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Krasnodar GRES Project

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Environmental Assessment

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The North Caucasus region of Russia has a significant electric power capacity deficit and within this region the Krasnodar power system has the biggest deficit. Existing generating capacity in the Krasnodar Krai is approximately 75% of the projected demand in the year 2000, and many power stations are old and operating beyond their design life. To address this electric power deficit, a joint stock company has been formed with the objective of constructing a new gas turbine combined cycle power plant near Mostovskoy. The identified shareholders in the new joint stock company (referred to as "Kuban GRES") are RAO EES Rossii, AO Kubanenergo, RAO Gazprom, AO Energo Machine Building Corporation, Unified Electric Energy Complex Corporation, and the administrations of the Krasnodar Krai and Mostovskoy District. The proposed power plant facility is called Krasnodar GRES.

The Mostovskoy site was originally selected, in the mid-1980's, as a site suitable for construction of a nuclear plant. The plans for a nuclear plant were subsequently canceled. Site investigations were later carried out for a fossil power plant and a preliminary feasibility report was prepared in 1991 by Rostovteploelectroproject (RoTEP), the Design Institute in Rostov. This report recommended that the site be developed for a 1,350 MW combined cycle plant. The feasibility report prepared by RoTEP provides the basis for the current project.

This Environmental Assessment report was generated from data and information supplied by Krasnodar State Agricultural University (KSAU) and Russian Oil Initiatives Limited (ROIL) under the direction of Burns and Roe.

1.2 Project Description

In order to address the electric power deficit in the North Caucasus region, a natural gas fired combined cycle power plant is proposed to be built near the village of Mostovskoy in the Krasnodar Krai of Russia.

The Krasnodar GRES plant is a 900 MW combined cycle plant with future planned expansion to 1,350 MW. It is composed of two modular blocks of 450 MW each, with each block containing two combustion turbines of 150 MW capacity, two heat recovery steam generators (HRSGs), and one 150 MW steam generator. Using modern combustion technology, power plant efficiency is estimated at 50.4% with a plant availability factor of approximately 90%. The plant will use a dry cooling tower system to eliminate the need to withdraw large quantities of water from the Laba River and will be fueled with natural gas. The gas will be

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supplied from a new 60 kilometer pipeline connected to the Trans-Caucasus gas pipeline.

Site investigations to assess both the design considerations and the plant design bases necessary for construction and operation, have previously been carried out during the Feasibility Studies conducted by RoTEP. These studies include the hydrology, geology, and meteorological aspects of the subject site.

The plant will be connected to the existing 220 kV and 500 kV transmission systems in the North Caucasus Region. New transmission lines will be constructed for this purpose and the existing transmission lines running through the site will be rerouted.

Transmission line design was accomplished by carrying out a detailed study of the region's existing transmission system to determine the upgrades that will be required to bring 900 MW of new capacity on line. These studies included detailed load flow and fault analysis, dynamic studies and system stability studies.

1.2.1 Site Description

The project site is located approximately 5 km south of the settlement of Mostovskoy and approximately 2 kilometers from the Laba River. The site, approximately 130 hectares of level farmland, is in a valley with hills on both sides, and slopes towards the north with elevations varying from 410 to 416 meters. There is an existing drainage ditch on site which carries storm water from the adjacent hilly areas on the south. There are no known sensitive ecological areas, such as critical habitats, bird nesting areas, or biosphere reserves, either on or sufficiently proximate to be impacted by plant, transmission line, or water pipeline construction or operation. The land for the project has been secured by Kubanenergo from the local government. The top 0.8 to 1.5 meters of soils consists of excellent top soil that will require removal from the construction areas and reuse or disposal. The next 6 to 15 meters consists of large gravel mixed with clay and sand. Below the gravel there is a solid layer of water tight clay up to 150 meters deep. The water table is approximately 2 meters from the existing ground surface. There is an existing 110 kV transmission line running through the site.

1.2.2 Infrastructure

There are several district infrastructure improvement projects that the project Ownership Group has undertaken in support of the Krasnodar GRES project. The existing Mostovskoy water treatment plant is in the final stages of expansion in anticipation of the increased need for capacity due to the construction and operation of the Krasnodar GRES facility. In addition, a potable water pipeline is being planned which will improve the reliability of the Mostovskoy potable water system. Previously completed infrastructure improvements in support of the Krasnodar GRES include asphalt and cement production facilities and housing construction for management and senior staff of the power plant.

1.3 Potential Environmental Impacts

A thorough environmental impact assessment was conducted for the Krasnodar GRES and is included as Chapter 5 of this Environmental Assessment (EA). Potential environmental impacts during construction and operation of Krasnodar GRES were evaluated based on current site conditions, previously conducted studies, and mathematical modeling. No significant negative environmental impacts are anticipated during normal construction and operating conditions. In addition, design considerations, administrative controls, and engineering controls will be implemented to reduce the likelihood of negative environmental impacts during upset conditions and accidents/acts of nature.

An analysis of potential environmental impacts can be summarized as follows:

Positive Impacts

- Additional facilities (associated with construction) shall contribute to general development of the district and will have direct and indirect positive impacts on revenues and living standards of the population.

- Electricity generated by the plant will contribute to economic, industrial, and agricultural development in the entire Krasnodar Territory and further increase employment opportunities.

- The quality and reliability of the water supply for Mostovskoy village will improve due to the commissioning of a water intake in Andryuki village associated with the project.

- The construction of housing, sports facilities, medical centers, transportation, and other facilities associated with the project will cause considerable socio-economic improvement due to increased employment opportunities and improved living standards.

- There will be no resettlement of the population.

Insignificant Impacts

- The power plant facilities will not have a negative environmental impact on the ecological system of the Caucasus biosphere reserve and will not disrupt its reservation regulations.
- Impacts on surface and ground water, accounting for the mitigating measures to be taken, shall be insignificant.
- Impacts on aquatic and terrestrial biota shall be insignificant.
- Impacts caused by noise are not anticipated due to the noise mitigation measures to be taken.
- The proposed routings of the transmission lines are far enough away from population centers such that EMF exposure will not exceed regulatory limits.
- As no known flight paths intersect proposed transmission line routings, there will be no impact on bird migration.
- There will be no impact on general topography and land use in the area.
- Disposal of silty wastes from the process water treatment plant is considered to be an insignificant positive impact on the local population due to the agricultural benefits of land application of the silty wastes.

Minor Impacts

- Concentrations of SO_2 and NO_x in the atmosphere due to power plant emissions will increase slightly but will have an insignificant impact on air quality. The expected concentration increase will be within permissible limits.

The environmental impact assessment performed in accordance with Section 1.4 of the existing Russian Regulations for EIAs shows that the proposed Krasnodar GRES project meets the environmental requirements of the legislation of the Russian Federation.

1.4 Environmental Management Plan

Kuban GRES will have a Health & Safety Department and a separate Environmental Department. The number of personnel will be based on the power plant staffing structure. Department personnel responsibilities will be assigned based on statute laws, standards and regulations and will be described in the Department Regulations and appropriate operating instructions which are currently being developed by Kuban GRES.

1.4.1 Water Management

A system of management, institutional, and engineering controls will be established at Krasnodar GRES during construction and operation to ensure that all waters discharged will conform to permitted water quality parameters.

1.4.2 Emissions Monitoring

A continuous emission monitoring system shall be installed at Krasnodar GRES to ensure that the plant is operating within permitted limits.

1.4.3 Training

Environmental training programs in the areas of air and water quality monitoring, solid waste management, noise abatement, health and safety monitoring, and operation and maintenance of environmental monitoring equipment will be conducted at the Krasnodar GRES.

1.4.4 Emergency Response

An emergency response plan with appropriate staff assignments is currently being developed by Kuban GRES.

1.4.5 Mitigation Measures

Mitigation measures presented in Chapter 8 are segregated into two categories to reflect the potential impacts associated with construction and operation of the proposed Krasnodar GRES. Each phase of the project will involve specific activities which have the potential to generate environmental and socio-economic impacts. The proposed mitigation measures presented in Chapter 8 are intended to either minimize an impact or, wherever possible, to prevent the impact completely. A qualitative ranking of impacts (e.g., insignificant, moderate, severe, positive and negative) and the associated mitigation measures have been addressed in tabular form in Chapter 8 as follows:

Construction Activities

Potential Impacts

- Site Clearing - Dusting, vehicular emissions, erosion\runoff, loss of vegetation

- Site Earth Work - Dusting, vehicular emissions, erosion\runoff, loss of vegetation

- Road Construction - Dusting, vehicular emissions, erosion\runoff, loss of vegetation

- Site Building Construction - Dusting, noise, erosion\runoff

- Equipment Maintenance - Air emissions

- Labor Housing Construction - Dusting, vehicular emissions, erosion\runoff, loss of vegetation

- Labor Transportation - Air emissions

The above impacts will be minimized or eliminated through engineering controls and good construction practices such as dust suppression, maintaining equipment, revegetation, maintaining plans to respond to emergencies, and water and waste management.

Plant Operations

Potential Impacts

- Stack Emissions - Under unfavorable weather conditions, NO_x levels attributable to Krasnodar GRES will be less than half of the existing background levels which, when these levels are combined, will be well within the Maximum Permissible Concentration (MPC)

- Water Usage - Potential decrease in available quantity

- Process Water Discharge - Potential impacts to land and surface water due to spills or effluent pipeline rupture

- Plant Sewage Discharge - Potential impacts to land and surface water due to spills, effluent pipeline rupture, or Mostovskoy waste water treatment plant failure

- Noise Level - Potential nuisance to Local Population and Workers

- Solid Waste Disposal - Potential Recycling of materials

- Hazardous Waste Disposal - Potential impacts to surface water and groundwater if on site holding tank leaks

- Electromagnetic Frequency - No impacts anticipated

The above impacts are estimated to be negligible and therefore no mitigating measures would be required.

