone / recording system responses. It should be noted that these hydrophones were chosen specifically with low sensitivity in order to obtain the closest possible measurements. In all applicable cases we will scale the measured levels back to near-field distances. Our calibrated digital recording systems are capable of measuring pressure response through very wide frequency bandwidths: 5 Hz to 50 kHz.

We will only be endeavoring to make near field measurements at 5 m, because we show a modeled near field at 5 m display in the amplitude and frequency domains.

Pressure hydrophones will be used in all circumstances. Hydrophones with greater sensitivity: Reson TC 4043 hydrophones with nominal sensitivity -201 dB/V/uPa including internal 10 dB preamp, are used for longer-range measurements. We have used these successfully in the past for airgun measurements at ranges between 100 m and 20 km. We utilize calibrated post filter/amplifiers: Ithaco 451M and Reson VP2000 systems for programmable filtering and amplification to achieve best use of the available 16-bit recording bandwidth.

3. FISH EFFECTS ASSESSMENT

The following fish effects assessment techniques were developed by IMGG senior fisheries staff (John Kelso and Serge Metikosh). These personnel would also be involved in the test implementation, data assessment and report preparation.

WesternGeco is proposing to test the sonar equipment and assess background river noise prior to the Tests. Transducer properties and receiving system properties will be determined and tested in advance in a calibration tank jointly used by the University of Washington and BioSonics. The field crew also will use the equipment to search for fish in a variety of river conditions, to verify the functionality of the equipment on the Mackenzie River and to identify best sites for its use.

3.1 Vertical acoustic monitoring to determine distribution of fish species before and after airgun activity

If fish species present in the Mackenzie River avoid the discharge of the air guns, WesternGeco assumes that a return to normal distributions will occur after the survey vessel has passed. To determine the effect of the survey process on the distribution of fishes, WesternGeco will use a BioSonics 120 KHz split-beam transducer (aimed vertically or up to 30° off-vertical if we need to increase volume sampled in shallow water). The 120 KHz unit is proposed to reduce the probability of interference from riverine conditions (i.e. air entrapment, debris load, etc.). A series of transects in areas with different bottom profiles and different passage relation of vessel to shore, will be established at right angles to vessel passage and fish distribution data will be collected (TS and biomass by echointegration) before and after vessel passage (i.e., 4, 2, 1 hr, 0 hr).

The BioSonics data acquisition system will be mounted in an appropriate vessel that traverses transects (before and after seismic vessel passage) independent from the seismic survey vessel. WesternGeco will conduct this assessment at a minimum of 4 sites along the survey vessel course within each of the Test areas.

Prior to transect selection, we will use the BioSonics data acquisition system in a survey mode to provide preliminary assessment of fish density with depth and distance from shore. We will use

these data for final selection of transects in areas where fish density is higher, and the probability of collecting adequate data is better.

Use of the BioSonics acoustic data acquisition system in the vertical mode will provide frequency distributions of target strength (which is related to fish size) and estimates of fish mass or abundance per unit volume. This will allow statistical comparison of before/after (seismic vessel passage) distributions in the Mackenzie River and Delta using Kolmogorov-Smirnoff and ANOVA tests. Because river conditions may interfere with acoustic data collection, we may seek river transects with greater depths and uniform bottom topography to enhance the operation of the acoustic data acquisition system.

Repeated sampling of the selected transects should detect if 'herding' of fish occurs in response to air gun activity. If herding does occur, density of fishes in the volume sampled at the transect should increase as the seismic vessel approaches the transect. Consequently, we hypothesize that, if herding of fishes by the seismic vessel occurs, fish density should increase at the sampled transect immediately prior to the survey vessel passage. If this occurs, repeated acoustic sampling at the transect will determine the time required for 'normal' patterns of fish density and distribution to resume.

3.2 Horizontal acoustic monitoring to determine distribution of fish species before and after airgun activity

To determine if the general direction of fish movement changes in the river course when air guns are fired (i.e. fish move away from the air gun array when fired), we will collect data with a 120 KHz BioSonics split-beam transducer aimed parallel to the water surface. Direction of movement up/downstream (i.e., through the area monitored by the BioSonics split beam transducer) will be determined:

- for 0.5 h prior to air gun firing;
- during the ramp-up/firing; and
- for 0.5 h after the array stops firing.

During this test, the seismic vessel will be stationary.

Stables (1998), in a study of out-migrating young salmon in the Trinity River, determined that noise levels of circular and elliptical beam transducers were the same. Consequently, using the 7.25° (nominal) split-beam transducer seems appropriate.

We will use data collected from transects (vertical looking acoustic system, section 3.1) to determine the appropriate location of the horizontal beam in the water column for detecting fish. Further, we will use our assessment of fish density with water depth to direct placement of the air gun array in the river so that there is greater probability of the air gun array insonifying fishes. Our working hypothesis is that direction of fish movement will change when air guns insonify the river (i.e., fish will tend to move away from the airguns when WesternGeco insonifies the river). Our concern is that, if fish density is low, too few fish will pass through the volume sampled by the BioSonics data acquisition system.

