IWACO

Consultants
for water and environment

56116
June, 2001

West Siberia Oil Industry Environmental and Social Profile

Final Report

Client **Greenpeace**

IWACO

Consultants
for water and environment

Division International Projects
Hoofdweg 490
P.O. Box 8520
3009 AM Rotterdam
The Netherlands
Telephone +31 10 286 54 32
Fax +31 10 220 10 05
E-mail ip@iwaco.nl

Document title	West Siberia Oil Industry Environmental and Social Profile
Document type	Final Report | June, 2001
Project title	West Siberia Oil Industry Environmental and Social Profile
Project number	56116
Client	**Greenpeace**
Responsible person(s)	Mr. M. Lodewijkx
Project Manager	Mr. Henk Blok
Co-authors	Mrs. Verina Ingram / Mr. Reimond Willemse
Department	Environment International
Project Director	Mr. T.F. Huber
	|…………… …………………………. ………………
dated	|…………… …………………………. ………………

Summary

Introduction
IWACO BV Consultants for Water and Environment was commissioned to undertake a project for the Dutch, German and Russian Greenpeace offices in 2000, to assess the environmental and social impacts of the oil industry in West Siberia. The project was initiated by Greenpeace to support their scientific field trips to West Siberia in the summer of 2000 as part of a campaign targeted at the Russian oil industry. IWACO was requested to provide independent scientific data and views to support the Greenpeace campaign. The project that aims to provide an impression of the environmental and social impacts of the oil industry in West Siberia is focussing on the Nizhnevartovsk region. The location, extent and degree of oil pollution in West Siberia will be indicated. The Profile includes an environmental and social baseline of the oil sector in the region, an analysis of the potential key environmental and social issues, with which an assessment of impacts was made. Mitigation, monitoring and management measures are proposed for the sector.

The project focussed on the Nizhnevartovsk region in West Siberia. This region may be representative of the oil industry in Western Siberia, allowing the environmental and social impacts of the oil sector in this area to be extrapolated, with care and subject to stipulations, to other areas with oil industries in Western Siberia.

Greenpeace requirements
The ambitious Greenpeace campaign aims to initiate changes in Russian energy policy and practices of both Russian and international oil companies working in Western Siberia. International Financing Institutes (IFIs) are also targeted in the campaign as their financial aid and loan conditions to the oil sector can influence policy. It is understood that Greenpeace will use the IWACO Environmental and Social Profile as part of their Russian oil sector campaign. The long term aims of Greenpeace are to endorse IFI funding for oil pollution remediation, upgrading existing infrastructure and investment in energy efficiency and renewable energy in Russia. The short term goals of Greenpeace include convincing Russian authorities and public that Greenpeace wants to be actively involved to find a solution to reduce the negative effects of oil production. This includes raising awareness in Europe of the present status of the Russian oil industry, to influence the Russian government and IFI decision-makers and induce them to approve major loans to protect or mitigate the environmental and social impacts of the sector.

Aim and scope of the Environmental and Social Profile
The project that aims to provide an impression of the environmental and social impacts of the oil industry in West Siberia is focussing on the Nizhnevartovsk region. It also seeks to provide an overview of the location, extent and degree of oil pollution in West Siberia. The Profile includes an environmental and social baseline of the oil sector in the region, an analysis of the potential key environmental and social issues, followed by an assessment of impacts. Mitigation and management measures are proposed for the sector, resulting in five project identification sheets.

Project Activities
The following activities were conducted as part of the project. The range, scope, objectives and limitations of these activities necessarily limited the profile:

- A literature review was performed and during interviews many documents were obtained from different organisations. Furthermore literature was obtained from Internet.
- A remote sensing component supported the limited number of field surveys by providing an assessment of satellite data to provide large scale, objective measurements, inventories and observation of the project area. Landsat TM7 satellite images on a 180 x 180 km scale taken on 19 July 2000 were used. These were interpreted in conjunction with data collected during the field surveys and, after verification in the project area, resulted in an 'Oil spill map'.
- One and half months of field observations and sampling took place during the period of August and September 2000. This program was executed to supplement information gathered through literature research, interviews and field observations. The fieldwork team concentrated on the oil fields and surrounding rivers and villages. Areas of interest were prioritised based on interpretations of the remote sensing images and literature review. This information was used to identify locations for fieldwork visits. Two types of field observations were used, helicopter and ground observations. The one hour helicopter flight over the Samotlor oil field provided an initial impression and an overview of the oil sector impacts on the environment. Field surveys were carried out in the Samotlor oil field and surrounding areas. Remote sensing image interpretations were verified and ground truthed. An overview of exact spill locations (registered with a Global Positioning System), sizes and treatment methods was conducted. The focus of the field observations was on areas where risks to human health and the environment were expected, including:

  - Inhabited areas;
  - Drinking water sources;
  - Flare locations;
  - Rivers draining the Samotlor oil field.

  IWACO staff took all together fifty-five drinking water, soil and sediment and surface water samples during the field surveys. Local fisherman collected fish samples from two locations. Greenpeace staff collected surface water and vegetation samples. The sample points were logged on the remote sensing images.
- Chemical analyses of water, sediment and soil samples taken in the field were preserved and transported to the IWACO Sterlab and ISO 9001 certified environmental laboratory in Rotterdam, The Netherlands, where analyses took place. Fish samples were analysed by the TNO-MEP Laboratory in Apeldoorn, The Netherlands. Chemical analyses of the Greenpeace surface water and vegetation samples were performed by the Bashkir Republic Ecological Research Center in the Russian Federation. The samples were analysed for one or more of the following parameters:

  - Mineral oil;
  - Polycyclic aromatic hydrocarbons;
  - Volatile aromatic hydrocarbons;
  - Heavy metals.

- Interviews constitutes an important source of information about the environmental and social impacts of the oil sector activities in the study area. Interviews also assisted in collecting data and verifying information, and helped to meet Greenpeace's short-term project goal of showing Russian authorities and the public that Greenpeace wants to actively assist finding solutions.

A number of interviews were conducted in Nizhnevartovsk, Tyumen and Moscow, some together with Greenpeace staff, with representatives from the following groups:

- Local and national environmental authorities;
- Universities and research institutes;
- Russian oil companies operating in Western Siberia;
- Local population and non-governmental organisations;
- Environmental media;
- International financing institutions;
- Reporting took place in the Netherlands and Russia and comprised all activities performed as part of the project. The Draft Final Report was distributed among interviewees for verification and comments, which were incorporated into the final version of the report. The report provides an independent assessment of the environmental and social impacts of the oil industry in West Siberia for Greenpeace.

A major problem for the project was that the accuracy and reliability of data could not always be optimal due to the following factors:

- Restrictions to access (part of the Russian officials were not willing to verify information or discuss the matter in depth, or at all);
- The team did not have full or official access to the oilfields;
- The requirement for translation of many documents;
- The tendency for official data only to be available on a amalgamated regional or sector level, with no detailing on background of the data;
- Conflicting data.

Unfortunately, the results of the sampling program also cannot be used to statistically substantiate the assessment of impacts. Due to the scope of the project, the available time frame and budget limitations, the aim of the sampling program was limited to providing additional data only regarding critical environmental impacts and locations.

Findings

The following sections summarise the main findings of the Environmental and Social Profile.

<u>The West Siberian Environment</u>

West Siberia covers a huge geographical area with rivers and lakes being the predominant features. The Nizhnevartovsk region covers an area of about 11,785 km^2. The region is largely covered by taiga and tundra forest, and is a unique and fragile wilderness with a harsh sub-arctic, including areas of permafrost, and continental climate. The area has largely low nutrient peat based soils supporting fragile bogs and forest ecosystems, high groundwater levels with waterlogged soils possessing long degradation and biological recovery times. The ecosystems support populations of bears, wolves, foxes and a number of herbivorous animals. The many water bodies support a number of fish species, many of which are commercially important, and endangered species, including the beaver and sturgeon. The region is largely inhabited only in a number of urban, industrial areas, which have grown enormously over the last 40 years due to immigration. The region has, compared with the Russian average, particularly low health rates and high rates of a number of diseases, often related to environmental quality.

Indigenous peoples of West Siberia include the Khants, Mansis and Nenets, whose numbers have been declining, particularly in relation to the high levels of migration of Russians from other areas into their traditional homelands. Their traditional extended family based, hunting, semi-nomadic lifestyle has disintegrated since the 1950s.

The West Siberian Oil Industry

Exploitation of West Siberian oil resources has occurred on a massive, world important scale and has been a major source of revenue for the Russian Federation for over forty years. The Russian Federation is one of the world's top five energy producers, being the second to third world largest exporter of petroleum. In 1998 82,770,000 tonnes was exported in total. From 1993 to 1998, Western Europe imported between 55% and 78% of Russia's total exported oil, with Germany, Switzerland, the UK, Italy and Spain being the major importers. It is not transparent who the importing companies exactly are, although all or many of the major international oil companies are probably importers. Total Fina Elf is reported as purchasing 18 to 20 million tons annually from Russia, with Tymen Oil Company stating that 70% of its export is sold to Total Fina Elf. Within Russia, West Siberia is the most highly developed and oldest oil and gas region, producing about 78% of all Russian oil. The Nizhnevartovsk Region contains some of the oldest fields, the Samotlor field being 40 years old. The fields are exploited by mainly Russian, recently privatised companies and a number of joint ventures with international companies. The top six privately owned oil companies today are LUKoil, Surneftegaz, Yukos, Sidanko, Tatneft and Tyumen Oil Company (TNK), who together account for about 60% of Russia's yearly oil production of 265 million tons (1998).

Private companies, mainly Russian owned, with some joint ventures with international concerns, have taken over oil production from the Russian government during the last decade. All aspects of the exploitation and production process currently occur in West Siberia. Investment and development of the sector is closely correlated with crude oil prices. Privatisation of the oil sector has transferred responsibility for past and current environmental and social impacts of the sector from the government to Russian and foreign oil companies exploiting the fields. Governmental authorities however remain responsible for monitoring and enforcement of environmental legislation and developing strategies for the energy sector.

International Financing Institutes

The major IFIs active in the Russian energy and environment sector have not identified or named the West Siberian oil sector as a priority in their current or future strategies or policy plans except TACIS, although the EBRD is now reconsidering reallocation of funds. Most IFIs allocate financing on the basis of where they and their Russian counterpart authority set the highest priority and expect a positive financial or technical return on investment. The historical and current environmental and social management and impacts of the oil sector do not appear to be a priority for the government, the current operating oil companies and most donor agencies. IFI financing of environmental projects in the sector is not anticipated as a major source of investment, although bilateral and country funds may be, depending on individual policies. Private sector financing by both national and international companies currently active or wishing to invest in the area appears to be the major potential source of funding for environmental projects, although this appears to depends on oil prices strongly.

Causes of impacts

The activities of the oil industry in West Siberia have caused a wide variety of impacts. The most significant activities that cause multiple environmental and social impacts are:

- Pipeline and equipment breaks, spills and accidents;
- Inadequate emergency planning and equipment;
- Normal operational practices with inadequate environmental mitigation and management measures;
- Operational errors and negligence by oil company personnel;
- Low company and personnel environmental management and organisation, awareness and education of environmental impacts of operations, particularly spills;
- Lack of environmental management systems within oil companies;
- Inadequate remediation measures for spills to soil and water;
- Lack or under-investment in equipment and use of unsuitable or outdated equipment;
- Incomplete policy regarding native peoples, access and rights to traditional lands on oil fields.

Environmental and Social Assessment

This part summarises the evaluation of the impacts per environmental and social issue. Spills, due to their multi-media impact, were considered separately.

- Between at least 700,000 to 840,000 hectares of polluted soil in West Siberia and around 2% of land in the oil fields in the Nizhnevartovsk Region are polluted by oil, with 6500 hectare of contaminated soils confirmed in the Nizhnevartovsk Region. This is a much larger area than indicated by official government and oil company statistics. Soil pollution has been caused largely by oil pipeline and well spills, but also by oily muds, drilling and production waste, chemical waste disposal and leaking storage places; saline production water; operational discharges and leakage and oil production site drainage.
- Unquantifiable shallow and deep groundwater and aquifer pollution in Nizhnevartovsk Region, particularly the older oil fields such as Samotlor, with oil concentrations around 0.1 mg/l in groundwater layers up to 200 m deep. Causes include oil spills, leaks from oil and chemical waste storage; operational discharges and water re-injection and leaks from abandoned old wells.
- Surface water pollution in West Siberia, particularly in water bodies around oil fields, and especially older fields in the Nizhnevartovsk Region. The main pollutants are oil products, reaching between 5 to 50 times the Russian PDK norm, also salt minerals including chlorides and production chemicals. The causes are oil spills and accidents, releases of drilling wastes, leaks from waste disposal areas, flares and transport emissions into surface water. Surface water hydrology has also been unquantifiably changed due to dams, dikes and roads constructed as part of oil field infrastructure;
- Negative, unquantified impacts on air quality caused by emissions of Polycyclic Aromatic Hydrocarbons (PAH), hydrocarbons, particulate (soot) and greenhouse gases particularly from flaring and venting of associated gases, oil spills and oily waste burning, and fugitive emissions from oil spills, vents and production facilities.

- Negative impact on the quality of drinking water in the Nizhnevartovsk Region. 97% of drinking water extracted from the River Vakh over a five-year period was polluted with oil exceeding the PDK norm. Whilst treated surface and ground water presents a low risk to human health, the large number of water supply stations and numerous, unofficial, private wells providing untreated drinking water presents a considerable, unquantified health hazard.
- Negative impact on the aquatic biological environment. Over 50% of fished rivers in the region is contaminated with oil products, resulting in reduced health, breeding ability, changed spawning behaviour and possibly linked to declining fish catches. Causes include pipeline and product spills and accidents, releases of drilling wastes, leaks from waste disposal areas, flares and transport emissions into surface water.
- Possible unquantified impact of radioactive contamination of the wider environment resulting from radionuclide contaminated oils (both naturally and unnaturally occurring) extracted from certain areas of West Siberia.
- Negative, unquantified impacts on terrestrial flora and fauna, resulting in changed terrestrial habitats such as decreased or increased water levels, limitations of access, flora damage and loss, disturbance and possible contamination of fauna, particularly water birds. The causes include oil spills, noise from oil production facilities, vehicles and construction works, vehicle impacts of oil facilities construction and maintenance works, flares, fires and roads, pipelines, well platforms, dams and dikes related to oil facilities.

The Nizhnevartovsk Region of West Siberia has changed greatly during the last 40 years, largely as a result of the development of the oil fields. The Region has industrialised and has seen a huge increase in migration as well as large changes in land use with the development of cities, oil fields and designation of nature reserves. Environmental legislation has developed on a national and regional level to protect resources, along with monitoring and enforcement mechanisms and authorities. The socio-economic environment has also been directly and significantly affected by the activities of the oil sector. The impacts are however largely unquantifiable, but include:

- Negative and positive impacts on the socio-economic conditions in the Nizhnevartovsk Region, resulting in increased access to employment within oil sector and related services; increased and changed access to social services; denser infrastructure and transport links in the region
- Negative and positive impacts on demography in the form of a huge increase in migration into the region, an increase in urbanisation and industrial activities; increased exposure to cultural and racial differences and increased conflicts between migrants and ethnic minorities.
- Negative impact on health caused by pollution, urbanisation and industrialisation of the region, partly due to the oil sector as the major industry in the area. There is a potential, suspected relationship between the `poor environment` in Nizhnevartovsk and a higher than Russian average level of certain oncological, cardiological and endocrinological diseases and shorter life expectancies.
- Negative and positive impacts on Khanty, Mansis and Nenets indigenous peoples traditional culture and socio-economic systems, resulting urbanisation of the traditional hunting areas partly caused by activities of the oil industry, the oil sector presenting alternative cultural values and economic opportunities, changes in land-use due to oil activities and facilities, restriction of access to oil company lands preventing access to traditional lands and infringing on traditional land use, compensation paid for damage and land use, pollution of natural resources used for traditional subsistence lifestyle (i.e. hunting, fishing and farming).

The activities of the oil sector have consequently resulted in significant direct environmental impacts and a number of direct and indirect socio-economic impacts in the Nizhnevartovsk region. It can be concluded, with caution, that particularly environmental impacts to soil, surface water, groundwater, and terrestrial biology have similar impacts in a wider area of in West Siberia, resulting in widespread but unquantified oil and chemical polluted soils, groundwater and surface water that among others, contaminates drinking water, inducing human health risks and affects fish. Oil spills have caused some of the most significant, widespread negative impacts to the environment in West Siberia and affected all environmental media. Both past and new spills continue to have a major impact the present environment. The industry has also had widespread indirect effects on local ecosystems and native cultures. The sector's most notable positive impacts have been socio-economic, including employment and infrastructure development in urban areas in the main oil fields.

The findings of impacts in the Nizhnevartovsk region, the Khanty Mansiysk District and the Tyumen Oblast, indicate that extrapolation of the main findings to the whole of Western Siberia seems justified. It is likely that other oil fields have experienced similar impacts of a similar or lesser significance, as there are strong indications that environmental and social impacts significantly increase with the age of the oil fields. However, local environmental conditions (particularly permafrost and hydrology) and socio-economic circumstances (for instance the age of the oilfield), will cause differences in the specific impacts and magnitude of the impacts. In general however, one can safely assume that similar impacts occur in other oil and gas exploration and production regions of Western Siberia.

Measures

\`General solutions\` for mitigation of environmental and social impacts due to the oil sector in West Siberia are proposed in this Profile. Solutions are presented in terms of environmental management measures. These are feasible and effective measures that may reduce significant, adverse environmental and social impacts to acceptable levels.

Besides measures which are already "ongoing activities" measures named and many others, which are not covered within this study take possibly decades to implement. Before implementing, questions will rise like: Why cleaning such an area? Where to start ? And who will pay? Stakeholders in Western Siberia (or within a smaller entity) should develop a shared vision in the first place. This vision may serve as starting point or reference for all stakeholders and for all future development plans. In such a shared vision adequate weight could be given to all stakeholder interests. Ideally, the vision becomes a guiding principle for major planning and development decisions in the coming decades. However, this requires that stakeholders will be committed to the vision, which is best obtained by their active participation in the process of formulating the vision. Within this vision as a framework, concrete measures will get its own place. The above does not imply just to stop already ongoing processes and environmental measures since those two are closely related and will support each other. The already ongoing processes and environmental measures, like development of rehabilitation techniques and re-use of associated gas should be encouraged.

This report provides an independent and a fair assessment of the environmental and social impacts of the oil industry in West Siberia. As far as known by the consultant this is a first attempt to bring together information of the oil industry and environmental and social baseline data on a rather basic level. Impacts in the region related to the oil industry could be substantiated. A further mapping of the oil spills will complete the picture for the whole of Siberia. With a complete picture of the (potential) oil spills in Siberia, combined with the environmental and social sensitivities, priorities can be set for further activities. For possible further investigations it is advised to involve local authorities and representatives of the oil industry to a further extent to come to a more in-depth insight. Much attention should be paid to institutional development and awareness raising since the information seems only fragmentary available and scattered over different organisations. Therefore, it seems right now not very worth while to invest in extensive sampling campaigns/ broad inventarisations without a proper framework for further activities.

Contents

List of Abbreviations

EBRD	European Bank for Reconstruction & Development
EIA	Environmental Impact Assessment
EIB	European Bank for Investment
EU	European Union
GDP	Gross domestic product
GEF	Global Environmental Facility
IFC	International Financing Corporation
IFIs	International Financing Institutions
NGO	Non-Governmental Organisation
PCF	Prototype Carbon Fund
SCEP	State Committee for Environmental Protection
TNK	Tyumen Oil Company
NREC	Nizhnevartovsk Regional Environmental Committee
KMREC	Khanty Mansiysk Regional Environmental Committee
RS	Remote sensing

List of Figures

List of Appendices

1 Introduction

1.1 General

This draft report is submitted in response to the request by Greenpeace on 11 April 2000 to support Greenpeace's Scientific Field Trips to West Siberia in the summer of 2000 as part of their campaign concerning the oil industry in West Siberia.
IWACO B.V. Consultants for water and environment, The Netherlands was requested to provide independent scientific data to support the Greenpeace campaign. Due to the available time and money it was decided to focus on the Nizhnevartovsk Region (see figure 1, as enclosed in 'Figures'). This region was chosen because:

- the oil industry has been active in this region for over 40 years and therefore an in-depth picture of its effects is available;
- the Samotlor oilfield, as one of the 'well known' older oilfields is situated in the Nizhnevartovsk Region;
- good accessibility of this region;
- many oil companies and authorities are based in Nizhnevartovsk.

Due to the historic and still expanding oil sector activities in the Nizhnevartovsk Region, this region can be seen as representative for the oil industry in Western Siberia. The physical and social environment will of course differ from region to region (permafrost, hydrogeology, cultural traditions etc.) and with that, impacts on the physical and social environment. Nevertheless an extrapolation to the whole of Western Siberia is relevant provided these conditions and stipulations are borne in mind.

1.2 Background of the project

Greenpeace's aim of their campaign is to positively influence Russian energy policy and Russian and international oil companies working in Western Siberia. International Financing Institutes (IFIs) are also targeted as they can influence Russian policy to a certain extent by the conditions connected to financial aid for the oil sector. It is understood that Greenpeace will use the IWACO environmental profile as part of their Russian oil sector campaign. In the long term, Greenpeace aims to endorse IFI funding for oil pollution remediation, uplifting the existing infrastructure (improving and emphatic no expansion) and investment in energy efficiency and renewable energy in Russia. Short terms goals of the Greenpeace project include: convincing Russian authorities and public that Greenpeace wants to be involved in a positive manner to help to find a solution for the negative effects of oil production. This includes awareness raising in Europe of the status of the oil industry in Russia in order to influence the decision-makers at IFI and to induce them to restart important mitigation loans.

1.3 Aim and scope of the environmental & social profile

The West Siberia Oil Industry Environmental & Social Profile aims to provide an impression of the location, extent and degree of oil pollution in West Siberia. This project focuses on the Nizhnevartovsk Region in West Siberia. The results (with the necessary stipulations) will be extrapolated to the whole of Western Siberia. This project provide also insight into the environmental and social impacts caused by the oil sector. For the latter a global environmental baseline will be drawn based mainly on literature. Mitigation and management measures are described for the different impacts and causes of impacts. IWACO published the results in a final report.

Consultants' activities and the subsequent preparation of the final report have been carried out in full independence.

Greenpeace believes the statements and data in this report to be accurate. However, the views and findings in this report are those of the authors and do not necessarily reflect the views of Greenpeace.

1.4 Approach

To compile the Environmental Profile a phased approach is used. Scheme 1 gives an overview of the project phases and activities. In the first phase, two information lines can be distinguished; information concerning the oil industry (1a) and environmental and social baseline data (1b). A literature review was used to gather relevant information on the environment and social situation and the oil industry in West Siberia. Oil sector activities have an impact on the environment and are therefore constitute environmental hazards. These hazards are identified in (2a). Simultaneously, environmental and social baseline information generated a sensitivity analysis (2b). After consultation with the client regarding issues of priority and based on the experience of the consultant in the oil industry, key environmental and social issues are determined (3). This phase consisted of a desk-study and was carried out in The Netherlands. For the key environmental issues (4) data were gathered through literature review, interviews, remote sensing and fieldwork. Next to this an assessment of impacts took place (5). This phase was executed in Russia as well as in The Netherlands. Finally, a description of environmental measures (6) was conducted. The information gathered and results have been made suitable for publication in the third phase. The study will be made public by a report and a press conference (7).

1.5 Structure of the report

The report presents information collected as a result of literature reviews and field trips by the project team to Moscow and West Siberia in August, September and October 2000. In Chapter 2, activities performed as part of the project are detailed. Chapter 3 covers the baseline environmental and social conditions and in Chapter 4 information on oil industry sector is presented. Chapter 5 describes the analyses of potential environmental and social impacts and the identification of key issues. An assessment of impacts is made in Chapter 6. Chapter 7 presents environmental management measures and recommendations for the oil sector in West Siberia. Some brief descriptions of projects suitable for implementation in the short to medium term are presented in chapter 8.

2 Activities performed

As part of the Environmental Profile, a number of activities were performed. The work consisted of a literature review and desk study, remote sensing analysis combined with ground truthing in West Siberia, and fieldwork, including field observations and sampling in West Siberia and chemical analysis of samples in the Netherlands. The following section describes the activities, the objectives, and limitations of the activities.

2.1 Remote sensing

Introduction

The aim of the remote sensing component of the project is to provide insight into the extent and location of oil pollution in West-Siberia. West Siberia is a vast area, and only a limited number of field trips can be carried out in order to obtain such an overview. Remote sensing is potentially an ideal alternative for such a large-scale assessment, provided oil pollution can be distinguished on the satellite images.

Background

Remote sensing is a method to obtain information of the earth's surface, through the analysis of data obtained by a sensor present on for example satellites or aeroplanes that are not in contact with the surface. By means of this technique objective measurements are recorded at potentially large scales. This scale of observation is closely linked with resolution or accuracy of the measurement. Remote sensing has large advantages when compared to alternative fieldwork. It is objective, repetitive of character, gives continuous cover and is low cost per km^2.

Remote sensing is an ideal tool for large-scale field investigations and inventories of land use change, such as caused by pollution. Furthermore, in order to choose appropriate locations for detailed field studies an assessment of different satellite images and/or aerial photographs is very useful. Remote sensing can also be employed to extrapolate the point data, collected during detailed field observations, to a complete large-scale coverage. Lastly, the technique can be used to map change detection. By comparing satellite images from different dates it is possible to map changes in land use.

Approach and analyses

For the current application it was decided that the most suitable RS image was a Landsat TM7 image. On the one hand such an image has a large spatial coverage (180*180 km) and on the other hand the resolution or accuracy is acceptable for the current application (30 m). A recent Landsat 7 image (19 July 2000) was purchased of the study area. For the analyses and interpretation the Centre for Geo-Information of Alterra, Wageningen was subcontracted. Alterra is very experienced with land use classifications and have state of the art soft- and hardware for image analyses available. The final interpretation was carried out as a combined effort of Alterra, Greenpeace Russia and IWACO. Appendix 3 gives their report on the processing and interpretation of the image.

The first interpretation was carried out based on a visual interpretation and the data collected during the first field trip. This resulted in a preliminary map of areas affected by oil spills and leakages. A differentiation was made between recent and relatively old oil spills. This is an interesting factor as the oil industry has declared that the spills originate from the eighties and no serious spills have occurred since then.

It was also attempted to run an automatic classification, based on the reflection of oil. As the reflections of water and oil are very similar, except for the near infrared wavelength where there is some difference, the output contained a lot of incorrectly classified pixels. This resulted in a rejection of the output.

As the effects of oil on vegetation in the area are very apparent (see photo on left page), an alternative is to make a classification based on vegetation affected by oil. Also, these areas are spectrally unique, providing a better source for classification, than pure oil. To collect further data of this oil affected areas, an additional field trip was carried out. This resulted in a data set of 33 points, with a description of the sites itself and the direct surroundings. Also photographs were taken for later reference.

Based on five training sites (affected areas), a classification was carried out assigning all pixels with similar reflectance as the training sites to a specific class. A differentiation was made between recent and old contaminated areas. After evaluation of the results it turned out that the location of the spills could be identified, although the extent of each location was difficult to establish with high accuracy. This is caused by the pixels at the fringes of the contaminated areas that consist of both affected and un-affected vegetation. In order to include these pixels to the classification, the outer fringes of the affected area were verified visually and hence included.

2.2 Fieldwork and chemical analyses

Introduction

Fieldwork consisted of field observations and sampling. The sampling and chemical analysis program was executed in order to support information gathered through literature research, interviews and field observations.

The fieldwork concentrated on the oil fields and surrounding rivers and villages. With the interpretations of remote sensing images and literature review a first prioritisation of areas of interest has been made. This information was used to decide were field visits were organised. It is emphasised that in the used sampling strategy, a very limited amount of samples were taken from the obvious oil-spills itself. All observed oil spills were indicated on the remote sensing images.

It must be stated that the results of the program can not be used to substantiate the conclusions by statistical means. Due to the design of this project and the related available time and budget samples have been taken sparse and only at those places where observations needed additional data or at places which are critical concerning environmental impacts. The latter can be surface water used for drinking water, drinking water wells, etc.

Field observations

Two types of field observations can be distinguished in this project, as there are observations from a helicopter and observations from the ground. The former consisted of a one-hour flight over the Samotlor oil field (see figure 2 as enclosed in ‘Figures’). This helicopter flight was carried out to get a first impression and an overview of the effects caused by oil industry on the environment. Field visits were carried out in the Samotlor oil field and the surroundings (appendix 4 gives an overview of the field visits). In the Samotlor oil field several spills were visited and an overview was gained of the size and amount of spills and the way they were treated (or not treated).

In the surroundings the focus was on these areas where risks for human beings and the environment could be expected, as there are: areas with datsja's, sources for drinking water (rivers and wells), area's where flares are located, rivers which drain the Samotlor oil field, etc.

Samples and chemical analyses

During the field visits several surface water, drinking water, soil and sediment samples were taken by IWACO staff. Furthermore, at two point's fish samples were collected from local fisherman. Greenpeace staff collected samples of surface water and vegetation. The exact position of each sample taking point was registrated with a GPS instrument. In appendix 5 an overview of the sample points is presented together with the co-ordinates. The sample points are also shown on the remote sensing images. Oil-spills are also registrated with the GPS and sometimes pictures were taken to demonstrate the situation in the field (see appendix 7).

Samples are preserved, kept in cooling boxes and taken to The Netherlands by IWACO consultants. The samples are analysed by the Environmental Laboratory of IWACO. The laboratory of TNO-MEP in Apeldoorn carried out analyses of fish. Chemical analyses on the samples taken by Greenpeace staff are performed by the Bashkir Republic Ecological Research Center. One or more of the following parameters where conducted on the samples: mineral oil, polycyclic aromatic hydrocarbons, volatile aromatic hydrocarbons and heavy metals. The analysing method for mineral oil used by IWACO includes a clean-up as part of pre-treatment. This means that organic compounds like humic substances are removed. This method prohibits interference with the organic component to be analysed for. Most analysing methods used in Russia don't use this clean-up, so interference is possible and happens especially in soils and water rich in organic matter. The above described differences in analysis method could cause discrepancies in results between different laboratories.

2.3 Interviews

Interviews form an important source of information about environmental, and particularly social impacts of the oil sector activities in the study areas. Interviews with representatives from the following organisations have not only assisted in collecting and verifying information of the impacts and extent of oil pollution, but have helped to meet the short term project goal of showing Russian authorities and public that Greenpeace wants to actively assist finding a solution. This communication was therefore vital to the success of the project. Interviews are important communication channels for gaining the support of the authorities and public and stimulating their positive co-operation with the project. Interviews were conducted with Greenpeace staff and were organised with representatives from the following groups:

- Local and national environmental authorities;
- Universities and research institutes;
- Russian oil companies operating in Western Siberia;
- Local population.

Interviews were conducted in the following areas:

- Nizhnevartovsk;
- Tyumen;
- Moscow.

A list of interviews is presented in Appendix 1.

2.4 Literature and desk study

A literature review was performed and during interviews many documents were obtained from the different organisations. Furthermore literature was obtained from Internet. A list of literature obtained is included in Appendix 2.

2.5 Reliability of data

It should be noted that the accuracy and reliability of data can not always be guaranteed due to:

- restrictions to access (many Russian officials were not willing to discuss the matter in depth, or at all);
- the team did not have full or official access to the oilfields;
- the requirement for translation of many documents;
- the tendency for official data only to be available on a amalgamated regional or sector level, with no detailing on background of the data;
- conflicting data.

3 Description of environment

3.1 Introduction

This section describes the current baseline; that is the physical, biological and socio-economic conditions in West Siberia. The environmental and social components are not treated exhaustively due to the aim and scope of this project. However, the baseline provided is sufficient within the framework of this project to describe the different impacts of the oil industry.

3.2 Physical environment

3.2.1 Geography

Western Siberia is an enormous region that includes the major mountain systems of the Altai, Kuznetskii Alatau and Salair; steppe and forest-steppe massifs, a wide zone of the western-Siberian taiga, and the forest-tundra and tundra in Yamal and Gydan peninsulas, and also smaller Arctic islands. Western Siberia includes the Republic of Gorny Altai, the Yamalo-Nenetskii and Khanty-Mansiysk Okrug (also known as Khanti Mansiski or Khanty Mansiysk), the Altai Territory, the Kemerovo, Novosibirsk, Omsk, Tomsk, and Tyumen regions. The main natural axis of the region is the Ob River, with its main tributary of Irtysh. The riverheads of the Ob are the rivers of Biya and Katun, which rise in the Altai Mountains. The sources of Irtysh and its big tributary Tobol lie beyond Russia. The most important tributary of the upper reaches of the Ob River is the Tom River, which rises in the Kuznetskii Alatau Mountains. The Ket, Tym, Vasyugan, Yugan and others take their origin in the watershed swamps of the Western-Siberian Lowlands, which accounts for vast spaces between the Irtysh, Ob and Yenisei rivers. In the north of the Region, another two big northern rivers, i.e., Pur and Taz, flow into the Ob Mouth. There are around 25 thousand lakes in the Khanty-Mansiysk region surrounded by forest and rivers such as the Ob and Irtysh (Source: www.zapovedniks.ru/frames/book/western…/western_siberia%20text.ht.).

The Nizhnevartovsk Region covers approximately 11,785 km^2. Table 3.1 gives an overview of the land-use in the Region.

Table 3.1: Land-use in Nizhnevartovsk Region in km^2

Forest and swamps	11,379
Agriculture	67.5
Cities and villages	64.0
Industry	41.5
Water	16.6
Protected lands	0.074
Others	215.6

3.2.2 Climate

Western Siberia has a sub-arctic and continental climate. This type of climate has an annual precipitation between 400 and 500 mm. The duration of snow cover varies with latitude as well as altitude from 120-250 days per year in Siberia, which is around 145-155 days per year in the sub arctic region. Table 3.2 provides details on the temperatures in Nizhnevartovsk Region.

Table 3.2: Temperature Nizhnevartovsk Region

Average temperatures (degree C)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-22.4	-20.5	-13.7	-3.6	4.1	13.2	16.9	13.8	7.5	-1.4	-13.9	-21.1	-3.4
Absolute minimum (degree C)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-51	-57	-50	-40	-23	-7	-1	-6	-11	-31	-48	-57	-57
Absolute maximum temperatures (degree C)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
-3	-6	10	20	32	34	34	30	26	21	8	2	34
Average relative humidity (%)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
79	78	74	69	67	66	70	78	81	82	82	80	75.5

Source:
http://ourworld.compuserve.com/homepages/alfred_kuhn/s_Nizhnevartovskhne.htm

The table shows that the climate is severe with sub-arctic long frosty winters and short warm continental summers. The average temperature is in January around -22°C and +17°C in July.

