9 SUMMARY & CONCLUSIONS

9.1 IMPACT SUMMARY

The key environmental issues associated with the planned Lunskoye seismic survey can be grouped under the following headings:

- noise and disturbance impacts on marine mammals;
- noise and disturbance impacts on other marine biota;
- impacts on other users of the area;
- pollution impacts from emissions, effluents and wastes;
- accidental spills, leaks and dropped objects.

The preceding chapters of this Environmental Statement have reported the process of identifying, evaluating and mitigating these environmental issues. This was achieved through the completion of the following four stages:

- the description of the baseline environment in the Lunskoye Field and surrounding area and the identification of potential receptors;
- the identification of the environmental risks and potential effects associated with the proposed seismic survey;
- assessment of the character and probability of environmental impacts;
- development of mitigation measures, environmental monitoring plans and management procedures that will reduce potential environmental impacts to as low as reasonably practicable (ALARP) levels.

The key findings of this ES on the Lunskoye seismic survey are summarised in the following sections, and the residual impacts, taking the agreed mitigation measures outlined in *Chapter 7* into account, are presented.

9.2 NOISE AND DISTURBANCE EFFECTS ON MARINE BIOTA

The key environmental concerns and risks associated with the proposed seismic survey operations relate to physical interactions and disturbance effects, primarily regarding the acoustic impacts of the survey on marine biota and particularly concerning the Critically Endangered western gray whale.

The identification and evaluation of acoustic impacts was based on a review of research work carried out to date on the effects of seismic survey activities on marine biota (particularly the effects of low frequency noise). A primary

finding of this review is that the issue of noise impacts is a complex area and it is difficult to definitively predict effects.

The subsections below summarise the evaluation of noise and disturbance impacts on marine mammals and other marine biota.

9.2.1 Marine Mammals

Marine mammals rely heavily on the use of underwater sounds to communicate and to gain information about their surroundings. Experiments also show that they hear and react to many man-made sounds including sounds made during seismic exploration.

The hearing systems of baleen whales are almost certainly more sensitive to low-frequency sounds than are the ears of the small toothed whales. Even so, small toothed whales can apparently hear pulses from airgun arrays tens of kilometres away. Pinnipeds can undoubtedly hear seismic pulses, given what is known about their hearing abilities.

There are several zones or radii around a strong source of sound within which various effects on marine mammals are expected. The zones include the area within which the underwater noise is audible to the marine mammal, the areas with behavioural responses or auditory masking, and the (theoretical) zones within which there could be hearing loss and physical damage.

Assuming that the ramp-up ('soft-start') mitigation method is applied, physical effects (temporary threshold shift or TTS, permanent threshold shift or PTS, and non-auditory physiological effects) on baleen whales, toothed whales, and pinnipeds are likely to be *minor* because of the known avoidance reactions of the species that have been studied at the close distances that are necessary for damage to occur.

Although a fairly large area (327 km^2) will be affected during the Lunskoye seismic programme, individual baleen whales (other than western gray whales), most toothed whales, and pinnipeds will be disturbed only periodically and in small numbers because of the species' distributions. Some species of toothed whale may be encountered in large pods, so larger numbers may be affected. The most significant behavioural reactions are likely to consist of short-range avoidance movements.

Western Gray Whales

Known feeding areas for western gray whales are some 50 to 200 km north of the Lunskoye area, however, the speciesprobably migrates past the Lunskoye Field. Peak northward migration past the field probably occurs between May and June, and the peak for southward migration probably occurs during October and November. Limited surveys have been carried out in the Lunskoye Field and surrounding area, and a small number of whales have been sighted nearthe survey area during the months that the survey is

planned. The area is not considered, however, to be an important feeding ground for western gray whales.

If western gray whales do feed within the field and some individuals were to incur a significant reduction in feeding opportunities for one month or more due to the survey operations, detrimental effects could result. Given the small population size of western gray whales, effects to individuals could have impacts at the population level, such as loss of reproductive potential, reduction in growth, and a reduction in the ability to survive winter conditions. Taking a precautionary approach, if such a situation were to occur, the potential acoustic impacts on feeding western gray whales could be predicted to be *major*. The implementation of mitigation measures including 'soft start' and the ceasing of survey operations when whales are within the agreed safety radii will reduce this potential impact to *moderate*.

If the seismic survey occurs during a migration period, and if gray whales migrate through mid-shelf waters where the Lunskoye seismic survey is to occur, they could be displaced from their usual migration route. Any displacement of the migration corridor is likely to be by a few kilometres. Predicted acoustic impacts on migrating western gray whales are judged to be *moderate*.