3.3 Caged fish assessment

The DFO have stated that exposing caged fish to insonification is essential to evaluate potential physiological effects at varying distances from the airguns.

Fishes may suffer direct mortality from air gun pulses if they are within approximately 2 m of the air gun array at the time of release (Falk and Lawrence 1973, RL&L 1986, RL&L 1998). We propose to determine the immediate effects from sampling and insonification by the 1500 in³ seismic array upon 2-3 endemic small species that are readily available from the river. Cages (plastic minnow traps with sealed entry and exits, or fabricated mesh cages) will be suspended mid-water by a float/anchor system at 3 distances (plus a reference site) where hydrophones will measure in-water pressure and noise level (dB) at distance from the stationary seismic array. If hydrophones are not available for each caged fish test location, the sound attenuation data over distance and depth plot (section 2.3.3) will be used to estimate approximate conditions at intermediate locations.

DFO requested that a species such as broad whitefish be included in this portion of the Test. A suitably sized (3 m x 3 m) holding pen will be constructed in close proximity to the cages, at a distance to be determined after review of the sound level data, but expected to be approximately 10 m from the airgun source. Local fishermen will be contracted to catch 10 to 20 broad

whitefish, and transport these alive to the holding pen at least 48 hrs prior to the exposure tests. The Test team will attempt to locate the holding pen in water depth and clarity that will allow visual observation of the fish when the exposure to the sound from the airguns occurs. If this is achievable, notes will be kept on the behavior of the fish in the holding pens.

The sound would be produced from a stationary vessel, with the cages located at the defined distances. The exposure of the fish to the sound would occur during the ramp-up and subsequent firing at full strength, at 8 second intervals, for one minute.

We are uncertain of the availability of test fish species but we propose to use local fishermen, working with fisheries biologists, to collect the fish and suggest that broad whitefish (holding pen only), young common white suckers, young northern pike and cyprinids common to the area would make acceptable Test species. Consequently, we will use triplicate cages at each sampling distance, 2-3 available (small) species at 4 locations (3 test locations plus reference). Test cages will be retrieved and animals will be observed at 0.5, 2, 4 and 8 h. The triplicate samples will be pooled and fish will be observed up to 48 h after exposure. Any fish that die during the experiment, and a subsample of surviving fish, including broad whitefish in the holding pen, will be examined in the field for visible damage to swim bladders, gills and internal organs, and tissue samples will be collected and preserved for histopathological examination.

3.4 Radio-telemetry to estimate fish response to airgun seismic array (contingency)

Caged fish tests (see above) are expected to provide a conservative estimate of short term physical effects of air gun operation on an array of local species. Acoustic estimates (vertical operation) will determine any difference in fish density (based on target strength and echo counting or echo integration measurements) induced by survey vessel passage. However, these tests and measures are a worst case scenario (in cage tests, exposure is maximized and escape cannot occur) or are constructs of acoustic estimates of fish size and distribution (no species information is available, acoustic data is not corroborated by net-catch data). Consequently, we propose, if radio tags can be procured in the near future, to attach transmitters on individual fish readily available (local fishers as providers for test fishes) and determine movement of individuals in response to airgun operation.

We would propose to release fish with transmitters into the stationary air gun array while it is not operating (control) and when it is firing (treatment). Fish will be fitted with an externally attached transmitter and located and positions fixed in relation to the release point (the array), at intervals following release, until animals are beyond the influence of the array, or up to 8 h after release if they do not move from the release site. We propose 4 releases with a minimum of 5 fishes in each batch released, so that 10 fish are released when the air gun array is in operation (two treatment tests) and 10 are released when the air gun array is not operating (two control tests). The same relocation strategy will be used when the air gun array is and is not operating and rates of movement (m/unit time), displacement from release site (m), and number of turns per unit time will be compared to test for differences between the control and treatment groups.

We propose using only one local species available from the local fish community (e.g., common white sucker, northern pike). All animals fitted with transmitters will be held and observed for 0.5 h prior to release to determine that we are introducing healthy animals that carry the transmitter readily. Prior to transmitter attachment, individuals will be measured, weighed, and sample scales will be removed for age analysis. Relocation of an individual/individuals will cease when that animal has left the influence of the airgun array (0.5 km).

4. MONITORING

4.1 Aquatic mammals and waterfowl

As discussed in the assessment, sightings of aquatic mammals in the immediate test program area are not expected due to the lack of preferred habitat for aquatic mammals. A main objective of the monitoring is to confirm the low relative density of aquatic mammals in the Test area. However, if animals are seen, maximum use will be made of the opportunity to record reactions to the airguns. In addition, the program will be halted if aquatic animals come within 200 m of the source vessels, which should be equivalent to the noise of the barge traffic.