3.2.3 Geology

The West Siberian basin's unique geological structure means that it is the principal producer of petroleum in Russia and in the former USSR, and possesses the largest undiscovered resources of both oil and gas. The main play is in structural traps that include the Neocomian (Lower Cretaceous) deltaic section of the Middle Ob region. The play is maturely explored, and much of the remaining oil potential is expected to be found in stratigraphic traps in Neocomian rocks and in structural and stratigraphic traps in the pre-Neocomian (mainly Jurassic) section. Most of the discovered gas reserves are found in Cenomanian (Upper Cretaceous) continental clastic reservoirs in huge structural traps of northern West Siberia. All the larger structures onshore have been drilled. The main gas play clearly extends into the southern Kara Sea region; three recent huge gas discoveries support the very high resource assessment numbers.

3.2.4 Hydrology

The Great Basin of the Ob'-Irtysh river system, the world's third largest, drains Western Siberia to the north. A secondary basin along the Middle Ob' is occupied by the Eastern Khanty. This basin is drained by major tributaries of the Ob', the Lamin, Pim, Trom-Agan, Agan, Vakh, Yugan, and Salim. Characteristic features of the hydrological system of Western Siberia are the wetlands, lakes and beaded drainage patterns. During the long winters the shallow lakes and rivers freeze for a couple of months. Large parts of Western Siberia have perfect climatic and topographic features for wetland formation. This is caused by a low evaporation rate because of low temperatures, lack of drainage due to a low gradient, a small infiltration rate and a short growing season.

Hydrology is also affected by permafrost, resulting in a complex pattern of drainage and vegetation. Natural thermokarst occurs as subsidence due to melting ground ice. `Patterned ground` is a product of frost action, with unsorted high centre and low centre polygons being the most common features. Other hydrological features include thaw lakes, thermokarst pits, ground ice lenses and pingos. Tyumen and Surgut lie in areas prone to flooding and thermal activities but with no active permafrost, Nefteugansk and Nizhnevartovsk in areas of partial permafrost with some ice cover (Interview: Institute of Ecology).

The Regional Environmental Committee of Nizhnevartovsk report that more than 2000 rivers and streams are located in the Nizhnevartovsk Region with a total length of 4000 km. There are 2,5 thousand lakes on the territory of the Region. Torm-Emtor is the biggest lake. Other big lakes like Samotlor, Kimil-Emtor and Beloe are situated in the Samotlor oil field. The surface water of the Region contains high quantity of naturally occurring iron, manganese and ammonium.

3.2.5 Soils

Temperature and permafrost largely determine soil depth and type in the project area. Soils are typically shallow, low in temperature and deficient in nutrients. Western Siberia is the largest peat region of the world, with the dominant soil in the Taiga being podzols, mixed with sandy soils on ridges, commonly formed from glacial moraine. Areas of boreal forest with high moisture levels are the most suitable for the formation of peat. The limited decomposition cycle results in a build-up of organic material over time. In addition, the combination of low temperatures and frequently waterlogged conditions reduces microbial activities in the soil, thus slowing the rate of decay of vegetation. Consequently there is a large accumulation of energy and nutrients in dead organic matter and a scarcity of freely available nutrients' (IUCN, 1993). Other soil types found in West Siberia are classified as a `loess-like loam` in southern West Siberia, `light clay` in Tyumen region and `light clay premier` in the Surgut area (Interview: Moscow State University).

3.2.6 Radioactivity

According to the Nizhnevartovsk Regional Environmental Committee radioactivity in the Nizhnevartovsk Region complies in general with the Russian standards. The natural background level of gamma radiation is between 4 and 8μ/hour and the norm is 33 μ/hour. The Federal Monitoring Service of Radiation Safety reports that gamma background levels are even and low for the whole region; 8-13 μR/h. (0,7-1,1mSv/y) A maximal level of 17 μR/h (1,5mSv/y) was recorded in Nizhnevartovsk in 1993. The concentration of natural radionuclides in the soil, water and vegetation of Nizhnevartovsk, Megion and other cities of the region, and in places with definite radioactive contamination, is reported in general to not exceed the norms. However, in some areas soil radioactivity with created/non-natural radionuclides, mainly with St_{90} and Cs_{137} has been reported.

First research in the field of environmental radiology in Nizhnevartovsk Region started in 1993 at the initiative of the Ecological Committee, financed by Nizhnevartovsk Regional Independent Ecology Fund. In 1993 the presence of radionuclides in the natural environment of the region was studied to assess contamination levels. At the same time gamma tests were carried out (ground and aviation gamma tests) in the cities and the territories around the cities and oilfields. In 1992, a radioactivity control lab opened in Nizhnevartovsk, also financed by the Nizhnevartovsk Ecology Fund.

The laboratory records natural gamma background daily in the city and 11 other settlements of the region, and carries out a number of food, water, wells, equipment and company inspections, also checks the oil sector for radioactivity

The Federal Monitoring Service of Radiation Safety reports that since 1978 no underground A-bomb tests were performed in Nizhnevartovsk Region and there have been no accidents or radioactive leakages recorded and registered.

3.3 Biological environment

3.3.1 Fresh water environment

The Middle Ob River Basin ecosystem is characterised by wetlands consisting of riverine floodplains with Spaghnum raised bogs. Peat mosses and cotton grasses are widespread. The quality of the Ob, one of the main Russian rivers, was characterised in 1996 and 1997 in terms of ‘a considerable level of water contamination`, from ‘slightly polluted’ to `dirty` (Russian State Committee for Environmental Protection 1997, 1998).

3.3.2 Terrestrial environment

Flora

The terrestrial environmental consists of sub-arctic, taiga, boreal forest and bog at an elevation of between 25 and 100 meters above sea level. The taiga occupies the Russian and West Siberian plains. A distinction is made between the Western Taiga and Eastern Taiga (beyond the Yenisey River). In the Western part dense forest of spruce and fir occurs in moister areas, alternated with pine, shrubs and grasses. The Taiga is the world largest timber reserve. There are large stands of birch, alder, and willow forests along the rivers and streams. In the poorly drained areas, swamp and (Spaghnum) peat bog exist, flanked by islands and strips of pine forest. The project area is characterised by the latter.

The main taiga forest species are the Siberian spruce and Siberian pine, with Siberian true moss, lichen and sphagnum forests, with pine lichen and cowberry forests. There are about 360 plant species, including 45 trees and shrubs. Fir-spruce and fir-spruce-Siberian pine true moss, lichen and sphagnum forests prevail. The under story is formed by Tartar dogwood, bird cherry, guelder rose, honeysuckle; the herb-shrub layer is formed by cowberry, blackberry, blueberry, ledum, crowberry. Swamps with thick peat mosses are widespread in watersheds. The pine forests and moors have a thick cover of developed reindeer moss, which serve important habitats of game birds and reindeer. Sandy soils and ridges tend to supporting forests, comprised of the Siberian pine and spruce. A mixture of larch, fir, birch and Siberian pine can be found alternated with thickets of alder and willow. Tatar dogwood, bird cherry, guelder rose, honeysuckle, and duschekia fruticosa form the under-storey. Cowberry, whortleberry, andromeda polyfolia, field and wood horsetail, blackberry, blueberry, ledum and crowberry commonly form the herb-shrub layer. Wood sorrel and maylily can be found.

Fauna

Common fauna in the middle taiga include: wild reindeer, moose, brown bear, lynx, sable, red fox, wolf, European hare, squirrel, chipmunk, wolverine, sable and ermine. European Beaver colonies are present and are a protected species.

Characteristic birds include the capercaille, black grouse, willow grouse, hazel grouse, white tailed eagle, nutcracker and Siberian jay. The Northern part of the area includes important migratory routes for species such as the Siberian crane and red-breasted goose. Other species include Berwicks swan, Whoopers swan, Common eider, King eider, Stellers eider, Long tailed duck and the Northern fulmar. Sea birds found in the northern areas include the Glaucous gull, Black legged kittiwake, Ivory gull, Little auk and Brunnichs guillemot.

In water bodies over twenty fish species have been identified, including Beluga Sturgeon, Carp (carass), Atlantic Salmon, Inconnu, Whitefish, Smelt, Pike, Burbot, Perch, Arctic flounder, Sosva herring, Elets, Siga, Nalim and Grayling. The Siberian Sturgeon is, due to over-exploitation, diminishing in the project area, and in 1998 listed in the Russian Red Book as a rare species. According to the Regional Environmental Committee of Nizhnevartovsk, there are twenty species of fish in Nizhnevartovsk Region, classified into seven families and six groups/subfamilies. The main populations are of Siberian Sturgeon, Nelma, Muksun, Pike and Carp. The Muksun, migrates between the Ob in the Tomsk region and Irtish River.

The water bodies of the Khanty Mansiysk District serve as transit passages for certain kinds of fish on their way to the places of multiplication (Sturgeon, Siga, Nalim).

Endangered species

Rare animal species are listed in the Russian Federation `Red Book`. West Siberia contains in between 8 to 13 listed species (Fesach, 1994), which includes beavers and, since 1998, the Siberian Sturgeon.

Species of commercial interest

A number of commercially important species are found in West Siberia, these include Reindeer (for meat and hides), Fox, Wolverine and Sable (for fur). Fish species include Muksun, Nalim, Siga, Beluga, Carp (carass), Atlantic Salmon, Whitefish, Pike, Burbot, Perch and Arctic flounder. The Regional Ecological Committee of Khanty Mansiysk reported in 1998 that 33% of fish caught in internal water bodies of the Russian Federation were caught in the Ob-Irtish basin. For the last 5 years the average catch of fish in the water bodies of the District has been 3,7 thousand tons. Catches of Sturgeon have been decreasing; between 1955-1958, 194 to 223 tons of Sturgeon were caught, since 1995 turgeon catches have not exceeded 6 tons a year. The lowest catch, 1.5 tons, was recorded in 1995.

Protected areas and nature reserves

There are a number of protected areas, parks and reserves in West Siberia (see Appendix 8). The areas Yugansky Zapovednik and the proposed Yuganski Khanty Biosphere Reserve are located just south of Nizhnevartovsk.

3.4 Socio-economic and cultural environment

3.4.1 Regulation and Legislation

National legislation concerned with the effect of oil activities on the environmental is contained in the following acts:

- (State Regulation) Law on Conservation/Use of Natural Resources and Environment 19.12.1991
  This is the main law on Environment Protection and sets out the basic principles and rights for environmental protection, including which activities should not cause harm to the environment, inadmissible activities, assistance in environmental emergencies, the different levels of state responsibilities for the environment. It covers the principle of `polluter pays`, such that oil companies have to pay – via tariffs- for environmental damage caused in the past and present. The current privatised oil companies are also legally responsible for former activities in the geographical area of Khanty Mansiysk (Interview: Ministry of Fuel and Energy)

- Federal Law 78-FZ On State Regulation of Social and Economic Development of the Northern Part of the Russian Federation 1996
  Clause 12 of the Law, effective from July 19,1996 regulates questions of environment protection from the point of view of creation of specially protected natural territories and ethno-ecological areas in the North.

- #168 Provision of the government of RF On Licensing of Economic Activity Related to Environment Protection, Feb 26,1996

- Regulations on Carrying Out State Ecological Monitoring by Officials of the Ministry of Environment Protection and Natural Resources of the RF and its Territorial Bodies

- Law on Atmosphere Conservation 1982
  There is a list of Maximal Air Concentrations (MACs) of pollutants in atmospheric air of built-up areas approved by the USSR Health Ministry No 3086-84, 1984. This list quotes short-term (20min) and 24-hour maximal concentration of air pollutants. It is understood that this list presents emissions in urban (built-up) areas rather than emissions of industrial plants. The Russian air quality limits are significant lower than those set by the World Health Organisation and the American Conference of Government Industrial Hygienists. It should also be noted that the Russian air quality standards are stringent.

- Law on Ecological Expertise 1995
  This `EIA` law sets the procedure for identification of the compliance of the planning activities with the environmental requirements, i.e. standards and norms, etc., in order to prevent any possible negative impact on the environment, human health and habitats. I was effective from Nov 15, 1995

  The ecological expertise according to the Law is based on the principles of sustainable environmental and economic development and adequate environmental policy. The basis of environmental policy is the procedure of environmental impact assessment (so-called OVOS in Russian). The EIA or OVOS has the standard procedures and can cost up to 3 per cent of the total project budget.

Furthermore, the procedure, subjects, functions and responsibilities related to the ecological expertise are clearly defined in the law about ecological expertise. The time frame for the ecological expertise depends on many factors but should not exceed 6 months. In some cases due to the complexity of the proposed project the time frame of the ecological expertise was at least one year.

Other relevant legislation includes:

- Law on wastes from production and consumption 1998
- Forest Code 1997
- Law on Application of Atomic Energy 1995
- Law on Wastes from Production and Consumption 1998

In 1996, Russian government passed additional acts and sublaws, related, directly or indirectly, to the economic activity in the sphere of economic protection and monitoring. Some other aspects of environment are regulated also by Water and Land codes. Current proposals for new legislation include:

- Ministerial Order for preventing and working with liquid wastes(to be proposed in September). This order requires companies to implement a structure or system for handling and preventing pollution from oil wastes and emergency/contingency plans and services to deal with major spills. This in a prevention team, whose financing would be shared between all oil companies (Interview: Ministry of Fuel and Energy).
- Environmental Impact Assessment
- Early notification and exchange of information
- Mutual consultations
- Precautionary principle

Local regulations in the project area include:

- Law on Rational Use of Natural Resources passed in Khanty-Mansiysk Autonomous Okrug
- Provision of the Governor About Plan of Activities of Khanty-Mansiysk Autonomous Okrug Administration in the Sphere of Environment Protection # 157 effective from 04.05.96
- Provision of the Governor of Khanty-Mansiysk Autonomous Okrug About Land Exploitation Procedures # 105 effective from 21.03.96
- Provision of the Governor of Khanty-Mansiysk Autonomous Okrug About Suspending and Prohibiting the Operation of Enterprises and Organisations Violating Environment Laws
- Provision of the Governor of Khanty-Mansiysk Autonomous Okrug About Ecological Education of Population

The Nizhnevartovsk Regional Ecology Committee carries out on the territory of Nizhnevartovsk Region the monitoring of compliance of enterprises with federal and local laws on behalf of Federal Ecological Committee and the Territorial Committee for Ecology of Khanty and Mansiysk Autonomous Okrug. Its activity can be assessed as satisfactory (KMREC). In 1996 850 acts were made in North Region to fine enterprises for violating environmental laws. 54 cases of contamination of environment were taken to Prosecutor’s office for further investigation.

Enforcement

Environmental monitoring and enforcement are primarily the responsibility of the oil companies and local government. Companies are required to maintain a set format with specific reporting requirements and produce an annual report for their local administration. A copy is sent to the Ministry of Fuel and Energy, who complies a contribution towards the Annual State Environmental Report, with a description and amalgamated data and accident reports. Other monitoring data is obtained from forms filled in for the Federal Statistics and State Statistics department. Many laws to protect the environment in Russia do not work due to different reasons, i.e. lack of enforcement, weak institutions, red tape, slow pace of economic reforms, etc.

The status of enforcement of environmental laws is currently unclear due to a reorganisation of the major institutional actors in the environmental field in Russia. In May 2000 a decree announced by Vladimir Putin announced that the State Committee for Ecology (SECP, also known as the State Committee for Environmental Protection) and the Forest Service were to be brought under the Ministry of Natural Resources. The decree has provoked strong reactions. The SCEP was responsible for monitoring, enforcement and environmental protection. The Ministry of Natural Resources is responsible for exploitation of natural resources such as oil and forestry. Criticisms of the reorganisation focus on the capacity of a one organisation to both protect and exploit natural resources. For example, 67 Russian and international organisations criticised the World Bank's loans to Russia and the uncertain impact of the status of a monitoring, enforcement and protection body for the environment, in the light of the now `legally questionable` status of the SCEP.(www.paceenv.org)
(www.unfoundation.org/unwire/archives)

There are expectations in the Russian environmental journalists and NGO communities that the dissolution of the SCEP will make it easier for both Russian and international oil companies to exploit the oil in West Siberia without regard to environmental and social consequences. The example of Sakhalin in Russia's Far East was quoted as a bad example of where the Russian and international companies were able to `get round` legislation. It was predicted that this would be made easier in the future without an SCEP organisation acting as watchdog and safeguard for environmental interests (Interview: Russian Environmental Movement). There are often long timescales and large costs of `prescriptive` environmental impact assessments and complying with regulatory requirements. Up to 13 separate, different permits from different authorities must be required for new oil field developments, taking up to 8% of the total project budget (Interviews: Wintershall, Russian Environmental Movement). An environmental fee is payable to the local Oblast authorities to recompense for environmental damage caused by a project. This is partially a fixed amount and partially negotiated with individual companies. To compensate for indirect and social benefits. Both the local Oblast authorities and the national government have a say in oil field developments, particularly where international companies are concerned. Sometimes the jurisdiction and powers between central and local government, and subsequently receipt of the environmental fee, is not clear. This can cause project delays and costs. For oil field developments this meant that environmental interest are often seen as hurdles to project development instead of necessary measures.

3.4.2 Demography

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in their report: “The ecological situation, the use of natural resources and nature protection of the Tyumen Oblast, 1994” that the death rate is taking over birth rate with the lowest population growth of only 0.8 on thousand inhabitants. The increase in death rate of children continues, in some regions with 40 on 1000 new born.

The Regional Ecological Committee of Khanty Mansiysk Report of 1998 and State Statistical Committee report that the population of the Khanty Mansiysk District as of 01.01.99 was 1369.5 thousand., 12 thousand more than in 1997. A noticeable increase of population occurred in the cities of Langepas 2.3 thousand , Surgut & Hanti-Mansiisk 1.3 thousand people and Nizhnevartovsk 0.1 thousand.

These cities are some of the main centres of oil and industrial activity, and have experienced considerable growth since the oil boom in the 1960s, particularly with an influx of immigrants from other regions in Russia into the area. The influx of migrants into the area totalled 300,000 in 1989. Nizhnevartovsk for example, is a young city; 25 years old, its demography being strongly linked to the development of the Samotlor oilfield. It grew from 17.000 in 1970 into 300.000 in 1999 (http://www.suri.ee/eup/ob.html).

The District has the second highest natural population growth in Russia. According to the State Statistical Committee the natural growth of the population for the year of 1998 reached 21%.

Table 3.3: Population characteristics of Khanty Mansiysk District

City	Birth ‘97	Death ’97	Birth ‘98	Death ‘98	Nat Growth ‘97	Nat Growth ‘98
Nizhnevartovsk	10.0	5.1	10.5	5.3	5.0	5.7
Nefteugansk	10.6	6.3	11.0	5.3	4.3	5.7
Langepas	12.2	2.9	13.6	3.2	9.3	10.4
District	10.9	6.3	11.4	6.0	4.6	5.4

According to the Nizhnevartovsk Regional Environmental Committee The birth rate in Nizhnevartovsk City in 1998 was 10,9 on 1000 inhabitants and the death rate was 5,2. Data of previous years are given below in Table 3.4.

Table 3.4: Dynamics in Demographic Situation in Nizhnevartovsk, 1990 to 1996

Indicators	Unit of Measure	1990	1991	1992	1993	1994	1995	1996
Population	Abs.	259,900	247,874	243,472	242,363	240,593	239,151	238,323
Born	Abs.	3,982	3,404	2,623	2,403	2,647	2,443	2,515
	Abs. /1000	16.0	13.8	10.7	9.8	11.0	10.2	10.0
Deceased	Abs.	884	900	1,240	1,707	1,709	1,702	1,505
	Abs . /1000	3.5	3.6	5.1	7.0	7.1	7.1	6.3
Deceased before and at the age of 1	Abs	85	74	86	61	39	51	27
	Abs. / 1000 born	21.3	22.0	32.7	25.4	14.7	20.8	10.3
Natural growth		13.5	10.2	5.6	2.8	3.9	3.1	3.7

3.4.3 Health

In the report on health situation (tumours and cancer) in Tyumen Oblast for 1999 by the Chief Doctor of the Oncological Clinic of the Tyumen Oblast, Mr. N.Naumov, the situation concerning oncological diseases is described. The total number of persons within this category in the Oblast in 1999 is 5,659. This is 25.2 % more than in 1989. Children account for 0.68 % of the total and people between the age of 15 and 59 for 60% of the total. The total number of persons affected by oncological diseases increased from 143 to 194 per 100,000 in the Tyumen Oblast. Children with oncological diseases increased from 173 in 1989 to 351 in 1999 per 100,000.

Table 3.5: Increase in oncological diseases for Tyumen Oblast in the last 10 years

Disease	% Increase
Men (total)	28.5 %
Rectum Men	28.5 %
Lungs Men	28.5 %
Women (total)	35.5 %
Rectum Women	53.9 %
Cervical	53.9 %
Colon Women	42.5 %
Breast	34.6 %

The Regional Ecological Committee of Khanty Mansiysk indicated in their 1998 report that the main groups of illnesses are:

- diseases of the respiratory system;
- traumas and poisoning;
- infectious and parasite diseases.

Alcoholism is 1.5 times higher in Khanty Mansiysk than the Russian average. There is a tendency of increase of tuberculosis and death related to this disease.

Since 1990 Nizhnevartovsk has been on the list of the cities having the highest indicators for diseases caused by a poor environment. Nizhnevartovsk is one of the worst from environmental point of view along with Dalnegorsk, Bereniki, Nevinnomissk, Solikamsk, and Volgodonsk where indicators are found to be 1,5 times higher as average for practically all groups of diseases. Nizhnevartovsk is in the first and the second position within the group of cities having highest indicators for 9 groups of adult diseases. Its positions range from 2 to 7 in the children diseases groups.

Indicators for oncological diseases in Nizhnevartovsk has been exceeding the Russian average since 1994 for the age groups of 15 to 19 years and 50 to 59 years. Indicators for endocrinological diseases exceed the average for Russia 1,17 to 1,87 times for the age groups of 20 to 29, 40 to 49 and 50 to 59. It exceeds the average for children 2,52 times. In 1995 there were found increases in tumours, rheumatic and skin diseases with adults and endocrinological, opthalmological, ear and skin diseases with children. The year of 1996 showed the same tendency. 90% of expectant mothers experienced complicated pregnancy and 35 % of infants were born with anomalies in Nizhnevartovsk in 1995.

Data from “AGIS – Environment and Health” show that illnesses related to ecological problems in the city Nizhnevartovsk in the period 1991-1996 are between 1.3 and 3.6 times higher than average for Russia. In the city Nizhnevartovsk the total of illnesses in 1998 has increased significantly compared to 1991. The worsening of the ecological situation in combination with the prevailing climatic conditions lead to an important worsening of the population its health, especially that of children. In 1991 there were 351 cases of cancer on a total population of 248,734 while in 1993, there were 892 cases out of a population of 243,604.

According to the State Service Sreda –Zdorovie (Environment-Health) the situation in Nizhnevartovsk health standards are critically low; since 1990 the city of Nizhnevartovsk has been among the group of cities with highest indicators of diseases among children and adult population in Russia. The indicator for oncological diseases (tumours of different etymology) is 2 to 3 times higher than anywhere else in Russia, within the age group of 15 to 49. Cardiological diseases exceed the average indicator for Russia 9 times, while endocrinological diseases exceed the average indicator 2 to 5 times.

3.4.4 Socio-Cultural Environment

Indigenous people

The indigenous people of Western Siberia largely depend on natural resources in particular plants and animals. There are three main groups of native people living in the project area, the Khants (also known as the Eastern Khanty), Mansis (also known as Volguls) and the Nenets. Their traditional livelihood was conducted over a large, dispersed area along the Ob River and its tributaries in a semi nomadic way. Subsistence consists mainly of reindeer herding, hunting and fishing. The Khants and Mansis culture is based on extensive clan systems, a native religion, language and a traditional way of life in widely separated extended family settlements on traditional hunting territories. The hunting territories vary in size depending on the size of family members usually they are between 400 and 600 hundred square kilometre. The family size varies between six to forty individuals. Their culture was born in and is specifically adapted to the forest and swamp ecosystem of Western Siberia middle taiga. The families follow a seasonal round between their main summer place near the river and a hinterland winter location in between these two locations there are several camps. The route differs depending on the availability of food and fur resources; the most important fur-bearing animals being sable, fox and mink. The turnover from the sale is used to buy basic products like ammunition, spare parts of snowmobiles and other needed supplies. The major food supplies during wintertime are moose and fish.

Since the 1950s, the traditional lifestyle for a number of indigenous peoples has begun to disintegrate and change. Many now do not practice the traditional nomadic lifestyle and live in urban areas. The Khants and Mansis have become insignificant minorities in their own historical settlement areas: The percentage of Khants decreased from 9.2% in 1959 to 1.8% in 1989. The percentage Mansis decreased from 6.2% in 1938 to 0.6% in 1989.

During the last decade they have become entitled to claim ownership of their traditional lands and rights to the traditional subsistence practices that they are used to. This has contributed to the development of a fairly active environmental protection and indigenous rights movements.

4 Oil industry in West Siberia

This section presents an overview of the historical and current oil activities and facilities in West Siberia.

4.1 General

The Russian Federation is one of the top five world's largest energy producers and responsible for 7% of the worlds total energy consumption. It is variably second or third world largest exporter of petroleum. Within Russia, West Siberia is the most highly developed oil and gas region (Fesach 1994), with significant unexplored structures in the northern and eastern Siberian territories. About 78% of oil produced by the Russian Federation comes from Siberia. The main oil producing fields within West Siberia lie in the Tyumen and Khanty Mansiysk Autonomous Okrugs (Districts). Together with gas, oil accounts for 30% of hard currency earnings for Russia.

In the mid 1950s oil was first discovered in the basin of the middle Ob River. Great changes took place in the northern districts, where in the 1960s, world-important oil and gas fields were discovered. Through the forest and swamps, railroads were constructed, new cities appeared as Surgut, Nizhnevartovsk, Nadym and Urengoi. By the 1980s, the Samotlor field, near Nizhnevartovsk, was one of the main oil producing fields. By 2000, 62,000 oil wells have been drilled and around 64,000 kilometre of pipelines has been built in the Khanty-Mansiysk Autonomous Region. 112 oil fields have been now in exploitation in the last 10 to 20 years, 38 for more than 20 years and 7 for more than 30 years. 166.7 million tons of oil was produced in 1998. From 1990 to 1998 the decrease in production reached 45.5 %.

During the development of the oil fields and operation up till the 1990s, no technological schemes or consideration was made for the environmental impacts of the oil activities. This has lead to much of the extremely poor environmental performance of the current industry. Today, when the requirements for environmental performance are clearly defined, environmental safe technological systems of oil production and transportation are still not accepted. The task of the reconstruction of the existing pipelines and the oil production equipment and increasing the safety of operational equipment proved to be impossible. According to some assessments, the level of physical depreciation of oil production equipment is 50-70 %, depreciation of pipelines exceeds 30 % (Interview: Regional Ecological Committee of Khanty Mansiysk).

The privatisation of the oil sector by the government in the early 1990s created the major oil companies of today, headed by politically important executives from oil, banking and business circles. In 1992 Yeltsin signed a decree creating the first oil companies today: LUKoil, Surneftegaz and Yukos, the new breed of so-called \`oligarchs\`. The top six privately owned oil companies today are LUKoil, Surneftegaz, Yukos, Sidanko, Tatneft and Tyumen Oil Company (TNK), who together account for about 60% of Russia's yearly oil production of 265 million tons (1998). The privatisation decree did not modify the pre-existing soviet organisational model; the large oil companies being created through the merger of regional operating units and refineries into cluster companies, often set up around the trading arm of the producing units. Though a formal holding units with shareholding systems were created, organisationally the various operating components remained largely under the control of an autonomous and often fiercely independent management. This unique form of \`confederate\` corporate structure has made the re-organisation of the industry and its rationalisation into western style vertically integrated companies a highly complex, and up to date, not very successful process (EBRD, 1999). The changes in share ownership since 1992 have not always been transparent, leading to a lack of clarity about exact ownership. This has left the real powers of the state, the actual owners of companies not easily identifiable, and the functions and state powers (legally secured in statutes and in nominal capital of the companies) also not clear. The state is however represented in all oil companies, with majority shareholdings. The Russian oil industry has been described as “not an open and transparent business and there is nothing to be done about it, but it is murky everywhere” (Source: Steven Dashevsky, analyst, Aton Investment Company, Moscow Times June 20, 2000). Many of the oil companies have multiple joint ventures, subsidiaries and joint stock companies, the exception being the more structurally simple Surgutneftegaz. Companies such as LUKoil are now trying to smooth over internal contradictions and are now beginning a process of strengthening intercorporate links, consolidating entrusted enterprises and concentrating profits with the main holding company. This should be intensified by the `Decree on Urgent measures on the improvement of oil companies activity` which sums up the privatisation process and adds to the 1992 # 1403 decree (Kryukov, 2000). The role of Western oil companies in all this is also rather obscure.

As long as oil prices remained high, the holding companies and operating units could generate revenues to keep both sides in balance. However, with the oil price slump in the mid 1990s and the Russian economic crisis in 1998, oil prices were at an all time low. In 1998 prices on oil dropped by 20 % in the internal oil market. This forced oil and gas companies to decrease their costs (costs of construction, reconstruction of pipelines, rehabilitation of pipelines, etc). The crisis and stalled implementation of tax reforms and production sharing agreements affected oil production outputs, with crude oil and petroleum product output declining sharply since 1998. This was also due to a decline in drilling, lack of necessary capital investment to maintain capital stock. Recent economic problems include mismatching domestic supply and demand of refined petroleum products, declining production in major fields, and increasing market competition between oil companies and problems attracting sufficient foreign investments. This has affected the rehabilitation, privatisation and upgrading of the majority of the Siberian oil fields. Along with continuing inflation and the economic stagnation during that period, exchange rate of rouble to hard currencies lowering - these circumstances aggravated sharply financial-economic state of oil companies. However cost cutting programs have been considered by the Director Councils of Nizhnevartovskneftegaz, Yuganskneftegaz, Surgutneftegaz and many have departed from their earlier declared as paramount goals of "keeping the body of workers" and have come to the decision on unprecedented, by Russian standards, jobs reduction by 20-30%. Rationalisation attempts did not eliminate but have only slowed down financial difficulties. Last year, oil enterprises suffered 55% of all losses in the fuel and energy sector. Until 2000 one of the most persistent problems in the sector has been a lack of investment, which badly needs modernisation in order to bring it’s mostly Soviet-era infrastructure up to speed and Western standards. With a few exceptions, most companies have been busy maximising current profits at the expense of their own futures and reinvestments (source Moscow Times, June 20 2000) – this has also had environmental and social consequences. Since 2000 the rouble and US dollar oil prices have remained stable and been rising, and improvements and investments in environmental management are now anticipated.

4.2 Russian companies active in West Siberia

Detailed information about the Russian oil companies can be found in the Almanac of Russian Petroleum 1999 (Energy Intelligence Group). The main companies with some of their characteristics currently active in West Siberia are listed in Table 4.1.

Table 4.1: Characteristics of Top-10 Russian oil industry in West Siberia

Company	Oil production (x 1000 ton)	Oil export x 1000 ton)	Associated gas production (mln m3)	Total exploitation wells
LUKoil	53,667	18,349	2,459	19,708
Surgutneftegas	35,171	13,996	10,329	14,506
Yukos	34,111	12,207	1,193	14,898
Tatneft	24,440	8,319	736	20,600
Tyumen Oil Company	19,652	6,987	1,446	10,155
Sidanco	19,903	6,149	1,831	10,885
Sibneft	17,314	5,772	1,463	6,950
Basineft	12,891	3,791	422	15,070
Rosneft	12,626	6,884	2,261	7,542
Slavneft	11,784	4,481	717	3,583

Four of these companies operate in the project area; Sibneft, Surgutneftegas, TNK and Yukos. Text Box 1 provides more a case study illustrating one company and its environmental activities, as one of the major companies active in the region. This information was provided during an interview at Yukos headquarters in Moscow, the Yukos Environmental Report 1997 and from a literature review.

Text box 1: Yukos

Yukos was established in 1993 and had 70,000 employees in 1997. It is 92% owned by Rosprom-Menatep. It has one exploration and production unit in West Siberia (Yuganskneftegas) and markets 9 oil and gas products. In 1998 its total crude oil and condensate output was 34,111 thousand tonnes, down from 51,498 in 1992. In 1998 it had 14,898 exploitation wells, with 11,496 operating, 9,521 producing and 5,377 idle. Between 1992 and 1998 Yukos developed 2647 new wells and explored 65 new wells. The last Environmental Report in English (1997) Yukos is the first company in Russia in terms of oil reserves, with about 15% of total confirmed Russian oil reserves and 2nd in terms of oil production. After losses in 1998, it made a profit in 1999 and plans to boost production, developing oil fields itself, without looking for external partners. It is also focussing on re-organisation in the next year. Yuganskneftegas is its main oil-producing subsidiary in Khanty-Mansiysk. Yukos states that it “considers environmental protection to be an integral element I and the top priority of its industrial performance. Its strategic goal is to be in harmony with the environment. Key principles of the company’s policy of protecting the environment, public health and safety are:

- Minimal impacts of the industrial activity on the environment
- Preservation and proper use of natural resources
- Safety of industrial processes
- Restoration of environmental components disturbed by previous production activity
- Respecting public interests
- Continuous dialogue with local communities
- Company management guarantee of conforming with environmental standards.

The company reported that they are committed to resolving environmental problems and aim to become at least leaders of the Russian oil sector in environmental protection, although sometimes working with Russian authorities is difficult; the large number of authorities they have to deal with, between 30 and 40 people in the region concerning control, licensing, audit and enforcement. The main environmental problems are the sensitive environment in West Siberia, water pollution and the need for preventive measures. They hired consultants Arthur D Little in 1998 to develop an environmental protection strategy for the company. Annual meetings are held with local and top managers , to which government agencies are invited for an open discussion about environmental issues. Round tables are also organised by operating companies, for example, a recent meeting in Samara, invited local public and environmental agencies, and was intended so that the company could react to criticism and advice about environmental and social issues. All company operating units also mandatory publishes an environmental report. Yukos current conducts annual environmental audits and is investigating ISO 140001 certification and has held 2 recent seminars in Moscow and Siberia to discuss the system and raise awareness.

Total company production was 36,02 millions of tonnes in 1995, and 35,39 in 1997.Yukos estimate they have spent about $ 30 million in 2000 to tackle environmental problems, this includes:

- $11million purchase of 2 process units for drilling waste cuttings from the American company Oil Tools, plus training;
- $3 million ecological monitoring laboratory installed at Nefteugansk;
- R 62 million oil sweeping booms purchased from the Finnish company Lamore for swampy areas pollution containment;
- replanting traditional grasslands and purchase of 2 soil cutting/propelling for 12 million roubles for soil rehabilitation in Samara.