Other Baleen Whales

No impacts relating to the disturbance of bowhead whales are predicted to occur as a result of the survey, as the species has only been observed in the region during February and March.

Fin and minke whales may be present in small numbers during the survey period, and impacts to them are likely to be *moderate*. The Endangered North Pacific right whale may also be present within the region. The species' status and significance has led to the prediction of potentially *moderate* impacts. The implementation of mitigation measures, including 'soft start' procedures and the ceasing of survey operations when whales are within the agreed safety radii [(1)], will reduce impacts to ALARP levels for North Pacific right whales, fin and minke whales.

Toothed Whales

White whales are known only to be present off Sakhalin's northeastern coast between May and June, so there will be *no impact* from a summer (July to September) seismic programme. Many of the species present in the region are known to prefer deeper, offshore water and/or have only been reported to the south of the Lunskoye Field. These species include the Dall's porpoise, sperm whale, Baird's beaked whale, Cuvier's beaked whale, northern right whale dolphin, short-finned pilot whale, Pacific white-sided dolphin and the bottlenose dolphin. The survey is predicted to have *minor* to *no impact* on these species. The harbour porpoise is a coastal marine mammal that tends to

(1) Radii within which significant impacts would be predicted to occur.

stay within a few kilometres from shore, so *no impact* on harbour porpoises is predicted.

Odontocete species that may be found near the seismic survey area, the common dolphin and the killer whale, may occur in large groups. The predicted acoustic impacts on those species are likely to be *moderate*. The agreed 'soft start' and safety radii mitigation measures will reduce impacts, but the survey is still predicted to have potentially moderate impacts on these species.

Pinnipeds

Effects of *No impact* to *minor* impact significance are predicted to occur to Steller sea lions and ribbon seals. This is due to the low numbers of individuals observed within the Lunskoye Field area between July and September when the survey will be underway.

The presence of a largha seal haul out site at Lunsky Bay, approximately 10 to 15 km due west of the survey area, and the distribution of the species along Sakhalin Island's entire east coast during the summer months has led to the prediction of *moderate* impacts occurring to the species. Mitigation measures will reduce these effects, but the potential impacts can still be considered to be of *moderate* significance. *Moderate* impacts are also predicted for ringed, bearded and northern fur seals.

9.2.2 *Potential Impacts of the Pre-Seismic Site Survey*

No impacts to baleen whales, including the western gray whale, are predicted from the side scan sonar survey as the sounds from side scan sonar are at frequencies far above the expected hearing range of these species. This is also true for the pinniped species that may be present during the survey period.

Odontocete species are considered to be the most sensitive of the cetacean species to high frequency sound. However, individuals that encounter the side scan sonar at close range are unlikely to be subjected to repeated pulses, due to the equipment's narrow beam width and short, low energy pulses. *No impacts* are therefore predicted to occur.

9.2.3 *Marine Invertebrates and Fish*

Available literature concerning the potential impacts to marine biota other than marine mammals from acoustic impacts and associated pressure effects indicates that direct impacts to species are predicted to occur only when they are within a few metres of the air guns. Safe radii have been identified within the reviewed literature (specifically the Polar Fisheries and Oceanography Research Institute and SakNIRO air gun research study (1998) reported in National Environmental Protection Committee of the Russian Federation, 2000). These radii range from 3 metres for zooplankton and jellyfish, to 0.5 m for crustaceans and molluscs. The majority of species are predicted to be driven away by the approaching sound source, the 'soft start' procedure (see

Chapter 7) and the movement of the vessel, and will therefore not be within range of the air guns to receive injury. Any injuries and fatalities that do occur are considered to be *minor* in the context of local species populations.

Disturbance impacts to the fish species themselves are considered to depend on the species and usual behaviour or habitat area. Disturbance impacts to fish species are considered to be transient and minor. No impacts on spawning are predicted, as no major spawning areas have been identified within the vicinity of the Lunskoye Field.

Many experiments have been conducted to deduce the effects of seismic surveying on fish catches, and no conclusive result can be determined, with some data indicating decreases in catches during seismic operations, some showing no change and others indicating increases (Gadus Associates, 1999). However, given the transient nature of the operations and the small area of the survey in relation to the available fishing grounds, potential impacts of the Lunskoye seismic programme on fish catches are predicted to be *minor*.

Limited studies on shrimp have shown no decreases in catch rates during seismic survey operations, and shellfish species in general are considered to show little spatial variation (Gadus Associates, 1999). Impacts on shellfisheries are considered to be *minor.*

9.2.4 Birds

Potential noise and disturbance impacts to species of birds observed and recorded in the coastal environment to the west of the Lunskoye Field include:

- disturbance from usual feeding, breeding or migration patterns;
- secondary impacts resulting from the noise and disturbance impacts on prey fish species.