Thus, all impacts that have been anticipated have been correspondingly eliminated or reduced through a combination of administrative and engineering controls or good construction practice. Therefore, no permanent negative impacts are anticipated as a result of construction or operation of the Krasnodar GRES. In fact, there are several overall positive impacts associated with construction and operation of the proposed facility.

1.4.6 Monitoring Requirements

Routine environmental monitoring of Krasnodar GRES activities, which is presented in Chapter 9, will be conducted in two stages: monitoring during construction and monitoring during operations. In both stages, monitoring data will be archived on-site and will also be submitted to the appropriate officials of the Ministry of Environmental Protection and Natural Resources (MEPNR) and to the representative of the Public Environmental Control Commission (PECC). The PECC shall be formed by a special decree of the Mostovskoy Region. In addition, one time background monitoring will be conducted prior to construction activities.

<u>Background Monitoring</u>

Prior to commencement of construction activities, the following areas shall be evaluated in order to establish up-to-date baseline conditions:

- Water quality parameters shall be measured in the Laba River 0.5 km upstream from the discharge point of the Mostovskoy wastewater treatment plant;

- Drinking water parameters shall be measured from the potable water intake;

- Noise levels shall be measured at and beyond the Krasnodar GRES facility boundaries.

- The World Bank recommends that baseline monitoring of NO_x in the Caucasus biosphere reserve begin as soon as possible and continue through the operational phase of the plant.

Monitoring During Construction

Noise and dust will be measured in and around the Krasnodar GRES site on a monthly basis. Exact monitoring locations shall be approved by the PECC representative. In addition, CO and hydrocarbon emissions will be measured for on-site motor vehicles which lack an official exhaust inspection certificate.

Air Monitoring During Operations

A continuous emission monitoring system will measure basic parameters of plant operation (discharge velocity, temperature, etc.) as well as concentrations of NO_x, SO_2, CO, C_nH_m, O_3, and particulates in the flue gas in compliance with the Russian regulatory documents for environmental control. An automated on-site meteorological station will measure and record the following: Wind direction; Wind velocity; Temperature; and Humidity. Both the continuous emission monitoring system and the meteorological station will be connected to a central data receiving station at the facility which will archive average values of the data for 3 minute, 30 minute, and 24 hour intervals.

On-site ambient air quality measurements will be obtained by environmental control laboratory staff for particulates, NO_x, SO_2, and CO at intervals determined by PECC.

Off-site air monitoring stations are planned for the following sites:

- Mostovskoy settlement;

- Perepravnaya settlement;

- Psebai settlement;

- Caucasus biosphere reserve.

The off-site air monitoring stations will measure and record the concentrations of NO_x, SO_2, CO, C_nH_m, and Vanadium in compliance with the Russian regulatory documents for environmental control.

Environmental Monitoring During Operations

A mobile meteorological and water quality monitoring station will measure the following parameters:

Meteorological Measurements

- Temperature and humidity;
- Wind velocity;
- Wind direction;

Water Measurements

- Water level;
- Temperature;
- pH and conductivity;
- Dissolved oxygen;
- Total organic carbon;
- Toxicity determination.

The mobile meteorological and water quality monitoring station will be used at the following locations:

Surface Water Locations

- Laba River - 0.5 km downstream of the Krasnodar GRES (i.e., approximately 9 km upstream of the Mostovskoy wastewater treatment plant);
- Laba River - 0.5 km downstream of the Mostovskoy wastewater treatment plant;

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Monitoring Well Locations

- Potable water intake;
- Adjacent to the mineralized waste storage tanks;
- Outside the fenceline of Krasnodar GRES.

Exact monitoring well locations will be determined in conjunction with PECC. Water quality monitoring shall be conducted periodically at intervals established by the local environmental control bodies of the MEPNR and the sanitary-epidemiological inspectorate of the Russian Federation.

1.5 Consideration Of Alternatives

Chapter 7 identifies and evaluates reasonable alternatives to the Krasnodar GRES location, design, operation, and other parameters in order to meet the ultimate objective of providing additional electrical power in the Krasnodar Krai and alleviating the current power deficit. The purpose of the analysis is to determine any options that may be more sound or beneficial from an environmental, sociocultural, or economic perspective than the originally conceived, designed, and proposed power plant. The specific alternatives evaluated for the Krasnodar GRES and associated conclusions are summarized below:

- The No Action Alternative: Due to the current and projected power deficit in the North Caucasus, the No Action Alternative was not considered to be a viable option.
- Alternative Power Generation Technologies: Alternative technologies evaluated included hydro power, wind energy, solar thermal, photovoltaics, and biomass energy. Due to acreage requirements, climactic considerations, cost and reliability, lead time, and the size of the North Caucasus power deficit, none of the alternative technologies evaluated is considered to be a viable alternative to the proposed project.
- Alternative Plant, Water Pipeline and Transmission Line Locations: Eighteen sites were evaluated as possible locations for the proposed power station by the Project Ownership Group. Site criteria evaluated included: land ownership, availability, and access; topography; existing and potential environmental impacts; availability of water; equipment transportation; proximity of gas pipeline; interconnection with regional transmission systems; and local infrastructure. The Mostovskoy site was determined to be the most suitable for construction and operation of the Krasnodar GRES.

In addition, the plant electric transmission lines and water pipelines shall be sited such that they will not impact flora, fauna, or ecologically sensitive areas.

- Alternative Plant, Water Pipeline and Transmission Line Designs: Transmission lines and pipelines shall be designed in conformance with International Standards acceptable to the Russian Federation and the World Bank and will not impact any ecologically sensitive areas. The proposed combined cycle natural gas plant is, by its very nature and design, one of the cleanest and most efficient fossil fuel plants available. Therefore, no alternative designs were considered to be a viable option.

- Alternative Fuel Utilization: Alternative fuels evaluated included oil, lignite and coal. Due to increased air emissions, storage considerations, and availability, no alternative fuel to natural gas was considered to be a viable option.

- Alternative Water Supplies and Intakes: The current plant design requires process water to be taken from the Laba River and a 33 kilometer potable water pipeline to be constructed. On-site wells are recommended for further analysis in order to reduce both environmental impacts on the Laba River and costs associated with a potable water pipeline.

- Alternative Sanitary and Plant Wastewater Disposal: The current proposed design of the plant wastewater system ensures that the chemical and thermal quality of all effluents will meet or exceed all appropriate Russian Federation and World Bank standards. Sanitary wastes from the proposed facility shall be directed to the existing treatment plant in Mostovskoy which will be upgraded in order to accept the anticipated increase in flow. Alternative disposal options and releases have been judged as unacceptable. Therefore, there are no viable alternatives to the current sanitary and wastewater systems.

- Alternative Solid Waste Disposal: The proposed waste disposal plan calls for environmentally safe disposal and recycling and reuse of a portion of wastes generated. No viable alternatives to the current solid waste disposal plan were identified.

- Alternative Pollution Control Systems and Equipment: The proposed pollution control systems will cause all liquid and gaseous plant effluents to meet or exceed all Russian Federation and World Bank requirements. Therefore, no viable alternatives to the current pollution control systems were identified.

Each of these alternatives, which is described and discussed in Chapter 7, is evaluated for its advantages and disadvantages according to its overall effectiveness, feasibility, implementability, cost, and regulatory and community acceptance as appropriate and consistent with this project's objectives and the environment and infrastructure in the Krasnodar Krai and Mostovskoy areas.

The only viable alternative requiring further investigation of those evaluated concerned an alternative water supply. It was recommended that the installation and use of on-site wells be investigated as an alternative to water from the Laba River.

1.6 Consultation With Affected People

Guidance documents of the World Bank and the Russian Federation stress the importance of public participation in development projects. In accordance with Russian practice, preliminary meetings to discuss the Krasnodar GRES have been held with various governmental and nongovernmental organizations (NGOs). These meetings included:

1. Ownership Group, Regional Environmental Committee, Consultants, 23 February, 1995.

2. Krasnodar Regional Environmental Committee (KREC) 18 April and 24 August 1995.

3. Kuban Folk Peoples Academy of Environment (NGO) 25 May 1995.

4. KREC Department of Regional Environmental Expertise, September 1995.

5. Mostovskaya District Administration, 2 July 1995.

6. Mostovskaya District Representatives, 12 July 1995.

7. Public Hearing of Governmental and Non-Governmental Organizations, 26 December 1995.

The public hearing held on 26 December 1995 was held in accordance with World Bank guidelines. This public hearing was attended by governmental and non-governmental organizations as well as members of the mass media. The public hearing concluded with the generation of a signed decree stating that the Krasnodar GRES project has been found to be acceptable from a technological and environmental standpoint.

In addition, several public meetings were held to support the previously prepared 1991 RoTEP Feasibility Study, including:

1. 4 February 1991 - Meeting with the public of the Mostovskoy Township.

2. 17 August 1992 - Meeting of citizens employed in Brigade #2 of the Frunze Collective Farm.

3. May 1993 - Meeting in Mostovskoy.

4. 18 August 1995 - Meeting of citizens of the Frunze Collective Farm in the Perepravnaya Settlement.

Documentation of public meetings\hearings is included in Chapter 11.

1.7 Institutional Requirements

In conjunction with engineering and administrative controls, effective environmental management and planning during the construction and operation of the Krasnodar GRES is required to prevent any adverse impact on the surrounding environment.

During the course of the development phase, the Owners Group will evolve into the project company, Kuban GRES. This company will manage the implementation of the project from issuing the invitation to bids through plant operation.

The project development phase of the project includes the development work by the Owner and its consultants, e.g., land acquisition, feasibility studies, environmental impact statements and regulatory permits. Sources of debt and equity financing and project contracts are also developed. This work is in progress.

During the construction phase of the project Kuban GRES will appoint a Project Manager who will have the overall technical and project management responsibility for administering the turnkey EPC contract. All functions of the project namely, purchasing, contract administration, engineering, construction, project control, schedules, costs, and quality control and assurance will report to the project manager. The project manager will be the sole point of contact for project contractors and will be responsible for resolving all contractors' issues relating to schedule, cost, change orders and will be responsible for controlling the budget. All correspondence from and to contractors will be by the project manager only.