Pollution discharges to air by the company fell from 402,02 thousand tonnes in 1995 to 342,14 in 1997. The ration of air pollutants to oil production fell from 6.45 n 1995 to 5.18 in 1997. Atmospheric emissions depend largely on the efficiency of associated gas utilisation; 76.3% of gas was utilised in West Siberia in 1997. Measures include gas collection systems, gas compressor systems and recovery of gases. Water protection measures depend on water supply and wastewater. Production water use fell from 1.44m3 per ton of produced oil in 1995 to 1.36 in 1997. Contaminated water discharged into water bodies fell from 2,04m3 per ton of produced oil in 1995 to 0,22 in 1997. Producing sites include water meters, process to reuse process water and reducing fresh water pumping. Oil spills are dealt with by Yukos engineering subsidiaries using oil clean up equipment, shallow wells and drainage systems and groundwater treatment systems. To prevent pipeline oil spills, `pipe-within-a-pipe` designs are used and a programme of rebuilding underwater crossings was in operation in 1997. Soil protection measures include anticorrosion coating for pipelines; produced by the Yukos plant to replace about 700km of pipes a year. Oil spills are remediated using oil-gathering assemblies; biological peat based reclamation and treatment of drilling wastes.

Environmental priorities for Yukos are:

- rehabilitation of polluted areas (pore-Yukos);
- work over and rehabilitation of pipelines;
- establishing environmental services departments in all daughter companies (Yugansneftegas, Tomnskneft and Samara);
- establishing ecological insurance against future risks.

In Khanty Mansiysk District, more than 62,000 oil wells have been drilled and around 64,000 km of pipelines have been constructed (Alexander's Oil & Gas14-03-00 Source Nezavisimaya Gazeta via News Base). Tyumen regional authorities say that their regional development strategy will rely increasingly on increasing its share of hydrocarbon processing facilities. The region lacks refinery capacity and has to transport crude oil to other regions for further treatment. It only processes 1.7% of Russia's diesel fuel and 0.5% of its gasoline. However the refining sector is picking up, growing by 14.4% in 1996, comprising 3.3 million tons. Despite the areas huge potential, the oil sector there faces a number of common problems. These include depletion of productive reserves, obsolete equipment and technology, harsh natural conditions such as permafrost in the North, existing oil and gas pollution and an underdeveloped road system (US Consulate General 1998).

The total square of Nizhnevartovsk Region is 118,520 km^2. There are 74 oilfields with total square 23,704 km^2 in this area, including 16 large ones exploited longer than 20 years (approximately 35% of the oil-bearing area). 41 oilfield are exploited for 5-20 years and 17 oilfields are in the initial stage of developing (less than 5 years). The total number of wells with different functions being drilled in the Nizhnevartovsk Region up to 1998 is 33,082. Out of this are some 28,000 oil wells. In total 4566 groups of wells (bushes) are developed. The total length of pipelines (production and trunk oil and gas pipelines) being built is 20,500 km.

In the Western part of the region the full range of oil sector activities can be found. In the middle part the activities are mainly limited to exploration and in the eastern part no activities have taken place yet. The following table gives an impression of the magnitude of oil industry in the Nizhnevartovsk Region. (Sources: Regional Ecological Committee of Khanty Mansiysk and Nizhnevartovsk Regional Environmental Committee).

Table 4.2: Magnitude of oil industry in Nizhnevartovsk region

	1996	1997	1998
Area of Nizhnevartovsk Region	118,500 km^2	118,500 km^2	118,500 km^2
Area occupied by oil exploitation	23,700 km^2	23,700 km^2	23,700 km^2
Oil fields exploited	-	-	57
Areas in preparation	-	-	17
Total oil produced	-	64 million tonnes	62 million tonnes
Total associated gas produced	6,720 million m^3	5,375 million m^3	5,400 million m^3
Number of oil and gas wells*	-	33,000	28,208
Number of oil wells	-	27,750	-
Total length of pipeline	-	-	20,400 km
Company roads	-	-	4,460 km
Pipelines needing replacement**	-	3,358 km	1,577 km

* Source: 1997 figure; Regional Ecological Committee of Khanty Mansiysk
Source of 1998 figure; Nizhnevartovsk Regional Ecological Committee

** Source: Nizhnevartovsk Regional Ecological Committee (different reports). The figure 2336 km is also used.

\- No data obtained.

The main concern of the oil companies operating in West Siberia today should be the reconstruction and maintenance of pipelines. This includes changing the damaged pipelines with the properly insulated ones, introduction of automated systems of locating damaged areas in the pipeline systems and blocking of the damaged pipeline in case of accident to prevent oil from being spilled etc. Problems of this kind are of course the prime concern of the oil companies today, but the scale in which these problems are being solved are not satisfactory.

Out of 21,000 km of oil production and trunk pipelines 2,350 kilometres (11 %) require immediate reconstruction according to the data provided by different oil companies. This number does not include pipes that get damaged 1 or 2 times a year. That makes practically the whole pipeline system in old oilfields outdated and in need of immediate replacement (NREC).

There are 106 registered underwater pipelines in the region. Their condition is very poor and insulation is often damaged. Most of the pipes are not placed on solid ground but are partly floating and therefore are often deformed. These pipelines are checked rarely if checked at all. No defectoscophic works are conducted and some oil companies don’t even remember the exact location of their underwater pipelines (NREC).

Environmental protection has been recognised as an important consequence of oil company activities in West Siberia in recent years. The government has therefore encouraged ecological nature saving programmes by the major oil companies, on a long and short term. For example, Surgutneftegas has a company plan with steps to decrease environmental impacts and remediate former pollution, also to decrease waste, clean groundwater and reduce the number of flares. Transneft has developed a programme to diagnosis and analyse pipelines to reduce leaks (Interview: Ministry of Fuel and Energy).

Russian is a major exporter of its oil. Table 4.3 provides an indication of where Russia has exported most oil to over a 6 year period. Figures for oil originating in West Siberia are not known.

Table 4.3: Volume of Crude Oil Export to Western Europe (000 tonnes)

	1993	1994	1995	1996	1997	1998
Finland	576	579	605	1256	1363	1514
France	2488	1392	74	272	650	531
Germany *	12937	20173	9577	18496	11297	11966
Ireland	5208	7709	20106	17049	23650	6181
Italy	8924	8374	6647	2339	9050	7253
Netherlands	791	1397	89	739	840	314
Spain	2057	474	43	411	1530	1304
Switzerland	4028	11197	5812	10966	10519	8474
United Kingdom	6682	15577	4645	3424	7133	4324
Others	27984	19048	20957	45059	21823	37238
Total Western Europe	51956	70530	48750	60678	70783	45532
Total Export	79940	89578	69707	105737	92606	82770

Source: Oil Industry Almanac

* The Bundesministerium für Wirstschaft und Ekologie gives different figures for oil import in Germany; in 1996 a total of 26,088 thousand ton, in 1997 25.483 thousand ton, in 1998 28.359 thousand ton and in 1999 a total of 31,500 thousand ton.

4.3 International oil companies in West Siberia

A number of international business interests are also active in exploration and production in West Siberia. Some operate independently, although many operate as joint ventures with Russian firms. It is difficult to get accurate information about who is active where. The following companies are known to be active in the area:

- BP; 10 % of Sidanco;
- Agip International BV (Eni) Severo Pokachevskoye field;
- Evidhon (Russian partner Royal Dutch Shell), Slaym field;
- Mobil, Nizhnevartovsk drilling analysis;
- Bashneft (Republic of Bashkorostan) in the Khazarsky concession, Khanty Mansiysk;
- Goliol, (Teton Petroleum company), Eguryakhskiy territory, near Samotlor;
- Geolibent (Purneftegas, Purneftegasgeolicam Benton Oil & Gas Company US), North Gubkinskoye & Prisklonovoye fields (EBRD loan 1996);
- CanBaikal Resources Inc. (Canadian Oil & Gas company), Kulun Poll block.

(Sources: Company web pages, Alexander's Oil & Gas, Oil Online, BisNis, EBRD, Eni)

Import of (Russian) oil is not a very transparent market. It is concluded in 'gas en olie uit Siberie' (Contrast Advies) that all the 'majors' like Shell, BP, Esso, Total Fina Elf are probably involved. The Moscow Times (August 4, 2000) reported that Total Fina Elf buys 18 to 20 million tons annually form Russia. A Tyumen Oil Company official said that Tyumen Oil Company sells 70% of its export to Total Fina Elf (Moscow Times). It is inevitable that foreign oil related industries will be involved in Russia's oil industry as well. An example of such involvement is given below, the source is Lloyds Energy Day (April 7 and September 12, 2000). The New York Branch of the Commerzbank, guaranteed by the US Export-Import Bank, approved a $500 million loan for the Tyumen Oil Company. The financial package for TNK supports the sale of US made oil and gas equipment and other services to rehabilitate part of the Samotlor oilfield and to upgrade the TNK owned Ryazan refinery. Halliburton, Bloomfield and ABB Lummus Global are involved.

4.4 Donor agency activities in West Siberia

A number of IFIs and donor agencies have been active in investing in Russia's oil sector, historically particularly in West Siberia. The rationale behind these interventions is that oil revenues constitute an essential economic commodity, are an important foreign exchange revenue and contribute significantly to Russia's GDP. The potential benefits of exploiting this wealth offer great economic potential, however they need to be balanced against the difficult legacies of state involvement, lack of modern technical and legal infrastructure and the economic, social and environmental risks.

The World Bank's strategy for involvement in the energy-environment sector in Russia is based on its overall goal of assistance in Russia to alleviate poverty and to increase human well being through building institutional capacity for sustained economic reform and growth, removing of distorted incentives and creating a favourable climate for private investments. The 1999 Country Assistance Strategy and Energy & Environment Review emphasise that air pollution in urban areas and strengthening of the institutional framework for enforcement of existing laws and regulations and good environmental practice are Bank priorities. To implement these goals, Bank assistance may focus on reducing energy intensity, fuel switching from coal, clean coal options, improved fuel oil quality and vehicle abatement measures. The Bank has chosen to focus on the Rostov region for these areas. The other proposed initiative that focuses on the oil sector include a reduction of associated gas flaring. The Bank aims to implement its objectives by working in close co-operation with EU member states, and possibly with TACIS, Global Environment Facility (GEF), the Prototype Carbon Fund (PCF) and or the IFC, mainly through technical assistance. For example for greenhouse gas reduction instruments and gaps in data required in developing mitigation strategies such as air quality monitoring, public health, emission and fuel inventories. The West Siberian oil sector is not included in the proposed future Bank initiatives, particularly as Bank policy excludes investment in private companies (this is the mission of the IFC). Also, as the Bank works in a sector or subject at the invitation of the host country, and it has not received an expression of interest from the Russian government for assistance in the oil sector (Interview: World Bank). New lending from the World Bank to Russia is also heavily dependent on the implementation of Russian Federal governmental structural reforms (Moscow Times, 2 August 2000).

Past World Bank projects have focussed on the West Siberian oil sector, although not in this project area. For example, the Bank contributed to the first `Russian Oil Rehabilitation Project` in 1993 and contributed $500 million to the financing plan for US$ 890million required for the `Russia Second Oil Rehabilitation Project` of 1994. The second project included a specific environmental component that included environmental management training, higher spill response capacity, implementing environmental management and a pilot cleanup programme. Yuganskneftegas was one of the three Russian oil company recipients of a project aimed at strengthening the Russian Federations ability to increase oil production and exports, transfer international technology and managerial practice, and support policy reform in the oil sector. This is a Category A environmental assessment project. Due to the 1998 financial crisis, the project was not fully completed, and the environmental component was re-initiated by the Bank in early 1999, despite the loan being completed. Yuganskneftegas was one of the major achievers in implementing the environmental components compared to the other companies in the project, although it suffered from understaffing and lack of authority.

Many lessons relevant to the situation in the project area can be learnt from the World Bank/EBRD jointly funded Emergency Oil Spill Recovery and Mitigation project, dealing with the Kharyage-Usinsk pipeline leaks in the Komi Republic. The project indicated that there is only now the beginnings of environmental awareness in Russia about oil pollution. It produced trained representatives from six oil companies assisted in developing the legal framework concerning spills and oil contingency plans. Problems that the project highlighted were the lack of enforcement capacity of local and state environmental protection agencies and lack of financing for enforcement. Also, as oil is the driving force of many West Siberian urban economies, `comprise` is often the byword of enforcement. Enforcement fines are also of such a low level that they do not act as deterrents. The lack of clear divisions in environmental responsibilities between the SCEP and local government was also highlighted as creating enforcement problems, such as `double fines` (Interview: World Bank).

The EBRD Natural Resources Operations Policy in Russia 1999 indicates the rationale behind the EBRD's investments, its portfolios and project pipeline. The EBRD promotes the transition to a democratic market economy. The EBRD's portfolio has to date concentrated on the upstream central Siberia oil production region. It total commitment to the natural resources sector in Russia at the end of 1998 was 551 million US$, down from 636 million US$ in 1997. About 636 million US$ were to upstream oil projects.

The first projects were in the upstream oil sector (in Western Siberia, the new Chernogorskoye oil field, north of Nizhnevartovsk, 1993 and Purneftegaz oil fields rehabilitation, 1993, Vasyugan oil field service equipment, 1994, Geoilbent loan for the development of the North Gubkinskoye and Prisklonovoye fields, 1996, Chernogorneft drilling programme- including environmental investments, Nizhnevartovsk 1997) and involved green field developments and rehabilitation, often with the participation of major international oil companies. All of these projects had either full environmental assessments of environmental investigations, public participation and consultation elements. Certain projects were also undertaken to address specific Bank objectives, such as the Komi Oil spill project. The Bank believes that its presence and contribution since its first project in 1993 have been a catalyst for direct foreign investments and improvements in the sector, drawing on its expertise and international business standards and experience. It oil production projects are thought to have had a significant positive economic and environmental impact.

Its preference for the future is to:

- decrease sector concentration risks and increase the transition impact of Bank lending is to move into other regions (north and East Siberia), such as Sakhalin);
- encourage investment in downstream sectors, encourage projects by vertically integrated oil companies;
- emphasise active restructuring to improve competitiveness and enforcement of the highest standards of business conduct;
- undertake a Strategic Environmental Assessment in those areas where multiple or cumulative impacts are unknown. West Siberia is not named as one of these areas.

Environmental considerations are explicitly named in the EBRD’s policy. Projects in `new frontier areas` will require elaborated EIAs, new projects require information on their greenhouse gas implications and possibilities for reductions, and emphasis is to be given to the environmental impacts of oil and gas pipelines. Projects must demonstrate replicable behaviour as environmental `models` and the environmental issues associated with economic transition, operational objectives and public consultation must be addressed.

The EBRD states that given the magnitude of funds needed by the sector and limited commercial bank interest, co-operation with other IFIs is key to meeting the sector demands. Closer collaboration with the IFC sector teams and EIB is important, as is collaboration with the EU. The EBRD’s future lending and `project pipeline` has been redefined and structured according to the issues identified above. Over the next 3 years it is expected to invest 18billion USD in the Russian and former Soviet union natural resources sector, with about 90 million US$ in each project. Upstream projects will account for 25/30% of the total, the combined share of transportation/downstream projects will rise to 50/55%. The Bank expects to continue to invest about 65% of its commitments in Russia, and also in `regional` projects involving several countries. The EBRD’s upstream priorities in Russia are large and medium-sized oil production projects. Rehabilitation projects are undertaken where the increase in production efficiency is financially viable, taking into account the costs of long-term environmental remediation and safety upgrades. The EBRD is monitoring a number of existing projects in West Siberia, and is actively looking at other opportunities in the region. The EBRD Natural Resources Strategy focuses on large-scale oil & gas projects in frontier areas of Russia; however, this position is evolving and staff are currently investigating the potential of rehabilitation projects in West Siberia and the Russian Far East”.

While the EBRD’s commitment to investing in Russia and the natural resources sector remains (Lemierre, 2000), it is clear that the project area in West Siberia is not specified as a priority area for future EBRD investment. Oil field rehabilitation and remediation, except perhaps for emergency or crisis funding, is also not a priority for investment

The International Finance Corporation (IFC), a member of the World Bank Group, fosters economic growth in the developing world by financing private sector investments, without government guarantees, investing in own resources and making loans. IFC mobilises funds in the international capital markets and also advises businesses and governments on investments related matters and provides technical assistance. IFC advisory work in Russia is focused on land privatisation and farm reorganisation. The priority for the next phase of IFC assistance will be the transfer of expertise in implementing and managing privatisation’s to Russian institutions. IFC emphasises its role as an equity investor in Russia as an additional tool for the IFC to maintain a strong voice in developing and executing restructuring plans. No investments were made in the energy sector up to now.

Following the break-up of the Soviet Union in late 1991, IFC initiated its privatisation and capital markets efforts in Russia. IFC’s assistance has been successful, both in the privatisation of individual enterprises and in the creation of model schemes that have wide demonstration effect. In 1977 IFC facilitate a corporate reorganisation in the energy sector (Support for Restructuring the Russian Power Sector). Other projects in the energy sector are not executed.

Tacis is one of the instruments of the EU for its relationship with Russia. The Partnership and Cooperation Agreement (PCA) is the institutional framework for the relation between Russia and the EU. The main characteristics of the PCA are: trade, political dialogue, economic cooperation and institutions. Environment management is a topic within the institutional projects financed by Tacis. Examples are projects for regional and municipal authorities for implementing measures concerning surface water quality improvement. Also demonstration projects are executed for energy efficiency, product quality improvement and reduction of waste. The Tacis activities focus on certain regions like Moscow-region, St. Petersburg-region, Tyumen-region and Samare-region, Oeral, West Siberia, South-West Russia, Kaliningrad, North-West Russia and Lake Baikal. The Tacis Technical Offices, which were opened since April 1997 serves to decentralise Tacis in Russia. Most recent projects on oil related matters are:

- New Oil Field Development, Tyumen (completed in 1998);
- Baltic Oil Pipeline Study (completed in July 2000);
- Oil Industry Environmental Code of Practice (to end in December 2000).

One project to start in 2001 (short listing just completed) in Northern Russia is called “Regulation of Energy Resource Development and Environmental Protection in the Timan Pechora Region”. The Timan Pechora Region consists of the Nenets Autonomous Okrug and the Komi Republic. The project aims at providing support to Federal and Regional authorities in implementing a development programme based on local socio-economic needs, on the rational use of natural resources and on respect of the environment. The overall aim of this project will be to improve the environmental situation in the Timan Pechora oil and gas province by means of more efficient administrative methods of control by the Russian Federal and regional authorities.

Another project planned to start in 2001 (tendering is being carried out) is "Environmental Monitoring in Russia". The project includes parts of West Siberia. This project is to consider environmental monitoring as an information tool for decision-makers and as a measurement tool to assess environmental changes. Since the SCEP of the Russian Federation for Environmental Protection is the formal beneficiary of this project the time of implementation is not yet clear.

In a meeting between the Royal Netherlands Embassy and IWACO the idea of launching a environmental project in West Siberia under Matra (Dutch Fund) has been discussed. The Royal Netherlands Embassy intend to support the idea for a project to (among others) contribute to organisational strengthening and environmental awareness.

4.5 Summary

The major donor agencies and IFIs active in the Russian energy and environment sector have not identified or named the West Siberian oil sector as a priority in their current or future strategies and policy plans except TACIS. Most agencies and IFIs allocate funds on the basis of where they and their counterpart (the Russian Federation) set highest priority and expect a positive (financial or technical) return on investment. The historical and current environmental impacts and environmental management of the Western Siberian oil sector does not appear to be a priority for most donors and therefore they can not be seen as a major potential source of financing. Bilateral and country funds may however be a potential source of financing. This again depends on the policies of bilateral donors and individual countries. Private sector financing may provide some financing opportunities, particularly for individual oil companies. Past projects in the area do provide a breadth of experience and indicate the lessons that have and can be learnt (such as the Komi oil spill project), from donor activities in the oil sector and in West Siberia.

5 Potential environmental and social impacts

This section provides a description of the assessment of potential environmental and social hazards of the oil sector in West Siberia and the environmental and social sensitivities in West Siberia, from which the key issues for the Environmental and Social Profile were determined. This exercise refined the scope of the project and defined the focus of the field surveys and interviews conducted in Russia.

First the general oil exploration and production process is described, extrapolated from the data in Section 4, and then its interactions with the environment analysed. This results in an assessment of potential hazards. The environmental and social sensitivities, as determined from Section 3; the description of the environment, have then been analysed. The key environmental and social issues were then identified.

5.1 The oil exploration and production process

In order to appreciate the potential impacts of oil exploration and production on the environment it is essential to understand the activities involved. In table 5.1 the operations and facilities connected with oil exploration and production are summarised.

The process of oil exploration and production begins with desk studies to identify areas with favourable geological conditions. This is usually followed by aerial surveys, to reveal favourable features which, if positive, result in seismic surveys. Particularly in large expanses of wilderness such as in much of West Siberia, these are vital exploration operations. Seismic surveys provide detailed information on geology. Prior to surveying data points and sensor locations are established. Line preparation can involve removal of vegetation, up to several square kilometres in total. Vehicles or helicopters will be used for transport purposes. If needed, roads will be constructed. Where necessary, due to local hydrological conditions, these may be built on dikes or ridges. In case of exploration drilling, to verify the presence or absence of a hydrocarbon reservoir and quantify the reserves, a pad is constructed for drilling equipment and support services. An average pad occupies between 5000 and 20,000 m^2. A drilling unit normally consists of a derrick, drilling mud handling equipment, power generators, cementing equipment and fuel and water tanks. Furthermore the camp will provides workforce accommodation and facilities, storage place, etc. Drilling operations last (depending of geological conditions) normally one to two months. If drilling is successful, initial well tests are conducted to establish flow rates and formation pressure. These tests may generate oil, gas and formation water. After drilling and initial testing, the rig is normally dismantled and moved to the next site. If exploratory drilling has discovered commercial quantities of oil, a wellhead valve assembly may be installed. In case the drilling has a negative result, the site is abandoned. Rock formations will be sealed to prevent short-circuiting of fluids.

If the appraisal is positive, development and production will take place to produce the oil (and often-associated gas) from the reservoir, through formation pressure, artificial lift and possibly advanced recovery techniques, until economically feasible reserves are depleted. A larger reservoir will need additional drilling than the initial exploratory drilling wells. The type and size of the installations needed depends on the nature of the reservoir, the volume and nature of produced fluids and the export option selected. Production needs (additional) roads, pipelines, storage facilities, etc. Disposal of waste is done by flares (associated gas), drainage systems (production water, domestic waste water, etc), waste pits (solid waste) and incinerators (combustible waste).

At the end of a reservoirs economic lifetime, and/or at each stage in the exploration process, abandonment and decommissioning and rehabilitation may occur. This includes demolition and removal of buildings and equipment, plugging of wells and, where required by law or good practice, restoration or rehabilitation of the site to its original or agreed after-use.

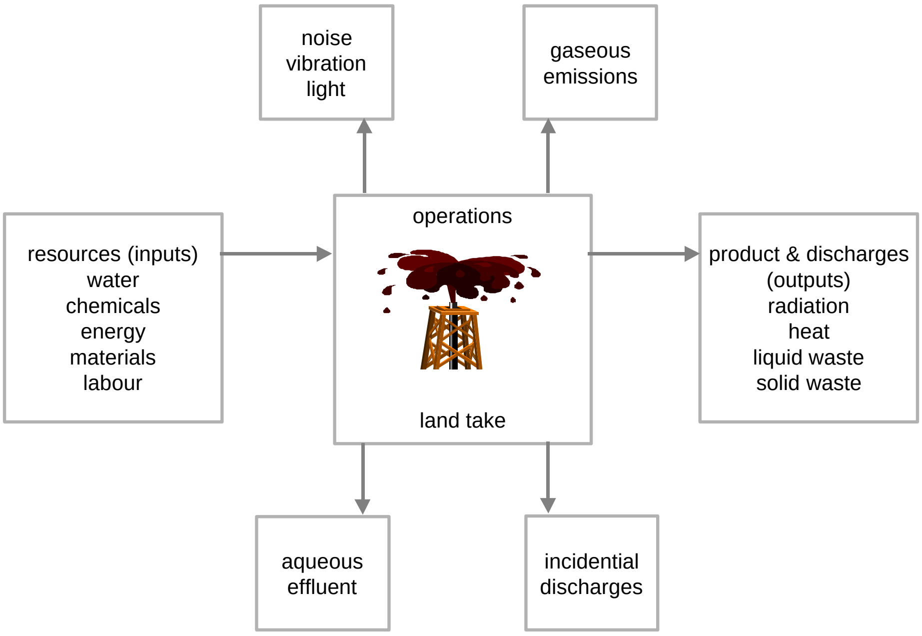
Table 5.1: Summary of exploration and production activities

Operations	**Facilities**	**Activities**
Exploration	Exploration & survey facilities	Desk geological study, aerial survey, seismic survey, Exploration surveying, seismic blasting sites, tests sites & exploratory drilling and wells, boreholes, access roads and drilling units and vehicles
	Disposal facilities	Drilling waste storage & disposal sites
Development and Production	Process facilities	Pipelines, wellheads, flowlines, separation & treatment facilities, oil storage, accommodation, infrastructure, pumps, glycol unit, drill rigs, storage pits, processing units, storage tanks,
	Disposal facilities	Flares, drainage systems, waste pits, incinerators
	Infrastructure facilities	Roads, air fields, cables, settlements & support facilities, control & booster stations, compression stations
Abandonment, Decommissioning and Reclamation		Redundant oil wells, plugged wells, demolition of installations, recultivation

5.2 Interactions between the oil industry and the environment

The oil industry information provided in Chapter 4 forms the basis for an identification of the interactions between the oil industry and the environment and the resulting hazards. These hazards have been identified and assessed based on the streams of inputs and outputs for each operation/activity as described in Table 7 above. A hazard is defined as the presence of dangerous materials and conditions at a site, where these are present above the `normal` (i.e. natural baseline environment) threshold level. Figure 3 (next page) shows the different streams, which can be distinguished for the oil industry in West Siberia.

Figure 3: Hazards from interactions between oil industry and environment



Resources are those streams that are needed to create the oil exploration and production process. Products are those streams that have a clear commercial value. Discharges are by-products (with no commercial value) which are disposed off or are seen as waste materials. The intensity of oil activities can produce a variety of effects, which vary in time and distance from the source i.e. the oil well, the drilling rig or the refinery. Effects may sometimes be far removed from the source, for example contamination of watercourses or changes in land-use caused by access roads.

Box 2: Polluting discharges

An example of a potentially polluting discharge is the disposal of drilling fluids and drilling muds. These contain toxic agents, anti-corrosion fluids and oils, and are commonly disposed of in waste pits, dumps or storage areas close to drilling rigs. Many storage places are located in water protection areas. Often storage areas are used to dispose of waste oil, waste chemicals, materials used to repair wells, etc. Many storage areas built in the past have not been hydroisolated, allowing ground and rain water to percolate through the waste. Research conducted by Tyumen State University's Ecological Faculty proved that chemical agents migrate from storage places into groundwater. Products of partial decomposition, which are present in storage places, are sometimes much more toxic and carcinogenic than the oil and waste itself.

5.3 Environmental sensitivities

The environmental and social baseline data described in Chapter 3 provides the basis for an analysis of the sensitive characteristics of the environment. Environmental and social sensitivity has been determined with reference to World Bank Guidelines on Natural Habitats (OP/BP/GP 4.04), (OP4.11) Safeguarding cultural property, Water resources management (OP 4.09) and (OD 4.20) indigenous peoples and the E&P Forum Guidelines on Environmental Protection in Arctic and Sub-arctic areas (IUCN 1993). The sensitive aspects of the West Siberian environment to oil sector activities have been summarised under the headings physical environment and socio-economic environment.

5.3.1 Physical environment

The main sensitivities in the physical environment include soil, air, water (hydrology), flora and fauna.

Impacts on air quality

Impacts on air are caused by:

- flaring, venting and purging gases, including soot;
- combustion processes (engines);
- fire protection systems;
- road traffic in summer, causing dust dispersal;
- hydrocarbon fuelled equipment;
- fugitive gas losses (from production, spills, etc.).

Gas emissions may include carbon dioxide, carbon monoxide, methane, volatile organic carbons, nitrogen oxides, sulphur dioxide, hydrogen sulphide and halons. Temperature inversion may result in high local levels of air pollution. The relatively clean air in the project area, particularly the remote, unorganised areas will be affected due to air discharges by, helicopters and machines. Emissions from flares and fugitive emissions contributes towards acid rain, greenhouse gases (and global warming) and in urban areas to local air pollution.

Impacts on soil quality

Impacts on soil in West Siberia depend largely on soil type and on the amount of ice in the soil. Permafrost soils have a low resistance to degradation and are vulnerable to changes in temperature and compression. Especially the removal of the insulation peat layer leads to negative impacts. However, permafrost does not occur in the study area except from scattered patches in the Northern part. The most significant potential effects on soil in the project area include:

- compaction;
- excavation;
- changes in drainage pattern and pooling;
- contamination from operational discharges, leakages, site drainage and spills.

The changes to soil conditions can cause impacts on the capacity of the habitat to support fauna and flora and land use by people. Disturbance of the isolated active layer (in areas with permafrost) can lead to erosion problems and flooding. Heavy machines that pass on the roads cause serious damage to these isolated active layers. In areas without permafrost compaction can lead to disturbance in drainage.

Impacts on water quality
Impacts on surface and groundwater may arise from excavation and infill, which can cause alterations to existing watercourses and drainage patterns. Wetter, pond dominated or higher, drier landscapes can be introduced, which can subsequently lead to changes is vegetation, wildlife and land use by people. Damming of watercourses can disrupt water movement and may effect spawning areas of fish. Clearing of vegetation may cause changes to drainage patterns and water supplies. Regular oil production activities can lead to the release of contamination into surface and groundwater. Typical regular waste streams are:

- production water;
- drilling and well treatment fluids;
- process, wash and drainage water;
- sewage and domestic wastes.

Ground- and surface water is also subject to contamination due to oil and chemical spills from pipelines, wells and production facilities, production discharges, waste storage depots, leakage and site drainage. The quality of water in the project area is generally high, unless already polluted by oil sector activities. The ecology and water quality of spaghnum swamps and peat bogs can be altered by disruption of their drainage, which happens due to road and pipeline constructions. Due to the low water temperatures the self-cleaning capacity of surface water is relative low. Where groundwater forms the main source of drinking water, there is a danger of contaminated drinking water.

Impacts on fauna
Habitat, food supplies, breeding areas and migration routes of animals may be affected by changes in vegetation, soil, water and noise. Major potential effects on animals include:

- Direct habitat loss or habitat modification;
- Displacement or blockage of access to habitats.

Habitat loss results from direct land take by the oil industry. Displacement of wildlife occurs when animals avoid a site because of its changed nature, for instance due to extraneous light or noise. Wildlife can also be disturbed by employees (hunting, feeding). Blockage of habitats can occur due to roads and pipelines. The impacts on animals can have subsequently influence on the livelihood of indigenous peoples. Several seabirds and waterfowl are very vulnerable to oil spills or disturbance, since it can for instance effect their build-up of fat reserves. Noise (flares, traffic) at migration routes can disturb reindeer in their breeding season which can cause increased calf mortality. Fish health and breeding can be damaged as a result of oil polluted waters. The effects on biodiversity include:

- the status, distribution and vulnerability of individual species;
- the dynamics of ecosystems that support threatened or endangered species;
- the rate of extinction occurring and likely to occur;
- regional differences in extinction rates;
- minimum sustainable gene pools and population size.

Impacts on flora
The peat layer and flora can be seriously damaged by compaction by vehicles and equipment. Damage to vegetation can take decades to recover, due to the slow rate of plant growth in these sub-arctic regions.

The different constructions for infrastructure cause damage to vegetation and soil, directly of via drainage effect. Furthermore, flora will be affected by contamination from operational discharges, leakages, site drainage and spills.

5.3.2 Socio-economic & cultural environment

The main socio-economic impacts include social, cultural, health, noise and visual impacts.

Social impacts

Impacts caused by the oil industry are especially important to indigenous people in the area since oil industry causes social, economic and cultural impacts on their traditional way of live. Social impacts may include changes in:

- economic activity and employment;
- land-use patterns such as agriculture, fishing, logging, hunting and trapping;
- population levels and the subsequent pressure on land-use;
- socio-economic systems (employment, income differentials, rent, etc.);
- socio-cultural systems (social structure, organisational, cultural practices and beliefs;
- availability of, and access to goods and services (housing, medical, educational).

Social effects may be adverse of beneficial, depending on the community in the area and the type of oil industry activities. Beneficial effects might be employment and medical services, while adverse effects often occurs in social and organisational structures.

Cultural impacts

Since the indigenous peoples strongly depend on the use of renewable resources, their traditional patterns of resources use will be affected due to land take by the oil industry and deprivation of natural resources.

Visual impacts

Visual impacts can be caused by:

- poor siting and design of facilities, encroachment of the environment;
- clearing of vegetation (direct or indirect by waterlogging);
- flaring and floodlighting.

Noise impacts

Noise impacts are caused by:

- traffic;
- drilling and production operations;
- flaring.

Noise will have direct influence on humans and wildlife. The latter can be affected for instance through disturbance of migratory bird roosting and nesting areas, which in turn affect hunting opportunities.

Health impacts

Human health can be affected by air pollution resulting from oil production and particularly refining activities, from the consumption of hydrocarbon polluted (ground and surface) drinking water and polluted food (e.g. vegetables, fish, game), by contact with hydrocarbon polluted soil and food grown in this soil.

5.3.3 Identification of key issues

The environmental and social data and the information on the oil industry were analysed concurrently to provide a preliminary assessment of the 'key issues' for both information streams. Key issues are those issues which are of priority for the research project and of interest for further study (see table 5.2). The list of preliminary key issues was discussed at meetings with Greenpeace in order to focus the project on the most relevant for the purpose of the campaign. Factors that influenced the choice of key issues included:

- extent of possible impacts on the environment. These effects may be local (e.g. solid waste), regional (e.g. discharge of effluent to rivers), continental or global (global warming);
- access to information. Due to the present situation in Russia it is difficult to acquire up-to-date and accurate information on many topics;
- available project budget and time.