The main bird populations observed in northeastern Sakhalin Island inhabit the coastal areas. None of the species showed tendencies to hunt or habitat areas in the vicinity of the Lunskoye Field and the proposed survey operations, preferring instead to stay closer to the shore. The migration routes for all species are also coastal, being confined to land or the nearshore environment. Injury, fatality or disturbances to seabirds occurring as a result of the survey activities are considered unlikely. *No impacts* are therefore predicted to occur.

Noise and disturbance impacts on fish are discussed in the section above. Predatory bird species are unlikely to hunt as far offshore as the Lunskoye Field, and the survey vessel will not enter coastal waters within 4 to 5 km of the shore due to water depth restrictions. *No impacts* to predatory birds are therefore predicted to occur.

9.3 *OTHER USERS OF THE MARINE ENVIRONMENT*

The proposed seismic survey has the potential to interfere with other users of the area and the local social environment. The following issues have been considered and evaluated:

- interference with commercial fishing activities and damage to fishing equipment;
- interference to marine mammal hunting;
- interference or disturbance effects on the local social environment and economy;
- interaction or interference with marine traffic;
- interference or damage to submarine infrastructure and offshore oil and gas production facilities;
- damage to wrecks or submerged archaeology;
- interference with military uses for the area.

9.3.1 *Commercial Fishing Practices and Equipment*

The seismic survey has the potential to cause interference with fishing activities and damage to fishing equipment (*eg* nets, lines, fixed gear) in the Lunskoye Field. Damage to fishing equipment is a concern from both a safety perspective (*ie* potential risk to personnel on the fishing vessel and the survey vessel) and in terms of adverse reactions / complaints and subsequent compensation claims from fishermen whose equipment has been damaged (*ie* loss of equipment and temporary loss of earnings / livelihood). Damage to the streamers from fishing gear is also a concern (see *Accidental Spills, Leaks and Dropped Objects*).

Detailed information on the level of fishing activity around the Lunskoye Field is not available. Fishing activity, if any, is thought to be small scale and local (*pers comm* SEIC, 2002), however, damage to fishing gear in the area could have a moderate impact on fishing activity. Providing that all planned and recommended control and mitigation measures are adhered to, it is considered that potential conflicts between the survey operations and the local fishing industry can be maintained to within acceptable levels, with *minor* impacts on fishermen being predicted.

9.3.2 *Hunting of Marine Mammals*

Hunting of marine mammals close to the Lunskoye Field exists only in the form of sea ice seal hunting by indigenous groups during the winter season. It

is predicted, therefore, that there will be *no impact* on sea mammal hunting from a summer seismic survey.

9.3.3 *Local Social Environment and Economy*

The seismic vessel will arrive in the Lunskoye Field fully fuelled and supplied to conduct the survey without having to visit port in Sakhalin Island. Contact with local communities is therefore very unlikely, except in the event of an accident or emergency when the vessel may be forced to visit port or personnel are airlifted to the island for hospital treatment.

There are no records of any diving or marine-based tourist or recreational activities in the vicinity of the Lunskoye Field. As a precautionary measure, warnings of the proposed activities will be issued (Notice to Mariners) and a vigilant watch will be maintained throughout survey activities.

It is predicted that there will be *no impact* on local communities, the local economy, recreational activities, tourism or amenity from the proposed survey.

9.3.4 *Vessel Navigation*

The key concerns regarding interactions with other vessels include the potential for injury and loss of life in the event of collision, concomitant pollution effects (fuel oil or cargo spillage) and damage to the streamer resulting in a release of kerosene to the marine environment.

Vessel traffic in the survey area is considered to be at a low level, consisting of local freight traffic, local fishing boats and occasional oil field supply vessels. Encounters with these vessels have been identified as a potential hazard, and operational procedures will be in place to minimise the risk of conflict.

On the basis that all planned and recommended control measures are adhered to, it is considered that potential conflicts between the survey operations and local vessel traffic can be maintained to within acceptable levels. *Minor* impacts are predicted.

9.3.5 *Submarine Infrastructure and Offshore Oil and Gas Production Facilities*

There are currently no offshore oil and gas production facilities, pipelines or submarine infrastructure (*eg* cables) within the seismic survey area. *No impacts* on existing infrastructure due to collision or disturbance are therefore predicted to occur.