The project management team will be responsible for review of design, engineering, procurement specifications submitted by the contractor for Owner's review and oversee construction to ensure that engineering, construction, and procurement are in compliance with the contract documents, applicable codes and standards, local and federal government regulations and conditions of environmental permits. The project management team will interface with the utility, the gas company, the oil supply company, the water supply company, the local government and the environmental authorities.

During the operation phase of the project Kuban GRES will be structured to take over from the project development organization at the close of construction and to transition smoothly into an organization representative of power utility operations. Prior to plant startup, and before staffing is in place, programs must be established to provide the necessary training to all operating, maintenance, technical, and clerical employees Detailed training programs must be developed to insure all members of the various crafts are tested to be competent in their respective work areas. These should include:

- Operator Training
- Maintenance Training
    - Electrical
    - Mechanical
    - Welding
    - Instruments and Controls
- Chemistry
- Equipment Operators
- Industrial Safety
- Management Information Systems
- Inventory Control
- Environmental Control
- Fuel Handling

Training facilities should be installed at an early stage in construction to provide for adequate training time of personnel prior to startup.

1.8 Gas Pipeline

A separate Environmental Assessment (EA) Report of the gas pipeline has been prepared. The gas pipeline portion of the overall project is being treated as a separate project because the pipeline will be constructed and owned by a different corporate entity than the Krasnodar GRES. The pipeline EA presents pipeline routing alternatives and associated mitigation recommendations to be incorporated into the environmental design specifications for the pipeline project once a route has been selected.

The pipeline EA makes a preliminary recommendation of pipeline routing along the river terraces that flank the west side of the Laba River valley and along the Khodz River valley, through the Adygey Autonomous area and the Mostovskoy District for a total length of approximately 41 kilometers. The specific conclusions and recommendations of the gas pipeline EA are:

1) Based on information provided by the Russian counterparts, it appears that the recommended routing is the most appropriate from an environmental and technical perspective. It is the shortest of the four routes; involves only one major river crossing, over the smaller of the region's two major rivers; passes through more stable terrain which appears to be less prone to landslides and gully erosion than the other options; and involves less impact on valley bottom soils than other routing alternatives.

2) This recommendation has been given because not enough information on sociocultural impacts of this route was available during the preparation of the pipeline EA. The gas pipeline was discussed during the 26 December 1995 Public Hearing. One attendee at the Public Hearing with administrative ties to a village along the recommended pipeline route requested a tie-in for his village to the gas pipeline. No other pipeline issues were raised at the Public Hearing.

3) Mitigation measures that have been recommended are aimed at protecting valuable agriculture soils; minimizing surface soil erosion and resulting degradation of water quality for human consumption and fish habitat; protecting remnant wildlife habitat within the area; and minimizing disruption and disturbance to local community life.

4) Once a final decision has been made on whether to proceed with the recommended route, it will be necessary to incorporate findings of the pipeline EA into a detailed design. Site specific information will be required and the mitigation measures outlined in the pipeline EA would then be incorporated into the environmental design specifications to deal or ameliorate the particular impacts identified.

1.9 Summary

Combined cycle natural gas power plants are by their very nature environmentally acceptable as a means of generating electricity. The Krasnodar GRES is no exception, and is expected to meet with all Russian and World Bank environmental requirements. The Russian language EIA has been approved by KREC, MEPNR and the Ministry of Fuels and Energy. Air emissions are preliminarily estimated to cause no long-term, significant changes in ambient air quality, nor any environmental or health impacts, in either the local Mostovskoy environment, or the IUCN Biosphere Reserve, which is located some 48 kilometers distant. The plant will be utilizing dry cooling towers, thus no long-term deleterious impacts are predicted on either water quality or availability of water for consumptive use. Additionally, no indigenous personnel resettlement is required, and the existing roadways and rail line will meet the area's transportation requirements.

The several unavoidable impacts expected during plant construction are transient, short-term, and commensurate with normal construction activities. Other potential impacts during both construction and normal plant operations are controllable, and can be readily minimized through good environmentally sensitive construction practices, and the development and use of appropriate mitigating measures.

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This section of the EA identifies and discusses the policy, legal and administrative framework upon which this EA is based. It includes information on Russian Federation Environmental Impact Assessment (EIA) policies, procedures and requirements, including:

- EIA preparation, review and approval processes,
- Current national, sectoral and local laws and regulations,
- Air and water quality criteria requirements,
- Occupational health and safety,
- Emergency response measures,
- Noise standards,
- Electromagnetic field intensities,
- Institutional responsibilities for environmental management, and
- International agreements, treaties and protocols.

Thus this section provides an overview of the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, power plant siting, land use control, and related issues as practiced in the Russian Federation.

2.1 Russian Federation EIA Requirements

The Ministry of Environmental Protection and Natural Resources of the Russian Federation (MEPNR) is a federal agency of executive power. It exercises state management and coordination in the fields of environmental protection, regulation of natural resource use, provision of environmentally sound conditions, and, together with the executive power authorities of the subjects of the Russian Federation, MEPNR is responsible for overall improvement of environmental quality. Concomitant with regulating the use of natural resources MEPNR also coordinates and approves the standards and requirements for using natural resources, as well as any economic and other activities which effect the environment. MEPNR has final approval authority for all EIAs in the Russian Federation unless they have delegated this authority to one of their regional or territorial subsidiaries, such as the Krasnodar Regional Environmental Commission (KREC).

In order to implement its functions, MEPNR has set up regional and territorial commissions, such as KREC, in the regions of the Russian Federation. These commissions are empowered to establish local governmental protection bodies upon agreement with the corresponding authorities of the local governments, and they are duly authorized state agencies of the Russian Federation in the field of environmental protection. MEPNR and its regional commissions act in close cooperation with other federal authorities, such as the Ministry of Fuels and Energy, law enforcement organizations, local governments, public associations, and other recognized non-governmental organizations. Within the Krasnodar Krai, MEPNR has established KREC to assist it in carrying out its mandated activities. The Krasnodar GRES falls under the aegis of both MEPNR and KREC.

In accord with the Law of the Russian Federation on "Conservation of the Environment" dated 19 December 1991, construction of the Krasnodar GRES power plant in the Mostovskoy district of the Krasnodar Krai meets the requirements of immediate and future environmental legislation. Therefore, environmental and economic impacts, health and welfare of the population, and other potential impacts of the plant's construction and operation are of importance. The capacity of the Krasnodar GRES exceeds 300 MW, and in accord with "Regulations for the Environmental Impact Assessment in the Russian Federation" it falls within the category of facilities requiring mandatory EIAs. The EIA was developed to meet those requirements, and investigates and evaluates environmental and health related issues for the following stages of plant development:

- Plant and associated structure design,
- Plant and associated structure construction,
- Normal operating conditions, and
- Accidents, natural disasters, and emergency operating conditions.

This EA meets all the requirements of the World Bank and the U. S. Agency for International Development and the EIA upon which this EA is based was approved by the Russian Federation.

2.1.1 EIA Preparation, Review, and Approval Process

Prior to the development of this EA a number of significant developmental steps have occurred. Official approvals have been obtained from the appropriate Russian Federation regulatory agencies on documents relating to site selection, land allotment, feasibility of the proposed power plant and other related issues including:

- Protocol of the technical meeting on construction of the recycled water supply system for the Krasnodar power plant. RAO "EES Rossii", 16 August 1995;
- Site data "Water supply system for the residential compound of the Krasnodar power plant". Engineering design agency "Krasnodarselkhozvodoprovodstroj", # 19, 15 May 1995;
- On possible emissions to atmosphere at the Krasnodar power plant site. Letter by "Kubangazprom" # 7/9-107, 8 August 1995;
- Reply by the Mostovskoj district department of state statistics # 385, 27 June 1995; and
- Reply by the Mostovskoj district central Clinic # 380, 15 June 1995.

These approvals and actions were necessary for the development of the Krasnodar GRES design and its implementation. They satisfied Russian Federation procedural requirements and became the initial bases for preparation of the EIA. Preparation, review and approval of the Krasnodar GRES EIA then includes the following major activities:

- Preparing the Statement of Environmental Impact (SEI) which includes discrete chapters and information on "Environmental Impacts", "Mitigating Measures", and "Analysis of Alternatives" for the proposed project,
- Holding Public Hearings in Mostovskoy based on the SEI, in order to inform all sides concerned about the proposed project, identify both positive and negative environmental and related impacts, and to search for mutually acceptable solutions to prevent and reduce any negative impacts,
- Incorporating the results of the Public Hearings into the EIA and submitting the complete EIA to KREC for review and approval,

- Incorporating comments from KREC into the EIA, and then submitting the EIA to MEPNR for review and approval,

- Incorporating comments from MEPNR into the EIA, and resubmitting the EIA to MEPNR for final review and approval, and

- Obtaining the "Letter of Approval" from MEPNR.

2.2 Current National, Sectoral and Local Laws and Regulations

In order to implement the law on "Conservation of the Environment", KREC, MEPNR and other Russian Federation regulatory agencies have promulgated procedural requirements for mandatory EIAs for regionally proposed facilities that have the potential for environmental impacts. With respect to an inquiry on any additional, local, requirements required in the EIA (Letter by Kubanenergo #112-25, 11 August 1995) KREC has decided on no additional requirements. Therefore, the EIA is based on Russian Federation, World Bank, U. S. Agency for International Development and, where appropriate, other international regulations, standards and guidelines. The EIA meets all requirements of the World Bank and the Russian Federation and has been approved by the Russian MEPNR, KREC and the Ministry of Fuels and Energy. The EIA also addressed those comments made to the fourth edition of the Feasibility Study by KREC, and as concurred with by MEPNR.

The EIA used the following principal Russian Federation governmental documents in developing its bases, analyses and conclusions:

- The Law of the Russian Federation On Conservation of the Environment #2060-1, 19 December 1991.