Table 5.2: Summary of potential environmental & social impacts of oil industry in West Siberia

Environmental Issue	**Oil industry activity**	**Potential impact**	**Significance of Impact**
PHYSICAL			
Air	Emissions, flares and venting of CO_2, H_2S, SO_2, NOX, acid gases, associated and combustion gases etc, also fugitive leaks and evaporation of exposed oil and processing by-products	Air pollution (especially from CO_2, H_2S, SO_2, NOX, particulate) leading to global warming, acid rain and snow, health impacts to local population and fauna and flora)	Moderate, short term and transient to Significant, long term
	Oil burning (as clean-up after spills)	Air pollution and fires	As above
	Energy production combustion emissions	Air pollution, addition to greenhouse effect	As above
	Chemical discharges	Acid rain and snow, sulphur and nitrogen, benzene and metal air pollution and ground level deposition	As above
	Support facilities/equipment (e.g. transformers, pumps), transport	Atmospheric emissions from engines	Low; short term and transient
Noise	Operations	Noise disturbance to local populations and wildlife	Low?
Visual	Facilities, wells, pumps, pipelines, clearance	Visual impact to local people	Low; permanent
Soil and Groundwater	Liquid production waste (production water, drainage water, treatment plants wastewater, sanitary waters)	Soil and groundwater (including drinking water) hydrocarbon and chemical contamination	Significant, transient

Environmental Issue	**Oil industry activity**	**Potential impact**	**Significance of Impact**
	Solid waste disposal (oil settling pits {production wastes and spent drilling fluids}, waste pits, sludge, chemical wastes, landfills)	Soil and groundwater (including drinking water) hydrocarbon and chemical contamination	Significant, long term
	Well leakage	Soil and groundwater (including drinking water) hydrocarbon and cross contamination	Significant, long term
	Pipeline breaks, leaks (mechanical, ice damage, corrosion etc), spills, sabotage	Oil spills resulting in soil and groundwater (including drinking water) hydrocarbon contamination	Significant, exceptional
	Compaction, excavation	Change in drainage rate, habitat loss	Long term moderate
Surface Water (rivers and marshes)	Waste disposal (waste pits, sludge, chemical wastes, storage)	Seepage or direct flow – surface water hydrocarbon and chemical contamination	Significant, long term
	Liquid production waste (drilling muds, production water, drainage water, treatment plants wastewater, sanitary waters)	Soil and groundwater hydrocarbon, salinity and chemical contamination	Significant, transient
	Site operations	Water supply and availability issues at the production sites	Moderate
	(Raised) access roads (e.g. dams) and damming of waterways	Changes to local hydrology and surface water patterns	Significant, long term
	Storage tanks, Pipeline break, leak and oil spill	Hydrocarbon pollution	Significant, exceptional
BIOLOGICAL/ ECOLOGICAL			
Aquatic	Operations activities, tanks, valve and pipeline spills and leaks (due to human error or accidents)	Hydrocarbon effects and mortality to aquatic ecology	Significant, long term, exceptional
Terrestrial	Access roads	Barriers/dangers to wildlife (e.g. migration)	Moderate, transient
	Operations Tanks, valve and pipeline spills and leaks (due to human error or accidents)	Hydrocarbon effects and mortality to terrestrial ecology	Significant, long term, exceptional
	Removal of flora along right of way for pipeline maintenance and security	Vegetation clearance, effect on fauna	Moderate
	Pipeline break or leak and oil spill	Explosion and fire damage to surrounding vegetation, pollution of terrestrial flora (feeding grounds) and mortality of fauna	Significant, long term, exceptional
Natural resources	Landtake	Wildlife disturbance, loss of endangered species, habitat loss and modification. Displacement or blockage or access to habitats, loss of biodiversity	Long term, moderate

Environmental Issue	Oil industry activity	Potential impact	Significance of Impact
SOCIO-ECONOMIC AND CULTURAL			
Health and safety	Normal operating conditions, spills	(Occupational) health and safety, of workers and local populations	Moderate, long term
	Oil spill, fire/explosion	Loss of income from pastures contaminated by oil or damaged by fire/explosion.	Significant, exceptional
		Health hazards, public safety, social disruption Socio-economic implications for fishermen and people depending on high quality land and water for their livelihood Risk of oil seeping into groundwater supplies and causing drinking water pollution	Moderate to significant, long term Significant, long term Significant, long term
Socio-economic	Oil field and pipeline right of way, land take, and oil field access	Access/ right of way for ethnic groups and land users (depends on land rights and ownership)	Significant, long term
	Employment / economic activity/social infrastructure	Employment from operational activities and oil spill/accident prevention	Significant, positive
	Availability of goods, housing	Change of living standard	Significant, long term, positive
	Immigration of other ethnic groups	Change in cultural values	Significant, long term, negative

This identification exercise lead to a precise definition of the areas of interest for the research and particularly fieldwork and enabled IWACO to focus on information that is needed to describe the impact of oil industry on the physical and social environment in a the project area. Main fields of interest determined are:

- oil spills and their effects on the environment;
- air pollution (by flaring etc.);
- health affects of the oil industry.

As already discussed in Chapter 1.1, it was decided to concentrate particularly on the area around Nizhnevartovsk. Information on the wider Khanty-Mansiysk District or the even wider Tyumen Okrug has been used where necessary to place particular information about the project area in perspective.

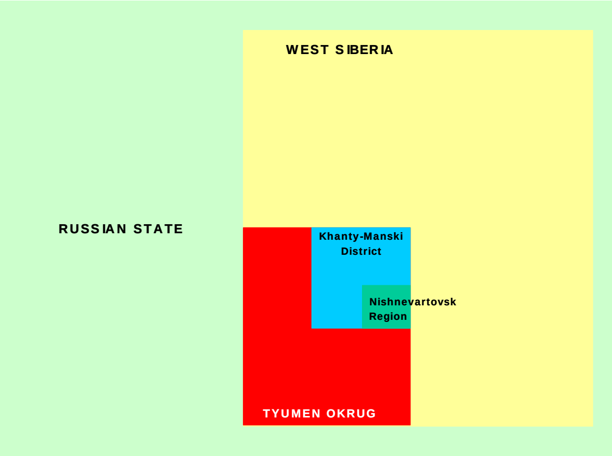
6 Physical & social environmental assessment

6.1 Introduction

It is a matter of common knowledge that the environment in West Siberia is seriously affected by the oil industry. However, accurate data on the effects on the environment is difficult to obtain. This section assess the effect initially of oil spills, which impact upon all components of the physical environment: air, water, soil, terrestrial and aquatic flora and fauna, and on the socio-economic environment. The impacts of the oil sector on the physical, biological and social environment are then considered separately.

Data on impacts, where available, have been presented according to their level of aggregation in the following format:

- Russian State
- West Siberia
- Tyumen Okrug
- Khanty-Mansiysk District
- Nizhnevartovsk Region



6.2 Physical environment impacts

6.2.1 Oil spills

Oil spills are the most obvious phenomena affecting the environment, therefore oil spills are dealt with separately in this section. Accurate data on the number and magnitude of oil spills in the region in the last decade is extremely difficult to obtain. This partly relates to the unreliability of data and a lack of monitoring and reporting. A wide range of figures can be found relating to the number of spills and quantity of oil spilled. However, to get an impression about the magnitude of the problem, several documents are quoted in the next section with respect to spills and their causes.

According Dobrinsky and Plotnikov (Ekologia), global experience with oil exploitation shows that about 2% of the total oil quantity produced is spilled into the environment. Polluting surface water, groundwater and soil and finally leads to transformation of the flora and fauna. They calculate that the average oil spill loses about 2 tonnes of oil and covers about 1000 m^2 of the surrounding environment. The amount of oil on the surface decreases with about 40 to 50% in the first few months after the spill. After two years the amount of oil is reduced with about 70% but than the degradation of oil slows down.

On a Russian Federation level, it is estimated that between 10 to 20 million tons of oil and oil products are lost per year (Rossiyskaja Gazetea, 2000). The World Bank reports that Russia's over 350,000 km pipelines are prone to leaks and other accidents due to intensive corrosion. Between 30-80% of these pipelines lie in sensitive environments (taiga, wetlands, forests, inhabited areas etc). These are often poorly constructed, of low quality and poorly maintained, with trunk pipeline systems often not corresponding to modern, international requirements. There are no Russian state regulations for safety of trunk pipeline systems. The law on trunk pipelines was supposed to be passed in 1997, but has not been completed. The decreasing financing of maintenance and construction of such pipelines has created a critical situation. Research to introduce new technologies and new equipment are not funded either. The severe weather circumstances in Western Siberia exacerbate these technical factors, resulting in pipeline breaks, leaks and accidents. The causes and impacts of the most widely publicised spill from a pipeline in Russia, the `Usink accident` in the Komi Republic in 1994 are well known worldwide and applicable to West Siberia.

In West Siberia there are about 100 thousand kilometres of pipeline in operation, of which 30% is over 30 years old. The rate of change of pipelines is less than 2% a year. As a result 35-40,000 accidents a year happen in this region with oil being discharged into the surrounding territories, including water bodies. Many accidents are not reported and therefore are not recorded. Besides pipelines, non-productive oil wells also cause spills. To day circa 3,500 oil wells wait to be sealed up, with little or no funds to carry out this work. Of all districts in the Russian Federation, oil spills, their past environmental liability and their future prevention are seen as one of the biggest environmental problems in West Siberia, particularly in the Tyumen and Khanty Mansiysk Oblasts (Interviews Ministry of Fuel and Energy, World Bank). In Western Siberia, the Regional Ecological Committee reports 1,000 spills annually (www.pacenev.org).

As a whole the number of accidents in mainline pipelines rose from 62 in 1996 to 78 in 1997. Due to linked corrosion, a reduction in the number of over hauls, the absence of diagnostics of the technical state of the pipelines, poorly planned technological for transportation routes, incorrect pipeline pressure and inadequately qualified personnel (State Committee for Environmental Protection 1998). As a result of these accidents, 2650 tons of oil and 1438 tons of petroleum products were spilled in Russia in 1997. Every year around 50 thousand accidents take place on pipelines in Russia. The main reasons for this is the progressing obsolescence of pipelines in general together with old technologies of maintenance and diagnostics of pipelines. For instance, anticorrosion monitoring is lacking. On the territory of oil fields natural landscapes underwent drastic transformation. Spills of oil and production liquids as well as migration of polluting substances into the hydrographic network are the main factors of degradation of the oil production territories. Ecological monitoring of the areas where oil is produced finds numerous violations of technology of operating the oil fields; deviations from environmentally approved projects, unsatisfactorily implemented recultivation works etc.

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in 1994 that despite the continuing decline in oil production the number of accidents occurred in 1994 increased. This is due to lesser investments, including into environmental measures, and the low quality of materials and equipment used. Tyumen Oblast maintains its premier position as the most dangerous area in Russia due to oil exploitation and transport.

In the Russian Forestry Service Report 1998 it is also stated that Tyumen Oblast is the world leader in oil associated accidents – the yearly quantity of oil spilled have reached 50-70 thousand tons and for the year of 1996 the total territory polluted with oil was estimated as 50 thousand hectares. The number of accidents increased from 150 – 250 in the 80's to 2300-3200 in the 90's yearly.

In Khanty Mansiysk District around 30% of the 64,000 km of pipeline are eroded and several million tonnes of unutilised waste have accumulated from oil companies. Oil leaks in Khanty Mansiysk are believed to amount to about 2 million tonnes per year. (Alexander’s Oil & Gas14-03000 Source Nezavisimaya Gazeta via News Base). The Regional Ecological Committee of Khanty Mansiysk reported only about 10,000 ton of spilled oil in 1998. Their report of 1998 stated that the technological aspects of the oil production today operate in such a manner that one way or the other, oil escapes into the environment in large quantities during the production process and affects the environment. The report also stated that according to some experts the yearly loss and subsequent penetration into the environment is estimated as 1.5-2 million tons.

The state policy concerning utilisation of oil in Khanty Mansiysk District in the 60’s to 80’s, was to produce as much oil as possible with least possible investments. The equipment and technologies, which were used for oil production, were not environmental friendly. Almost no financing went to technological improvement of pipelines’ corrosion resistance. No attempts were taken to remove oil spills or rehabilitate lands until the beginning of the 90s. All this lead to the current situation of environmental disaster in the region. One of the todays tasks of the Regional Ecological Committee is to identify new and old oil spills, some of which date back several years, in order to make plans about recultivation of lands. Almost all oil companies have oil spills on their territories, which they have not reported and which have yet to be assessed. At the demand of the Ecological Committee, oil companies organise departments responsible for dealing with the effects of oil spills and other environment-related accidents.

Almost all the oil produced in Khanty Mansiysk District is transported through the transportation trunk pipelines. The length of these main pipelines equals 19,000 km. The network of production pipelines exceeds 60,000 km. According to experts’ assessment 4 million tons of oil is present in the soil and water of the whole District. Equipment is getting out of order because most of it is working years past their depreciation period. Most operational equipment should immediately be replaced. Environmental disaster has also been caused by wrong technological projects of production, collection and transportation of oil, deviation from original projects when implementing them, low work discipline and in most cases use of unqualified personnel.

Table 6.1 shows the number of accidents with the recorded amount of spillages and the polluted area in the Khanty Mansiysk District (Regional Ecological Committee of Khanty Mansiysk).

Table 6.1: Spillage in Khanty Mansiysk District in 1998 (RECKM)

Company	Oil production (mln tons)	Number of Accidents	Spillages in tons of oil (rounded)	Polluted area (ha)
OAO Surgutneftegaz	35	29	37.6	35
OAO Jugansknefte gaz	26	571	661	41
ODAO Nizhnevartovsk	-	47	368	2.2
DOAO Belozerneft	-	76	564	0.5
ODAO Priobneft	-	87	68.8	1.9
ODAO Samotlorneft	-	15	2	0.23
TPP Langepasneftegaz	-	24	23.0	0.79
OAO Varieganneftegaz	2.7	12	1.7	0.19
OOO SP Belie Nochi	0.44	-	-	-
OAO Varieganneft	1.6	7	3484	2.2
Slavneft MNG	-	91	52.3	7.2
NK Jugraneft	-	1	17.6	1.3
NGDP Ermakovskoe	-	1	6.8	0.95
NGDU Strezhevoineft	-	275	68.2	1.4
SP Varieganneft	2.8	5	8.0	5.9
OAO Kondpetroleum	2.5	261	4301	56
TPP Kogalimneftegaz	-	3	0.12	0.03
TPP Uraineftegaz	-	29	114	24
UUMN	-	1	17.0	0.06
OAO Sibnefteprovod	-	1	32.0	0.48
OAO Sibtransgaz	-	1	?	?
Others	?	?	?	?
Total		1,633	9,827	181

The Regional Ecological Committee of Khanty Mansiysk reported that in the Khanty Mansiysk oilfields 1,537 accidents occurred in 1998 due to old equipment and the poor condition of technical means of production. In 1998 the total length of the pipeline in need of repair reached 1,577 kilometres. The contaminated area added up to 181 ha, which is 85 ha more than in 1997. In 1998 there were 381 less accidents than in 1997. The biggest number of accidents in the Khanti Manski District; 3137, was recorded in 1995. From that year the number of accidents started to decrease slowly. The decline in spills is partly due to the fact that oil companies have started to change the most deteriorated pipes, but in many cases it is also due to companies withholding information about new oil spills in order to avoid economic sanctions from government. In 28 cases information about the spills was withheld. 40 companies paid fines for not obeying the state regulations.

Cases of accidents with larger pipelines (with often larger spills) are however, increasing; in 1998 the Ecological Committee recorded 736 accidents.

The overall number of accidents in 1998, is broken up according to oilfields in the table 6.2 below (Source: Regional Ecological Committee of Khanty Mansiysk).

Table 6.2: Number of accidents in oilfields

Oilfield	Number of Accidents	Areas Contaminated [rounded in ha]
Beloiarski	1	-
Kogalimski	3	0.03
Kondinski	26	21
Nefteiuganski	556	13
Nizhnevartovsk	736	20
Oktiabrski	204	55
Sovetski	4	2.8
Surgutski	45	37
Khanty-Mansiysk	58	1.4
Total	1633	150 *

* The reason for the difference in the total amount of polluted area is not known.

In comparison with 1997 the number of accidents caused by corrosion increased by 4%, the causes of accidents in the pipeline system were:

Table 6.3: Causes of accidents

Cause of accident	Percentage of total
Corrosion	97.8 %
Mechanical	0.6
Bad construction	0,6
Other	1

The following table gives an overview of the accidents in the Khanty Mansiysk District in 1994:

Table 6.4: Accidents in Khanty Mansiysk District in 1994

Total accidents	2311
Accidents with oil transport	1702
Amount of polluting substances	9856 m^3
Area affected	493 ha
Percentage caused by corrosion	95

Most accidents happened in the Nizhnevartovsk Region (1210), Nefteugansk Region (528) and Okyabr Region (228).

The Ecology Committee Inspection System has investigated about 60 % of all accidents occurring in recent years, including all major accidents. 96,3 % of the accidents occurred due to corrosion of pipelines. The reason of corrosion is that designers still use materials for pipelines approved 30 years ago based on oil, groundwater and associated gas corrosion activity data of those days. The coefficient of corrosion activity of groundwater was taken as 0,3 mm/year, but in practice the pipes corrode much faster – the real corrosion coefficient being 3-4 or even 17 mm/year. This leads to accidents and practical depreciation of pipelines after only 2-3 years of exploitation. Recommended means of corrosion prevention like corrosion inhibitors proved to be of little effect.

The Nizhnevartovsk Regional Environmental Committee stated that the oil industry has an enormous impact on the environment because of the extensive way of exploiting with cheap and old technology. In 1998 the oil companies used 52,000 ha for exploitation (oilfields and other areas like facilities, pipelines, etc.). In the Nizhnevartovsk Region a total of 736 accidents with pipelines at 15 companies took place. This includes 18 accidents that were not mentioned to the Committee. As result of these accidents, 4,745 tonnes of polluting substances came into the environment and covered a surface of 20 ha. 726 of the accidents were caused by corrosion, 3 by technical faults, 3 mechanical accidents, and 4 by other causes. In 1996, 1587 accidents with negative ecological effects were recorded in the Nizhnevartovsk Region. 1543 of these accidents were caused by poor condition of production pipelines.

Box 3: Spills in the Samotlor oil field

The Samotlor oil field provides as an example of an oil field that has been developed for several decades now. On this territory only 1,1 % of lands are leased out for a long term period and 4,6 % for a short term period. Nevertheless, 22,3 % of the whole territory of Samotlor oil field is polluted today. In total 3,136 ha of land has been contaminated with oil in Nizhnevartovsk Region up to now. Of which 1,437 ha are located in Samotlor oil field. These figures are according to the Nizhnevartovsk Regional Ecological Committee far lower that in reality. Deciphering of air photos of Samotlor oil field of the years1994 and 1995 proved that as a result of migration of contamination instead of 1437 ha (as reported by oil companies), 33,300 ha of land are contaminated by 10 times more than background contamination. The real level of contamination has yet to be identified. According to NIPINEFT Oil Research Institute prognosis (Interview: NIPINEFT), if no measures are taken now to reconstruct Samotlor Oil Field pipeline system by the year of 2010, 13,000 spillage a year will take place. Often it is easier and more profitable to underreport spills and pay fines than to meet Ecological Committee standards. In Samotlor oil field for example, only 33 ha need to be recultivated (cleaned up) according official figures. However, more than 3,000 ha of land is polluted from oil spills (NREC).

On company level, the following is reported:

Chernogorneft is mentioned in the report of 1998 of NREC as one of the first companies to introduce high corrosion resistance pipelines. It will of course take many years to replace completely all pipeline system, but this process should start today. Companies have enough financial means to proceed with the project.

Slavneft and Megiongas companies have experience of using plastic pipelines, which are absolutely resistant to corrosion. This considerably decreased the number of accidents. Sobol JV (Russian –Belgian) has experience using fibreglass pipelines. They have not had any accidents since introducing such pipelines into practice.

Yugansneftegaz reported 571 accidents in 1998, 546 of which were caused by corrosion of pipelines. Out of the 660 tons of oil spilled, only 200 has been removed. A territory of 15 ha was covered with oil. The biggest accidents in 1998 were recorded in Mamontovsky and Aliokhinski oil fields as a result of which respectively 87 and 500 tons of oil were spilled. In the latter case, 17 tons of oil ended up in the river.

Different oil companies dedicated different scopes of work to the solution of problems concerning pipeline failure/accidents. Langepasneftegas for example, carries out checking of its pipeline system regularly and has an automated diagnostic system for bad/damaged areas. This company also uses pipelines that are insulated properly, this increased the durability of certain areas of the pipeline system.

Some companies have pipelines operating for more than 10-15 years without check and naturally this negligence leads to numerous accidents. Liquidation of consequences of accidents is problematic for many companies because of absence of specialised divisions/departments within the structure of such companies. The lack of relevant equipment adds to these difficulties. As a result of accidents oil companies experience economic losses and unexpected expenses. Due to direct loss of oil, expenses on liquidation of oil spills and recultivation of lands, reconstruction of pipelines etc.

The Ministry of Fuel and Energy is encouraging companies to develop their own services to prevent spills as well as emergency teams to deal with spillages. For example, Surgutneftegas has an emergency team and has recently brought Western spill remediation equipment and set up an educational centre to train staff (Interview: Ministry of Fuel and Energy).

Sometimes oil spills occur due to negligence of oil company staff. A high-pressure pipeline (820 mm) spill, occurred due to improper co-ordination between different oil companies using this pipeline (going from North Variegansky Oilfield to Samotlor LPDS). The mis-coordination lead to the situation that oil was spouting from the pipe for several weeks, resulting in the spill of 3500 tons of oil on 2,2 ha. In 1998 only 6 major accidents were recorded in the region with 1000 tons of oil spilled. The accident on a high-pressure pipeline in Agan oil field in 1995 caused release of 520 tons of oil into the Maly Egan River. Similar accident in Vatinski oil field resulted in the contamination of 27 ha of land with 1127 tons of oil.

In case of a big accident the oil company and the Ecological Committee are responsible for quick clean-up. For small accidents there are no rules. Many companies hide data on accidents, which partly explains decreases in accidents in company reports. Covering up the information about accidents and spilled oil is common and leads to a situation where the quantity and impact of oil spills on the environment can not be assessed objectively. The reasons for non disclosure are often that oil companies are unwilling to pay fines for polluted territories and try as much as possible to cover up the facts of pollution and they clean up the territories using unauthorised methods like burning the oil, burying oil under turf and soil, etc. Advanced methods (such as bioremediation) are used extremely rarely due to their expense (NREC). The NREC stated in their report that the figures quoted are in reality much higher. Quantities of spilled oil are identified by ‘expert assessment commissions’.

These commissions are formed with representatives from oil companies, which of course can influence the reporting process. The activities of most oil companies are therefore still being carried out with serious violations of environmental requirements. The current situation is dictated by the circumstance that it is easier and more profitable to pay fines than to keep up with the requirements dictated by the Ecological Committee.

6.2.2 Remote sensing

The output maps (see appendix 3) shows the areas contaminated with oil with an reliability of >98% and an accuracy of new spills with 80% and old spill with an accuracy of 40%. This means that 98% of all the areas classified as contaminated are indeed contaminated. However, especially the older oil spills might not all be recognised. This is not surprising as many of these areas show some vegetation recovery. The degree of contamination could therefor be more widespread than shown; i.e. the map shows the most optimistic scenario. The analyses is based on 33 field observations, consisting of contaminated and non-contaminated areas. The outer fringes of the contaminated areas could not be well established using an automatic classification. The outer fringes identified were further based on a visual interpretation.The total area contaminated in the area of study is 6500 ha.

The contamination is spread throughout the area and seems to be the result of many spills. This is an indication for the seriousness of the situation. Based on the extent of contamination it seems that many oil pipes could be in deplorable condition. Although a figure cannot be given it seems that many spills are recent and do not originate from the eighties as often been told by the oil companies.

Despite the large amount of spillages that already have been detected, some improvements can be made in this part of the investigation. A winter Landsat TM7 image could be used to map the pipelines. Difference in reflectance and temperature will be very significant. By doing this the possible spill sites will become clear. Furthermore , an Iconos image with a spacial resolution of 1 m in the panchromatic channel and 5 m in the multi-spectral channels could give a more detailed mapping of the spills. The total figure for the extent of spillage will probably not be different from the analyses of the Landsat images, but for specific spills the information will be more detailed. To map the age of spills, a more detailed field campaign would be desirable. To assess the damage to the ecosystem and the possibilities for rehabilitation a more ecological oriented investigation could be necessary.

Evaluation of oil spill impacts

The main sources of oil spills in West Siberia are:

- pipeline (and equipment) breaks and accidents;
- corrosiontechnical errors;
- oil company negligence (personnel);
- low company and personnel environmental management, awareness and education of environmental impacts of spills;
- lack and under investment in equipment and equipment replacement;
- inadequate emergency planning and equipment.

Oil spills are a major source of significant pollution. Data on the quantity and extent of spills is unreliable and analysis requires estimation from a variety of data.

An increasing trend in the extent and quantity of oil spills can be seen. This increase in the number of spills is exacerbated by increased production. Whichever statistics are taken, the scale of the problem is enormous and the impacts can be seen to be exacerbated by the climatic, hydrological and biological environment in the project area. Many of the impacts are both past and present and have accumulated with the increasing development of the oilfields in the project area.

Interpretation of remote sensing images result obvious in higher numbers of ha polluted than numbers reported by the oil companies.

All environmental media are impacted as a result of oil spills, with soil, groundwater and surface water throughout the entire project area being the most significantly impacted physical receptors. Social impacts include health consequences for employees involved in clean–up operations and general public health impacts resulting from polluted drinking water and air.

6.2.3 Air quality impacts

In principal gaseous emissions from oil and gas include carbon dioxide, carbon monoxide, methane, volatile organic carbons, nitrogen oxides and halons. Emissions of sulphur dioxide and hydrogen sulphide can occur and will depend on natural gas and diesel usage. In some cases, flaring and combustion can lead to odour production. According to Dobrinsky and Plotnikov (Ekologia) special attention should be paid to the polycyclic aromatic hydrocarbons (PAH) emissions as some are carcinogenic and persistent and have a long breakdown time. When spills of oil are burned, combustion products like PAH, SO_2 and soot usually are spread in a northerly direction by wind.

Air pollution in the region of West Siberia is serious; according to the State Committee for Environmental Protection, sulphur and nitrogen compounds, benzene and metal discharged into the air exceeds Russian standards. Gross emissions of `harmful substances` caused by the oil refining sector were reduced by 3.6% in 1997 across Russia. Air pollution in excess of maximal permissible concentrations of toxic substances in industrial areas, despite the `inadequate urbanisation` of West Siberia in general, has been caused in part by emissions from petrochemical enterprises (State Committee for Environmental Protection 1997).

According to the Ministry of Fuel and Energy, one of the most contaminating factors is associated gas flaring. The rate of gas utilisation varies from 52% to 95% depending on an oil field. Gas utilisation is very low in cases when population or other users are located too far from the oilfield and transportation becomes economically not effective. In other cases it is necessary to build a GUP (Gas Utilisation Plant) to safely utilise gas.

In the project area, there is currently a goal of an 80% reduction of flared gases. A current programme in the Ministry of Fuel and Energy covers all energy and oil companies, regarding energy efficiency. The Ministry currently oversees several projects in the Surgut area, which aim to decrease the burning of associated gases. Particularly for flares where the economical gas content is low, which are far from urban centres or areas to reuse the energy, there are several projects at sites to investigate gas utilisation and reinjection. In new fields in regions such as Harkaki (Tattanuw field), gas flaring is prohibited and increased utilisation is enforced. A major problem faced by the ministry and companies is financing of these projects.

Many of which seek foreign investment and technologies (e.g. Surgutneftuganskt seeks a World Bank grant, the tender of which is still open and Japanese grants connected with Kyoto protocol obligations are being sought) (Interview: Ministry of Fuel and Energy).

In the Russian Forestry Service Report on the situation in the West Siberia Forestry, 1998 it is stated that flares contaminate 3-4 times more than the territory allocated directly by the oil industry. This is due to heat radiation, pollution of the atmosphere and discharge of products of partial combustion.

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in their 1994 report that in 1993 in the Tyumen Oblast flares burned 4.6 billion m^3 production gas. This brings the total of flared gas since the beginning of the oil production on 180 billion m^3. In 1994 the oil industry discharged 951 thousand tonnes pollution into the air. In 1994 stationary sources have discharged 8.6% less into the air compared to 1993, which is mainly due to production decline (see table 6.5). Only 1.2% reduction is achieved by environmental measurements.

Table 6.5: Flared gas in Tyumen Oblast

Region	Thousand tonnes	Difference with 1993
Khanty-Mansiysk	1150.0	-200.2 (14.8%)
Yamalo-Nenets	560.4	+ 24.3 (4.5%)
Southern zone	95.5	+ 6.7 (7.5%)

(Source: Tyumen Oblast Committee for Protection of Environment and Natural Resources.)

Reduction of air pollution in the Khanty Mansiysk Region is mainly due to the decreasing oil production. The increase of air pollution in the other two regions is mainly due to the more strict control and reporting by state authorities.

Air pollution is most serious in the regions of Surgut, Nizhnevartovsk, Nefteugansk, Oktyabr, Beloyarsk, Purovsk and Nadymsk, mostly caused by oil industry. Besides regular flaring about 29.8 thousand tonnes of air pollution was caused by accidents, including 23.8 thousand tonnes by burning of spills. Companies that caused most air pollution were: Yuganskneft, Mamontovneft and Pravdinskneft.

The Regional Ecological Committee of Khanty Mansiysk has indicated in their report of 1998 the following information. 2841 enterprises – as sources of contamination- are registered in the Ecological Committee of this District. A total of 1922 thousand tons of contaminating substances were discharged into the atmosphere in the year 1998. Of which 673 tons accounts for the transport sector (37%). CO accounts for 581 thousand ton, hydrocarbonates for 50 tons, nitrogen oxides for 39 thousand tons. A complete picture could not be drawn from the available sources.

Four cases of accidental discharge of polluting substances with a total amount of 1,038 tons were registered in 1998. Of this amount CH_4 accounted for 98 % (source RECKM). The most serious accident with gas took place at the company "Sibgastrans" in the region of Belozernogo GPZ were it is connected to the pipeline GPZ-Parabel-Kuzbass; 1,300,000 m^3 (1,021 tonnes) of gas polluted the air (source NERC).

According to the Nizhnevartovsk Regional Environmental Committee the quantity of nitrogen dioxide exceeded the allowed norm 2 times while carbon monoxide exceeded the norm 1,1 times and hydrocarbonates 2,4 times the norm in 1995.

In 1996 the total amount of substances discharged causing air pollution, added up to 1,179 million tons. In fact this figure should be much higher because of the use of unsatisfactory methodology and normative documents to measure and register pollution. Moreover, in some cases it is impossible to technically measure and register output of substances caused by accidents. For example, hydrocarbons, evaporating from the oil spills and containing highly toxic and carcinogenic components (like benzeen), are not measured and recorded. Also, it is impossible to measure the unsanctioned output of gas as a result of technological misuse of Vacuum Compressor Stations. Out of 200 enterprises in the region 181 accounted for the discharge of substances into the atmosphere in 1996. In comparison to the year of 1993 the overall quantity of discharges into atmosphere has decreased which is caused by the decrease of production in the industrial sector. The 1998 Nizhnevartovsk report states that total air pollution in the Region (including transport) was 1,220 thousand tonnes (see table 6.6).

Table 6.6: Air pollution in the Nizhnevartovsk Region

	Tonnes x 1000 of air pollution		
	1996	1997	1998
Total air pollution	1,179	-	1,220
Air pollution through transport	-*	-	905
Air pollution oil companies(59,010 stationary sources)	-	-	315
Of which hard particles	-	-	10
Of which gas	-	-	304
Flares (134)	129	104	176

(source: Nizhnevartovsk Regional Environmental Committee)

*- no figures obtained

There are 134 flares in the region which burned 1,493 mln cubic meters of associated gas out of 5,253 mln cubic meters produced in 1998.

Air emissions by oil companies in Nizhnevartovsk are summarised in table 6.7.

Table 6.7: Discharge of substances by oil companies into atmosphere of Nizhnevartovsk Region

	Thousands of tonnes			
	1993	1996	1997	1998
Total	265.7	129	-	-
Solids	7.7	-*	-	43
liquid/gas	257.9	-	-	1090
sulphur dioxide	3.6	3.6	2.3	7.8
Carbohydrates	122.3	20	146	474
carbon monoxide	124.9	99	143	506
Nitrogen oxides	7.1	1.4	6.3	74
Soot	-	5.9	-	-

(source: Nizhnevartovsk Regional Environmental Committee and Khanty Mansiysk Regional Environmental Committee)
*- no figures obtained

IWACO specialists observed air pollution particularly around the several flares in the Nizhnevartovsk Region. Several flares produced black coloured smoke. Flares are not only located outside residential areas. A fieldtrip was made to a pit-flare located in the middle of an area with datsja's. Interviews made clear that in wintertime the snow near the flare is blackened with soot. The snow is not used anymore for preparing drinking water. Last year a datsja was burned down due to a shooting-flame from the flare. Other datsjas close to the flare are protected from the heat by iron plates. Visual inspection of the pit made clear that waste had been burned in the pit; cinders and burned oil drums were at the bottom. The burning of waste in the pit will cause additional emissions. Soil samples were taken from the adjacent kitchen-gardens. The soil samples are analyses for polycyclic aromatic hydrocarbons (PAH). No concentrations of PAH are detected. No air samples were taken for analysis.

Evaluation of air quality impacts

The primary sources of emissions to air from the oil sector in West Siberia are:

- flaring and venting of associated gases;
- burning of oil spills and oily waste;
- fugitive emissions from oil spills, vents, production facilities.
- combustion emissions from energy production

From the obtained information it can be concluded that a high amount of discharged contaminating substances causing air pollution were (and still are) released continuously. In 1998 more than 1200 thousands tonnes of substances were discharged to air in the Nizhnevartovsk Region. One of the most contaminating sources is the burning and flaring of associated gas. The oil industry is the second (next to transportation) most air polluting industry in the region (300 thousands tonnes), particularly emitting toxic compounds such as Polycyclic Aromatic Hydrocarbons (PAH), hydrocarbons, particulates and gases like SO2, NO, etc. Emissions like CO_2 and methane also contribute to the greenhouse effect. Air pollution/emissions is most serious in the regions of Surgut, Nizhnevartovsk, Nefteugansk, Oktyabr, Beloyarsk, Purovsk and Nadymsk..

In the last 5 years the situation has been slowly improving due to increased associated gas utilisation. However, emissions are strongly linked to production levels and can give a misleading impression of increased industry performance in decreasing emissions. Financial problems are the cause of low utilisation of new technologies and end of pipe projects to really improve the situation.

6.2.4 Soil quality impacts

Pollution of lands with oil and oil products is recognised as a major problem in West Siberia. The main causes of soil pollution are oil settling (disposal) pits and broken pipelines (State Committee for Environmental Protection 1997). This leads to a recommendation by the SCEP that federal legal acts, supported by normative and methodological documents, are required to manage the zones under impact of the oil enterprises and determine the status of lands. Present and former hydrocarbon pollution of soil and groundwater is also seen as one of the biggest environmental problems in Tyumen and Khanty Mansiysk District by the Ministry of Fuel and Energy, Environment Department (Interview: Ministry of Fuel and Energy).

Dobrinsky and Plotnikov (Ecologica) estimate that lands polluted by oil increase every year by about 10,000 hectares. The amount of oil on the soil surface decreases by about 40 to 50% in the first few months after the spill. After two years the amount of oil is reduced by about 70%, by than oil degradation slows down. When an oil spill occurs, especially marsh vegetation dies. In peat soils, oil penetrates to about 15 cm, in sandy soils, oil penetrates to about 1 meter.