9.3.6 *Damage to Maritime Archaeology and Wrecks*

No features of archaeological or cultural heritage importance have been identified in the vicinity of the Lunskoye Field. There are reports of two whaling vessel wrecks to the north of the Lunskoye Field; however, their exact location is unknown. A side-scan sonar survey will be carried out prior to the seismic survey to identify any potential obstructions on the seabed. A 500 m

exclusion zone will be established around the site of features considered to be of possible importance. The risk of collision with a feature of potential archaeological or cultural heritage importance and the consequential damage to the feature and the seismic survey vessel equipment is considered unlikely. *No impacts* are therefore predicted to occur.

The seismic operations may result in a temporary disturbance of seabed sediment. This disturbance is not predicted to be significantly greater than that produced by natural processes, and *no impacts* to any features are expected to result.

9.3.7 *Military Use*

There is no known military interest or activity in the Lunskoye Field and therefore *no impacts* are predicted.

9.4 *POLLUTION IMPACTS FROM EMISSIONS, EFFLUENTS AND WASTES*

Effluent discharges, atmospheric emissions and generation of solid and scheduled wastes from vessels engaged in survey activities have a range of potential environmental consequences. Potential discharges and impacts include:

- oil contaminated surface drainage, sanitary and other waste water effluent discharges may effect water quality or have direct or indirect adverse effects on marine organisms;

- short-term localised increases in down-wind pollutant concentrations, reductions in local air quality, reduced visibility and contributions to regional and global atmospheric pollution (*eg* acidic deposition ozone layer depletion and the greenhouse effect);

- physical and toxicological damage to marine organisms, impacts on water quality and damage to seabed and coastal habitats from accidental release or inappropriate handling of solid or scheduled wastes.

9.4.1 *Effluent Discharges and Water Intakes*

Surface Drainage

Drainage effluents such as rainwater and sea spray run-off from uncontaminated deck areas will have *no impact* on the water quality and ecology of the receiving waters.

Controlled Drainage

Drainage from cable handling areas, bilges *etc* may be contaminated with hydrocarbons. These effluents will be treated in an oil / water separator in compliance with MARPOL and discharged with a maximum hydrocarbon concentration of 15 ppm. The survey vessels will also be required to have an

International Oil Pollution Prevention (IOPP) Certificate and slop oil tank and to maintain an Oil Record Book. Impacts on water quality and marine biota from controlled discharges are therefore predicted to be *minor*.

Sanitary Effluent

Sewage will be treated prior to discharge and is therefore predicted to exert a minor biological oxygen demand on receiving waters and residual chlorine in the waste water will have a minor and transient impact on water quality. Natural dispersion by wave action, current flow and the assimilative capacity of the water column is predicted to ensure that a *minor* impact result from these discharges.

Cooling Water Discharge and Water Uptake

Heated engine cooling water will rapidly lose its heat on discharge into the marine environment and is therefore predicted to have *no impact.*

The installation of a coarse filtration system on seawater intake equipment will prevent the entrainment of fish species. Smaller fish species or free-floating planktonic organisms will be entrained, damaged or killed, however, this small-scale, localised and short-term impact is considered to be *minor*.

9.4.2 *Air Quality*

Emissions from the vessel propulsion and power generation systems together with intermittent releases from the onboard solid waste incinerator will result in slight increases in downwind pollutant concentrations. Given the short-term nature of the survey operations, impacts from the survey on local air quality are predicted to be transient and *minor*.

Total quantities of acidic gases and greenhouse gases emitted will be low, and the contribution of the survey emissions towards total Russian emissions are considered to be *minor*. No release of ozone depleting substances is expected to be associated with the survey operations.

9.4.3 *Solid and Scheduled Wastes*

Scheduled wastes generated onboard the survey vessels will be disposed of at the appropriate facility when the vessel returns to port. Providing the handling, management and disposal of these wastes is conducted in accordance with appropriate legislative requirements and guidelines, and the vessel's standard operating procedures, *no impacts* from the generation of wastes are predicted.

9.5 *ACCIDENTAL SPILLS, LEAKS & DROPPED OBJECTS*

There are a large number of potential interactions and accidental / unplanned events that may result in the release of hydrocarbons, contaminants or materials to the marine environment. Key scenarios have been identified as:

- small accidental spills and leaks of harmful substances or objects into the marine environment from the survey vessels due to minor accidents (*eg* collision with fishing equipment) and poor operation management (*eg* discharge of untreated bilge water);

- large accidental spills and leaks of harmful substances or objects from the survey vessels due to major accidents (*eg* collisions with other vessels, vessel grounding) or equipment damage.