- The USSR State Committee on Environment resolution On Environmental Impacts by Economic Entities # 06-11-37, 13 December 1989.

- The Resolution by the Russian Government On Endorsement of the Statute on State Environmental Impact Assessment # 942, 22 September 1993.

- The Statute by the Ministry of Conservation of the Environment On Environmental Impact Assessment in the Russian Federation # 222, 18 July 1994.

- Recommendations by the USSR State Committee on Environment On Development of the Environmental Impact Assessment # 06-11-37, 13 December 1989.

- Regulations by the Russian Federation Ministry of Ecology On Procedures for Environmental Impact Assessment during site selection, development of feasibility studies, design, construction, reconstruction, build-up and modernization for economic entities and facilities, 1992.

- Regulations by the Main Department of the State Environmental Impact Assessment of the Russian Ministry of the Conservation of the Environment On Environmental Impact Assessment of Preliminary Project Documentation, 10 December 1993.

- Instructions by the Main Department of the State Environmental Impact Assessment of the Russian Ministry of Conservation of the Environment On Environmental Assessment of Economic and Other Activities in the Pre-Investment and Project Documentation, 15 July 1994.

- Regulations by the Ministry of Fuel and Energy On In-branch Development of EAs, Moscow, 1992.

- Building Code 1.02.01-85. Conservation of Environment.

- Building Code 3.01.04-87. Commissioning of completed facilities.

Additionally, a wide range of other legal instruments, regulatory, technical and reference documents, as well as surveys and approvals by official authorities were consulted in the preparation of the EIA.

2.2.1 Atmospheric Emissions

Nitrogen oxides (NO_x) are considered to be the only gaseous pollutant of significance in combustion of natural gas in combined cycle power plants. Emissions from Krasnodar GRES are in agreement with Article 2.8.15 "Gas turbines for turbine generators", GOST 29328-92 of the Russian Federation. This standards limits the amount of nitrogen oxide emissions to 125 milligrams/cubic meter (mg/m^3) and 86 mg/megaJoule (MJ) for natural gas plants with generating capacities greater than 300 MW. The Krasnodar GRES will use multi-stage fuel combustion with low NO_x burners which provides highly efficient combustion resulting in very low NO_x and other gaseous pollutant emissions. All types of gaseous emissions meet the requirements of the following Russian Federation regulatory documents:

- GOST 17.2.3.02-78. Conservation of Environment. Atmosphere. Rules for determining permissible emission quantities for industrial entities,

- Building Code 245 -71. Sanitary standards for industrial entities design, and
- List 3086 - 84. List of maximum permissible concentrations of pollutants in atmosphere.

Further information on allowable power plant atmospheric emissions and air quality criteria are found in Section 2.2.7, Tables 1 and 2.

2.2.2 Aqueous Effluents

The Krasnodar Power Plant is planned to have a water supply and treatment system with dry cooling towers and process water treatment systems. Drinking water will be supplied from a well field approximately 33 kilometers distant, and technical and process water will be supplied from the Laba River. The quality and quantity of discharge water, from all effluent sources, as well as water quality in the water intake, meets the following requirements:

- GOST 17.1.3.05-82. Conservation of Environment. Hydrosphere - General Requirements towards Russian Federation and underground water protection against oil and oil product pollution,
- GOST 17.1.3.06-82. Conservation of Environment. Hydrosphere - General Requirements towards conservation of underground water,
- GOST 17.1.3.13-86. Conservation of Environment. Hydrosphere - General Requirements towards Russian Federation water protection against pollution,
- GOST 17.1.5.02-80. Conservation of Environment. Hydrosphere - Hygiene requirements towards recreation zones of water facilities,
- SanRegStds 4630-88. Sanitary Regulations and Standards for protection of Russian Federation water against pollution, and
- "Methodological Regulations for maximum permissible disposal of waste discharged to water reservoirs # 13-3-05/190, 1 February 1982, Ministry of Water Management.

Specific chemical and physical liquid effluent criteria are found in Section 2.2.7, Table 3.

2.2.3 Occupational Health and Safety

The Krasnodar GRES will be designed to provide a safe and healthful labor environment. All Russian, World Bank and appropriate international standards and guidelines will be utilized in the plant's deign and operational procedures. Safety policies, procedures and regulations promulgated within divisions of Kubanenergo, a Joint Stock Ownership Company of Krasnodar GRES, complete, specify, and satisfy corresponding provisions of the Labor Code of the Russian Federation as amended by the Supreme Soviet of the Russian Federation, # 3543-1, 25 September 1992. The principal standards governing design, construction and operation of the Krasnodar GRES include:

- GOST 12.1.002-84. SSLS. Electric fields of industrial frequency - Permissible intensity levels and requirements towards control procedures at the work station,
- GOST 12.1.003-83. SSLS. Noise - General Safety Requirements, and
- GOST 12.1.005-88. SSLS. General sanitary and hygienic requirements towards air quality in the work zone.

Additional information of occupational health and safety is found in Chapter 6, and work place air quality criteria and permitted noise levels are found in Section 2.2.7, Tables 4 and 5, respectively.

2.2.4 Emergency Response Measures

In accordance with the Decree Of the President of the Russian Federation # 643, 8 May 1993 the Krasnodar GRES will have an Emergency Response Team (ERT) headed by the Plant Executive Officer. The ERT shall be provided with the necessary equipment, training, and procedures to respond quickly and appropriately to both on-site and off-site incidents and emergencies. The ERT's emergency response activities will be developed as part of the Krasnodar GRES' policies and procedures documentation. These policies and procedures will be regulated by plant and site specific operational procedures that will be developed in conformance with the Russian Federation "Law on Protection of the Population and Environment Against Emergencies of Natural and Technogenic Origin". Additional information on the management and structure of those companies responsible, in part, for emergency response measures is presented in Chapter 10.

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2.2.5 Noise

The design and construction of the Krasnodar GRES will include a complete set of noise reduction measures, such as:

- Active Measures - use of low noise equipment and effective control technologies on equipment,
- Passive Measures - mounting mufflers, noise reduction covers and shields on equipment, and
- Individual Measures - use of ear plugs and muffs.

These measures will result in noise values and potential exposures below those specified by GOST 12.1.003-89 for work stations and the site, and those specified by GOST 12.1.036-81 for residential areas. Other standards which will be employed in the design, construction and operation of the Krasnodar GRES include:

- GOST 26279-84. Energy Units for power plants using organic fuel - General noise reduction requirements,
- Regulations for calculation and design of noise reduction means for thermal power plants. TEP, NIISF, MEI, 1988,
- SS 3223-85. Sanitary standards for permissible noise at work stations and industrial sites,
- SS 3077-84. Sanitary Standards for permissible noise inside residential and public buildings and within residential compounds, and
- SSR II-12-77. Noise Reduction - Design standards.

A compilation of allowable and recommended noise exposure levels is found in Section 2.2.7, Table 5.

2.2.6 Electromagnetic Field Intensity

Technical and technological solutions in the design, construction and operation of the Krasnodar GRES will assure and provide for maintaining human and environmental health by preventing any unnecessary exposures to potentially hazardous levels of electromagnetic energy. Sources of electromagnetic radiation will be properly shielded at the plant and along transmission lines, resulting in electromagnetic field intensities below Russian Federation maximum permissible exposure levels. Additionally, adequate rights-of-way will be allocated along all transmission line routings. The design and operation of the Krasnodar GRES meets the requirements and standards of:

- SRS 2971 - 84. Sanitary Standards and Regulations for protection of the population against the impact of electromagnetic field induced by industrial frequency voltage transmission lines, and

- SS 245-71. Design sanitary standards for industrial enterprises.

Allowable electromagnetic field intensities are found in Section 2.2.7, Table 6.

2.2.7 Air and Water Quality Standards

The design, construction and operation of the Krasnodar GRES will be based on meeting or bettering the appropriate effluent release rates, air and water quality criteria, and work place air quality requirements of the Russian Federation and the World Bank. These values, along with other international standards, are shown below in the following tables:

- Table 1 - Power Plant Stack Emission Limits,

- Table 2 - Air Quality Criteria

- Table 3 - Power Plant Liquid Emission Limits

- Table 4 - Work Place Air Quality Criteria

- Table 5 - Electromagnetic Field Intensity Limits

TABLE 2.1 -
Power Plant Stack Emission Limits - Natural Gas Plants

Contaminant	Russia	World Bank	U. S. EPA
NO_x	86 mg/mJ and 125 mg/m^3	0.20 lbs/mmBTU of heat input	0.20 lbs/mmBTU of heat input
SO_x		500 TBD if background air quality <50 mg/m^3 100 TPD if background air quality >100 mg/m^3	0.80 lbs/mmBTU of heat input
Particulates		100 mg/m^3	0.030 lbs/mmBTU of heat input

TPD = Tons per day

TABLE 2.2
Air Quality Criteria (ug/m^3)

Substance	Russia		World Bank		Ranges in Europe		U. S. EPA	
NO_2	85[e]	40[b]	100[a]	100[a]	30[a]-80[a]	80[b]-200[b]	100[a]	100[b]
SO_2	50[a]	50[b]	100[a]	1000[f,b] -500[g,b]	30[a]-140[a]	100[b]-365[b]	80[a]	365[b]
CO	3,000[d]	1,000[b]					10,000[c]	40,000[d]
Ozone	160[e]	30[b]						235[d]
Particulates	4[a]		100[a]	500[b]	40[a]-150[a]	100[b]-200[b]	50[a]	150[b]

a: annual mean; b: 24-hour mean; c: 8-hour mean; d: 1-hour mean; e: 0.5-hour mean; f: inside the fence; g: outside the fence