In the Russian Forestry Service Report on the situation in the West Siberia Forestry, 1998 it is stated that of the 8 to 24 thousand hectares of lands allocated to oil companies annually for exploitation purposes, only 79% was given as concessions. Oil companies are granted a land concession by the State on which to operate. Officially a concession has to be returned in its original status to the State. However, returned concessions are usually heavily polluted, so when the concession period is passed, the costs for restoring land are passed to the state. As a result, oil companies usually take concessions for more years than originally agreed. There is no regulation or organisation concerning the recovery of oil polluted lands between the State and the user, the oil company. Dobrinsky and Plotnikov recommend that guidelines are needed to prevent oil spillage, to develop instructions what to do when oil is spilled, and develop juridical sanctions when instructions are not followed. Over the last 30 years, the Forestry Report estimates that 400 thousand hectares of land were allocated to the oil industry. The total land affected today by the impact of oil companies is estimated as 700 thousand hectares. The Forestry Report also recommends that recultivation should not only take place for land polluted by oil, but also when it is contaminated by chemicals and mineralised water (chloride).

The Regional Ecological Committee of Khanty Mansiysk indicated in their report of 1998 that in some cases oil companies are required to carry out «simplified» recultivation. This implies covering the polluted area with soil or sand. According to Dobrinsky and Plotnikov (Ekologia), with this type of recultivation, the biological recovery of these areas is very slow and after nine years often no more than 20% is recovered. In such areas the amount of the toxic 3,4 benzo(a)pyrene is very high and can be 500 times above the norm of 13 μg/kg. A way to speed up recovery of these sites is the use of turf. They report this has been performed once in 1985 at a site of Surgutneftegaz. Dobrinsky and Plotnikov also report that peat has a positive effect on oil spills; absorbing carcinogenic elements and fastens the biodegradation of the oil due to its rich micro-flora.

The peat in Western Siberia contains in average about 1% of bacteria that break down oil, compared to sand with only 0,1%. This means that recultivation with a sand-peat mixture is more effective than with sand alone.

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in their 1994 report that in the Khanty-Mansiysk region on the first of January 1994 more than 142 thousand hectares were given into concession to oil companies. When concession lands are returned to the state often recultivation has been done very insufficiently or not at all and usually lands are returned too late. In the period till 1994 the oil production had polluted an area of 30 thousand hectares of forest, 25 thousand hectares was flooded, about 24 thousand hectares were polluted by gas and chemicals through the air and just as much forest were covered with spills of drill chemicals and saline production water. The total area of recultivated land in the Oblast in 1994 was 9.4 thousand hectares, mostly realised by Surgutneftegaz and Gazprom.

The Regional Ecological Committee of Khanti Manski stated in their report that in the District 561 ha of land and 74 oil mud storage places were recultivated in 1998. Storage places where oil products and various chemical agents are dumped make the possible chemical composition of waste and the period of recultivation of storage place unpredictable. 30-40% of the territories around groups of wells is polluted with oil and from 3 to 10 % is flooded with water.

In the Khanty Mansiysk region the amount of drilling waste had grown to 5.8 million tonnes till 1994 (Khanty Mansiysk Ecological Committee)

According to the Nizhnevartovsk Regional Environmental Committee, oil remaining after an oil spill slowly and constantly pollutes soil and groundwater. This endangers the drinking water supply in many living areas. The area of oil pollution in soil and groundwater is sometimes much bigger than the size of the original spill. Within the first ten years of exploitation of each oil well, between 6 till 14 hectares are polluted. In the next years this amount reduces to between 2 and 3,5 hectares.

Most of the existing technologies for reducing negative effects of oil spills and preventive measures are practised on a small scale practise in the Nizhnevartovsk Region. Experience has been gained with “least cost most-effect solutions”. In 1997 about 100 hectares and 74 oil sludge storage places were recultivated. In 1998, 3100 hectares of oil spills were added to the area already covered with spills of which 560 were recultivated in the same year. In the Nizhnevartovsk Region, six companies specialise in recultivation work, with the “Green Company” executing most of the recultivations. It has developed several types of milling techniques that go as deep as 15 to 30 centimetres. A special mixture with micro bacteria obtained from local soils and different species of plants are seeded. Some oil companies have recultivated their lands themselves. For example, Chernogorneft recultivated 203 hectares of their land (Environmental Annual Report 1998, Chernogorneft).

All recultivation works are carried out under the strict monitoring of the Ecological Committee and using technologies approved by the State Environmental Expertise. The Committee monitors the process of making recultivation works more effective. Land recultivation is entrusted only to organisations or enterprises that hold relevant licenses.

Information received from the Nature Development Institute shows the following results of oil content in soils and oil spill areas in the Nizhnevartovsk Region.

The state-accredited laboratories executed chemical analyses of soils by infrared spectrometry and luminescent chromatography standard methods. These methods are adopted as the standard for Russian oil industry. The results of analyses are given in table 6.8. Calculated values include not only oil, but also a part of the natural hydrocarbons, which are usually present in soil.

Table 6.8: The average concentrations of oil in soils in Nizhnevartovsk Region

Parameters	Oilfield period of exploitation		
	>20 years	5-20 years	< 5 years*
The number of investigated oilfields	6	7	12
The total area of the investigated oilfields (km^2)	1,785	1,624	2,516
The number of samples (chemical analyses)	161	125	249
Maximum oil content (mg/kg)	19,700	9,649	5,062
Minimum oil content (mg/kg)	0.3	6	0.002
Standard deviation (σ)	1993	1340	509
Average oil content (mg/kg)	636	567	200

* Including undeveloped oilfields

Official data of enterprises were used by the Nature Development Institute to evaluate oil spill areas. Besides that, more than 800 km^2 area was investigated with aerial photography and topographic survey. A conclusion of the interpretation of aerial photos from oil fields in the south part of the Yamalo-Nenets District (part of the Tyumen Oblast) is that about 7% of the territory is polluted. Measured oil spill areas appeared substantially larger than official data given by the enterprises (see table 6.9). The quantity of spilled oil usually is in limits from 2 and 39 kg per m^2, its arithmetic mean is 15-22 kg/m^2. For example in 18 sites of Yuganskneftegas company an average of 170 ton of residual oil products were found per ha. In 11 of these sites the amount fluctuated between 103 and 409 tons of oil per ha (Dobrinsky and Plotnikov in Ekologia).

Table 6.9: Oil spill area in the Nizhnevartovsk Region

Parameters	Oilfield period of exploitation	
	>20 years	5-20 years
The number of the investigated oilfields	7	7
The total area of the investigated oilfields (km^2)	3006	2360
Oil spilled areas according to data of enterprises (km^2)	17,6	1,4
Oil spilled areas according to the NDI estimation (km^2)	56,8	2,6
Pollution density (%)	1,9	0,1

Since the beginning of oil production activities in Nizhnevartovsk Region, 7000 storage places have been built according to the Nizhnevartovsk Regional Environmental Committee. For more than 5000 of them, the only protective measure is that they are covered with sand, with no protection layer to prevent oil from flowing into the soil and groundwater or from flooding (i.e. during spring melts or if located near surface waters). Containing oil, chemicals and drilling by-products, these storage places are a permanent source of pollution. Soil tested within 10-20 meters from 10 years old storage places sometimes contains more chemical agents then the storage itself. At present 1552 storage places await recultivation. They contain 340,000 tons of drilling by-products (NERC).

During the IWACO fieldtrips spill sites with soil pollution in the Samotlor Oilfield were visited. Also flares were inspected to provide an impression of soil contamination around flares. The sites were selected on the basis of satellite images and information obtained from interviews. Most of the sites were visually inspected since it is not within the scope of this project to characterise the soil contamination in detail. The observations are predominantly used to further interpret the satellite images in order to come to an understanding of the magnitude of the environmental impact. At the flares, soil samples were taken to be analysed for oil and Polycyclic Aromatic Hydrocarbons (PAH). One area is situated in a complex of cottages near Megion (West of Nizhnevartovsk). Here the soil of a kitchen garden was sampled. The second area is situated East from Radoesjnie. The following can be concluded from the analysis results:

- in the soil sample from the kitchen garden near the flare in the Megion area, no mineral oil and almost no PAH was detected;
- In the soil sample near the flare East from Radoesjnie, no mineral oil and no PAH was detected.

Soil contamination at the recent spill sites was visibly obvious. The depth of the soil contamination could not be established. Since at most places sandy soils were observed, it is believed that the oil will easily penetrates into the soil. As groundwater is shallow in the project area, contamination of groundwater will occur easily. At places with significant and older oil spills groundwater contamination is seen as highly likely.

A summary of the analyses results of samples taken in the Nizhnevartovsk region is presented in table 6.10 (left page). In appendix 6 the certificates of the analyses results are attached. In appendix 5 a list with samples and their relating co-ordinates are presented.

Evaluation soil quality impacts

The most significant sources of impacts from the oil sector activities on soil in West Siberia are oil and chemical contamination from:

- pipeline and well spills and accidents;
- oily (muds, drilling and production waste) and chemical waste disposal and storage places;
- saline production water;
- operational discharges and leakage;
- production site drainage.

Of all environmental problems related to oil production, soil is one of the most impacted environmental media in West Siberia. It is officially estimated by the Russian Forestry Service and Nature Development Institute that at least 700,000 hectares of land in West Siberia is polluted, although the actual extent of contaminated land is probably higher by about 20%. The Nature Development Institute estimates that around 2% of land in the oil fields in the Nizhnevartovsk Region is polluted by oil spills in oil fields with more than 20 years of exploitation. Oil company data reports that only 0.6% is polluted. Oil fields exploited for between 5-20 years are estimated by the Nature Development Institute having 0.1% polluted soils; oil companies reporting figures half of this.

Data and observations indicate that oil polluted soil has a long degradation and biological recovery time in West Siberian soils and, depending on soil type, is therefore particularly prone to seeping into groundwater. In groundwater contamination can easily spread to a much larger extent than on the soil surface.

The recultivation of contaminated soil is extremely limited in comparison to the area of contaminated land, despite co-ordination and monitoring by local Ecological Committees. If recultivation figures from Tyumen are extrapolated to the rest of West Siberia, an estimated 66% of all polluted lands remains polluted and is not remediated. The term `recultivation` does not always imply remediation; oil contaminated soils may simply be covered by soil or sand (as in Khanty Mansiysk) which means that even land reported by companies as recultivated remains a significant, albeit, disguised, pollution risk and statistic. The interpretation of the remote-sensing images support the above.

6.2.5 Water quality impacts

Groundwater

The majority of the project area consists of an area of high groundwater levels (close to ground surface level). Coupled with the marshy, waterlogged soil conditions, this creates and environment where oil spills on the ground can quickly disperse. In permafrost areas, oil contamination can not permeate deeper than the permanently frozen layer. However, in non-permafrost areas, where deeper groundwater layers are in one way or the other hydraulically connected with the top groundwater layers, pollution contained in surface water and upper groundwater layers could gradually permeate into all groundwater layers. Horizontal flow is somewhat restricted by the shallow inclines towards sea level and the major rivers (Interview: Institute of Ecology).

In the State Report on Environmental situation in the Russian Federation 1998, from the Russian State Environmental Committee it is mentioned that one of the main concerns for groundwater contamination are the thousands of ‘ownerless’ oil wells. Out of 7500 such wells in Russia 3587 are located in Tyumen Oblast. Every year only 16 to 18 old wells are abandoned in an environmentally responsible manner.

Groundwater from the Mesozoicum layer is used as technical water, to keep pressure on the oil reservoir**.** There are 1207 water injection wells in the whole Khanty Mansiysk District. This figure may not be correct because of insufficient studies of technical characteristics of wells. Many of the water injection wells get damaged at the depth of 400 - 600 meters at which clay layers are softened due to the water injection. Oil companies do not want to abandon such wells because it is costly to drill new ones. Each defected well is a potential threat to the environment because of leakage of oil and other substances into the adjacent groundwaters (NREC). No known studies have been carried out to assess the condition of wells or the threat they may be carrying. In order to monitor the groundwater quality, 30 services are spread over the Tyumen Oblast, checking at least 520 wells.

In 1985, the Russian Society for Nature Protection noted that all major oil companies existing at the time allowed drilling wastes to separate in artificial bunded lakes. Although this practice has since largely been stopped, it has left residual groundwater and surface water pollution.

According to the Nizhnevartovsk Regional Environmental Committee, Nizhnevartovsk groundwater is used for household water and for drinking water. Characteristics for groundwater in the Nizhnevartovsk region include a high amount of iron and manganese (mainly derived from the marshy soils) and in some locations, a high amount of phenols and oil products. Phenols, whilst naturally occurring, are also suspected to occur in such high quantities due to the degradation of hydrocarbon products in groundwater. Practically all groundwater does not comply with Russian drinking water standards (GOST 2874-82) for visual parameters (suspended solids and colour), iron, manganese and sometimes on organic substances such as ammonia, phenol, and also regarding oil products.

In Samotlor oil field deep groundwater is already polluted; the Nature Development Institute report that oil concentrations of around 0.1 mg/l have been measured in different groundwater layers up to 200 m deep.

No field samples or analyses were made of groundwater in the project area.

Evaluation groundwater quality impact

The main sources of impacts from oil sector activities on groundwater in West Siberia are the same as for soil and surface water:

- oil spills;
- oil and chemical waste storage;
- operational discharges;
- production site discharges;
- and water re-injection and leaks from abandoned old wells.

As the majority of the project area consists of an area of high groundwater levels and marshy soil conditions, oil on the ground can easily disperse in and permeated from shallow into deeper groundwater and aquifers. Shallow and deep groundwater and aquifer pollution occurs in Nizhnevartovsk Region including the Samotlar field. Oil concentrations around 0.1 mg/l in groundwater layers up to 200 m deep are recorded. This provides reasonable grounds to extrapolate that groundwater pollution is common in other areas of West Siberia as well, particularly in areas of long-term oil sector activities (with permafrost areas being the exception). A secondary impact of this pollution is the impact on drinking water sourced from groundwater.

It is notices that groundwater is not really of an environmental concern compared to soil and surface water. For instance, oil companies have to report on surface water and soil but not on groundwater.

If spills and water (re-)injection wells are not treated correct it is inevitable that groundwater get contaminated seriously. On the long run this will create a tremendous negative environmental impact, since the spills and wells will be a continuous source of pollution.

Surface water

Surface waters from the project area drain into the Great Basin of the Ob'-Irtysh river system to the north. Whilst the Eastern Khanty occupies the Middle Ob' river basin, impacts of the oil sector on surface water therefore eventually impact this whole river basin drainage system in Northern Western Siberia.

In 1985 a conference was organised by 15 institutes and universities on environmental issues in West Siberia. The already mentioned practice of allowing drilling wastes to separate in artificial bunded lakes, which were often flooded by the spring thaw, causes significant pollution of watercourses and rivers in the area. Although this practice has since largely been stopped, it has left residual surface water pollution. Other sources of water pollution are reportedly caused by accidents during the process of oil production and transportation, waste mud and well drilling cutting storage facilities, operational discharges, leakage and site drainage. The Russian Society for Nature Protection report that “The average petroleum hydrocarbon of water in the Ob, lower Vasyugan and Tom Rivers was 0.38 mg/l in 1992, more than 7 times the maximum permissible level for the protection of fisheries. Near Nefteugansk the average concentration in 1992 was 0.72 mg/l or 16 times the permissible concentration. Much higher peak levels of hydrocarbons have been reported in the Yugan River up to 7.5 mg/l. The annual concentration of phenol in rivers in the region is 0.012 mg/l to 0.020 mg/l or 12 to 20 times the maximum permissible concentration. The maximum level of phenol near Surgut in 1992 was 0.07 mg/l or 70 times the permissible concentration”. The Russian norm (known as the PDK/MAC) for oil products in surface water intended for fishery is 0,05 mg/l, and 0,03 mg/l for surface water intended for domestic use.

The alteration of drainage patterns due to topographical changes (e.g. dikes for pipelines and road building) also appears to affect the region (the creation of a wetter pond dominated landscape). Roads to production platforms are built straight through marshes and lakes for several miles cutting through one of the largest lakes in the region. Pipes in dams prohibit water exchange between the different parts of the lakes. Because the diameter was too small the exchange of water between the different parts stopped and the result was the death of fish due to a lack of oxygen.

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in their report: “The ecological situation, the use of natural resources and nature protection of the Tyumen Oblast, 1994” that the oil industry is with 40-45% the most important water consumer of the Oblast. In the area of oil exploitation the amount of 167 wastewater purification installations are located, including 131 biological purification installations. Wastewater from 54 of these installations (less than 33%) complies with the Russian norm.

Compared to 1993 Tyumen Oblast received an increasing level of pollution by rivers from its surrounding Oblasts: Kurgan, Sverdlovsk, Chelyabin and Tomsk. Oil products are among the contaminants measured in Ob, Ishim, Tobol and Tura rivers. In a majority of the rivers in the Tyumen Oblast water pollution continues to be high with an average level of oil products of almost 50 times Russian surface water standards (PDK). For example, in 1990 the River Irtysh contained oil products between 28-35 times above PDK, although in 1994 the quality of river water improved, with the average concentration of oil products decreased between 11-12 times (PDK) compared to 1993. Recent figures could not be obtained.

The Regional Ecological Committee of Khanty Mansiysk state that in their report of 1998 that bogs, marshes, lakes and other water bodies comprise 40 to 70 % of the territory of the whole District. There are 34 hydrological monitoring points on 17 rivers of the District, 16 points responsible for chemical analysis. Whilst concentrations of iron in the waters of the District are 7 to 20 times higher than PDK, because of natural conditions, all surface waters also reported as polluted with hydrocarbons of industrial origin. Pollution with phenol (1997) in winter equals 0.5 times PDK and in summer it goes up to 7 to 19 times PDK. In some places (the city of Khanty Mansiysk) it has reached 15-23 times PDK.

According to the RECKH the content of oil products in surface water lies between 0.5 – 5 times PDK. Their regular checks indicate no tendency towards a decrease in the concentration of oil products.

Table 6.11: Oil products in rivers, 1998

River	Location	Date	Concentration mg/l	Times PDK
Irtish	Khanty Mansiysk	08.04.98	4.9	100
Ob	Neftejugansk	03.09.98	3.06	61
Vah	Vahovsk	01.11.98	8.01	160
Konda	Vikatnoe	06.05.98	3.19	64

(Source: Regional Ecological Committee of Khanty Mansiysk)

Table 6.12: Pollution Surface Water Summer 1998 (mg/l)

River	Location	Oil	Phenol	NH4
Irtish	Khanty Mansiysk	0.39	0.008	1.29
Ob	Neftejugansk	0.68	0.004	0.52
North Sosva	Sosva	4.98	0.002	0.44

(Source: Regional Ecological Committee of Khanty Mansiysk)

Table 6.13: Pollution Surface Water Winter 1998 (mg/l)

River	Location	Oil	Phenol	NH4
Irtish	Khanty-Mansiysk	0.34	0.001	0.98
Ob	Neftejugansk	1.7	0.004	0.60
Ob	Nizhnevartovsk	0.18	0.004	0.69

(Source: Regional Ecological Committee of Khanty Mansiysk)

According to expert estimations of the Nizhnevartovsk Regional Ecological Committee, 53 % of oil, contaminating the water bodies in the region, comes from the accidents in the pipeline systems, 35 % from the oil in the mud storage places, 9 % from oil in waste waters, 2.5 % from flares and 0,5 % from river fleet and transport operations at the fuel ports. This investigation was conducted without taking into consideration air transportation and wash-off from relief. Seen in the light of the above (impacts on soil), the latter will have a serious contribution. A considerable source of surface water pollution are the patches of land, sometimes several hundreds hectares, polluted with oil caused by accidents with pipelines (production or trunk) or by groups of oil production wells (bushes). Production wells are usually located in a quadrangle earth bank the size of around 1 ha. The embankment around it, which is usually 1-2 meters high, should keep the spilled oil from penetrating into the environment. Almost every embankment is damaged and during the spring floods, the river water carries the oil away. Damages of trunk pipelines cause the largest oil spills. The analysis of monitoring results show that the wash-off of oil from those patches is most intensive during the spring floods when the run-off is formed at all geomorphologic levels. Summer run-off will only occur on surfaces with high angled slopes or high groundwater levels. The highest concentration of oil in the river waters is found especially during spring and fall flooding.

According to Sibribniiproekt Fish Resources Research Institute 50 % of the rivers where fish are caught have oil products present in the sediment. The concentration of oil ranges from 25 to 60 mg per kg dry sediment for 50 % of all sediment and from 5 to 25 mg per kg dry sediment for 29-37 % of all sediment. In some parts of the Vatinsky Egan, Ust Egan and Jukh Egan rivers the concentration of oil is 89 mg per kg dry sediment. The concentration of oil in different locations along the course of the Ob varies from 2,5 to 7 mg per kg dry sediment. In the lower parts of the Ob it reaches 21 to 36 mg per kg. In the Ob Bay the concentrations reaches 23 to 54 mg per kg.

The Regional Environmental Committee of Nizhnevartovsk report that the approximately 40000 km of surface waters in the Region contains high quantity of (naturally occurring) iron, manganese and ammonium, as well as oil products. Water quality is monitored with samples from 221 points with seventeen substances are regularly measured: pH, clearness, biological oxygen demand, permanganate oxygen, suspended solids, oil products, phenols, amnionactive surfactants, chloride, nitrite, sulphate-, phosphate-, carbonate, ammonium, iron and copper. Minor rivers and springs on the territory of oilfields are reported to contain high quantity of chlorides, which come from highly mineralised production waters. As oil products in pipelines comprise 50 to 95% salt water (up to 45 g/l NACl), saline contamination of surface water also occurs due to pipeline spills, particularly during high water spring floods, when some small rivers contain saline thousand times above natural levels.

According to the State Ecological Control Office in Nizhnevartovsk, the content of oil products in waters of the Ob and the Vakh for 1996 fluctuated between 1,7 to 2,3 times the norm, ammonium between 1,7 - 2,2 times the norm and iron between 13,7 to 28,8 times the allowed norm.

The Nature Development Institute reports that in the Nizhnevartovsk district (all waters except the River Ob, with seasonal variations) the natural hydrocarbon content between 1994 and 2000 was 0,08-0,12 mg/l. They indicate that this is the product of decay of natural organic substances. The concentration of hydrocarbons in river Ob increases 1,5-2,5 times near the big cities. The analyses for the Nature Development Institute were executed by certificate laboratories by infra-red spectrometry and luminescent chromatography standard methods. A summary of surveys in different oilfields is given in Table 6.14. Calculated values include not only oil, but also a part of the natural hydrocarbons (see above).

Table 6.14: Average concentrations of oil in surface water

Parameters	Oilfield period of exploitation		
	>20 years	5 - 20 years	< 5 years*
The number of the investigated oilfields	6	13	11
The total area of investigated oilfields (km^2)	1748	1894	2387
The number of samples (chemical analyses)	157	308	140
Maximum oil content (mg/kg)	9,5	5,14	0,68
Minimum oil content (mg/kg)	0,007	0,004	0,01
Standard deviation (σ)	1,454	0,581	0,104
Arithmetic mean	0,533	0,206	0,119

* Including undeveloped oilfields

In 1998 an amount of 207 accidents took place in the Samotlor oil field. The result was an extremely high content of oil products in the surface waters; 86 times PDK. Other oilfields' average indicator for the content of oil products in surface water varies from 1 to 5.6 times PDK. One more indicator that proves the extremely poor condition of the environment is the content of chlorides in surface water. The average concentration equals 1.7 times PDK (3.3 times PDK as a maximum).

The Vatinsky River provides an example of the condition of rivers passing through oil fields. The Vatinsky River passes through Samotlor and Vatinsky oilfield. There are thousands of oil wells, oil mud storage places and oil spills located within the basin of the river. The river itself, as well as its many tributaries is criss-crossed with production pipelines. The river is constantly polluted with oil products, drilling solution and by-products. Investigation of the chemical composition of the Vatinsky River, which has been conducted during the last several years by SIBRIBPROEKT, shows the increase of contamination. The content of chloride in water is 2, 34 and 20 times PDK in respectively the upper, central and lower parts of the river. The contamination of the river with organic and biogenic substances can be assessed as 'moderate' (Source: Regional Ecological Committee of Khanty Mansiysk).

Table 6.15: Content of oil in the surface waters of other oilfields

Oil Field	Times PDK
Variegan	0.08-1.8
West Mogutlor	0.8 (average)
Severo-Orehovsky	2.8 – 4
Megion	2.6 (average)

(Source: Regional Ecological Committee of Khanty Mansiysk)

The Nizhnevartovsk Regional Environmental Committee controls the quality of water in all water bodies, including minor rivers and streams. In 1998 the average monthly concentration of oil products in the Ob and Vakh River were fluctuating within 0.55 - 1.98 times PDK. In 1997 the contamination level with oil products in the rivers fluctuated between 0,46 and 1,42 times PDK. However, recent data show that PDK for oil content in the rivers is decreasing and approaching the norm. All data on the quality of surface water is kept in an environmental database of the Ecological Committee.

The results of fieldwork and analysis performed by IWACO in the Nizhnevartovsk Region are presented in Appendix 6, with Appendix 5 listing samples and their relating co-ordinates. Table 6.16 gives a summary of the analyses results. Sampling sites were chosen based on sensitivity criteria (i.e. rivers, drinking water and surface water near villages and oil spill sites). Water samples and corresponding sediment samples were taken. From the observations and analyses, the following can be concluded:

<u>Rivers</u>
- samples of river water and sediment of the rivers Ob, Agan (near Varyegan) and Kirtipiakh (north-west from Samotlor) show analyses results for mineral oil and/or PAH below reporting limit;
- a sample from sediment of the Amputi river (near Varyegan) shows a result exceeding the Dutch target value for mineral oil (water sample is below reporting limit[1]);

[1] A reporting limit means the sum of detection limits of the components

- a sample from sediment of river Rjazanskiy, shows a result of 2500 mg/kgdm for mineral oil (exceeding Dutch intervention value[2]);
- Vatinsicy River is visited north of Megion. Along the river, heavy oil and tar was observed on high levels along this river (high water line in spring). Samples of sediment of River Vatinsicy show results of sediments of 1,300 and 17,000 mg/kgdm for mineral oil (exceeding Dutch intervention value). A water sample shows a result for PAH of 6.8 ug/l;
- near a branch from river Vakh (west from Nizhnevartovsk) an oil pumping station is situated. Nearby this pumping station contaminations around a small lake, a dry lake and a small pool were seen, all were sampled. Sediment of the small- and dry lake shows respectively 53,000 and 47,000 mg/kgdm for mineral oil (exceeding Dutch intervention value). A sediment sample of the small pool shows 120 mg/kgdm for mineral oil (exceeding the Dutch target value). The sediment of the river branch itself shows 75 mg/kgdm for mineral oil (exceeding the Dutch target value), water of River Vakh shows a result below reporting limit;
- near lake Symtoetor east from Radoesjnie, a small river was sampled. Results show here for mineral oil an concentration of 890 mg/kgdm (exceeding Dutch halfway value);
- analyses of metals only show high concentration for Iron and Manganese in water and sediment.

<u>Samotlor oil field</u>
- High concentrations for mineral oil were found in sediment samples of spill site '93 (16,000 and 29,000 mg/kgdm, exceeding Dutch intervention value), sediment from north Samotlor (180 mg/kgdm, exceeding Dutch target value[3]) and sediment from small lake (600 mg/kgdm, exceeding Dutch halfway value);
- sediment samples near a flare show analyses results for mineral oil of 14,000 mg/kgdm at 30 meters and 22,000 mg/kgdm at 100 meters. Results of PAH are not exceeding the target values.

<u>Radoesjnie oil field</u>
- High concentrations were found in sediment samples of a spill site near lake Symtoetor near Radoesjnie for mineral oil (58,000 mg/kgdm, exceeding Dutch intervention value)and PAH (33 mg/kgdm, exceeding Dutch halfway value).

Evaluation of surface water quality impacts

The main sources of surface water quality impacts from the oil sector in West Siberia are:

- spills and accidents;
- run-off from spill sites, particularly during spring thaws and floods;
- drilling wastes and mud storage (particularly unbunded and damaged stores);
- dams, dikes and roads related to oil facilities;
- untreated waste water emissions to surface waters;
- flares and transport emissions.

The quality of surface is particularly contaminated by hydrocarbon products, saline and chlorides (contained in production waters and pipelines) and chemicals used in production.

[2] Intervention value is explained in Appendix 11

[3] Target value is explained in Appendix 11

Given the highly dispersible nature of hydrocarbon and chemical pollution in all types of surface water (both in water and in sediments), the impacts of oil sector on water in West Siberia are estimated to be extremely significant and extensive, more so than the impact of the oil sector on any other environmental media. For example in Tyumen Okrug, surface water bodies are estimated to comprise 40 to 70% of the landcover, this level of cover is estimated to be relevant similar for Western Siberia in general.

Various reports indicate that surface waters in West Siberia, particularly located close to the main centres of activity, such as Nizhnevartovsk, and older oilfields such as Samotlar, are polluted with oil products from between 5 to 50 times the Russian PDK norm. A clear correlation can be seen between the length of exploitation of oilfields and the average concentration of oil products in surface water. It is debatable if surface water pollution is decreasing, as appears to be the case in some areas, such as the river Ob and Vakh near Nizhnevartovsk and as supported by sampling. Other continuous monitoring data (providing a fuller overview of water quality, including seasonal variations) indicate continuing high pollution levels, such as in Samotlar and the Vatinsky River. Since a full set of primary data on surface water monitoring during recent years was not available, no clear picture could be obtained. However, the presence of sediments in which Dutch and Russian oil content norms are exceeded indicate that these surface waters have been and are being polluted in the long term with at least hydrocarbon products. The seasonal variations, due to run-off differences in surface water quality in West Siberia also affect the measurement of concentrations of oil products.

The oil sector is also one of the most important users of surface water, in Tyumen they are the main consumer. This has significant impacts for the reuse of polluted water and continuing pollution.

A particularly significant secondary impact is where oil polluted surface water is the source of drinking water (such as in Nizhnevartovsk City).

Drinking water

Groundwater is the main source of drinking water in the Nizhnevartovsk Region (apart from Nizhnevartovsk City, which utilises surface water). Most water is abstracted from the 658 artesian and 92 senomanic wells in the area. 10 % are reserve wells, about the same percentage are not currently operating. The Regional Ecology Committee gave out 48 licences in accordance with Water Codex. As a result only 310 artesian and 77 senomanic wells got official registration. Water for drinking water requires treatment before being used. Many companies have their own facilities to clean the water for drinking, mainly of iron. Small settlements do not have water-treatment stations and water is not treated at all. Almost all wells use water abstracted from the alluvial and lake-alluvial Paleogen fourth-layer. Many private, individuals wells do not comply with sanitary safety zones. From an inspected group of 2354 wells, 54% had no sanitary safety zone, 6% needed renovation and 25% had to be abandoned. The uncontrolled drilling of new private, groundwater wells is commonplace and continuing.

The Drinking Water Company of Nizhnevartovsk City uses surface water from the Vakh River as a source for drinking water. The water intake from the Water Company is situated 25 kilometres North-East of the city. The water is used for industrial purposes and for consumption. 90 % of Nizhnevartovsk population has access to the centralised water distribution system, using 280 litres of water per person (the norm is 400 litres pp). Two water treatment stations clean the water (chlorinisation, coagulation and filtering). Groundwater is not used for Nizhnevartovsk because of high amounts of iron and manganese. The drinking water company analyses intake water and treated water once a month. Results for oil products of the intake water as analysed by the drinking water company are presented in the following table. (PDK= 0.03 mg/l).

Table 6.16: Oil products (mg/l) in intake water from river Vakh from 1995-2000

year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1995	0.13	0.11	0.21	0.04	0.02	0.02	0.05	<	0.3	0.15	0.13	0.56
1996	0.16	0.19	0.12	0.14	0.12	0.07	0.11	0.24	0.05	0.06	0.11	<
1997	0.05	<	<	0.12	0.21	0.09	0.13	0.16	0.14	0.06	0.17	0.11
1998	0.15	0.4	0.14	0.1	0.07	<	0.05	0.05	0.13	0.23	0.07	0.04
1999	<	0.06	<	0.1	0.19	0.11	0.07	0.06	0.08	0.05	0.12	<
2000	0.07	<	0.05	0.06	0.08	0.06	0.07					

Source: Drinking Water Company of Nizhnevartovsk

Analysis of this table indicates that only for 2 months in 5 years the oil product content of river water in the Vakh was under the PDK norm. The Nizhnevartovsk Centre for Sanitary and Epidemiological Monitoring included information about drinking water in their State report on Sanitary and Epidemiological Situation in the City and the Region of Nizhnevartovsk for the year of 1996. Table 6.17 gives an overview.

Table 6.17: Oil products (mg/l) in drinking water in Nizhnevartovsk

year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1996	0.0 6	0.0 9	0.04	0.04	0.02	0.02	0.05	0.03	0.02	0.04	0.03	0.03

Source: Drinking Water Company of Nizhnevartovsk

The results of fieldwork and analysis performed by IWACO in the Nizhnevartovsk Region are presented in Appendix6, with Appendix 5 listing samples and their relating co-ordinates. Sampling sites were chosen based on sensitivity criteria (i.e. rivers, drinking water and surface water near villages and oil spill sites). Water samples and corresponding sediment samples were taken. From the observations and analyses, the following can be concluded (see also table 6.16A and 6.16B):

- drinking water from Radoesjnie (from groundwater) shows results for mineral oil and PAH below reporting limit;
- drinking water from a well at Protoka Mega shows results for mineral oil and PAH below reporting limit;
- rainwater used for drinking water Mega shows results for mineral oil and PAH below reporting limit;
- water at intake water company Nizhnevartovsk and water after treatment (drinking water) show results for mineral oil and PAH below reporting limit;
- analyses of metals only show high concentrations for Iron and Manganese in water and sediment.

An evaluation of the sampling indicates that after treatment, river water conforms to the Russian norms.

It must be stated that this limited sampling does not give a thorough insight in the quality of drinking water resources. For instance, as mentioned in the former section, contamination of surface water can differ strongly throughout the year(s).

Evaluation drinking water quality impacts
The main sources of drinking water quality impacts form the oil sector in West Siberia are pollution of drinking water sources. As both groundwater and surface water are used as sources of drinking water, any negative impact upon the quality of these waters has a direct impact upon the quality of drinking water. Whilst water quality tends to be low in the region due to naturally occurring iron, manganese and organic substances, oil pollution is a serious problem in West Siberia, particularly for urban and industrial centres, as demonstrated by the situation in Nizhnevartovsk.

In Nizhnevartovsk City 97% of drinking water intakes from the River Vakh over a five year period were polluted with oil (over the PDK norm). This water is however treated, and providing it is treated to standards, presents a low risk to human health. This is equally relevant for drinking water obtained from groundwater, as long as it is treated. However, many water supply stations do not have the capacity or facilities to treat all groundwater; this presents a considerable, but un-quantified impact on human health. Significant hazards exists concerning the numerous reported unofficial, private wells, where over 85% do not conform to standards, and oil content is expected to exceed the Russian norm for drinking water.