In conjunction with the above fisheries studies, observations by biologists and monitors, of any aquatic mammals and waterfowl (e.g., beaver, muskrat, otter, ducks) that occur within the Test area, and the reactions to the Test, will be documented. Two monitors will be in a boat ahead of the test program and two will be in a boat behind the test program. One monitor will be on a source vessel along with project biologists. It is expected that the monitors will be familiar with these species, and a meeting will be held to train and discuss appropriate observation techniques and data to be collected. Monitors will be in radio contact with biologists at all times during the test and can discuss issues with data gathering if they arise. In addition, biologists will meet with monitors at the end of each day to discuss results, review the filling in of data sheets and discuss any problems monitors encountered. Direct observation during the program was determined to be the most practical way to locate these species, and would be limited to surface observations due to the visual obscurity of the silty water. A standard observation form will be completed by the monitors that would note the date, time, species observed, distance from the airgun, reaction and comments. It is expected that mammal and waterfowl observations would be primarily made by the lead scout boat ahead of the barges. Observations (e.g., species, location, time, weather conditions, behavior) of mammals and waterfowl will be radioed to the follow-up scout boat so that a post-disturbance observation can be made during the monitoring, and this information included onto the data sheets. This recognizes that the animals are mobile and may not be detectable because they have moved onto shore, or moved out of sight. As discussed with RWED, a draft data sheet will be provided to them for review prior to finalization.

4.2 Fish and Wildlife Injury/Mortality

WesternGeco will employ monitors from local communities, HTC's or RRC's that would be responsible for identification and resolution of potential conflicts in front of the vessels (i.e., tourists, flocks of waterfowl, beaver), as well as identification of mortalities by direct observation by the monitors, related to fry, fish, birds and aquatic mammals behind the vessels. As discussed above, the Test will be shut down if aquatic mammals come within 200 m of the air gun arrays. After discussion with RWED it was decided that any wildlife ahead of the project will not be hazed, but rather the Test would be put on hold until they move away from the Test vessels. If such movement did not occur RWED Regional staff would be contacted for advice.

In addition, the scout boats will be equipped with fish finders to be used to detect large schools or concentrations of fish. In the event that schools of fish are detected ahead of the seismic vessels, this information would be relayed to the Party Manager, the fisheries biologists, and the follow-up scout boat to incorporate the information into the monitoring data collected, and to increase vigilance for potential mitigation (i.e., shutdown procedures).

It is expected that the monitors would follow behind the vessels at a distance that would not interfere with the acquisition of data, but close enough (e.g., approximately 500 – 2000 m behind the streamer cables) to observe injured fish or wildlife, or mortalities. All fish and wildlife that are collected during the testing will be subject to an in-field necropsy by a qualified biologist to determine the cause of death. Selected samples may be preserved for further analysis. The local monitors would be in place for the Tests.

The use of direct observation of mortalities is related to effects to swim bladders or direct killing of fish, which would likely float to the surface. With the monitors being up to 2 km or more down stream of the vessels, this would allow a time lag for impacted fish to surface. Again, WesternGeco emphasizes that with the mitigation proposed, avoidance is expected, and no mortality is predicted.

5. MITIGATION

The mitigation options proposed for this study include the following:

- Routing the study in the deepest portion of the channel;
- Scheduling to avoid sensitive spring and fall spawning periods in the appropriate areas;
- Identifying sensitive fish habitat and/or fishing areas (i.e., Gwich'in Fish and Wildlife Harvesting Areas GIS data; Sahtu GIS Project data; environmental monitors) to avoid conflict;
- Utilizing ramp-up procedures to scare fish from the study area prior to commencing shooting;
- Cessation of activities during streamer cable length adjustment; and
- The Test itself will monitor potential effects, and used to verify predictions of low impacts.

In addition, the following mitigation options will be enacted for the Test:

- Evaluation of utilizing a smaller air gun array, depending on data quality;
- Suspension of activities if aquatic mammals are observed within 200 m of the air guns, 1000 m for marine mammals; and
- Suspension of activities (length of time to determined in consultation with regulators) and subsequent ramp-up if study induced fish mortality is proven by fisheries biologists/technicians (e.g., if a rotten fish is found floating in the Test area, it would not require a cessation of the Test).

WesternGeco expects limited exposure to submerged aquatic mammals, considering where the Tests have been routed (i.e., main channel of the river). Any aquatic mammals are expected to hear the program vessels approaching for a period of time that will allow them the opportunity to swim away from the noise, or leave the water.

WesternGeco does not expect fish mortalities, but has included the above mitigation options as a contingency. These mitigation options are expected to limit the exposure of additional fish in that

given area of exposure and allow them time to swim to the side, further upstream, or past the vessels. The ramp-up would be expected to expose fish in the area to increasing levels of noise to “drive” them away from the airguns.

6. REPORTING

Following the completion of the Test, a report will be submitted to the NEB, DFO, FJMC and RWED that provides: rationale for the study, location, methods, results and discussion sections.

Following the report a full paper will be submitted. Both the initial report and final paper including all raw data will remain the property of WesternGeco (Canada) Ltd. Any use of these reports including but not limited to, copying or disclosure to third parties other than in connection with the proposed WesternGeco (Canada) Ltd. Mackenzie Delta River seismic program would not be permitted without prior written permission from WesternGeco (Canada) Ltd.

7. REFERENCES

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