TABLE 2.3
Liquid Effluent Limits

Contaminant or Parameter	Russia	World Bank	U. S. EPA	
pH	6.5 - 8.5	6 - 9	6.0 - 9.0	
BOD		50 mg/l		
Heavy Metals (total)		5 mg/l		
Oil & Grease		10 mg/l	20 mg/l[a]	15 mg/l[b]
Suspended Solids (total)	0.25 mg/dm^3	60 mg/l	100 mg/l[a]	30 mg/l[b]
PCBs			0.000044 ug/l[c]	
Temperature (at edge of designated mixing zone)	Max 3°C above hottest month of year over past 10 years	Max 3°C above ambient temp of receiving water		

a: Maximum for any one day; b: Average of daily values for 30 consecutive days;
c: Domestic drinking water

TABLE 2.4
Work Place Air Quality Criteria (mg/m^3)

Contaminant		Russia	World Bank	Range in Europe	USA		
					ACGIH	NIOSH	OSHA
CO	TWA		29.0	20.0-57.0	29.0	40.0	55.0
	STEL	20.0		40.0-458.0		229.0	
NO_2	TWA	1.0	6.0	4.0-10.0	5.6		9.0
	STEL	2.0		1.8-20.0	9.4	1.8	

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Contaminant		Russia	World Bank	Range in Europe	USA		
					ACGIH	NIOSH	OSHA
SO_2	TWA		5.0	3.0-20.0	5.2	5.0	13
	STEL	10.0		6.0-13.0	13.0	10.0	
Particulates	TWA		10.0				
	STEL						
O_3	TWA			0.1-0.2	0.2	0.2	
	STEL			0.2-0.6		0.6	
PCBs	TWA			0.01-1.0	1.0 (42%Cl) 0.5 (54%Cl)		
	STEL	1.0		0.03-1.5			

TWA-8 hour time weighted average; STEL-15 minute short term exposure limit; ACGIH-American Conference of Governmental Industrial Hygienists; NIOSH-National Institute of Occupational Safety and Health; OSHA-Occupational Safety and Health Administration.

TABLE 2.5
Allowable or Recommended Noise Levels (dB)

Type or Location	Russia	World Bank	USA-ACGIH
Work place impact noise	125	140 (max)	140 (max)
Work place continuous noise	80	90 (8 hour average)	85 (8 hour average)
Indoor residential		45 (daily average)	
Outdoor residential	60	55 (daily average)	

TABLE 2.6
Electromagnetic Field Intensity Limits (kV/m)

Inside residential buildings	0.5
Built-up areas	1.0
Populated areas outside built-up areas	5.0
High voltage transmission line crossings	10
Unpopulated areas	15
Hard access areas and restricted areas	20

2.3 Institutional Responsibilities for Environmental Management

Institutional responsibilities for environmental management rests with the Joint Stock Ownership Company of the Krasnodar GRES. This company is responsible to the Russian Federation, and duly authorized agencies of the Russian Federation, for operating and managing the plant in an environmentally sound manner, and for providing a safe and healthful workplace for the power plant employees. They are also responsible for responding to and mitigating environmental incidents and emergencies. A description of their structure, management practices, and capabilities is found in Chapter 10.

Legal oversight and enforcement of Russian Federation requirements rests with KREC, MEPNR, the Ministry of Fuels and Energy, the State Committee on Sanitary and Epidemiological Control, and other federal, regional, and local government entities.

2.3.1 Legal Oversight and Enforcement of Environmental Regulations

Enforcement of Russian Federation environmental and health legislation is based on a system of measures for management, control, and damage assessment. A hierarchical system of punitive and compensatory civil fines and criminal prosecutions, adjudicated through the Russian court system, is the focus, and forms the basis for governmental enforcement of environmental, and health and safety laws and regulations. Russian citizens also have the right to bring actions in tort, and seek compensatory damages, against individuals, institutions, organizations or enterprises for violations of environmental, and health and safety regulations, or for causing environmental, or health and safety impacts or damage. The types of violations or actions which may give rise to government enforcement or civil suit includes, but is not limited to:

- Failure to observe standards and regulations of environmental quality,
- Failure to fulfill statutory obligations with respect to the EIA, as well as deliberate submittal of incorrect and negligently unjustified expert conclusions,
- Violation of environmental requirements during the planning, designing, locating, constructing, reconstructing, commissioning, and operating of enterprises, buildings, and other facilities,
- Environmental pollution and resulting damage to human health, flora and fauna, and the personal property of natural and legal entities,
- Damage and destruction of environmental objects, including natural reserves, and depletion or destruction of natural reserve complexes and natural ecological systems,
- Failure to take the measures required for restoration of damaged environments and for replenishment of natural resources,
- Failure to follow regulatory instructions of the state environmental supervision,
- Failure to meet environmental requirements towards neutralization, processing, utilization, storage or disposal of industrial waste,
- Failure to meet environmental requirements during use and disposal of hazardous wastes and materials, or other chemical and harmful agents,
- Exceeding standards for maximum permissible levels of noise, electromagnetic fields and other harmful physical agents, and
- Failure to provide timely and accurate environmental, and health and safety information, or refusal to provide such information, to the government.

Should any of the above, or other violations occur, and should enforcement actions be taken by an appropriate government agency or agencies, the degree of punitive and compensatory civil penalty, and whether to pursue criminal prosecution, will be based on such parameters as: degree of willfulness, negligence or non-negligence; degree of environmental or health and safety damage caused; degree of pollution caused; and whether or not the violation is repetitive. It should be noted that under current Russian law both the employee(s) that caused the violation, and the executive(s) responsible for that employee or violation, can be held jointly and severably liable. Should civil suit be brought, compensatory damages are typically limited to actual quantifiable losses or damages.

2.4 International Treaties and Protocols

The following international agreements, signed by the Russian Federation, were consulted while developing the EIA:

- "Convention on Trans-Boundary Air Pollution for Long Distances". Brussels, Switzerland, 11 March 1979,
- "Declaration on Low Waste and Waste-Free Technologies and Waste Utilization". Brussels, Switzerland, 11 March 1979,
- "Role of Carbon Dioxide and Other Gasses Causing Greenhouse Effect in Climate Changes and Associated Impacts". Statement of the International Conference of the UN Environment Program (UNEP), World Meteorological Organization (WMO), International Council of Scientific Unions (ICSU). Filles, Austria, 9-15 October 1985, and
- "Convention on Environmental Impact Assessment in Trans-Boundary context". Espo, Finland, 25 February 1991.

2.4.1 "Convention on Trans-boundary Air Pollution for Long Distances", "Resolution on Trans-boundary Air Pollution for Long Distances", "Declaration on Low Waste and Waste-free Technologies and Waste Utilization"

Signed by all European countries, USA and Canada in 1979 at All-Europe Conference for Cooperation in Conservation of Environment

In accordance with a report by P. A. Polovinko, Chairman of the Krasnodar Territory Committee on Conservation of Environment, aggregate values for NO_x emissions to the atmosphere meet the requirements of these agreements. Construction and operation of the Krasnodar GRES will not be associated with any violation of the commitments undertaken by Russia.

2.4.2 Convention on Environmental Impact Assessment in the Trans-boundary Context

Adopted by all European countries, USA and Canada on 25 February 1991 in Espo, Finland

The Krasnodar GRES design, construction and operation is in agreement with this Convention since:

- It accounts for all measures to prevent and control trans-boundary impacts and meets all Russian and International requirements on environmental conservation,

- The feasibility study and the EIA meet all legal, regulatory and technical requirements of the Convention member-state (Russia),

- The EIA was developed prior to authorization or implementation of the proposed type of activities,

- The international community has been informed of the proposed type of activities, and

- Foreign countries, companies and organizations can and are taking part in the project and development of the EIA.

2.4.3 Convention on Global Warming, Black Sea Preservation, etc.

There are a number of important international agreements affecting environmental preservation of the Black Sea and regulating the issues of trans-boundary transfer of pollutants and contaminants between the bordering states. These agreements impose international obligations on all or some of the Black Sea area countries, and demand their effective execution through national legislation. The agreements to which Russia is a signatory, include the:

- MARPOL Convention, 1973/1977,

- Law of Maritime Convention. New York, UN, 1982,

- Basel Convention on trans-boundary dangerous waste. Basel, 1989,

- Bucharest convention on the Black Sea. Bucharest, 1992,

- Agenda of the 21st century. New York, UN, 1992, and

- Odessa Declaration on the Black Sea. Odessa, 1993.

The design, construction and operation of the Krasnodar GRES meets the requirements of these agreements since:

- The project will be in agreement with the Convention on Environmental Impact Assessment in the Trans-boundary Context",

- National territories of all the bordering states are more than 100 km from the Krasnodar GRES,

- The proposed plant shall not have direct waste disposal to the Black Sea or rivers flowing through national territories of other countries,

- Quantity and quality of effluent emissions to the atmosphere and hydrosphere, and all waste discharges meet national and international requirements,

- Emissions to the atmosphere will not contain radioactive agents or components aggravating degradation of the ozone layer.

2.4.4 IUCN Biosphere Reserve

The Caucasus State Biosphere Reserve, also known as the IUCN Biosphere Reserve, was established on 12 May 1924 and is located approximately 48 km south/southwest of the power plant. According to a Resolution of the Soviet Presidium of the International Coordinating Council of the program, "The Man and Biosphere", 19 February 1979, taken with UNESCO authorization, the Caucasus State Reserve acquired the status of a biosphere reserve, and was included in the International network of biosphere reserves. In 1985 it was registered with the INFOTERRA International information register as a source of environmental information. In 1986 Djug, a mountain biosphere station, started its operation in the reserve, and was also included in the International program.

Activities associated with the IUCN biosphere reserve are subject to the "State Law of the Russian Federation on Specially Protected Natural Territories", passed by the State Duma on 15 February 1995, and signed by the President of the Russian Federation on 14 March 1995. These activities include, but are not limited to:

- Preserving the environment of the North-Western Caucasus biosphere region of the Pre-Black-Sea-Caucasus-Girka biosphere world province, in its natural form,

- Preserving the genetic variety of the indigenous biota,

- Studying natural functioning of typical environmental complexes compared to anthropogenic analogs, and

- Monitoring background condition of the biosphere components with respect to changes of the global level of technogenic pollution and climate changes for possible environmental assessment.