A serious threat for the quality of drinking water in future will be the numerous untreated oilspills and storages.

6.2.6 Impacts of radioactivity

The Regional Ecological Committee of Khanty Mansiysk has indicated in their report of 1998 that the main source of the radioactive contamination of the Khanty Mansiysk District is the transboundary carriage of radionuclids, the main sources being:

- effects of 132 air, water, underwater and underground A-bomb tests in the Semipalatinsk and Novaya Zemlia Regions (since 1957). Particularly during the atmospheric tests, radionuclids, especially Cs_{137}, C_{14} and St_{90} either fell out in Northern Russia or dispersed into the District (RECKM);
- Beloiarskaya Nuclear Power Plant on the Pishma River in the Irtish River Basin;
- 5 underground A-bomb testing from 1975-1985; 3 were intended for seismic probing and 2 for intensification of oil recovery.

The Nizhnevartovsk Regional Environmental Committee reports that the Nizhnevartovsk region complies in general with the Russian standards; exploited oil has a level in between 4 and 30 μR/hour (0.4 and 2.6 mSv/y). Some exceptions can however reach up to 100 μR/hour (8.7 mSv/y). The Ministry of Fuel and Energy confirms that in some traded oil and water nearby oil industry a far too high level of “toria-232” and “radium-226”can be found. The level of alfa and beta radioactivity is besides a few exceptions within norms.

In 1996 the Institute of Geophysics of Russian Engineering Academy discovered a series of gamma - anomalies directly related to oil industry: in several oilfields there are natural radioactive salt residues and drilled rock containing Ra_{226}, Th_{232} and K_{40} with gamma radiation from 60 to 5600 μR/h (5.3 to 490 mSv/y) in the well pumps and compressors.

These anomalies required further research and tight radioactivity control in the oil industry in order to objectively assess the level of pollution of oil products and by-products and introduce methods of radioactive safety.

Evaluation of impacts of radioactivity
The general radioactivity in the Khanty Mansiysk and Nizhnevartovsk Region complies with Russian standards. However, in some areas oil is radioactivity contaminated, the sources being either naturally high radioactive levels, and/or fall out from A-bomb tests, performed as part of oil exploration and intensification activities. The exploited oil in these areas is generally below Russian standards, although some exceptions have reached to significant high levels of up to 100 µR/hour (8.7 mSv/y). Internationally used dose limits are those of the International Commission on Radiological protection (ICRP). The occupational effective dose should not exceed 20 mSv/y. It is not known how this oil has been treated or handled. There is a significant risk therefore, that releases of radioactive oil into the environment (i.e. a spill or leak) could contaminate wider areas with radioactivity, possibly affecting the environmental and human health. The doses received by members of the public should not exceed 1 mSv/y (ICRP).

6.3 Assessment of biological environment

Twenty five years of intensive energy resource exploitation has caused great damage to the biological environment in Russia, particularly in West Siberia, contaminating vast areas of soils, water basins, and negatively impacting the quality of flora and fauna at production sites. The Samotlar field is now classified an `ecological disaster zone` (World Bank 2000).

According to Dobsinsky and Plotnikov, the ecosystem along the river Ob is at the limits of its capacity for self recovery. They report that the oil industry has significantly impacted the biological environment. Among others through pollution, tree felling, road building (changed surface water flows created water logging and impacted animal and fish migration routes) and disturbance of natural animal habitats. The reproduction of animals such as waterfowl and fish is reported to have decreased. In general from the early 1980s animal reproduction decreased by 20% compared to the late 1950s. In the Nizhnevartovsk Region the decrease was 35%, in Kondinsk 22% and in Berezovsk 18%., despite large areas of the Ob River basin being covered by nature reservation status, with corresponding levels of prohibitions of activities (Interview: Ekologia).

6.3.1 Impacts on aquatic environment

The Tyumen Oblast accounts for 65-70 % of Siga fish catches in Russia. During the last decade the quantity of fish legally caught in rivers took a downward trend; in 1994 14 thousand tons was caught, in 1998 the catch was 12 thousand tons. This is attributed to a decrease in economic activities, negative environmental impacts and illegal fishing.

The Regional Ecological Committee of Khanty Mansiysk reported in 1998 that 33% of fish caught in internal water bodies of the Russian Federation were caught in the Ob-Irtish basin. This statistic reinforces the ecological and commercial importance of the region for aquatic fauna. Fish catches have declined by 6 times compared to the pre oil and gas development period (1951-1960) (see Tables 6.18 and 6.19).

Declining fish catches, particularly of sturgeon have been linked to both over-exploitation, the impacts of water pollution and changes to aquatic ecosystems, resulting from urbanisation and industrial emissions in the District, particularly the oil sector. The main concern is the area of Middle Ob where there is the most intense production of oil and gas, and therefore aquatic pollution. It is reported that 40 % of the natural fish breeding grounds and 90% of wintering pits have been reduced, also that fish spawning grounds have changed. The commercially valuable Muksun changed its spawning grounds from the tributaries of the Ob in Tomsk region to the Irtish River between 1992 and 1998, resulting according to the Sibribniiproekt Fish Resources Research Institute in a decreased catch of 30 tons per year.

The Regional Environmental Committee of Nizhnevartovsk also reports a decrease in fish catches. The lower catches are due partly to higher costs of selling and transporting fresh fish. The Fish Inspection Department of Nizhnevartovsk stated that due to economic reasons fish catches have decreased over the last 10 years by a factor of 10. The Regional Ecological Committee of Khanty Mansiysk stated that declining catches are also due to pollution, as fishing is concentrated in the more urban areas affected by industrial activities, particularly oil production and spills. In 1997 an amount of 9,812 cases of intensive oil spills were recorded in fish protection zones.

Table 6.18: Catch of Sturgeon, Pike and Muksum in 1998

Fish	Catch ‘98 in tons	Allowed catch in tons
Sturgeon	0.6	2
Pike	343.4	1300
Muksun	204.0	280

(Source: Regional Environmental Committee of Nizhnevartovsk)

Table 6.19: Maximal Catch of Fish

Fish	Year	Catch in tons
Pike	1960	7,110
Muksun	Beginning of seventies	303-506
Nelma	1936	610

(Source: Regional Environmental Committee of Nizhnevartovsk)

Declining fish catches are a strong indicator of declining fish populations and an indicator of the overall health of aquatic ecosystems. Oil pollution of surface waters and sediments over the PDK norms (as described in previous section 6.2.3) changes aquatic habitats and worsens conditions for reproduction. According to Sibribniiproekt Fish Resources Research Institute the impact on both fish inhabiting polluted waters and migrating fish passing through to their spawning places, is that oil product accumulate in fish tissues, including reproductive organs and eggs. This affects the embryo and results in the mutation of fish. Oil pollution also affects the ability of fish to migrate.

The Regional Environmental Committee of Khanty Mansiysk investigated the content of mineral oil in 16 commercially exploited fish species. The content of mineral oil was checked in muscles, livers and eggs of fish. The result of the tests shows figures with a high variance. For example the content of mineral oil in Siga muscles ranges from 0.1 to 29.9 mg/kg, in liver from 1.9 to 61.7 .

The reason why these variances in the content of oil products occur is the different level of contamination in different parts of the rivers, different composition of oil products and also particularities of accumulation and assimilation processes of oil products in different types of biomass. Table 6.20 shows the figures as reported.

Table 6.20: Mineral oil in fish organs

Fish Groups	Year Range	Muscle (mg/kg)	liver (mg/kg)
Pikes	1993/98	5.46 $\pm$ 2.304	12.57 $\pm$ 1.92
Carps	1989-93	8.69 $\pm$ 1.390	24.84 $\pm$ 4.460
Nalim	1993-98	3.16 $\pm$ 1.000	3.28 $\pm$1.338

(Source: Regional Environmental Committee of Khanty Mansiysk)

The most informative indicator, which identifies oil pollution, is the content of mineral oil in fish liver. As mineral oils accumulate in lipids, the highest quantity is found in organs with a high lipid content (liver, fat tissues). For example the Elets, contains 17 to 45 mg/kg of oil products in muscles, 60 to 212 in internal organs and 207 to 259 in eggs/caviar.

Table 6.21 shows that average content of mineral oil in fish of the Central Ob basin is higher than for fish in the lower Ob Basin. The main reason given is the increased contamination of this part of the river due to its location near the main oil fields.

Table 6.21: Average content of mineral oil in fish of the Ob basin

Central Ob		Downstream Ob	
Muscles	8.0 mg/kg	Muscles	7.6 mg/kg
Liver	22.6 mg/kg	Liver	15.1 mg/kg

(Source: Regional Environmental Committee of Khanty Mansiysk)

Table 6.22 shows an increase in fish catches in Khanty Mansiysk , in contrast with other data obtained.

Table 6.22: Fish catches in Khanty Mansiysk

Year	1995	1996	1997	1998
Amount (tons)	97	113.6	150.0	163.3

(Source: Regional Environmental Committee of Khanty Mansiysk)

For this study two fish samples are analysed for poly-aromatic hydrocarbons (16 EPA), mineral oil (C_{10}-C_{40}) and metals, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, Fe and Mn. The results for the determination of PAH (expressed in µg/kg ww) in the fish samples are given in Appendix 9, table 1. The results are already corrected for the recovery of the internal standards. The PAH content ranges from less than 0.1 µg/kg up to 21 µg/kg (naphthalene in sample 362-02). The most abundant PAH found in the samples are naphthalene, phenanthrene, fluoranthene and chrysene. Benzo(a)pyrene, the PAH often found in regulations, was not detected. There is only a limited amount of information about background levels of PAH in fish. The Dutch Governmental Institute for Environmental Hygiene (RIVM) gives a range of 0.09 µg/kg for anthracene up to 0.91 µg/kg for phenanthrene (Basisdocument PAK, RIVM, 1989).

Another report by Netherlands Organisation for Applied Scientific Research (TNO) gives values of 45, 50 and 60 µg/kg ww. for respectively fluoranthene, phenanthrene/anthracene and naphthalene in fish livers of herring and other fish species from the North Sea (PAH in the North Sea. An inventory, TNO, 1992). The PAH content found in this study is in the range of these background levels.

The results of the determination of mineral oil are given in table 2 (Appendix 9), expressed in mg/kg ww. In both samples individual alkanes as well as an unresolved hump in the baseline in the range of C_{10}-C_{40} were detected. Data on background levels of mineral oil in fish and standards are not available since mineral oil consists of different components. A very rough figure (rule of thumb) is the limit of 40 to 160 mg/kg ww at which fish could show effects of the pollution. Finally, the results of the metals are given in table 3 of Appendix 9, expressed in mg/kg ww. Iron and zinc seem to be the most prominent of the metals determined in the fish samples. In Dutch law (Warenwet) only standards are available for Cadmium, Lead and Mercury. Those standards are not exceeded. Iron and Zinc are non toxic substances and therefore, in general terms, they will not cause health problems.

Evaluation of aquatic environment impacts

The main sources of impacts on the aquatic environment from the oil sector in West Siberia are those activities, which affect surface water:

- pipeline and product spills and accidents (particularly during spring thaws and floods);
- drilling wastes and mud storage (particularly unbunded and damaged stores);
- dams, dikes and roads related to oil facilities;
- untreated waste water emissions to surface waters;
- flares emissions to aquatic receptors;
- transport emissions to aquatic receptors.

Literature shows that the quality of surface water is particularly affected by hydrocarbon products and chlorides (contained in production waters and pipelines). Data relating to polluted surface waters has particularly focussed upon the impacts on fish. Over 50% of rivers where fish are caught appear to be contaminated with oil products according to the Sibtibniiproekt fish Resources Research Institute. Besides fish, also benthos fauna is negatively affected by the oil. This affects the health, breeding ability and spawning behaviour of fish. There appears to be a positive correlation between fish contamination with oil products and declining fish catches, and pollution caused in the main oil production and exploitation areas in the Tyumen Oblast, Khanty Mansiysk district and Nizhnevartovsk. It can therefore be expected that fish in other oil production and exploitation areas in West Siberia are similarly impacted.

6.3.2 Impacts on terrestrial environment

According to the Regional Environmental Committee of Nizhnevartovsk the construction of roads and facilities for oil production (pipelines, well-drillings etc.) result in an changes in the terrestrial habitat, resulting in both marshland creation and marshland drying, as well as erosion and deflation or mechanical damage of lands. This in turn results in the degradation of vegetation or changes in structural populations of plants. This reduces the productivity of the territories natural feeding values for animals.

With that, it causes population changes in fauna, not only on the territory of oilfields, but also on adjacent territories. Noise also affects animals. Presence of man in remote areas results in illegal hunting and fires, which have negative effects on populations of animals and their quantity. Oil specifically pollutes soil, which results in contamination of groundwater, vegetation and animals. An important factor in all this is the temperature regime. Among others this causes slow growth rates of vegetation and limited biological activity. This makes the habitat particular slow to recover from damage. Extracting large quantities of oil, gas and water under certain conditions can result in settling of the surface.

Fauna

Changes in vegetation, soil, water and noise can effect the animal population. These changes can cause direct habitat loss and modification, shifting in migration routes, loss of breeding areas and even loss of populations, etc.

Direct habitat loss and disturbance and modification occur in site-specific areas for example oil spill sites, road and drilling well platform construction. The roads are often constructed on dikes, causing artificial slopes in the area, which change fauna habitats. This can also increase flooding and changes the natural drainage patterns and wild life migratory routes and tracks, such as migrating birds. Access to habitats is blocked due to road construction and pipelines. The noise at the construction areas and close to the platforms has an impact on animal tracks and leads to depopulation of these areas, more over in combination with increased human populations and hunting, particularly of fur-bearing animals such as the fox and the wolverine. Oil contaminated fish affects terrestrial fish eating predators (such as bears and foxes). Vegetation is degraded and contaminated by soot and oil from flares and spillages, which will impacts the health of herbivores.

Flora

Any destruction of vegetation caused by oil activities in the taiga has a big impact on it. In general the footprint or track of a vehicle in the flora in this region takes 10-15 years to recover (Interview: Institute of Ecology). The effect of construction works, vehicles, roads etc. obviously has an even heavier impact on the vegetation. Loss of vegetation effects the nutrient cycle due to a decrease of the organic litter layer and it accelerates the rate of soil loss through erosion. The short growing season and a low annual production of nutrients are due to a slow recovery. (Un)controlled fires cause important damage to the flora.

Evaluation of terrestrial environment impacts

The main sources of impacts on the terrestrial environment from the oil sector in West Siberia are:

- spills;
- noise from oil production facilities, vehicles and construction works;
- vehicle impacts of oil facilities construction and maintenance works;
- flares;
- fires;
- roads, pipelines, well platforms, dams and dikes related to oil facilities.

The impacts on terrestrial flora and fauna are un-quantified and limited to observations and informal reports. The sources listed above result in changing in terrestrial habitats such as decreased or increased water levels, limitations of access, flora damage and loss, and disturbance of fauna. Flares and fires will cause pollution by particles (soot) and chemicals (SO_2, etc.). Fires also influence the vegetation directly by burning.

6.4 Socio-economic and cultural impacts

6.4.1 Demographic impacts

Large increases in population in Khanty Mansiysk and Nizhnevartovsk have occurred since the 1960s. Population increases can be largely attributed to the employment opportunities and indirect economic activities of the oil sector.

Demographic changes have resulted from migration into the area, in turn resulting in the traditional natives of the area becoming even smaller ethnic minority groups than in the 1950s.

Traditional, dispersed settlements and small urban centres have also changed, with an increased percentage of the population, particularly of indigenous peoples, living in cities.

6.4.2 Health impacts

Health impacts are seen as one of the main impacts of the Russian energy sector by the World Bank. The most significant aspect being urban air pollution and its negative impact on health. The impact of the energy sector waste waters on the general quality of Russian drinking water can not be assessed because of a lack of relevant epidemiological data (World Bank 2000).

The Tyumen Regional Oncological Centre reports that it has been conducting research on environmental effects of oil pollution and relation with diseases. The Centre receives statistical information from other hospitals within the Tyumen Region for about 20 years, when health effects thought to be related to the oil industry were first noticed. There is no real budget for research on diseases available, particularly not in the last 10 years. According to Doctor Nicolai Raycov the radioactivity of oil (Radon) has increased because of several nuclear activities within the region during Soviet times. Doctor Raycov draws the following conclusions:

- in general oncological diseases have increased in the Tyumen Oblast over the last 20 years by 150%;
- cancer in testicles has increased by 300% in the last 20 years;
- the number of oncological diseases of people in the age of 25-69 years has increased from 30 to 60% of the total in the last 20 years;
- oncological diseases in children up to 25 years have increased by 100% in the last 20 years;
- rectum cancer has increased by 80 % in the last 5 years;
- in Nizhnevartovsk, Surgut, Nishnirovgorod and Langepas Regions, oncological diseases are 30-40% higher than in surrounding regions;
- in the towns of Nizhnevartovsk, Radoesjnie, Megion, Langepas and Gagalin, oncological diseases have increased in the last 5 years by almost 100%.
- the higher incidence of testicle and rectal cancer in Russia, compared to lung cancer being the most common cancer worldwide, was reportedly due to the radioactive contamination of food and drinking water.

The Tyumen Oblast Committee for Protection of Environment and Natural Resources stated in their report: “The ecological situation, the use of natural resources and nature protection of the Tyumen Oblast, 1994” that the sanitary-epidemiological situation in the Tyumen Oblast is far from desirable, with about two hundred thousand people work under conditions that are destructive or dangerous to their health.

The general health of the population in the Nizhnevartovsk Region worsened in 1994. This is due to a number of reasons including decreasing environmental quality; particular water and air, and radioactivity. According to the State Service Sreda-Zdorovie (Environment-Health) the situation is seen as critical. The diseases experienced by the inhabitants of Nizhnevartovsk are indicators for poor environmental standards. Data from “AGIS – Environment and Health” also show that illnesses related to ecological problems in the city of Nizhnevartovsk in the period 1991-1996 are between 1.3 and 3.6 times higher than average for Russia. Although in recent years the absolute figures for pollution decreased, the cases of environment related diseases have increased. For example, the NERC reports that insufficient canalisation and purification of the city waste water and non-compliance of drinking water with Russian drinking water standards (GOST 2874-82), particularly for iron, manganese and ammonia and bacterial quality.

Evaluation of health impacts

Data obtained on health are very incoherent and amalgamated. Therefore, a true evaluation could not take place. Nevertheless, it is obvious that significant oil contamination could lead to health impacts, for instance through contaminated drinking water.

6.4.3 Socio-economic impacts

With the introduction of the oil industry in the 50s and 60s the traditional economy of the indigenous peoples in Western Siberia changed considerably. Changes include a decrease in traditional subsistence activities such as fishing, hunting, trapping, etc. Due to the increased population levels the pressure on the natural resources increased. Migrants have been attracted to the area, based largely on new industrial activities (particularly the oil sector) since the 1960s. This has resulted in socio-economic systems and services built up to service the industrial and oil sector activities. Differences between the `traditional` socio-economic systems and the new are based on income differentials, inflation, taxation, rent, etc. The availability of, and access to, goods and services improved, although this is largely based on financial capacity. The break-up of the Soviet Union in the early 90s had a severe socio-economic impact on the oil based economy of Western Siberia, with much of the local economy collapsing. The transition to a market orientated economy started slowly and has caused a decline in living standards, employment and social values. This has only recently started to change with increased oil revenues.

Evaluation of socio-economic impacts

The socio-economic impact of the oil sector on West Siberia has been significant. Since the oil boom in the 1960s, the economic base of the area, and associated social and economic services, have developed enormously and are the economic base for a number of urban centres in West Siberia, Nizhnevartovsk being an example. This has lead to the increased availability of, and access to, goods and services compared to the situation prior to oil sector activities in the area. In particular, the oil sector has contributed towards a change in the traditional subsistence economy of the native Khanty, Mansis and Nenets peoples. There is very little data that directly links the impacts of the oil industry in West Siberia to the poor health of local inhabitants.

However, reports from Tyumen, Khanty Mansiysk and particularly Nizhnevartovsk indicate links between poor environmental quality - particularly air and water quality, radioactivity and industrial pollution. These indicate that there may be a correlation between impact of industrial activities in the area (the oil sector being the most prominent) and a higher than Russian average incidence of cancers, cardiological diseases and endocrinological diseases.

6.4.4 Socio-cultural impacts

Oil and gas exploration and production since the 1950s have appeared to have had considerable social, economical and cultural impacts on particularly the indigenous groups in the region. The culture of these small groups is fragile and in its nature rather unable to resist the expansion of the technological civilisation. The expansion of oil and gas industry has been one of the catalysts for changes in the traditional lifestyle for these people. Changes in the economic situation of the indigenous people have several causes. The first was that in the beginning of the oil boom oil companies financed a shift to extensive mechanical technologies for example snowmobiles on which they now depend. Second, the collapse of the state economic structures including the subsidised markets for furs. The third, the pressure on natural resources from pollution and from families sharing land with displaced family members makes surviving even more difficult.

Since the oil fields in Khanty Mansiysk province have been operating from the mid 1950s, there had also been a significant increase in the non-native population immigrating into the area traditionally inhabited by indigenous people. The proportion of Khanty and Mansis people in the province has decreased from 13% and 6.2% respectively in 1939 to 1.8% and 0.6% in 1989. “In the 1960s the natives were forced against their will from their scattered settlements into large villages, which meant change from nomadic life-style into to a resident one” http://www.suri.ee/eup/khants.html. The Khants became a minority in their historical settlements, in 1959 they where 9.2% and in 1989 just 1.8%. The Mansis become an even smaller group, in 1938 they where 6.2% and in 1989 0.6%. The influx of migrants into the area has reportedly led to cultural and racial conflicts, particularly culture differences as the majority of industrial migrants settled only temporarily and they have little desire to understand the way of life of the indigenous people.

The Socio-cultural systems (social structure, organisation and beliefs) are very different between the “locals” and the people who in-migrated because of the oil and gas boom. This boom contributed to a shifting in the way of life of the indigenous people.

Due to land-use and land concessions granted to oil companies, large areas of lands used and inhabited by indigenous peoples have been demarcated and fenced. This has resulted in ‘voluntary’ self-removal and relocation from traditional hunting and family areas to the industrialised centres due to pollution and encroaching industrialisation. In some cases, people have been forced into large villages from scattered and nomadic settlements. Families who used to live outside in tents with reindeer herding and fishing found themselves in an area where oil companies concessions determine land boundaries. Traditional land-use patterns have changed as oil company constructed roads and platforms on the marshlands, limit access to some traditional hunting lands and have cut and divided some traditional family territories. Oil pollution and limited access to reindeer pastures due to oil field demarcation has reportedly severely affected the traditional herding and availability of reindeer grasslands. Oil pollution of traditional fishing lakes and rivers has also reportedly affected fishing.

Raised roads have trapped water causing flooding and ruining forests, a traditional hunting area. Hunting has also been affected by the removal of vegetation and ground preparation for seismic lines and pipes and floodlighting and flares and noise caused by flares, helicopters and other vehicle movements, exploration activities, drilling operations and production operations. The noise also effects the wildlife for example during the breeding season. Cleanup fires caused by oil companies and petroleum-soaked debris has contributed to air pollution and acid rain. Siting and design of exploration sites, roads and production facilities cause a negative visual impact.

Oil companies are obliged to compensate local people and affected groups for damage and land-use, subject to agreement with the local government administration. The Ministry of Fuel and Energy acknowledges that the compensation issue is difficult. It is affected by interest of indigenous peoples for a changing way of life and their choice for a traditional or modern lifestyle, the alternatives available and the activities and compensation offered by oil companies. Many of which are conflicting but both attractive. An international conference was held in April 2000 concerning oil exploitation and refining and indigenous people, assisted by Canadian consultants, that addressed a number of these issues. (Interview: Ministry of Fuel and Energy).

The indigenous people believe that the land and the ancestry have sacred powers. The occupation of land by oil companies causes problems because on areas that are sacred for the indigenous people constructions are build. The importance of these sacred places for the local people are neglected and most of the time not known by the oil companies.

The lack of education and differences in culture has made integration in the new system difficult. The availability of and access to goods and services (housing, medical, educational) is reportedly different for indigenous peoples, as discrimination and inadequate communication means that indigenous people can not get proper jobs. The children of the indigenous people therefore spend the greater part of the year in boarding school. They are separated from their family and culture. The understanding for their culture, knowledge of their mother tongue and way of life gets more difficult. The indigenous people who are loosing their identity become social outcast unable to adapt to the industrial mode of living. The feelings of alienation have contributed to increased alcoholism and suicide rates in the indigenous populations

To develop a stronger force of local people many organisations, such as indigenous groups and environmental organisations, help to deal with the consequences of development. The alleged `dubious and unfair practices` and violations against Russian Federal law concerning natives permission for land use permits and lack of legal safeguards for native land rights have lead to the setting up of indigenous peoples rights groups and development of local development/management plans, conservation strategies and multinational treaties and agreements. In the Khanty-Mansiysk District the decree of giving communal land to aborigines for term less use was adopted in 1992. “According to the law the oil industry must not be expended to the territory possessed by the indigenous inhabitants without the owner’s permission.” (http://www.suri.ee/eup/ob.html). Although the decree exists, opportunities have been found to avoid it. Companies have bribed people with alcohol, food and other gifts. The intellectuals of the Khants, Mansis and Nenets have founded the association ‘Save Yugra’. To support indigenous reindeer herders to unite their resistance against oil exploitation and voice their demands for a compensation for the losses they had suffered. Except change in laws and the set up of organisations, nature reserves were formed. This to protect reserves of the indigenous people.

(References: http://www.suri.ee/eup/ob.html, http://www.koeln-online.de.nenets.html, http://www/nmsu.edu/`english/hc/eastkhanty.html, Widget A. 1997)

Evaluation of socio-cultural impacts

The socio-cultural impact of the oil sector on West Siberia has been significant. Since the oil boom in the 1960s, the sector has resulted in a huge migration into the area.

The oil sector has contributed towards a change in the traditional cultural values and livelihood of the ethnic native Khanty, Mansis and Nenets peoples of the area. The following oil sector activities have contributed to socio-cultural changes of these peoples:

- changes in land-use due to oil sector activities and facilities (e.g. siting of pipelines, waste pits, facilities, flares etc.);
- restriction of access to oil company lands;
- access to employment within oil sector and related services;
- increase in urbanisation and industrial activities;
- increased and changed access to social services.

The impacts of the activities listed above include:

- changes in access to traditional lands and land use;
- pollution of natural resources used for subsistence;
- changes in economic activities (i.e. hunting, fishing and farming);
- compensation for damage and landuse;
- cultural and racial differences and conflicts (between migrants and ethnic minorities).

It should be noted that the extent to which the oil sector has resulted in changes and other autonomous factors also impacted the socio-cultural environmental is not quantifiable.

6.5 Extrapolation

Looking at the findings of Nizhnevartovsk Region in relation to the bigger Khanty Mansiysk District and the even bigger Tyumen Oblast, extrapolation of the main findings to the whole of Western Siberia seems justified. However, conditions of climate (permafrost) and for instance the age of the oilfield will cause differences in the specific environmental impacts and magnitude of the impacts. In general, it can be concluded that the same impacts will occur in other oil and gas exploration regions in Western Siberia as well. This holds specifically true for the older oil and gas regions.

7 Environmental management measures

7.1 Introduction

`General solutions` for mitigation of environmental and social impacts due to the oil sector in West Siberia are proposed in this chapter. Solutions are presented in terms of environmental management measures. These are feasible and effective measures that may reduce significant, adverse environmental and social impacts to acceptable levels. Besides measures which are already "ongoing activities" measures named below and many others, which are not covered within this study take possibly decades to implement. Before implementing, questions will rise like: Why cleaning such an area? Where to start ? And who will pay? Stakeholders in Western Siberia (or within a smaller entity) should develop a shared vision in the first place. This vision may serve as starting point or reference for all stakeholders and for all future development plans. In such a shared vision adequate weight could be given to all stakeholder interests. The vision could cover, but should not be limited to:

- environmental quality;
- urban infrastructure (water supply, sewerage, etc.);
- activities of the oil industry;
- waste management;
- ecological quality;
- employment;
- institutional strength;
- enforcement and effectiveness of environmental regulations;
- dissemination of relevant information.

Ideally, the vision becomes a guiding principle for major planning and development decisions in the coming decades. However, this requires that stakeholders are committed to the vision, which is best obtained by their active participation in the process of formulating the vision. Within this vision as a framework, concrete measures will get their own place.

The above does not imply just to stop already ongoing processes and environmental measures since those two are closely related and will support each other.

The already ongoing processes and environmental measures, like development of rehabilitation techniques and re-use of associated gas should be encouraged.

In general two main types of measures are distinguished: preventive and mitigation measures. Preventive measures are meant to control the hazard at the source. Mitigation measures are end-of-pipe measures that control the effects in the environment and do not tackle the hazard itself. The enumeration in section 7.2 gives an indication of possible measures applicable to the project area. The list is not exhaustively and measures are not described in detail since this is beyond the scope of this project. The list is more or less limited to the measures related to the circumstances observed in the study area.

7.2 Measures

7.2.1 Preventive measures

For socio-economic impact:

- avoidance or awareness of existing land and resource use patterns and rights of access (alternative routes of pipe-lines, minimisation of land take for facilities, positioning of flares, avoidance of flooding, construction of buffer zones for national parks);
- control access to and exploitation of the local resource base;
- control immigration and local migration (adequate housing and settlement policy);
- initiate actions to assist local people with the consequences of development (education, health programmes).

For environmental impacts:

- avoidance of spills (above ground pipelines, alternatives for activities leading to cleaner production, containment measures to control hazards, (additional) treatment of discharges, alternative disposal processes, better transport system);
- avoidance of impact on drainage patterns by introducing proper designed infrastructure;
- avoidance of emissions to air by proper design and correct engineering, consider gas re-injection;
- avoidance of waste streams, proper waste handling.

Organisational aspects:

- establish environmental departments in all oil companies;
- introduction of an Environmental Management System to promote long term sustainable development in the oil sector and promote adherence to transparent, demonstrable standards (Contingency Planning and Emergency Response Management, Detailed Incident Assessment, Waste Management Plan);
- adequate training of personnel.

7.2.2 Mitigation measures

- Remediation of contaminated soils and water;
- set up indigenous peoples reserves for remaining people- based on traditional boundaries & activities;
- rights for natives/indigenous peoples should be set;
- all companies in area should compensate local population for land used;
- strengthen role/enforcement by local authorities, especially fines;
- set up ecological insurance fund – paid into by all oil companies.

7.2.3 Soil and groundwater remediation

It can be concluded from the study that oil spillages and improper waste handling are the main cause of negative impacts on the environment; soil, groundwater and surface water contamination. Therefore, the focus in this section will be on oil spillages and oily waste with the related mitigation measures. This section can be seen as an approach to come to one of the measures which should be taken. It does not necessarily implies a prioritisation of possible measures but it sure is a necessary step.

Since the amount of spill sites and oily waste storages is massive it is obvious that not all those sites can be dealt with, within a few years. There will not only be a time constrain but also a constrain of means (money and manpower). Therefore, a realistic approach has to be developed to cope with the situation. The approach generally accepted is to set priorities based on environmental risks associated with the contaminations. Experiences of various mitigation programmes in Western Europe show that it is also not cost effective to start a mitigation programme without first having done a solid, reliable prioritisation of the different polluted sites and their related risk aspects. The approach should be simple and transparent for optimum effectiveness.

Central to the approach is the aim to take away the environmental risks related to the contamination. Whilst this is in fact the central backbone of the approach, there is a great deal of flexibility in mitigation measures. This is necessary as the approach need to be adapted to and refined with issues specific for the different oil fields/areas. The starting point of this so called ‘risk based’ approach are the risks related to the pollution, rather than the pollution itself. If there are risks, mitigation measures has to be carried out. In fact, such measures will be nothing more than the elimination of the environmental risks. By using this approach, remediation starts at those places where it is needed most (high priority considering environmental risks). Another aspect in favour of this approach is that remediations will be carried out effective and therefore will be efficient.

Three types of investigations prior to the actual mitigation measures can be distinguished within this approach. As there are: historical investigation, indicative environmental investigation and the supplementary investigation. Those types of investigation are designed around the central concept of risk-elimination. A historical investigation should among others present site information, (underground) infrastructure, information about the direct surroundings, local stratigraphy and hydrogeology. The product should be a qualitative evaluation of the source(s), exposure pathways and receptors. Those three will describe of how sources could contribute to increased levels of risks in potentially exposed receptors. For instance the oil from spills or storages affecting the quality of drinking water and therefore pose risks upon human beings. When the historical investigations are completed within an ‘organisational body’ (for instance an oil company or region), the different cases can be classified and ranked according to their potential environmental risk. Criteria for classifying/ranking can be the age of the oilfield, the age of the well, the nearness of a drinking water well, the recorded accidents etc. The highest ranked cases will be most urgent for further investigation, the so called indicative environmental investigation.

The purpose of this indicative investigation is to verify the results of the historical investigation and get an impression of the possible contamination on the site. The exact type of indicative investigation has to be developed in close cooperation with the competent authorities. Although the extent of contamination on the sites is probably not exactly known at the end of this investigation, another ranking based on potential risks will take place. By describing the case, a consistent process for evaluating and documentating human health and environmental threats is obtained. The assessment of qualitative risks for both human being and the environment will form the risk score. For further evaluation the focus will be on pathways which are ‘complete’ for the particular site. This means that there is a source of sufficient strength, a pathway for migration of the contaminants of concern from source to receptor and an exposure point for the receptor. The relevant data will be screened against ‘risk based screening levels’ which have to be developed if not existent. The exceedance of the criteria along an exposure pathway towards a receptor implies a defined potential impact of a source.

By now the known pollution will be prioritised on the basis of more exact data. Further to this investigation a remediation investigation will be performed prior to establish the exact measures to be taken.

7.3 Possibilities for funding environmental measures

Environmental management is primarily a matter for the oil industry itself. Nowadays, it becomes more and more common practice to incorporate environmental management measures in the day to day business. Since the current situation in Russia gives reasons for serious concern, (more) international involvement should be considered. Below. some possible projects are listed based on the findings of the study. A project description is given in Appendix 12 as well as an indication of the costs and possible International Financing Institutes. However, investments (financial and know how) by Western oil companies could be a possibility as well.

