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Shell Canada will be conducting a 3D seismic program for the Quest CCS Project. Environmental impacts such as potential disturbance to wildlife and culturally sensitive areas will be identified and mitigation plans will be put in place to minimize disturbance and avoid sensitive areas. During this process, Shell Canada will work cooperatively with the community and regulatory agencies to promote and implement a sustainable seismic program and minimize environmental impacts.

**HOW DO WE REDUCE THE ENVIRONMENTAL EFFECTS?**

We believe that resource development can be compatible with environmental protection when the principles of sustainable development, which include modern technology and environmental protection, are applied. We strive to achieve a healthy, safe, and implement a sustainable seismic program and minimize environmental impacts. How do we reduce the environmental effects?

**WHAT IS SEISMIC SURVEY?**

A seismic survey is a method of determining subsurface information by analyzing sound waves originating from an energy source. This energy source is typically from an explosive charge placed in holes up to 20 meters (66 ft) deep, or from vibrations generated from a series of “Vibroseis” trucks. The reflected sound waves are detected by listening devices called geophones attached to cables that are laid out along the seismic line. The cables connect into a recording truck or “dog house” that contains computers for recording the data.

**WHAT TYPES OF SEISMIC PROGRAMS ARE THERE?**

The different types of seismic operations are 2D or 3D programs. 2D seismic lines are single lines of regularly spaced geophone stations (e.g., every 20 meters), with energy source points established along the line, typically at every 3rd or 4th station. This program is generally used to retrieve a general sample of the subsurface being explored.

3D seismic programs are generally uniform and evenly spaced grids of lines. Receiver lines, containing the recording devices, are usually perpendicular to the direction of the source lines comprised of regularly spaced source points (e.g., at 50 or 60 meters intervals). This method generates a much more detailed “picture” of the subsurface.

**THE SEVEN-STEP SURVEY PROCESS**

After permission has been granted by the landowner and regulatory agencies, the following work processes are followed to retrieve data:

1. **PROJECT-SPECIFIC REQUIREMENTS**

All contractors and visitors are welcomed to the seismic project and with a thorough site-specific orientation related to the nature of the ongoing program—in this case Quest. During this briefing, the requirements from stakeholders and regulators are addressed.

2. **LINE CUTTING**

This portion of the seismic operation is site specific and is sensitive to the environment surrounding the project. As this is specific to forested areas, very little to no line cutting may be needed for this 3D seismic project. The use of low-impact seismic technology is used to reduce the effect of the project on the terrain. Crews work on foot and in machines called Mulchers. They are trained to avoid rare and endangered plants and animals. Mulchers “mulch” dense vegetation and spread it on the land, creating access for large wildlife once the survey is complete, and encouraging the growth of forage for these animals. In addition, this would be expected to improve ground nesting for larger birds. This would be beneficial for some smaller species that use dense vegetation to avoid predators, but over the long-term we would expect enhance habitat for larger wildlife such as deer.

3. **SURVEYING**

Surveying requires crews to determine co-ordinates and elevations using conventional survey methods, or with Global Positioning System (GPS) techniques. GPS is a method that uses a receiver capable of triangulating signals from a range of satellites, which enables it to render an accurate longitude, latitude and altitude.

The Inertial Navigation System (INS) is another common surveying technique that uses a reference point, sometimes referred to as the starting point. It uses a device, an INS pack, which tracks and senses the movements in reference to the known start point.

Both systems enable the users to collect reference points, which may signify terrain hazards and information for mapping (e.g., cliffs, fences, water bodies, rough terrain).

4. **DRILLING**

This phase of the seismic operation is only present when the energy source is dynamite. A series of shot points are reflected on a map, usually spaced between 10m to 100m. At each shot point, a hole is drilled and loaded with a charge and detonator. Once the hole is plugged, all that is left exposed is a wire connected to the detonator in the hole. These are left to be detonated later by a certified Shooter once the recording crew has their equipment in place.

5. **RECORDING**

The recording phase is the most important phase of the operation. It provides all of the subsurface records that the geophysicist needs to make a decision. This portion of the operation requires many pieces of equipment. Geophysical equipment cables and geophone recording devices will be deployed by helicopter. Geophones are placed by layout crews, which record the seismic activity from the energy source. These cables—with the geophones attached—are connected to recording devices, which are connected to the cable at known locations. Once all of the equipment has been laid out and connected, the recorder vehicle connects to the cable and the line is ready to be recorded.

6. **SHOOTING**

The methods for this portion of the project are specific to the type of energy used to create the seismic activity. The Quest seismic program is proposed as a mixture of Vibroseis trucks and traditional dynamite in drilled holes. With dynamite as the energy source, Shooters are required. The certified Shooters will visit each shot point and detonate the charge loaded in the hole.

Once the charges are detonated, the seismic waves are recorded by Geophones connected to the recording vehicle, where they are documented for future reference. After the records are taken, the information is sent to Calgary, Alberta for further analysis by a geophysicist.

7. **CLEAN-UP**

Once the records have been acquired in an area and the recording equipment is no longer needed, crews pack their equipment and leave. Crews will clear the line of all survey materials, garbage and debris in order to uphold our commitment to the environment.

**QUEST 3D 2010 FURTHER INFORMATION**

<table>
<thead>
<tr>
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<tr>
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<td>Telephone: 403 815 6995</td>
<td>Email: <a href="mailto:david.berry@shell.com">david.berry@shell.com</a></td>
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**QUEST CCS PROJECT: 3D SEISMIC BACKGROUND**

Quest CCS project: 3D seismic backgounder

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