The territory of the IUCN biosphere reserve is excluded from any economic or commercial use and development. Construction and operation of the Krasnodar GRES meets all Russian and International requirements with respect to the Biosphere and will cause no calculable or observable impacts to the Biosphere.

2.5 Appropriate International Values and Codes of Practice

The Russian Federation has a complete set of environmental, and health and safety regulations, requirements and guidelines to prevent and ameliorate any deleterious impacts due to industrial or commercial development, and operation of those facilities. Corollary regulations also stipulate environmental quality criteria for air, water and other media, and maximum and recommended levels of human and biotic exposure to pollutants and contaminants have been established. Yet, to assure that the Krasnodar GRES not only meets or exceeds all Russian Federation requirements, but is truly a world-class, state-of-the-art power plant, several steps will be taken to assure that it meets or exceeds all appropriate international values and codes of practice. These values and practice codes will be incorporated in the plant's design, construction and operation and were based on World Bank, United States and European Union criteria. These steps included, but were not limited to:

- Additional atmospheric pollutant modeling, above and beyond the Russian Federation approved model OND-86, to prove agreement with the World Bank and other international requirements. The TERI Model of Air Quality, TERIMAQ, Version 1.0 was used.

- Public meetings and hearings were and will be held according to both Russian Federation and World Bank requirements, and

- Environmental and workplace quality, quality and quantity of gaseous and liquid emissions and discharges will be assessed against corresponding requirements of the World Bank and other international standards, and it will be shown that the Krasnodar GRES met these criteria.

3.0 DESCRIPTION OF THE PROPOSED PROJECT

Within this chapter the general overall design criteria for the plant and its components, the project site, fuel characteristics, and natural gas, water, and transmission line connections are described. It will be noted in this chapter that the design of the Krasnodar GRES meets or exceeds all engineering and environmental Russian Federation, World Bank, and international requirements, guidelines and recommendations for combined cycle natural gas plants. Further information on plant design can be found in the Feasibility Study conducted and produced by RoTEP.

3.1 General Project Description

In order to address the electric power deficit in the North Caucasus region, a natural gas fired combined cycle power plant is proposed to be built near the village of Mostovskoy in the Krasnodar Krai of Russia.

The Krasnodar GRES plant is a 900 MW combined cycle plant with future planned expansion to 1,350 MW. It is composed of two modular blocks of 450 MW each, with each block containing two combustion turbines of 150 MW capacity, two heat recovery steam generators (HRSGs), and one 150 MW steam generator. Using modern combustion technology, power plant efficiency is estimated at 50.4% with a plant availability factor of approximately 90%. The plant will use a dry cooling tower system to eliminate the need to withdraw large quantities of water from the Laba River and will be fueled with natural gas. The gas will be supplied from a new 60 kilometer pipeline connected to the Trans-Caucasus gas pipeline. Power transmission will be accomplished by connecting to the existing 500 kV and 220 kV transmission systems.

3.2 Site Characteristics and Design Parameters

The project site as shown on the site vicinity drawing, Figure 3-1 is located approximately 5 km south of the settlement of Mostovskoy and approximately 2 kilometers from the Laba River. The site, approximately 130 hectares of level farmland, is in a valley with hills on both sides, and slopes towards the north with elevations varying from 410 to 416 meters. There is an existing drainage ditch on site which carries storm water from the adjacent hilly areas on the south. There are no known sensitive ecological areas, such as critical habitats, bird nesting areas, or biosphere reserves, either on or sufficiently proximate to be impacted by plant, transmission line, or water pipeline construction or operation. The land for the project has been secured by Kubanenergo from the local government. The top 0.8 to 1.5 meters of soils consists of excellent top soil that will require removal from the construction areas and reuse or disposal. The next 6 to 15 meters consists of large gravel mixed with clay and sand. Below the gravel there is a solid layer of water tight clay up to 150 meters deep. The water table is approximately 2 meters from the existing ground surface. There is an existing 110 kV transmission line running through the site.

Site investigations to assess both the design considerations and the plant design bases necessary for construction and operation, have previously been carried out during the Feasibility Studies conducted by ROTEP. These studies include the hydrology, geology, and meteorological aspects of the subject site. Other investigations carried out as part of the Feasibility Study included: site access, mode of transportation, fuel supply, intake and discharge arrangements for the cooling water, and general findings of the air quality and existing sources of emissions, water quality, acoustic noise pressure levels, animal and plant kingdoms, aquatic flora and fauna, and the sociological environment.

The results of these investigations as they apply to plant design considerations and establishing the plant design bases are described below.

3.2.1 Geology

The plant elevation will be located above the flood plain as described in feasibility studies conducted by ROTEP. The geological structure of the project site is composed of alluvial pebbly grounds of the Quaternary period, which are underlain by maikop clays at a depth of 10.0-14.0 meters. As a whole, the geolithological structure of the construction site is relatively uniform. The site will be filled to raise the grade above flood level and existing drainage ditch will be relocated to prevent flooding of the site.

Based on the geotechnical investigation conducted by ROTEP, site soils will provide adequate support for shallow foundations. These shallow foundations can consist of either spread footings or structural mat. The allowable soil bearing capacity is estimated to be between 0.4 and 0.5 MPa.

3.2.2 Hydrology

The hydrogeological conditions of the project construction site are characterized by a universally developed horizon of underground waters, confined to the Quaternary alluvial pebbly deposits. The depth of the acquiferous horizon is from 7.0 to 13.0 meters. However, underground water has been observed to rise up to a depth of 1.0 to 2.0 meters below the ground level.

3.2.3 Seismicity

The project site is located in a seismic region. The seismicity of the project construction site, with due considerations for ground conditions, resonance phenomena and ground water level, is 7 points on the MSK-64 scale with an average repletion period of 1000 years. The maximum acceleration amplitudes are not in excess of 0.04-0.08g.

3.2.4 Climate

The region where the project will be located borders on mountainous relief 50 km south of the Great Caucasus Ridge. The surrounding relief is relatively flat, low hilly, cut by shallow ravines with flowing creeks at the bottom. The climate of the project region is temperate-continental. The proximity of the Black Sea and high ranges of the Major Caucasus produce considerable effects on the general atmospheric circulation. With active inflow of cold the absolute minimum air temperature in winter may reach minus 36-38 deg. C, while in warm weather it reaches plus 18-20 deg. C. Summer is hot, dry and long (from May to September). The absolute air temperature may reach plus 40-45 deg. C. The relative humidity ranges from 69% to 82%. Average yearly precipitation is about 900mm.

3.2.5 Wind

The annual average site wind velocities, at different altitudes above the earth surface, are depicted in the table below:

Average Annual Site Wind Velocities at Varying Altitudes

Altitude (meters)	10	20	40	50	100	150	200	300	400	500
Velocity (Meters per second)	1.9	2.8	3.5	3.5	3.8	3.9	4.0	4.3	4.5	4.5

3.2.6 Atmospheric Pressure

The average atmospheric pressure at the site level is 963.5 millibars.

3.2.7 Water Source

The source of operational process water and non-potable water during construction for the project site is the Laba River, the largest tributary of the Kuban River. Its water shed area consists of 12500 square kilometers in the section of water intake by the project power plant is 3400 square kilometers. The bottom of the water intake by the project power plant is pebbly and the river mouth is sandy. The highest monthly water temperature in the Laba River near the project site intake has measured from 3.8 to 18.2 deg. C. The lowest monthly water temperature, for the same period, ranged from 0.0 to 15.7 deg. C. The average annual water discharge in the Laba River in the Krasnodar power plant intake section is 83.1 cubic meters per second.

A second source of process water is on-site wells. The project utilizes a dry cooling system, so makeup water requirements are mainly for HRSG blowdown. This means the water demand is relatively modest, about 120 m^3/hr. It is believed that the ground water and underground sources can easily supply the necessary quantity. The use of well water would eliminate the environmental impact of drawing water from the river. The use of on-site wells for process water makeup is a viable alternative to utilization of the Laba River.

Water wells can be established in the water bearing gravel layer overlaying the impervious clay layer. It is recommended that test wells be drilled at the project site to establish the quantity and quality of the subsurface water. The information obtained from the test wells will determine the appropriate cost for drilling of production wells, pumping equipment and water treatment.

Drinking water for the plant upon operations will be supplied from a pipeline extending approximately 33 kilometers in a northwesterly line from Andryuki to the site, and no end of pipe treatment will be required. There are no known ecologically sensitive areas along the proposed water pipeline route. Drinking water during construction will be supplied from the existing Mostokskoya system, and this system needs no improvements or expansion to meet the anticipated demand. Fire fighting water will be supplied from a buried, on-site concrete tank filled with water from the Laba River.

3.2.8 Site Drainage

The project site will be raised above the flood level using borrowed structural fill material. The existing drainage ditch will be relocated around the project site to prevent any possibility of the flooding. The relocated drainage ditch will be a concrete lined canal.

The project site will be provided with a storm drainage system. The storm drainage system will consist of catch basins, storm sewers and open drainage ditches. All storm water from the site will be collected in a settlement basin prior to discharge into natural waterways.

3.3 Plant Configuration

The results of previous analyses determined that a 900 MW combined cycle plant at the Mostovskoy site is necessary to meet the power demand of the North Caucasus, and that full capacity should be in operation by the year 2000. The Krasnodar GRES is planned to consist of two blocks of 450 MW each. Each block will consist of two combustion turbine generators, two Heat Recovery Steam Generators (HRSGs) and one steam turbine generator. Each of the three turbine generators will generate approximately 150 MW. The plant site arrangement will be laid out so that a future 450 MW block can be added for a total capacity of 1,350 MW.

The construction of the plant will be staged such that the combustion turbine units operating in a simple cycle mode will be brought on line first. The first unit of 300 MW will consist of combustion turbines 1 and 2 (CT_1 and CT_2) followed by a second unit of 300 MW consisting of CT_3 and CT_4. The second unit will follow the first after six months. The two simple cycle units will then be converted to combined cycle operation at six month intervals.