- Vision for sustainable development of Nizhnevartovsk Region
- Recovery of oil products from oil storages in Nizhnevartovsk Region
- Nizhnevartovsk Region Environmental Awareness Programme
- Nizhnevartovsk Region Environmental Medical Research Programme
- Decommissioning of abandoned oil wells in Nizhnevartovsk Region

8 Conclusions

8.1 Introduction

IWACO BV Consultants for Water and Environment was commissioned to undertake a project for the Dutch, German and Russian Greenpeace offices in 2000, to assess the environmental and social impacts of the oil industry in West Siberia. The project was commissioned by Greenpeace to support their scientific field trips to West Siberia in the summer of 2000 as part of a campaign targeted at the Russian oil industry. IWACO were requested to provide independent scientific data to support the Greenpeace campaign. The project that aims to provide an impression of the environmental and social impacts of the oil industry in West Siberia, focussing on the Nizhnevartovsk region. It also seeks to provide an overview of the location, extent and degree of oil pollution in West Siberia. The Profile includes an environmental and social baseline of the oil sector in the region, an analysis of the potential key environmental and social issues, of which an assessment of impacts was made. Mitigation and management measures were proposed for the sector.

The project focussed on the Nizhnevartovsk region in West Siberia for the following reasons:

- The oil industry has been active in this region for over 40 years;
- The well-documented Samotlor oilfield is located within the region;
- Good accessibility;
- Presence of several major oil companies and authorities.

The Nizhnevartovsk region is representative of the oil industry in Western Siberia, allowing the environmental and social impacts of the oil sector in this area to be extrapolated, with care and subject to stipulations, to other areas with oil industries in Western Siberia.

The following activities were conducted as part of the project:

- Literature review and desk study;
- Remote sensing analysis;
- Fieldwork and sampling;
- Fact finding missions and interviews;
- Chemical analysis of samples
- Reporting.

8.2 Findings

The Russian Federation is one of the world’s top five energy producers, being the second to third world largest exporter of petroleum. In 1998 82,770,000 tonnes was exported in total. From 1993 to 1998, Western Europe imported between 55% and 78% of Russia’s total exported oil, with Germany, Switzerland, the UK, Italy and Spain being the major importers. It is not transparent exactly who the importing companies are, although all the major international oil companies are probably importers. Total Fina Elf is reported as purchasing 18 to 20 million tons annually from Russia, with Tymuen Oil Company stating that 70% of its export is sold to Total Fina Elf. Within Russia, West Siberia is the most highly developed and oldest oil and gas region, producing about 78% of all Russian oil. The Nizhnevartovsk Region contains some of the oldest fields, the Samotlar field being 40 years old.

The fields are exploited by mainly Russian, recently privatised companies and a number of joint ventures with international companies. The top six privately owned oil companies today are LUKoil, Surneftegaz, Yukos, Sidanko, Tatneft and Tyumen Oil Company (TNK), who together account for about 60% of Russia's yearly oil production of 265 million tons (1998).

The major IFIs active in the Russian energy and environment sector have not identified or named the West Siberian oil sector as a priority in their current or future strategies or policy plans except TACIS, although the EBRD is now reconsidering reallocation of funds. Most IFIs allocate financing on the basis of where they and their Russian counterpart authority set the highest priority and expect a positive financial or technical return on investment. The historical and current environmental and social management and impacts of the oil sector do not appear to be a priority for the government, the current operating oil companies and most donor agencies. IFI financing of environmental projects in the sector is not anticipated as a major source of investment, although bilateral and country funds may be, depending on individual polices. Private sector financing by both national and international companies currently active or wishing to invest in the area appears to be the major potential source of funding for environmental projects, although this seems strongly dependent on oil prices.

The Nizhnevartovsk Region of West Siberia is characterised by sensitive environmental conditions. Particularly the sub-arctic and continental climatic conditions, high groundwater levels with waterlogged soils possessing long degradation and biological recovery times, numerous surface water bodies and fragile taiga forests and peat bogs. This environment has been directly and significantly impacted by the activities of the oil sector in the region. The impacts, in order of estimated significance include:

- between at least 700,000 to 840,000 hectares of polluted soil in West Siberia and around 2% of land in the oil fields in the Nizhnevartovsk Region are polluted by oil, with 6500 hectare of contaminated soils confirmed in the Nizhnevartovsk Region. This is a much larger area than indicated by official government and oil company statistics. Soil pollution has been caused largely by oil pipeline and well spills, but also by oily muds, drilling and production waste, chemical waste disposal and leaking storage places; saline production water; operational discharges and leakage and oil production site drainage.
- Unquantifiable shallow and deep groundwater and aquifer pollution in Nizhnevartovsk Region, particularly the older oil fields such as Samotlor, with oil concentrations around 0.1 mg/l in groundwater layers up to 200 m deep. Causes include oil spills, leaks from oil and chemical waste storage; operational discharges and water re-injection and leaks from abandoned old wells.
- Surface water pollution in West Siberia generally, particularly in water bodies around oil fields, and especially older fields in the Nizhnevartovsk Region. The main pollutants are oil products, reaching between 5 to 50 times the Russian PDK norm, also saline, chlorides and production chemicals. The causes are oil spills and accidents, releases of drilling wastes, leaks from waste disposal areas, flares and transport emissions into surface water. Surface water hydrology has also been unquantifiably changed due to dams, dikes and roads constructed as part of oil field infrastructure.
- Negative, unquantified impacts on air quality caused by emissions of Polycyclic Aromatic Hydrocarbons (PAH), hydrocarbons, particulate and greenhouse gases particularly from flaring and venting of associated gases, oil spills and oily waste burning, and fugitive emissions from oil spills, vents and production facilities.

- Negative impact on the quality of drinking water in the Nizhnevartovsk Region. 97% of drinking water extracted from the River Vakh over a five-year period were polluted with oil over the PDK norm. Whilst treated surface and ground water presents a low risk to human health, the large number of water supply stations and numerous, unofficial, private wells providing untreated drinking water presents a considerable, unquantified health hazard.
- Negative impact on the aquatic biological environment. Over 50% of fished rivers in the region are contaminated with oil products, resulting in reduced health, breeding ability, changed spawning behaviour and possibly linked to declining fish catches. Causes include pipeline and product spills and accidents, releases of drilling wastes, leaks from waste disposal areas, flares and transport emissions into surface water.
- Possible unquantified impact of radioactive contamination of the wider environment resulting from radionuclide contaminated oils (both naturally and unnaturally occurring) extracted from certain areas of West Siberia.
- Negative, unquantified impacts on terrestrial flora and fauna, resulting in changed terrestrial habitats such as decreased or increased water levels, limitations of access, flora damage and loss, disturbance and possible contamination of fauna, particularly water birds. The causes include oil spills; noise from oil production facilities, vehicles and construction works; vehicle impacts of oil facilities construction and maintenance works; flares; fires and roads, pipelines, well platforms, dams and dikes related to oil facilities.

The Nizhnevartovsk Region of West Siberia has changed greatly in the last 40 years, largely as a result of the development of the oil fields. The Region has industrialised greatly, seen a huge increase in migration, large changes in land use with the development of cities, oil fields and designation of nature reserves. Environmental legislation has developed on a national and regional level to protect resources, along with monitoring and enforcement mechanisms and authorities. The socio-economic environment has also been directly and significantly impacted by the activities of the oil sector. The impacts are however largely unquantifiable, but include:

- negative and positive impacts on the socio-economic conditions in the Nizhnevartovsk Region, resulting in increased access to employment within oil sector and related services; increased and changed access to social services; denser infrastructure and transport links in the region.
- Negative and positive impacts on demography in the form of a huge increase in migration into the region, an increase in urbanisation and industrial activities; increased exposure to cultural and racial differences and increased conflicts between migrants and ethnic minorities.
- Negative impact on health caused by pollution, urbanisation and industrialisation of the region, due in part by the oil sector as the major industry in the area. There is a potential, suspected correlation between the \`poor environment\` in Nizhnevartovsk and a higher than Russian average level of certain oncological, cardiological and endocrinological diseases and shorter life expectancies.
- Negative and positive impacts on Khanty, Mansis and Nenets indigenous peoples traditional culture and socio-economic systems, resulting urbanisation of the traditional hunting areas caused in part by activities of the oil industry, the oil sector presenting alternative cultural values and economic opportunities, changes in land-use due to oil activities and facilities, restriction of access to oil company lands preventing access to traditional lands and infringing on traditional land use, compensation paid for damage and land use, pollution of natural resources used for traditional subsistence lifestyle (i.e. hunting, fishing and farming).

The activities of the oil sector have therefore resulted in significant direct environmental impacts and a number of direct and indirect socio-economic impacts in the Nizhnevartovsk region. It can be concluded, with caution, that particularly environmental impacts to surface water, groundwater, and terrestrial biology have been impacted a wider area of West Siberia. The impacts in the Nizhnevartovsk Region can also be extrapolated to other oil producing areas in West Siberia. It is likely that other oilfields have experienced similar impacts of a similar or lesser significance, as there are strong indications that environmental, particularly pollution impacts and social impacts increase in significance in direct correlation with the age of the oilfields.

The activities of the oil industry in West Siberia have caused a wide variety of impacts. The most significant operations that cause multiple negative environmental and social impacts are:

- Pipeline and equipment breaks, spills and accidents;
- Inadequate emergency planning and equipment;
- Normal operational practices with inadequate environmental mitigation and management measures;
- Operational errors and negligence by oil company personnel;
- Low company and personnel environmental management and organisation, awareness and education of environmental impacts of operations, particularly spills;
- Lack of environmental management systems within oil companies;
- Inadequate remediation measures for spills to soil and water;
- Lack or under-investment in equipment and use of unsuitable or outdated equipment;
- Incomplete policy regarding native peoples, access and rights to traditional lands on oilfields.

As these operations have caused major environmental and social impacts and continue to pose hazards. These activities are therefore recommended as priorities for management measures or projects to mitigate or reduce significant, adverse environmental and social impacts to acceptable levels and as preventive measures.

8.3 Measures

`General solutions` for mitigation of environmental and social impacts due to the oil sector in West Siberia are proposed in this Profile. Solutions are presented in terms of environmental management measures. These are feasible and effective measures that may reduce significant, adverse environmental and social impacts to acceptable levels. Besides measures which are already “ongoing activities”, measures named and many others which are not covered within this study, take possibly decades to implement. Before implementing, questions will rise like: Why cleaning such an area? Where to start? And who will pay? Stakeholders in Western Siberia (or within a smaller entity) should develop a shared vision in the first place. This vision may serve as starting point or reference for all stakeholders and for all future development plans. In such a shared vision adequate weight could be given to all stakeholder interests. The vision could cover, but should not be limited to:

- environmental quality
- urban infrastructure (water supply, sewerage, etc.);
- activities of the oil industry;
- waste management;
- ecological quality;
- employment;
- institutional strength;
- enforcement and effectiveness of environmental regulations;
- dissemination of relevant information.

Ideally, the vision becomes a guiding principle for major planning and development decisions in the coming decades. However, this requires that stakeholders are committed to the vision, which is best obtained by their active participation in the process of formulating the vision. Within this vision as a framework, concrete measures will get its own place.

The above does not imply just to stop already ongoing processes and environmental measures since those two are closely related and will support each other. On the contrary, e.g. development of rehabilitation techniques and re-use of associated gas should be encouraged. In general two main types of measures are distinguished: preventive and mitigation measures. Preventive measures are meant to control the hazard at the source. Mitigation measures are end-of-pipe measures that control the effects in the environment and do not tackle the hazard itself. See for examples of possible projects Appendix 12.

8.4 Concerning the Project

The range, scope, objectives and limitations of the mentioned activities necessarily limited the Environmental and Social Profile. A major problem for the project was that the accuracy and reliability of data can not always be optimal due to the following factors:

- restrictions to access (part of the Russian officials were not willing to verify information or discuss the matter in depth, or at all);
- the team did not have full or official access to the oilfields;
- the requirement for translation of many documents;
- the tendency for official data only to be available on an amalgamated regional or sector level, with no detailing on background of the data;
- conflicting data.

Due to the scope of the project, the available time frame and budget limitations, the aim of the sampling program was limited to providing additional data only regarding critical environmental impacts and locations. No attempt has been is made to fully cover the area with sample points. Therefore sampling and analyses results only obtained a preliminary insight in the situation concerning soil and (ground)water pollution. Therefor the results of the sampling program cannot be used to statistically substantiate the assessment of impacts. In this respect also the lack of monitoring data from the oil industry itself and the competent authorities can be regarded as a major omission. Since most of the literature available deals with data on a an algamated regional or sector level, with no detailing on background of the data, a study of the basic data will certainly give a more complete picture of the situation.

Furthermore, this study clearly shows that remote sensing is an ideal tool for large-scale field investigations and inventories of land use change, such as caused by oil pollution. In order to select appropriate locations for detailed field studies an assessment of different satellite images and/or aerial photographs is very useful. Remote sensing can also be applied to extrapolate point data, collected during detailed field observations, to an applied large-scale coverage.

In spite of the above, this report provides an independent and a fair assessment of the environmental and social impacts of the oil industry in West Siberia. As far as known by the consultant this is a first attempt to bring together information of the oil industry and environmental and social baseline data on a rather basic level. A further mapping of oil spills may complete the picture for the whole of West Siberia. It is advised to use in this context also satellite images taken during wintertime. The latter will also give more insight in the position of pipelines (and other possible sources). With a complete picture of the (potential) oil spills in Siberia, combined with the environmental and social sensitivities, priorities can be set for future activities.

For possible further investigations it is advised to involve local authorities and representatives of the oil industry to a further extent to come to a more in-depth insight. It became clear that much attention should be paid to institutional development since the information seems only fragmentary available and scattered over different organisations and measures are not adequate implemented. Therefore, it seems right now not very worth while to invest in extensive sampling campaigns/ broad inventarisations without a proper institutional framework for further activities.

Appendix 1
Interviews

Interviews were made in Russia between 31 July and 1 September 2000. This list of includes meetings, telephone interviews and email correspondence.

Russian oil companiesYukos Oil, Moscow
Head of Environmental Protection & Safety Department, Mr Konvissar Grigory Petrovitch

Chernogorneft, Nizhnevartovsk
Head of the Ecology Department, Mrs. Ludmila Belova

Russian Ministries/Administrations
Ministry of Fuel & Energy, Ecological Department
Alexander A. Popov, Chief
Eleanor A. Ruet, Deputy Chief

City Administration of Nizhnevartovsk
Yiriy Timoshkov, Head

Ecological Department of the City Administration of Nizhnevartovsk
Victor Valuisky, Head

Regional Committee of Ecology of Nizhnevartovsk
Andre Chemakin, Deputy Head
Alexander Zinuk, Head of Accident Prevention Department

Nizhnevartovsk Federal Forestry Service
Michael Poliakov, Head

Fish Inspection Department Nizhnevartovsk (Federal Service)
Fjodor Ovechkin, Ichtologist

Ecology Department of Regional Administration of Nizhnevartovsk
Anatoly Zauzilkov, Chief Specialist

Oblast Ecology Committee, Tyumen
Vladimir Giljov, Director

European-Russian Oil and Gas Centre ERIP
Dominique Bertault

International financing agencies
World Bank Moscow
Ralil Kajaste, Environmental Specialist
Alexander Pozin, Energy Specialist

EBRD London
Liz Smith, Sr. Environmental Advisor

EBRD Moscow
Alexander L. Kurtynin, Associate Banker Natural Resources Department

TACIS EU Delegation (Moscow)
George Eliopoulos, Second Secretary Energy, Transport and Telecommunications

Embassies
Dutch Embassy Moscow
Joep van der Laar, Counsellor Economic and Commercial Section
Neline Koornneef, First Secretary Economic and Commercial Section

Ex- State Committee for the Environment
Nefediev Nickolay Konstantinovich, Director
Eugene Wystorobets
Micheal Kreidlin, Protected Areas Department

Universities and Research Institutes
Institute of Environmental Geoscience, Moscow
Dr Alexi Ragozin, Deputy Director of Sciences

Institute of Ecology, Moscow (All-Russian Research Institute for Environmental Protection)
Dr Andrey Peshkov, Director

Moscow State University
Valerii Sergheev, Professor Geological Environment

Institute of Global Climate & Environment, Moscow
Sergey Gromov, Head of Scientific Sector

Institute of Hydrometeorology, Moscow
Mr. Khudolev, Head of Department
Nature Development institute, Nizhnevartovsk
Alexander G. Khurshudov
Evgeniy L. Shor

Nizhnevartovsk Research and Design Institute for Oil Industry (NIPIneft)
Natalia N. Andreeva

Russian Academy of Natural Science/Committee for Natural Resources & Environment
Konstatin I.Lopatin

Institute of Cryosphere, Tyumen
Andrej Judenko, scientist

Institute of Fish Resources, Tyumen
Alexander I. Litvinenko, Director
Vladimir Krokhalevsky, Deputy head for research

Tyumen State University of Ecology
Victor Radjansky. Head of laboratory of ecological monitoring and research

Tyumen State University of Oil and Gas
Vladislav D. Shantarin

Water Supply Company Vodokanal, Nizhnevartovsk
Wadezhda Olgovskaya, Head Waterstation

Environmental media
Rosecopress Association
Mark Borozin, President

NGOs
Greenpeace Netherlands
Martijn Lodewykx, Oil and Gas Campaigner
Marjan Minnesma, Campaign Director
Greenpeace Russia
Alexi Kisselev, Toxic Campaign Coordinator
Serguei Mikhailov, Remote Sensing Specialist

Russian Environmental Movement (The Green) & Environmental Union
Mark Borozin, Chairman

Health Institutes
Sanitary and Epidemical Research Centre, Nizhnevartovsk
Larissa Boyko, Deputy Chief Doctor

Tyumen Region's Oncological centre
Nicolay Raycov, Manager of Surgery department

Oil industry contractors & suppliers
Wintershall
Aart Kijk in de Vegt, Manager Health Safety &Environment

Appendix 2
References

References

Almanac of Russian Petroleum, Energy Intelligence Group, 1999

Alexanders Oil & Gas, West Siberia reports

Chief doctor of the Oncological Clinic of the Tyumen Oblast N.Naumov, Report on health situation (tumors and cancer) in Tyumen Oblast for 1999

Contrast Advies, Gas en Olie uit Siberië, 2000

Deyanov, A., US Consulate General, Yekaterinaburg, Oil refining sector in the Urals and Western Siberia, 1998

Dobrinsky, L.N. and Plotnikov, V.V., Ekologia, concerning the period 1993-1995 for the Regional Committee of Khanty Mansiysk Okrug, 1997

EBRD, Natural Resources Operations Policy, 1999

Feshach, M. ed., Environmental & Health Atlas of Russia, Moscow 1994

Greenpeace, Greenpeace Magazine 22e 2000-3, August 2000

IUCN & E&P Forum, Oil & gas exploration and production in Arctic and sub-arctic onshore regions, Guidelines for Environmental Protection, 1993

Kryukov, V., `Industry Profile Siberian based oil companies`, Institute of Economics & Engineering, Novosibrisk, July 2000

Lemierre J, `New EBRD president bullish on region`, page 6, Moscow Times, August 5 2000

Moscow Times 'News/Environment', August 4, 2000

Moscow Times `Oil sector`, August 5 2000

Moscow Times, `World Bank to visit` page 11, August 2 2000
N. Krupinin, Chairman of Nizhnevartovsk Regional Environmental Committee, Effect of Oil and Gas Industry on the Environmental Situation in the City and the Region of Nizhnevartovsknevartovsk

Nizhnevartovsk Center for Sanitary and Epidemiological Monitoring, State report on Sanitary and Epidemiological Situation in the City and the Region of Nizhnevartovsk for the year of 1996.

Nizhnevartovsk interregional committee for environmental protection Nizhnevartovsk, 1999

Regional Ecological Committee of Khanty-Mansiysk, Report on assessment of environmental and natural resources, 1998

Regional Environmental Committee Nizhnevartovsk, Situation of the Environment and Natural Resources in the Nizhnevartovsk Region, 1998

Regional Environmental Committee Nizhnevartovsk, Report on Assessment of Environmental Situation in Nizhnevartovsk Region, 1996
Russian State Environmental Committee, State report on Environmental situation in the Russian Federation, 1998

State Committee for Environmental Protection, Federal Report 1996

State Committee for Environmental Protection, Federal Report 1997

State committee of environmental protection of the Russian Federation, 1999

Tyumen Oblast Committee for protection of environment and natural resources, The ecological situation, the use of natural resources and nature protection of the Tyumen Oblast, 1994

Tyumen State University, Russian Forestry Service Report on situation in the West Siberia Forestry, 1998

US Consulate General, Oil sector XXX 1998

Widget A., Black Snow: Oil and the Eastern Khanty, New Mexico Heritage Centre, August 1997

World Bank, Draft Sector Report Russian Federation Energy & Environment Review, June 2000

Yukos, Environmental Report, 1997

Internet sources

http://ourworld.compuserve.com/homepages/alfred_kuhn/s_Nizhnevartovskhne.htm
http://www.koeln.de/infoe/nenets.html
http://www.moles.org/projectunderground/motherlode/drilling/russia.html
http://www.nmsu.edu/~english/eastkhanty.html
http://www.nmsu.edu/~english/hc/impactoil.html
http://www.pacenv.org/oildev.html
http://www.suri.ee/eup/khants.html
http://www.suri.ee/eup/mansis.html
http://www.zapovedniks.ru/frames/book/western…/western_siberia%20text.html
www.ebrd.com/english/oipera/pressrel/
www.kingston.ac.uk/~ad_s702/case2.htm
www.koeln-online.de.nenets.html
http://www/nmsu.edu/`english/hc/eastkhanty.html
www.oilonline.com/newshttp://binis.doc.gov
www.suri.ee/eup/ob.html
www.zapovedniks.ru/frames/book/westren…/westernsiberia%20text.ht

Appendix 3
Report on remote sensing

Creation of the oil spill map

Materials

For this study two Landsat thematic mapper 7 images were available recorded in July 1999 and July 2000. Both images were geometrically corrected using the Landsat on-board calibration parameters. The accuracy of this method for geometric correction is regarded to be in the order of 100 meters. Field observations of oil polluted areas were made, at these areas the type of pollution, vegetation cover, relative age of the pollution and size of the polluted area were noted. The location of the pollution was recorded using GPS measurements. A total of 33 field locations were visited and the characteristics were noted.

Methods

An oil spill map was created by Greenpeace Russia using the 1999 Landsat image by visual interpreted of the image. Although visual interpretation can yield good results, it is also difficult to quantify the results in terms of objectivity, accuracy and reliability. Therefore a new map was created based on the 2000 image using a combination of automatic classification and visual interpretation. The following steps were carried out:

1. Selection of training samples. Based on the field observation five location were chosen in order to be used as training samples for the automatic classification. These were field observation: 23, 25, 16, 29 and 21, which contained both recent and old oil contamination sites.
2. A parallelepiped classification was carried out first, because this type of classification only selects pixels that are spectrally identical to the training sites. This procedure allowed us to gain insight in the spatial patterns of the oil contamination and the quality of the visual interpretation. The conclusion was that the visual interpretation was of good quality but probably yielded an overestimation of the total polluted area. A number of areas that were selected in the visual interpretation were not confirmed by the image classification.
3. A drawback of a parallelepiped classification is that the classification results generally yield a speckled pattern due to the fact that the algorithm does not select pixels that are spectrally similar but do not fall within the spectral limits of the training samples. A maximum likelihood classification was therefore carried out using the same training samples that were used for the parallelepiped classification. Besides a classification result also a distance image was generated which gives the Euclidean distance of each pixel to the class signature to which it was assigned.
4. A thresholding was then applied to the classification results on the basis of the distance image. All pixels that were classified to a certain class but that were spectrally too far away from the class signature were eliminated from the classification. The thresholding value was set empirically by comparing the results for different threshold values with the visual interpretation of the image. In practice, a threshold value of 20 was found to be appropriate.
5. Because image classification results usually yield a lot of isolated pixels a clump and sieve algorithm was applied which eliminated all clumps smaller that 5 pixels. This operation cleaned the classification result considerably leaving only contiguous zones of oil pollution.
6. The classification result was then crossed with the visual interpretation and only the pixels were selected that were both classified as oil spill in the classification result and in the visual interpretation. The final classification was then polished

using visual interpretation by smoothing the classification according to the patterns in the image that could be visually recognised. No new areas were added to the classification, only selected areas were smoothed and turned into more or less contiguous zones.

Validation of the oil spill map

The usual method of validation of a per-pixel classified satellite image is by comparing the classification with a set of known pixel locations. This method was also applied to the oil spill map. All 33 field observations were plotted on the satellite image. For each location, the field-checked area was digitised and classified as either polluted or non-polluted. Furthermore a distinction was made between old oil spills and oil spills that had occurred more recently. This distinction was made because a herbaceous vegetation recovers on old oil spill sites after a number of years. Using this procedures a reference map was created of polluted and non-polluted site. This reference map was then crossed with the image classification which resulted in a confusion matrix. This matrix can be used to calculate the accuracy and reliability of the classification.

	Reference data				
Classification	no pollution	new spill	old spill	**Total**	*Reliability*
No pollution	370	207	424	**1001**	*37,0%*
Oil spill	25	820	285	**1130**	*97,8%*
Total	**395**	**1027**	**709**	**2131**	
Accuracy	*93,7%*	*79,8%*	*40,2%*		

The main conclusion that can be drawn from the error matrix is that the oil spill classification is very reliable (98%) but that the accuracy is much lower (80% and 40% respectively). In practice this means that the oil spills that have been classified are virtually all correct, but that a number of oil spill sites were not detected by the classification. When looking at the accuracy it can be observed that this is mainly related to the older pollution sites, which are harder to detect probably due to (partial) recovery of the vegetation.

Description of field observations

Observation	Site description
001	Site crossed with pipelines, with thin oil film around the pipelines. No evidence of large scale contamination
002	Recent oil spill along the road, 50-100 meter wide
003	Large recent oil spill
004	Old oil spill, 70% of the site is covered with vegetation including pine forest (5-10 years old)
005	Oil spill along the road 50-80 meter wide, 700-1000 meter long.
006	No contamination
007	Old oil spill, traces of oil and a tar covered surface remain
008	Old oil spill, thin oil film on the surface
009	Recent oil spill
010	Old oil spill
011	No contamination
012	Recent oil spill of size 600x400 meter
013	Shore line is for 50% covered with oil or an oil crust
014	20-70 meter wide oil film along the road
015	Old oil spill, site fully covered with a tar surface
016	Old oil spills on both side of the road
017	Large recent oil spill between the two roads
018	Severe contamination over 200x500 meter,oil crust on soil, oil film on water. Site is crossed by pipelines.
019	Lake shore covered with a tar crust
020	No contamination
021	Old oil spill
022	Old oil spill with evidence of cleanup attempts
023	Large oil spill: 300m wide, 700 m long
024	Recent oil spill 50x100 meter
025	Large oil spill, evidence of both old and recent oil spills
026	Forest clean, slight contamination along pipelines
027	Oil spill, evidence of both old and recent oil spills and cleanup attempts
028	Large old oil spill
029	Oil film along the road and on water, oil in bottom sediments
030	No contamination
031	No contamination
032	No contamination
033	No contamination

Appendix 4
Field visits

Field visits Henk Blok

05 August:	Fieldtrip with car to Vata
06 August:	Round trip with helicopter over Samotlor oil field
13 August:	Field trip with car East of Nizhnevartovsk and in Samotlor Oilfield
15 August:	Field trip with car West of Nizhnevartovsk

Field visits Reimond Willemse

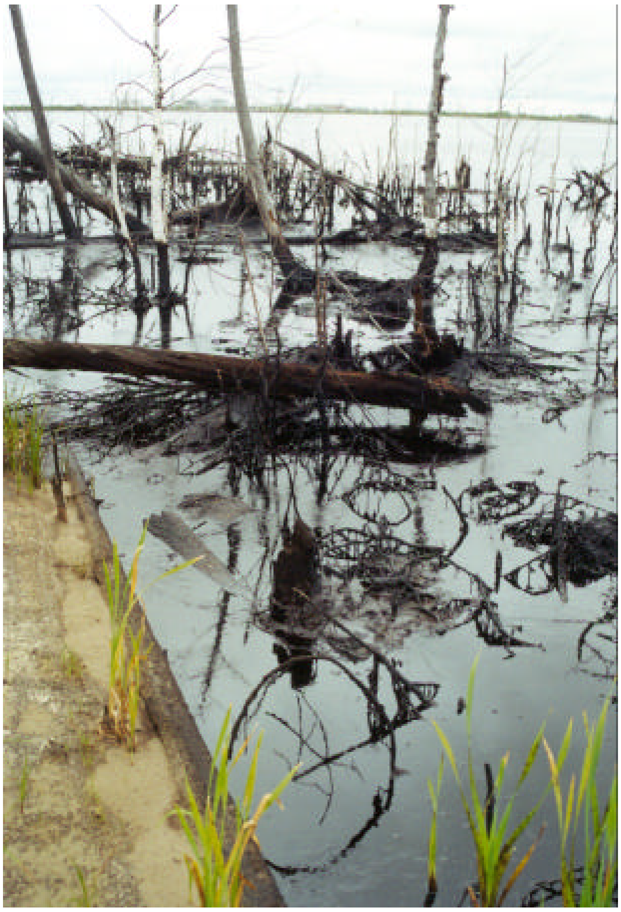
19 August:	Fieldtrip with car to Radoesjnie and Varyegan
20 August:	Field trip with car to Samotlor oil field
25 August:	Field trip with car to Branch Vakh river
26 August:	Field trip with car to Branch Vakh river
26 August:	Visit with boat to Ob river and Vakh river
27 August:	Field trip with car to river Vatinsicy Egan and Kirtipiakh river near Megion.

Appendix 5
List with samples and coordinates

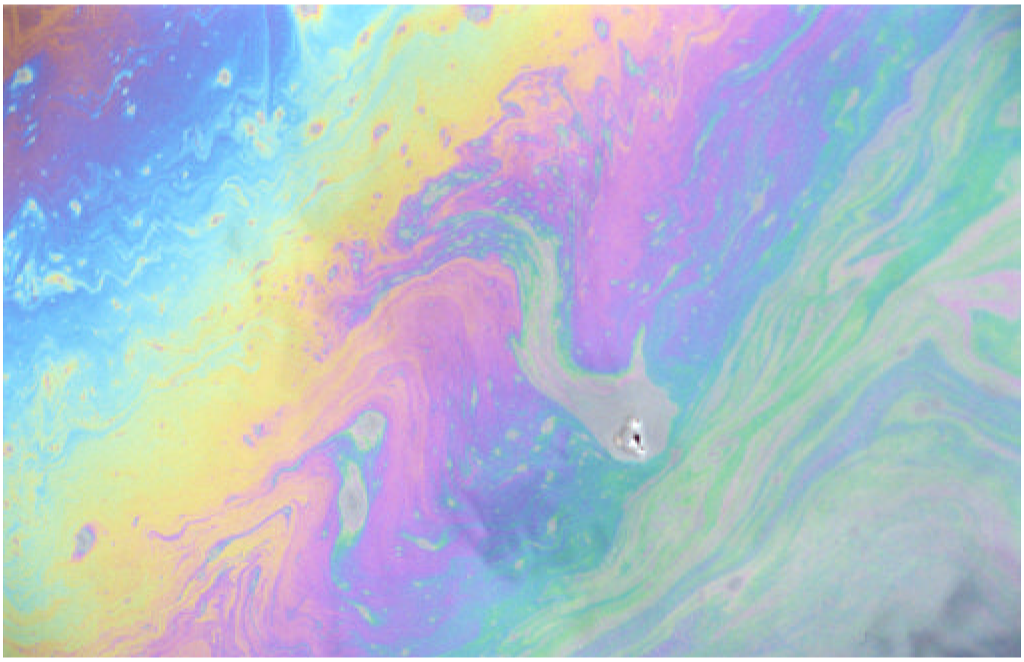
List of samples and sample locations						
waypoint	**N**	**E**	**observation**	**water sample**	**soil/sediment sample**	
7	6101694	7650628	spill		position measured from helicopter	
8	6106307	7711636	no sign of spill		idem	
9	6105961	7711893	spill		idem	
10	6102214	7644384	spill		idem	
11	6102179	7644146	no sign of spill		idem	
12	6059835	7635222	signs of oil in water near villages		idem	
13	6058394	7631554	datcha's and gardens		idem	
14	6057516	7629956	airport			
16	6105269	7549011	no sign of spill		sediment from Ob river	
17	6055948	7630116	sand winning, no sign of spill			
18	6103843	7657811	water intake for Nishnevartovsk		sediment from river Vach	
19	6109046	7655866	old oil spill	before oil seperator	sediment from lake bottom	
19	6109046	7655866	old oil spill	after oil seperator		
20	6107324	7657824	sand winning pit	water from lake		
21	6115964	7701165	flare		sediment from small stream	
22	6111943	7656110	spill	water from spill site		
23	6121005	7643018	river draining North Samatlor	water from river	sediment from river	
24	6058666	7631470	waste dump		sediment from pool	
25	6059070	7622369	flare		soil from garden	
26	6059009	7621572	some kilometers from flare		soil from garden	
27	6058881	7622484	no sign of spill		sediment from Rjazanskiy Egan	
28	6200014	7644802		water from Agan river	sediment 1 Agan river	
					sediment 2 Agan river	
29	6203526	7651419		water from Amputi river	sediment Amputi river	
30	6207810	7731560		water from small river	sediment from small river	
				drinking water Radoesjnie		
31	6207645	7733686	spill	water from small lake	sediment from small lake	
32	6208037	7737248	flare		soil 0-0.1 m	
					soil 0.1-0.2 m	
33	6202591	7731149	spill	water from lake in swamp		
34	6102836	7648352	spill			
35	6102988	7648002	spill			
36	6103334	7647583		water from small lake	sediment from small lake	
37	6103657	7644135	spill			
38	6104431	7644106	spill	water from dirty lake		
39	6105113	7644187		water from big lake		
40	6104969	7643666	spill			
41	6104688	7638508	spill			
42	6103798	7636444		water from round lake		
43	6105522	7638026	spill			
44	6105596	7639771	flare	water from small pool	sediment 100 m from flare	
					sediment 30 m from flare	
45	6110310	7638597	spill			
46	6110115	7638494	spill			
47	6053450	7652535		water from pool near Vakh	sediment from pool	
48	6053482	7652379		water from branch of Vakh	sediment from branch Vakh	
			spill		sediment from dry lake	
				water from small lake	sediment from small lake	
49	6049076	7648818		water from mouth of Vakh river		
50	6046208	7648253		water from Ob river		
51	6048209	7647700			sediment from Ob river	
52	6109042	7602508		water from river Vatinsicy	sediment 1 Vatinsicy Egan	
					sediment 2 Vatinsicy Egan	
53	6119890	7603643		water from Kirtipiakh river		
				water intake at water company		
				drinking water after treatment		

Appendix 6
Chemical analyses IWACO

Appendix 7
Photographs



IWACO / Willemse



IWACO / Willemse

IWACO / Willemse

Greenpeace / Morgan

IWACO / Willemse

Greenpeace / Oleferenko

Appendix 8
Nature reserves in West Siberia

Altaisky Zapovednik, within North-Eastern and Central Altai was established in 1932. It was closed in 1951-57 and in 1961-67 and has been existing in its present-day boundaries since 1981. Its area is 881.2 thousand ha, including 28.8 thousand ha of wetlands and Lake Teletskoye water area. It is located on the north-eastern and eastern shore of Lake Teletskoye, occupies the basins of the Chulymash River and its right tributaries (Shavla, Chulcha, etc.) and the rivers flowing into Lake Teletskoye (Kyga, Koksha, etc.). It comprises Chulymashskoye Upland, the south-facing slope of the Korbu Mountain Range, southwestern slope on Shapshalsky Range. The elevation ranges from 429 m to 3300 m above the sea level. The highest elevations are as follows: 3507 m (Shapshalsky Range on the Zapovednik boundary) and 3111 m above the sea level (Mount. Kurkurabazhi). There are numerous waterfalls and high-mountain lakes. Until 1976 only the Altai Reserve existed in the entire Western Siberia. In 1917 it was planned to reserve a plot of the Barabinskaya forest-steppe in the lake Chany region. It has not been done so far. In addition to the Shorskii National Park in the Kemerovo Region, there are local nature parks of the municipal level (e.g., Kondinskie Ozera Nature Park in the Soviet district of the Khanty-Mansiiskii Okrug, and also several big republican sanctuaries (zakazniks) (Verkhne-Kondinskii, Elizarovskii, Kirzinskii, Stepnoi and a number of others). Of great value in the region are such natural features as band coniferous forests in the Kulunda Steppe, Novosibirsk Region and Altai Territory. Some peculiar large lakes in the southern Tyumen Region renowned not only for waterfowl but also rare avian species listed in the Red Data Book, tundra landscapes of Yamal and other regions of the Far North.