9.5.1 *Impacts of Small Releases of Harmful Substances*

Streamer Kerosene Release

During seismic survey, if kerosene filled streamers are used, damage to sections of the streamers while deployed can release kerosene into the marine environment. The risk of damage to streamers depends on the hazards in the area (*eg* fishing equipment, submerged wrecks or other items), the weather conditions and the operational procedures. Kerosene losses in typical seismic surveys lasting for one month have been estimated to be between 100 and 500 litres (*pers comm* SEIC, 2002).

Kerosene is a volatile colourless liquid with irritant and toxic properties. It would be predicted to have a short residence time in the marine environment due to its volatility, however, the rate of evaporation would depend on ambient temperatures. Small spills of kerosene from damaged streamers are likely to affect localised areas only and *minor* impacts are therefore predicted.

Bunker fuel, Diesel, Lube Oil and Oily Sludge Release

Discharge of oily wastes into the marine environment due to minor accidents (*eg* failure of spill containment systems, separation of fuel hoses during bunkering operations or discharges of bilge water prior to treatment) will have an impact on water quality and marine biota. The impact will depend on the type of oil released, the volume of oil, the location of the spill and the prevailing weather and tidal conditions. These heavier oils would be expected to form a visible sheen on the surface of the sea, and would persist for longer periods than the more volatile hydrocarbons such as kerosene.

Marine mammals can be affected by oil directly either through skin contact, absorption, or ingestion, or indirectly by feeding on contaminated prey. Most marine mammals are not very susceptible to the effects of oil and oil fouling of the external surface does not appear to have any adverse thermoregulatory effects. Effects from small spills that dilute and disperse rapidly are unlikely to cause serious internal damage to marine mammals.

Small hydrocarbon spills would be predicted to have *minor* impacts.

Loss of Equipment

Streamer sections are unlikely to be lost during the course of the survey operations due to automatic devices that inflate when the streamer falls below a certain depth. The loss of small quantities of items such as depth control units (one metre long plastic 'birds') and lead weights strips used to control buoyancy in solid streamers is likely. These objects are unlikely to present a fouling hazard and losses of this nature are predicted to have *no impact.*

9.5.2 *Impact of Large Releases of Harmful Substances*

Large Hydrocarbon / Contaminant Releases

The effects of larger releases of bunker fuel, diesel or kerosene as a result of vessels grounding, collisions or other major accidents will depend on the quantity released, the location of the release and the prevailing weather/oceanographic conditions. Most marine mammals are not very susceptible to deleterious effects of oil, however, weak or highly stressed individuals may be vulnerable to oiling.

The potential impacts on marine ecology and coastal environment could be *moderate* with injury to weak or stressed marine mammals and injury and mortality to local populations of marine invertebrates and fish possible.

Major accidents are unlikely given the vessels standard operating procedures (including warning and navigation systems) and the pre-seismic side-scan sonar survey that will identify any submerged items. In addition, the seismic survey vessels will have oil and fuel spill response/ contingency plans and spill kits on board in accordance with MARPOL regulations. Oil, chemicals, and hazardous materials are required to be properly stored to prevent spills from occurring. In the event of an oil or chemical spill from one of those vessels, a response effort will be initiated immediately to contain and clean-up the spill and prevents it from spreading. Given the likelihood of major accidents and the quantity of oil and chemicals stored on the seismic vessels the residual impacts are considered to be *minor*.

Loss of Equipment

Any large items of survey equipment lost overboard have the potential to foul or create obstructions on the seabed and may act as a future source of pollution (*eg* loss of streamers due to vessel collision and release of kerosene).

In the event that equipment is lost, a detailed incident reporting system will be followed, recording the location of the lost equipment, and the items will be retrieved wherever it is considered to be practicable and safe to do so.

The potential for polluting the marine environment from lost equipment would depend on the amount of pollutant and the rate of release from the lost equipment. Standard vessel operating procedures including warnings to other vessels operating in the area mean that the risk of vessel collisions and

loss of equipment is low. Environmental impacts from loss of equipment will be localised and are predicted to be *minor*.

9.6 *ENVIRONMENTAL MANAGEMENT*

An outline Environmental Management Plan (EMP) has been developed which highlights the environmental conditions and constraints pertinent to the proposed Lunskoye seismic survey and sets out specific environmental protection measures consistent with Russian Federation and international regulations and guidelines, industry guidelines and SEIC policy. The seismic survey contractor will be required to adopt the measures set out in the EMP.

9.7 *CONCLUDING STATEMENT*

The potential environmental impacts of the proposed 2003 Lunskoye seismic survey have been assessed through a process of Environmental Impact Assessment and have been reported in this Environmental Statement. It is concluded that providing the proposed mitigation measures are developed, incorporated into the survey EMP and monitored to reduce impacts then there will be no *major* environmental impacts and all *moderate* impacts will be reduced to ALARP levels.