The plant will also include separate gas fired district heating steam and water boilers, and district heating heat exchangers.

3.3.1 Plant Design and Design Criteria

The design criteria for the plant conforms to International Standards acceptable to both the Russian Federation and the World Bank. Environmental considerations have ensured that air quality, thermal discharge and wastewater effluent quality are in compliance with World Bank and Russian regulatory requirements.

Plant equipment is specified to be in compliance with the internationally acceptable codes and standards. Plant construction will conform to Russian

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standards in addition to any design criteria that may be required for compatibility with the internationally supplied equipment.

3.3.2 Combined Cycle Power Plant

The Krasnodar GRES at Mostovskoy is a combined cycle plant of 900 MW capacity (two modules of 450 MW each) with provision for a future expansion to 1350 MW. A conceptual plant layout is shown on Figure 3-2 (Site Plan). The main building will house the four combustion turbines, the four HRSG's and the two steam turbines, all with their respective auxiliaries and the electrical rooms. Housed in the main building are also the deaerators and the feed pumps. A common control room will be utilized for both units. A representative layout of major equipment is shown on Figure 3-3 (General Arrangement).

Combustion turbine generators with electrical outputs ranging between 140 MW and 170 MW and manufactured by companies, such as, ABB, Westinghouse, General Electric, and Siemens were studied for this project. The combustion turbine generator sets will be furnished complete with all accessories and auxiliary systems required for start-up and generating capability for combined cycle operation. The combustion turbine generator will include dual fuel firing systems, an air intake system including a filter system, and best available technology for NOx control utilizing dry Low-NOx combustors.

The generators will be synchronous machines operating at ±15.75 KV, 50 Hz and a power factor capability in the range of 0.85 (lagging) to 0.9 (leading). Each generator will be capable of delivering the output of the turbine over its full operating range.

The exhaust gas from each combustion turbine will be routed to an individual HRSG. Each HRSG will be a multi-pressure design. High pressure and intermediate pressure steam will be produced. The intermediate pressure steam will be reheated in the HRSG. The high pressure and intermediate pressure steam from two HRSG's will be routed to one steam turbine generator. Condensed steam will be returned to the HRSG condensate cycle.

The four HRSG's, each of which will be provided with a metal by-pass stack, will discharge into a common concrete stack, 150 meters high and 15 meters in outside diameter. In a location north of the main building are the power transformers and the switchyard and the annexed switchyard control building and a local cafeteria. East of this building are located the Administration Building and the 200 seat cafeteria.

A natural gas control station will be installed downstream of the reducing station to maintain the necessary pressure required by the combustion turbines. The natural gas control station, the repair and maintenance shop, the warehouse, and other necessary buildings to support plant operations, including a 25 car garage, are located south of the cooling tower area.

An intake structure, with pumps at the river or on-site wells, will provide make-up water for the plant. Make-up water equipment, including the chemical storage tanks and the neutralization tanks, will also be utilized. Demineralized water, obtained from chemically treating raw water, will be utilized for the HRSG's. Two demineralized water storage tanks will be provided.

As the heat sink, each power block will utilize one dry-type cooling tower. The cooling tower area is located adjacent and south of the main building. The selection of the dry-type cooling tower is mandated by the limitations placed by Russian regulatory authorities on the use of water from the Laba River and also by the concerns raised, by the public and environmental commission, about the fog and plume associated with a wet cooling tower.

3.3.3 Fuel

The plant will be fueled by natural gas, which will be piped from an existing trunk line 60 km away. The trunk line is owned by Gazprom. The gas line pressure is 5.5 megapascals (MPa) with an estimated fuel flow of 195,036 cu.m./hour for 900 MW. The pipe line will be sized for a 1,350 MW plant taking into consideration the future plant expansion. The properties of the natural gas fuel are shown in the table below.

Natural Gas Analysis

Analyte or Property	Value
Methane	97.7%
Ethane	1.2%
Propane	0.3%
Butane	0.005%
Oxygen	0.01%
Carbon dioxide	0.02%
Nitrogen	0.8%
Sulfur	< 36 mg/cu.m.
Low Heating Value	8,600 kcal/cu.m.
Density	0.8 kg/cu.m.

3.3.4 Estimated Plant Emissions

Air, water and thermal effluents estimated to be emitted from the Krasnodar GRES meet or exceed all requirements of the Russian Federation, World Bank and appropriate international requirements. Effluent values were calculated based on the plant's design and fuel analysis above, and are described below. A detailed discussion of their environmental implications is found in Chapter 5.

3.3.4.1 Air Effluents

Air emission calculations were based on simultaneous operation of two combustion turbines, one steam turbine and two HSRGs producing 900 MW. Emissions data under these conditions, given a flue gas flow of 23.4 m/s, a stack gas temperature of 120° C., a stack internal diameter of 14.4 meters, and the natural gas constituents listed above, are tabulated below. It should be noted that the calculated emission rates are within the regulations and guidelines of the Russian Federation and World Bank.

Calculated Air Emissions

Contaminant	Emission Rate g/s
SO_2	3.9
NO_x	534
CO	99.9
TSP/PM-10	12.2

3.3.4.2 Water Effluents

Process water releases to the Laba River are estimated at 116 cu.m./hour. Contaminant concentrations and the thermal quality in these waste waters will meet or better the values listed in the table below, and these values are within Russian Federation and World Bank regulations and guidelines.

Estimated Water Effluent Quality mg/l

Contaminant	Value	Contaminant	Value
Calcium	156	Chloride	21
Magnesium	10	Nitrate	8
Sodium & Potassium	86	Carbonate	2
Sulfate	337	Silicate	1
		Total Salts	890

Sanitary waste water discharges to the Mostovskoya Village Waste Water Treatment Plant, during normal plant operations, are estimated at 0.7 cu.m./hour.

3.4 Power Transmission System

The plant will be connected to the existing 220 kV and 500 kV transmission systems in the North Caucasus Region. New transmission lines will be constructed for this purpose and the existing transmission lines running through the site will be rerouted.

This design was accomplished by carrying out a detailed study of the region's existing transmission system to determine the upgrades that will be required to bring 900 MW of new capacity on line. These studies included detailed load flow and fault analysis, dynamic studies and system stability studies. These studies assumed that the existing ties between the North Caucasus region and the Ukraine will remain available and that the first stage of the interregnal tie between the Center region of the Russian Integrated System and the North Caucasus comprising three 500 kV lines from Balakovskaya Nuclear Plant to Rostovskaya Nuclear Plant will also become available.

The load flow studies indicated that to deliver power to the regional consumers at 220 kV, three new substations will need to be constructed in Kurgannaya, Cheremushki, and Zilposelok. These additions and changes include:

- Rerouting the existing 500 kV, 310 km line between Tzentralinaya and Zelenchukskaya via the 500 kV switchyard at the Krasnodar GRES,
- Adding a new single-circuit 220 kV line from the Krasnodar GRES to Cheremoshki substation,

- Adding a new double-circuit 220 kV line from Kurgannaya to Zilposelok via the Krasnodar GRES,

- Rerouting one circuit of the existing double-circuit 220 kV 185 km line between Tzentralnaya and Armavir via Cheremushki, and

- Rerouting the circuits of the above line via Kurgannaya.

3.4.1 The Switchyards

The Krasnodar GRES plant will have two switchyards, one at 500 kV and one at 220 kV. The two switchyards will be interconnected by three single phase 167 MVA non-PCB containing autotransformers. One spare transformer will be provided. A 180 MVA, 500 kV three phase shunt reactor will be provided to compensate for the reactive power in the 500 kV line. The switchyards will be designed to be able to accommodate connections to the three new substations and to the existing 500 kV and 220 kV substations.

3.5 Gas Pipeline

A new natural gas pipeline, 60 km in length and 700 mm in diameter will connect the plant to the Trans-Caucasus gas pipeline. The new gas pipeline will be installed underground and will include all necessary auxiliary components, such as valves, restraints, supports, cathodic protection, etc. to assure satisfactory operation. A metering station will be located on the plant site. The pipeline will be constructed and operated by GazProm and they will also prepare the EIA for the pipeline.

3.6 Staffing For Operations

The permanent staffing levels recommended are contained in Chapter 10. The duties of each functional title will be described in the company procedures manual to be prepared by Kubanenergo.

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4.0 BASELINE DATA

4.1 Air

4.1.1 Climatology

4.1.1.1 Type

The Krasnodar Territory is affected by the transformed air mass of the Atlantic and air inflow from the Mediterranean area. General atmospheric circulation is substantially affected by the proximity of the Black Sea and ridges of the Great Caucasus Mountains. Formation of the climate of the region described is affected by circulation processes of the southern zone of the moderate latitudes. The air mass affecting the climate can differ by physical properties and origination. The territory is accessible for intrusion of the cold air mass from the Arctic. The marine air mass comes from the Atlantic, with regular air intrusions from Kazakhstan.

Recurrence of the continental air in the area is 60-70 % in summer and 80 % and greater in winter.

The climate formation is greatly affected by the relief which causes transformation of the air mass circulation. The system of mountain ridges of the Great Caucasus, glens and depressions create complicated air circulation within the system. Mountain glen air circulation is pronounced during the warm period of the year due to thermal heterogeneity of glens and slopes. In the piedmont zone the cold air mass is checked and stationed, and atmospheric fronts are often actuated in front of orographic obstacles.

The latitudinal circulation prevails all-year round. Winter atmospheric circulation is determined by interaction of the Black Sea depression and the ridge of the Asian anticyclone and characterized by frequent alteration of colds and thaws, drizzles and icing phenomena. During inflows of cold the absolute minimum temperature can go as low as -36°C -38°C, while maximum temperature during thaws can go as high as 18°C to 20°C. Snow fall is not observed every year.

Usually, the winter begins in December and ends in February. In spring, air temperature increases quickly due to lower cyclones' activity accompanied by intensive thaws.