Malaya Sosva Zapovednik, in Khanty-Mansiysk Autonomous Okrug was established in 1976, partly on the territory of the ex-Kondo-Sosvensky Zapovednik. Its area is 225.6 thousand ha. Located on the upland plain in the basin of the Malaya Sosva River. The territory includes a floodplain with above-floodplain terraces. The Zapovednik protects the nature complexes of middle taiga of Western Siberia. Since 1977 the Verkhnekondinsky Nature Zakaznik (Federal) has been affiliated with the Zapovednik. The Zakaznik was established in an area of 241.6 thousand ha in 1971.
Verkhne-Tazovsky Zapovednik, in Yamalo-Nenetsky Autonomous Okrug was established in 1986. Its area is 631.3 thousand ha. It is located on Verkhnetazovskaya Upland, in the watershed of river Taz tributaries Pokolka and Ratta. The highest elevations are 160-170 m above the sea level.

Kuznetsky Alatau Zapovednik, in Tisulsky and Novokuznetsky districts of the Kemerovo Region was established in 1989. Its area is 412.9 thousand ha. Located in the middle part of mountain massif Kuznetsky Alatau, encompassing the ranges Tydyn (mountain Bolshaya Tserkovnaya 1449 m above the sea level, the Chemodan Mountain 1357 m above the sea level), massifs of the Krestovaya Mountain (1549 m above the sea level) and the Kanym Mountain (1871 m above the sea level) with sources of the greatest tributaries of Ob rivers Tom and Chulym. The nature complexes characteristic of the transition zone between Western and Eastern Siberia are widespread. Well-defined are the altitude zones from steppe and forest-steppe to taiga, alpine meadows and high-mountain tundra. Forests cover 253.6 thousand ha; meadows, 15.2 thousand ha; water bodies, 1.6 thousand ha.

Shorsky National Park, in the Tashtagolsky District of Kemerovskaya Region. The Park was founded in 1989. Its area is 418.2 thousand ha. It comprises the basins of the rivers Mrassu and Kondom on the south of the Salairo-Kuznetsk mountain country. On the west it is bordered by the outer spurs of the Altai, and on the east by Abakan mountain ridge. The relief is middle-mountain, with a maximum altitude of 1555 m above sea level (on Kubez mountain).

Katunsky Zapovednik is in the south of Gorny Altai Republic. The Zapovednik was established in 1991. Its area is 150.1 thousand ha. It is located in Southern Altai in the upper reaches of the Katun River. The topography features are middle mountains and high mountains with absolute elevations of up to 4000 m above the sea level.

Gydansky Zapovednik in Tazovsky District of Yamalo-Nenetsky Autonomous Okrug, on Yavay, Mamont, Oleny peninsulas and on the islands of Karskoye Sea Oleny, Shokalsky, Proklyatye, Pestsovye, Rovny, was established in 1996. Its area is 878.2 thousand ha, of them 71.8 thousand ha are water areas. The topography is formed by paludal valleys, with numerous rivers, brooks and lakes. In the plant cover communities of Arctic subzones of tundra are presented.

Malaya Sosova Zapovednik, in Khanty Mansiysk Okrug was established in 1976 with an area of 225.6 ha. It is located on a upland plan in the basin of the Malaya Sosova River and includes the flood plain and flood plain terraces. It protects the ecological zone of the West Siberian middle taiga/. Woodland covers 80% of the territory, bogs account for 14%. It contains about 360 plant species, including a number of rare species. Fauna includes the native European beaver, mammals and birds including the rare osprey, peregrine falcon and Siberian crane.

Yugansky Zapovednik, in the south of Khanty-Mansiysk Autonomous Okrug was established in 1982. Its area is 648.7 thousand ha. Located in the basin of the Ugan River, left tributary of the river Ob and the two arms the Bolshoi and Mala Yugan Rivers. The topography is typically plain, rising 80-100 m above the sea level. It consists of plains, rising to 100m above sea level. It is covered by middle taiga forest and bogs. Rare flora includes two Cypripedium species and the Calypso bulbosa. Rare birds include the osprey, white tailed eagle, golden eagle and black stork. The beaver colonies are protected. 10 valuable fish species have their spawning grounds in the reserve. The **Yuganski Khanty Biosphere Reserve** was proposed in 1996 under protected area status of the Okrug (OOPTTP) and international UNESCO designation as a biosphere reserve. It proposes an additional 2.3 million hectares around the Yuganski Nature Reserve, in a tripartite zonation based on both the nature preserve and indigenous people status.

(sources www.zapovedniks.ru
www.zapovedniks.ru/frames/book/western…/western_siberia%20text.html

Appendix 9
Report on fish analyses

Appendix 10
Analyses Greenpeace

Appendix 11
Dutch standards

Target values, intervention values and (T+I)/2 values

Foreword

The following is derived from a circulair on soil quality standards from the Dutch Ministery of Housing, Spacial Planning and Environment.

In this circular, dated 9 May 1994, the Dutch Minister of Housing, Spatial Planning and the Environment informs the Local Authorities in the Netherlands about the new soil quality standards, the intervention and the target values. This includes that since 1994, the Authorities in the Netherlands have to use these new values instead of the old ABC-values.

In the eighties, the Dutch policy on contaminated land made use of the ABC-values. In 1994 the ABC-values have been replaced by target values and intervention values. Target values indicate the soil quality required for sustainability. They can be compared with the old A-values. Intervention values for soil remediation indicate the quality at which soil is considered to be seriously contaminated. They can be compared with the old C-values. The old B-values have been replaced by the criterion:

1/2(intervention value + target value) = (T + I)/2 = Half way value

Intervention and target values for soil

1. Introduction

Policy on contaminated land makes use of two parameters, i.e. intervention values and target values. Intervention values indicate the quality for which the functionality of the soil for human, animal and plant life are, or are threatened with being, seriously impaired. Target values indicate the soil quality required for sustainability or, expressed in terms of remedial policy, the soil quality required for the full restoration on the soil's functionality for human, animal and plant life. These intervention and target values are presented here.

2. Intervention values

The intervention values for soil remediation (Parliamentary Paper II 1993/94, 22 727, no. 5) indicate the quality at which soil is considered to be seriously contaminated.

The intervention values are based on a detailed study by the RIVM (National Institute for Public Health and Environmental Protection; reports 725201001 to 725201008 inclusive) into the human toxicological and ecotoxicological effects of soil contaminants. The human toxicological effects are quantified in terms of those concentrations in the soil which result in the so-called maximum permissible risk level for human beings exceeded. For non-carcinogenic substances, this corresponds to the TDI (tolerable daily intake). For these purposes it is assumed that all exposure pathways apply.

The intervention values for groundwater are not based on a separate risk assessment in regard to the contaminants present in the groundwater, but are derived from the values for soil/sediment.

The intervention values are related to spatial parameters. These values are regarded as having been exceeded, and the soil as therefore being seriously contaminated, if the mean soil/sediment concentration of at least one substance in at least 25 m^3 of 'soil-volume' (i.e. approximately 7 x 7 0.5 m), or groundwater concentration in at least 100 m^3 of 'soil volume', exceeds the intervention value.

The protocols for the preliminary and further site investigations describe the manner in which compliance with the standards is to be tested. The protocols prescribe sampling based on a 7 x 7 m rectungular grid. In order to determine, whether the intervention values are exceeded in a 25 m^3 section, sampling can be carried out at the four corners to a depth of 0.5 m. If a different sampling procedure is used from that prescribed by the protocols, the person concerned must himself/herself ensure and adequately demonstrate that the 25 m^3 criteria is met.

The intervention values are related to the content of organic matter and clay in the soil. These relationships are set out in the form of so-called soil type correction factors.

The intervention values for soil remediation are presented in table 1. The correction for soil type is dealt with in the notes to the table.

3. Target values

The policy statement on the memorandum 'Environmental quality objectives for soil and water' ('*MILBOWA*' - Parliamentary Paper II 1991l92, 2l 990 and 21 250, no. 3) presented quantitative target values for soil and water for a large number of contaminants. The policy statement announced the replacement of the reference values and A-values in the Leidraad Bodembescherming (Soil Protection Guidelines) by the target values. The target values therefore indicate the soil quality levels ultimately aimed for.

In compiling the target values, environmental constraints applied in other policy areas were drawn upon, such as standards for drinking water and surface waters, standards and draft standards from the Commodities Act, and policy objectives previously formulated for nitrate and phosphate. Values for heavy metals, arsenic and fluoride were derived from the analysis of field data from relatively pollution-free rural areas and aquatic sediments regarded as uncontaminated. The target values for soil were tuned to the target values for surface waters where this proved scientifically possible.

Table 1 contains the list of target values re1evant for the remediation policy of contaminated soil and groundwater. The manner in which the target values are corrected to allow for differences in soil types are described in the notes to the table.

Table 1 Target and intervention values for micropollutants for a standard soil (10% organic material and 25% clay); mg/kg for soil/sediment

Target and intervention values for standard soil			
Organic matter: 10%		Unit: mg/kgds	
Lutum: 25%			
Substance	Target value	Half way value (T+I)/2	Intervention value
METALS			
Antimonium	-	7.5	15
Arsenic	29	42	55
Barium	200	412.5	625
Beryllium	-	-	30*
Cadmium	0.8	6.4	12
Chromium	100	240	380
Cobalt	20	130	240
Copper	36	113	190
Mercury	0.3	5.15	10
Lead	85	307.5	530
Molybdenum	10	105	200
Nickel	35	122.5	210
Zinc	140	430	720
Silver	-	-	15*
INORGANIC COMPOUNDS			
Cyanide (complex-pH < 5)	5	327.5	650
Cyanide (complex-pH ≥ 5)	5	27.5	50
Cyaniden-free)	1	10.5	20
Thiocyanates (total)	-	10	20
AROMATIC COMPOUNDS			
Benzene	0.05	0.5	1
Catechol	-	10	20
Cresoles (total)	-	2.5	5
Dodecylbenzene	-	-	1,000*
Ethylbenzene	0.05	25	50
Phenol	0.05	20	40
Hydroquinone	-	5	10
Resorcinol	-	5	10
Toluene	0.05	65	130
Xylene	0.05	12.5	25
Aromatic solvents	-	-	200*
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)			
PAH (total of 10)[2, 11]	1	20.5	40

CHLORINATED HYDROCARBONS			
Target and intervention values for standard soil			
Organic matter: 10%	Unit: mg/kgds		
Lutum: 25%			
Substance	Target value	Half way value (T+I)/2	Intervention value
1,1-Dichloroethane	-	7.5	15
1,2-Dichloroethane	-	2	4
Chlorobenzene (total)[3, 11]	-	15	30
Monochlorobenzene	(d)	-	-
Dichlorobenzenes (total)	0.01	-	-
Trichlorobenzenes (total)	0.01	-	-
Tetrachlorbenzenes (total)	0.01	-	-
Pentachlorobenzene	0.0025	-	-
Hexachlorobenzene	0.0025	-	-
Chlorophenols (total)[4, 11]	-	5	10
Monochlorophenols (total)	0.0025	-	-
Dichlorophenols (total)	0.003	-	-
Trichlorophenols (total)	0.001	-	-
Tetrachlorophenols (total)	0.001	-	10
Pentachlorophenol	0.002	2.5	5
Chloronaftalene	-	5	10
Dichloromethane	(d)	5	10
Dioxine	-	-	0.001*
Polychlorbiphenyls (total)[5]	0.02	0.5	1
Tetrachloroethene	0.01	2	4
Tetrachloromethane	0.001	0.5	1
1,1,1-Trichloroethane	-	7.5	15
Trichloroethene	0.001	30	60
Trichloromethane	0.001	5	10
1,2 Dichloroethene (total of cis and trans)	-	0.5	1
Vinylchloride	-	0.05	0.1
PESTICIDES			
Drins (total)[7]	-	2	4
Aldrin	0.0025	-	-
Dieldrin	0.0005	-	-
Endrin	0.001	-	-
Atrazin	0.00005	3	6
Azinphosmethyl	-	-	2*
Carbaryl	-	2.5	5
Carbofuran	-	1	2
DDT/DDD/DDE (total)[6]	0.0025	2	4

HCH compounds (total of 4)[8]	-	1	2
α-HCH	0.0025	-	-
β-HCH	0.001	-	-
γ-HCH	0.00005	-	-
Maneb	-	17.5	35
Chlorodane	-	2	4
Heptachlor	-	2	4
Heptachloro-epoxid	-	2	4
Endosulfan	-	2	4
Organotin compounds	-	1.25	2.5
OTHER POLLUTANTS			
Acrylonitril	-	-	0.1*
Butanol	-	-	30*
Butylacetaat	-	-	100*
Cyclohexanon	0.1	22.5	45
Diethyleenglycol	-	-	270*
Ethyleenglycol	-	-	100*
Phtalates (total)[9]	0.1	30	60
Formaldehyde	-	-	0.1*
Methanol	-	-	30*
Methyltertbutylether (MTBE)	-	-	100*
Methylethylketon	-	-	35*
Mineral oil[10]	50	2,525	5,000
Pyridine	0.1	0.3	0.5
Styrene	0.1	50	100
Tetrahydrofuran	0.1	1	2
Tetrahydrothiophene	0.1	45	90

Target and intervention values for micropollutants for groundwater, µg/l, unless otherwise stated			
Substance	**Target value**	**Half way value**	**Intervention value**
METALS			
Antimonium	-	10	20
Arsenic	10	35	60
Beryllium	-	-	15*
Barium	50	337.5	625
Cadmium	0.4	3.2	6
Chromium	1	15.5	30
Cobalt	20	60	100
Copper	15	45	75
Mercury	0.05	0.17	0.3
Lead	15	45	75
Molybdenum	5	152.5	300
Nickel	15	45	75
Zinc	65	432.5	800
Silver	-	-	40
INORGANIC COMPOUNDS			
Cyanide (complex-pH < 5)1	10	755	1,500
Cyanide (complex-pH > 5)	10	755	1,500
Cyanide-free	5	752.5	1,500
Thiocyanates (total)	-	750	1,500
AROMATIC COMPOUNDS			
Benzene	0.2	15.1	30
Catechol	-	625	1,250
Cresolen (total)	-	100	200
Dodecylbenzene	-	-	0.02*
Ethylbenzene	0.2	75	150
Phenol	0.2	1.000	2,000
Hydroquinone	-	400	800
Resorcinol	-	300	600
Toluene	0.2	500	1,000
Xylenes	0.2	35	70
Aromatic solvents	-	-	150*
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)			
Anthracene	0.02	2.5	5
Benzo(a)anthracene	0.002	0.25	0.5
Benzo(a)pyrene	0.001	0.025	0.05
Benzo(ghi)perylene	0.0002	0.025	0.05
Benzo(k)fluoranthene	0.001	0.025	0.05
Chrysene	0.002	0.1	0.2
Phenanthrene	0.02	2.5	5

Fluoranthene	0.005	0.5	1
Indeno (1,2,3-cd)pyrene	0.0004	0.025	0.05
Naftalene	0.1	35	70
CHLORINATED HYDROCARBONS			
1,1-Dichloroethane	0.01	450	900
1,2-Dichloroethane	0.01	200	400
1,2-Dichlorethene (total of cis and trans)	0.01	10	20
Dioxine	-	-	0.001 ng/l*
Chloronaftalene	-	3	6
Dichlorobenzenes (total)	0.01	25	50
Dichlorofenoles (total)	0.08	15	30
Dichloromethane	0.01	500	1,000
Hexachlorobenzene	0.01	0.25	0.5
Monochlorobenzene	0.01	90	180
Monochlorophenoles (total)	0.25	50	100
Pentachlorobenzene	0.01	0.5	1
Pentachlorophenol	0.02	1.5	3
Polychloorbifenyles (total)5	0.01	0.01	0.01
Tetrachlorobenzenes (total)	0.01	1.25	2.5
Tetrachloroethene	0.01	20	40
Tetrachlorophenoles (total)	0.01	5	10
1,1,1-Trichloroethane	0.01	150	300
Tetrachloromethane	0.01	5	10
Trichlorobenzenes (total)	0.01	5	10
Trichloroethene	0.01	250	500
Trichlorophenoles (total)	0.025	5	10
Trichloromethane	0.01	200	400
Vinylchloride	-	2.5	5
PESTICIDES			
Drins (total)	-	0.05	0.1
Aldrin	(d)	-	-
Dieldrin	0.00002	-	-
Endrin	(d)	-	-
Atrazine	0.0075	75	150
Azinphosmethyl	-	-	2*
Carbaryl	0.01	25	50
Carbofuran	0.01	50	100
DDT/DDD/DDE (total)6	(d)	0.005	0.01
HCH compounds (total of 4)8	-	0.5	1
α-HCH	(d)	-	-
β-HCH	(d)	-	-
γ–HCH	0.0002	-	-
Maneb	(d)	0.05	0.1

Chlorodane	-	0.1	0.2
Heptachlor	-	0.15	0.3
Heptachloro-epoxid	-	1.5	3
Endosulfan	-	2.5	5
Organotin compounds	-	0.35	0.7
OTHER POLLUTANTS			
Acrylonitril	-	-	5*
Butanol	-	-	5,600*
Butylacetate	-	-	4,100*
Cyclohexanon	0.5	7,500	15,000
Diethyleenglycol	-	-	13,000*
Ethyleenglycol	-	-	5,500*
Phtalaten (total)9	0.5	2.75	5
Formaldehyde	-	-	50*
Methanol	-	-	24,000*
Methylethylketon	-	-	6,000*
Methyltertbutylether (MTBE)	-	-	9,200*
Mineral oil	50	325	600
Pyridine	0.5	15	30
Styrine	0.5	150	300
Tetrahydrofuran	0.5	150	300
Tetrahydrothiophene	0.5	2,500	5,000

Notes to table 1:

1. Indicative level for serious contamination
   Acidity: pH (0.01 M $CaC1_2$). In order to determine whether pH is greater than or equal to 5, or less than 5, the 90 percentile of the measured values is taken.
2. PAH (total of 10) here means the total of anthracene, benzo(a)anthracene, benzo(k)fluoroanthene, benzo(a)pyrene, chrysene, phenantrene, fluoroanthene, indeno(1,2,3-cd)pyrene, naphthalene and benzo(ghi)perylene.
3. Chlorobenzenes (total) here means the total of all chlorobenzenes (mono-, di-, tri-, tetra-, penta- and hexachlorobenzene).
4. Clorophenols (total) here means the total of all chlorophenols (mnono-, di-, tri-, tetra- and pentachlorophenol).
5. In the case of the intervention value, 'polychlorobiphenyls (total)' means the total of PCBs 28, 52, 101, 118, 138, 153 and 180. For the target value it refers to the total exluding PCB 118.
6. DDT/DDD/DDE' above means the total of DDT, DDD and DDE.
7. Drins' above means the total of aldrin, dieldrin and endrin.
8. HCH compounds' above means the total of α-HCH, β-HCH, γ-HCH and δ-HCH.
9. Phthalates (total)' above means the total of al phthalates.
10. Mineral oil' above means the sum of all the alkanes, both straight-chain and branched-chain. Where the contamination is due to mixtures (e.g. gasoline or domestic heating oil), then not only the alkane content but also the content of aromatic and/or polycyclic aromatic hydrocarbons must be determined. This aggregate parameter has been adopted for practical reasons. Further toxicological and chemical disaggregation is under study.

11. The values for total polycyclic aromatic hydrocarbons, total chlorophenols and total chlorobenzenes in soil/sediments apply to the total concentration of the compounds belonging to the relevant category. If the contamination is due to only one compound of a category, the value used is the intervention value for that compound, where there are two or more compounds the value for the total of these compounds applies, etc.

For soil/sediment, effects are directly additive (i.e. 1 mg of substance A has the same effect as 1 mg of substance B) and can be checked/compared against an aggregate standard by summing the concentrations of the substances involved. For further information about the this additivity see, for example, the Technical Committee for Soil Protection (1989)[4]. In the case of groundwater, effects are indirect, and are expressed as a fraction of the individual intervention values before being summed (i.e. 0.5 of the intervention value of substance A has the same effect as 0.5 of the intervention value of substance B). This means that an addition formula must be used to determine whether an intervention value is exceeded. The intervention value for a category of substances is exceeded if:

$$\frac{\Sigma \text{ conc.i}}{\text{Ii}} \geq 1,$$

where: $Conc_i$ = measured concentration of substance i in the category concerned

I_i = intervention value for substance i.

'Trigger function' of EOX
No intervention value has been set for EOC1 or EOX. This is because the use of such a parameter has no value in toxicological terms. Estimation of the EOX content therefore serves no purpose in deciding whether a case of serious soil contamination has occurred. An EQX test can, on the other hand, provide a so-called trigger function. It can be used to indicate whether intervention values for individual halogen compounds may be being exceeded.

Correction for soil type
Inorganic compounds
The intervention values for heavy metals (including arsenic) in soil/sediment depend, like the target values, on the clay content and or the organic material content. In assessing the quality of the soil at a given location the values for a standard soil are converted to values applying to the actual soil concerned on the basis of the measured organic material (measured by percentage weight 1ost by volatilisation, on the total dry weight of the soil) and clay content (the percentage by weight of the total dry material comprising mineral particle matter with a diameter less than 2 µm in diameter). On this basis, relevant mean values are determined for the clay and organic material content. The converted values can then be compared with the measured concentrations of metals in the soil.

[4] Technical Committee for Doil Protection (1989). 'Advies beoordeling an bodemverontreiniging met polycyclische aromaten' (Advice regarding the assessment of soil contaminated with polysyclic aromatics). TCB A89/03

The following soil type correction formula can be used for this calculation:

$$Ib = Ist * \frac{A + B * \%lutum + C * \%org.stof}{A + B * 25 + C * 10}$$

where:

Ib	=	intervention value
Ist	=	intervention value
%lutum	=	measured percentage clay in the soil being evaluated
%org. mat.	=	measured percentage organic matter in the soil being evaluated
A, B and C	=	constants which depend on the substance (see table 2)

In order to apply the soil type correction to target values, the intervention values in the formula (I_b and I_{st}) are replaced by target values.

Table 2. Substance-dependent constants for metals

Substance	A	B	C
Antimonium	1	0	0
Arsenic	15	0.4	0.4
Barium[1]	30	5	0
Beryllium	8	0.9	0
Cadmium	0,4	0.007	0.021
Chromium	50	2	0
Cobalt[1]	2	0.28	0
Copper	15	0.6	0.6
Mercury	0,2	0.0034	0.0017
Lead	50	1	1
Molybdenum[2]	1	0	0
Nickel	10	1	0
Silver	1	0	0
Zinc	50	3	1.5

Notes to tabel 2:

1. The constants for barium and cobalt are taken from the report 'Achtergrondgehalten van negen sporen-metalen in oppervlaktewater, grondwater en grond van Nederland' (Background concentrations of nine trace metals in surface waters, groundwater and soil in the Netherlands); J.H.M. de Bruijn and C.A.J. Denneman (1992). Soil protection publication series l992/1.
2. No soil type correction is applied for molybdenum.

If measuring problems are caused by low organic matter or clay content, values of 2% can be assumed for both organic matter and clay. As measuring methods improve this will no longer be necessary.

In the case of the other inorganic compounds, the intervention values are not related to soil characteristics. This means that the same intervention values and target values will apply for al soils.

Organic compounds
The intervention and target values for organic compounds are related to the content of organic matter in the soil. In evaluating the quality of a given soil, the values for a standard soil are divided by 10 and multiplied by the measured content of organic material. The values converted in this manner can be compared with the measured content of organic compounds.

As a formula:

$$Ib = Ist * \frac{\%org.mat}{10}$$

where:

I_b = intervention value applying for the soil being evaluated (mg/kg)
I_{st} = intervention value for the standard soil (mg/kg)
%org.mat. = measured percentage organic matter in the soil. Where the organic matter measured is more than 30% or less than 2%, values of 30% and 2% respectively are used.

In order to apply the soil type correction to target values, the intervention values in formula (2) (I_b and I_{st}) are replaced by target values.

Groundwater
The intervention and target values for both organic and inorganic compounds in groundwater are independent of soil type.

Use of soil type correction
Intervention and target values are corrected for type of soil by taking account of the content of organic material and clay in the soil being investigated. Using the soil type correction formulae given, the appropriate intervention and target values can be calculated for any soil type.

In the everyday world it is often the case that many soil samples containing many different contaminants require evaluation. It may be simpler to adjust the measured concentrations to values appropriate for a standard soil (rather than adjusting the intervention and target values to allow for the properties of the soil being evaluated). The correction formulae can readily be modified in this way. The result of the assessment remains the same.

Figures

Appendix 12
Project sheets

Title	Vision for sustainable development of Nizhnevartovsk Region
Country	Russia
Location	Nizhnevartovsk Region
Project Owner	Nizhnevartovsk Regional Environmental Committee
Type of Project	Study of 1 to 2 years
Project Area	Physical planning Master planning Regional environmental action plan Institutional strengthening
Project Objective	The project aims to develop a vision for the sustainable development of Nizhnevartovsk Region in close consultation with relevant parties
Project Background	The Nizhnevartovsk Region is heavily polluted. Every year around 1500 accidents occur in the Region. Oil companies occupy today around 52,000 ha for exploitation. In total some 3500 (official reported figures) to 30,000 ha (Nature Development Institute) of land is polluted. Surface water and bottom sediment is contaminated. Low operational standards in the industry create health and safety hazards, air, water and soil pollution. All this makes the Nizhnevartovsk Region an environmental disaster in Western Siberia. A complete clean up of the Region will take billions of US dollars. Such sums will not be available in the coming years. Therefore, a pragmatic approach is required. First step in such approach is to articulate a vision for future development of the Region, so that environmental priorities can be identified accordingly.
Project Description	The project aims to create a healthier environment in Nizhnevartovsk Region and explores opportunities to revitalise and restore the Region. The project aims to bring together the key stakeholders: citizens, industry (public and private sector), service agencies and various authorities in order to come up with directions for: Role of the Region for Western Siberia as a whole; Development of the main sectors in the economy; Urban and rural planning; Delivery of services like water supply, sanitation and waste management; Sustainable solutions for existing environmental problems Elaboration of the concept of functional remediation; Institutional improvement. Most time will be devoted to communication between the above mentioned parties and seeking consensus on major issues. The project may be built around thematic meetings that are prepared in consultation with specific stakeholders. In these meetings participants exchange ideas, express views and define common ground. The project may also include consultations with sustainable development commission from other countries. The project will result in a report that describes the vision, addresses institutional and socio-economic constraints, and identifies necessary actions.
Project Cost	100,000 – 250,000 US Dollar
Potential Funding	Tacis EBRD Global Environmental Fund

Title	Recovery of oil products from oil storages in Nizhnevartovsk Region
Country	Russia
Location	Nizhnevartovsk Region
Project Owner	Oil Companies, Nizhnevartovsk Regional Environmental Committee
Type of Project	Investment with research survey component
Project Area	Oil spill/pollution prevention Solid and hazardous waste management
Project Objective	Reduced loss of oil products and chemicals from storages into the environment of Nizhnevartovsk Region
Project Background	Since the beginning of oil production activities in Nizhnevartovsk Region some 7000 storages have been built. For more than 5000 of them, the only protective measure is that they are covered with sand. They do not have protection layers to prevent polluting substances from flowing into the soil and ground water. Containing oil, chemicals and drilling by-products, these storage places are a permanent source of pollution. Wastes have accumulated during many decades and continue to be generated at present. It contains substantial amounts of oil products, which means that valuable product is lost.
Project Description	The proposed activity is a feasibility study on the issue including an inventory of the various types and quantities of oil waste and an evaluation of (alternative) treatment techniques. Preferred technologies will be identified, conceptual designs for facilities and (alternative) institutional arrangements for operation will be evaluated. The study will conclude on the financially feasible of the different alternatives. However the conclusion heavily depends on the market price for the recovered oil products. The investment part could include: Detailed design of a treatment facility Procurement of equipment and installation Training of operators operation and maintenance environmentally sound disposal of residues
Project Cost	Project cost may range between 1.5 and 3 million USD, depending on design decisions.
Potential Funding	Tacis Oil companies

Project Title	Nizhnevartovsk Region Environmental Awareness Programme
Country	Russia
Location	Nizhnevartovsk
Project Owner	Nizhnevartovsk Regional Environmental Committee, Consultant
Type of Project	Programme of 1 to 2 years
Project Area	NGO support Awareness raising within industry and local government Media communication
Project Objective	The project aims to promote environmental awareness through communication with relevant target groups and implementation of small-scale awareness raising projects in various sectors.
Project Background	The Nizhnevartovsk Region is heavily polluted. Every year around 1500 accidents occur in the Region. In total some 3500 (official reported figures) to 30,000 ha (Nature Development Institute) of land is polluted. Surface water and bottom sediment is contaminated. Low operational standards in the industry create health and safety hazards, air, water and soil pollution. All this makes the Nizhnevartovsk Region an environmental disaster in Western Siberia. A complete clean up of the Region will take billions of US dollars. Such sums will not be available in the coming years. Small-scale projects that focus on awareness raising and improvement in information dissemination help establish the necessary momentum for a more comprehensive cleanup and motivate all parties concerned. Successful examples of such grants programmes are available in Central and Eastern Europe.
Project Description	The project basically manages a fund for implementation of small-scale projects. Interested parties can submit proposals for projects ranging from education and training to information dissemination to the public and support for local NGO's. Proposals should meet certain criteria in order to be eligible. Selected proposals are awarded a grant. The project is subdivided in a preparation part and an implementation part. Preparation includes: defining scope of the programme and criteria for eligibility preparation of a transparent procedure for application and evaluation; public relations for the grants programme. Implementation includes: review of applications and discussions with applicants; evaluation of applications; contracting; monitoring of project implementation and advice; technical and financial finalisation; after care.
Project Cost	Project management: 100,000 – 200,000 US Dollar Implementation: 200,000 US dollar
Potential Funding	Matra Global Environmental Fund

Title	**Nizhnevartovsk Region Environmental Medical Research Programme**
Country	Russia
Location	Nizhnevartovsk Region
Project Owner	Nizhnevartovsk Regional Environmental Committee, Health Authorities (State Service Sreda-Zdorovie) & Clinics in Tyumen & Khanty Manski Oblast
Type of Project	Research
Project Area	Environmental oil pollution and health
Project Objective	Scientific analysis to identify links between oil pollution and health in Nizhnevartovsk Region. The overall aim is to identify the major health hazards from oil pollution to enable future health planning and prevention.
Project Background	Nizhnevartovsk has one of the highest rates among Russian cities of diseases caused by a poor environment. Oncological diseases are 2 to 3 times higher than anywhere else in Russia, within the 15 to 49 age group and cardiological diseases exceed the Russian average by 9 times, while endocrinological diseases exceed the average indicator 2 to 5 times. The indirect impacts of oil pollution are suspected by medical professionals in the region to also contribute to higher rates of child mortality, shorter life expectancies and child abnormalities and deaths. However the extent to which oil pollution has resulted in these higher than average poor health statistics has not been quantified.
Project Description	The proposed project is a research project which aims to investigate suspected correlation's between oil pollution as a contributing causal factor to the above average incidence of major diseases linked to a poor environmental situation in the Region. The research will build on the current work of the State Service and Oncological Clinics in the region. Its results will assist health officials in healthcare planning. The project will publicise and disseminate its results with the aim of alerting environmental authorities and the public as to the highest risks to human health from oil pollution and the oil sector. Its dissemination will also be directed at assisting decision-making regarding where remediation and mitigation efforts should be directed in order to decrease these statistics to more acceptable levels. Two kind of projects could be distinguished: with a local orientation; investigating health hazards and health effects from the oil industry (including occupational health) and more regional orientated investigations; taking into account the overall conditions of life in remote area's.
Project Cost	Project cost may range between 100,000 and 500,000 USD
Potential Funding	State Health Service Global Environment Fund Oil companies

Title	Decommissioning of abandoned oil wells in Nizhnevartovsk Region
Country	Russia
Location	Nizhnevartovsk Region
Project Owner	Different Oil Companies, Nizhnevartovsk Regional Environmental Committee
Type of Project	Investment with research survey component
Project Area	Oil spill/pollution prevention Solid and hazardous waste management
Project Objective	Reduced risk of oil pollution from abandoned oil wells and improved quality of the environment
Project Background	Obsolete infrastructure is a major liability for the oil industry in the Nizhnevartovsk Region and decommissioning is therefore a major challenge for the coming decades. It is reported that some 3500 oil wells wait to be sealed up, because their exploitation had become uneconomical. If such wells are not decommissioned properly they are a continuous source of pollution. Worse, the wells (or injection wells as reported) may not have been constructed properly in the first place, resulting in leakage through the annular space between casing and borehole wall. Risk of oil pollution from these wells is high, threatening the environment in Nizhnevartovsk Region.
Project Description	The project is meant as a pilot project for decommissioning of obsolete infrastructure in the Nizhnevartovsk Region. The project includes a study and an implementation component. The study encompasses a baseline survey, a risk assessment and a selection of techniques for the (safe) decommissioning/plugging of the wells. The implementation component includes the plugging of five wells. Based on results, a cost benefits analysis can be made as well as an estimate of total costs of decommissioning.
Project Cost	survey, risk assessment and feasibility: 80,000 – 120,000 USD pilot plugging/decommissioning (5 wells): 100,000 – 500,000 USD
Potential Funding	World Bank/IFC (small grants programme) Oil Companies (in kind: man power for survey, logistics) International oil industry (technical assistance)