As a rule, the spring is short, intensive, sunny; usually, it begins in March and ends late in April or early in May.

The summer is hot and long (it begins in May and ends in September). Absolute maximum air temperature can be as high as 40°C to 45°C. Rain showers, thunderstorms and hails are frequent; occasionally dust storms occur, but low cloudiness sunny weather prevails.

The fall is also long and warm (it begins late in September and ends early in December). The first half of the fall is dry and sunny, the second half is rainy with icing phenomena, fogs and generally overcast conditions.

4.1.1.2 Annual and Monthly Radiation Balance

Solar radiation and radiation balance at the Krasnodar GRES site are summarized in Table 4.1 according to the meteorological station of the town of Sochi for the areas located in the vicinity of the Krasnodar GRES site (i.e. Perepravnaya and Gubskaya) .

Table 4.1 Perepravnaya and Gubskaya Sites (met/stn of Sochi)

Months	Radiation Amount (Kcal/cm^2)			Radiation Balance (Kcal/cm^2)	Duration of Solar Shining (Hours)
	Direct	Dispersed	Total		
I	1.5	1.7	3.2	0.4	84
II	2.3	2.5	4.8	0.8	98
III	3.7	3.6	7.3	3.2	128
IV	5.2	4.9	10.1	4.9	158
V	8.2	6.2	14.4	7.6	223
VI	11.0	6.1	17.1	9.9	283
VII	11.7	6.1	17.8	10.3	313
VIII	10.9	5.1	16.0	8.2	305
IX	7.4	3.9	11.3	5.1	252
X	5.0	3.3	8.3	2.8	194
XI	2.5	2.2	4.7	0.8	121
XII	1.4	1.6	3.0	0.1	94
Year	70.8	47.2	118.0	54.1	2253

4.1.1.3 Temperature Range (max., min., etc.)

The temperature conditions at the Krasnodar GRES site is closest to that of the location of the Voznesenskaya meteorological station. Thus, to determine average long-term air temperature values at the site, the measurements taken at the Voznesenskaya meteorological station were used as the reference readings. However, the station was closed in 1935, so to adjust observations for the period of 1981 through 1988 to long-term ones and to make calculations that require long-term observations, the Labinsk meteorological station data was used for post-1935 data.

Table 4.2 is representative of the air temperatures accepted for the power plant site.

Table 4.3 is representative of the estimated air temperatures for construction design.

Table 4.2
Air Temperatures Based on Long-Term Observations (Centigrade)

Months	Mostovskoy site	Gubskaya site	Perepravnaya & Gubskaya Sites					
	Perepravnayamet/stn	Voznesenskaya met/stn	Voznesenskaya Meteorological Station					
	Average long-term[1]		Absol. Max	Absol. Min	Avrge Max	Avrge Min	Avrge Daily Δt[2]	Max Daily Δt[3]
I	-2.6	-2.2	19	-38	2.9	-6.5	9.4	25.3
II	-1.5	-1.1	23	-33	4.5	-5.4	9.9	27.4
III	3.2	3.4	33	-20	9.5	-1.0	10.5	22.7
IV	9.5	9.9	34	-13	16.1	4.2	11.9	26.8
V	14.8	15.3	34	-4	21.8	9.3	12.5	25.6
VI	17.9	18.7	36	2	25.1	13.1	12.0	23.7
VII	20.8	21.5	39	7	28.1	15.5	12.6	22.5
VIII	20.5	21.1	43	3	27.8	15.0	12.8	24.1
IX	15.6	16.4	37	-3	22.8	10.4	12.4	26.5
X	10.2	10.9	36	-11	18.0	4.9	13.1	24.4
XI	4.1	4.4	30	-28	10.7	0	10.7	23.3
XII	-9.6	-0.2	20	-32	5.2	-4.4	9.6	22.3
Year	9.3	9.8	43	-38	16.0	4.6	11.4	27.4

Notes:

1. Previous meteorological studies were conducted in the vicinity of the Krasnodar GRES for a now inactive nuclear plant project. The Perepravnaya met station referenced throughout this section is located approximately 2 km from the Krasnodar GRES site at roughly the same elevation. The Gubskaya met station is located approximately 11 km from the Krasnodar GRES site.

2. Average long-term air temperature for the Perepravnaya site was adjusted by correlating Perepravnaya met/stn data to Labinsk met/stn data (see Attachment 3), and for the Gubskaya site - to Voznesenskaya met/stn data.

3. Average daily Δt was determined as the difference between average maximum and minimum values.

4. Due to the absence of data for another close meteorological station, the maximum daily Δt is shown for the Krasnodar meteorological station which is inherent to the region and accepted as equal values for the Krasnodar GRES site.

Table 4.3 Estimated Air Temperatures for Construction Design

S/N	Air Temperature Specifications	Numerical Values	Information Source Justification
1	Average monthly temprature at 1 pm of the hottest month the coldest month	28.1°C 29°C	(Voznesenskaya meteorological station) accepted as the average maximum temperature
2	Average temperature of the coldest day; at 0.98 probability rate at 0.92 probability rate	-27°C -22°C	Building Code 2.01.01-92 (2); (Maikop meteorological station)
3	Average temperature of coldest 5-day periods at 0.98 probability rate at 0.92 probability rate	-21°C -19°C	
4	Duration of the heating period (with average daily temperature of 0°C at the most)	159 days	(Voznesenskaya meteorological station)
5	Mean date of beginning the heating period	30.Õ	
6	Mean date of ending the heating period	6.IV	
7	Average temperature of the heating period	1.2°C	
8	Duration of period with average daily temperature of 0°C at the most	74 days	
9	Mean date of beginning of period with average daily temperature of 0°C at the most	12.XII	
10	Mean date of ending of period with average daily temperature of 0°C at the most	23.II	Climate Reference Book of the Voznesenskaya meteorological station
11	Winter ventilation temperature (average temperature of the coldest period)	-5.5°C	

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4.1.1.4 Annual and Seasonal Precipitation

Table 4.4 is representative of the mean long-term precipitation values which were determined by correlation of actual 5-year-period (1981-1986) observations of precipitation at the Perepravnaya meteorological station.

Table 4.4
Mean Long-Term Precipitation Values For The Site (in mm)

Months												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
40	56	67	72	90	116	87	67	70	72	83	77	897

Table 4.5 summarizes the precipitation values for rainy and dry years of different probabilities. Annual precipitation values of different probabilities were based on mean long-term precipitation.

Table 4.5
Precipitation Values for Rainy and Dry Years of Different Probabilities at the Perepravnaya Met Station

Months	Precipitation Values For Different Years			
	Rainy With Supply Probability Rate Of		Dry With Supply Probability Rate Of	
I	5%	25%	75%	95%
II	50	41	31	24
III	74	62	46	35
IV	87	72	54	41
V	99	82	62	47
VI	124	103	76	59
VII	173	143	108	82
VIII	124	103	77	59
IX	87	72	54	41
X	99	82	62	47
XI	112	92	70	53
XII	112	92	70	53
Year	1240	1026	772	588

Annual precipitation distribution for years of different probabilities were based on percentage by the months of the mean year. Assessment of the data of the adjacent stations proved an insignificant difference of their distribution for rainy and dry years and data distribution for the mean year.

Daily precipitation rate at 1% supply probability was established to be 180 mm according to the Building Code 2.01.14-88 map based on more recent material and actual observations at Voznesenskaya meteorological station with 179 mm reading (observed on July 25, 1957) and at Kalidjinskaya meteorological station with 104 mm (observed on July 13, 1957).

Precipitation is usually accompanied by a northern wind.

4.1.1.5 Rainfall and Thunderstorm Intensities

Rainfall intensity is based on data of met stations in the vicinity of the Krasnodar GRES site which observe this parameter. Table 1.6 is representative of the highest rainfall intensity at a specific duration of the rainfall.

Table 4.6
The Highest Rainfall Intensity (mm/minute) At A Specific Rainfall Duration at the Krasnodar GRES Site

Meteorological Station	Minutes				Hours		
	5	10	20	30	1	2	24
Krasnodar	2.8	2.3	1.7	1.6	1.1	0.09	0.05
Labinsk	2.3	2.0	1.7	1.4	0.83	0.03	0.04

Rainfall rate of 20 min. duration with recurrence rate of once a year is 120 L/sec per 1 hectare.

4.1.1.6 Cloudiness - Recurrence and Duration

Assessment of the observations made at the Perepravnaya met station and surrounding stations proved cloudiness to be almost equal for the area of 50 km to the south and 150-200 km to the north of the power plant sites. Table 4.7 is representative of cloudiness specifications based on measurements at Maikop and Labinsk meteorological stations.

Table 4.7
Cloudiness Specifications at the Krasnodar GRES Site

Months	Total Cloudiness (Points) Maikop met/stn	Low-Llevel Ccloudiness (Points) Maikop met/stn	Number of Clear Days of 0-2 Points of Total Cloudiness Labinsk met/stn	Number of Overcast Days of 8-10 Points of Total Cloudiness Labinsk met/stn
I	7.4	4.5	3.6	13.5
II	7.5	4.7	2.4	12.9
III	7.2	4.2	2.9	14.2
IV	6.6	3.8	3.8	11.6
V	6.2	3.4	3.3	9.1
VI	5.1	3.0	6.0	5.9
VII	4.0	2.6	8.5	4.4
VIII	3.9	2.5	9.9	4.0
IX	4.3	2.8	10.2	5.4
X	5.5	3.5	7.8	8.2
XI	6.5	4.2	5.4	11.0
XII	7.2	4.6	3.8	13.4
Year	6.0	3.6	68	114

4.1.2 Meteorology

4.1.2.1 Wind Conditions and Wind Roses

Specification of wind direction is represented for the Krasnodar GRES site based on the observations made at the Perepravnaya met/stn in 1981-1987.

Table 4.8 is representative of recurrence of wind directions and stills.

Table 4.8
Recurrence of Wind Directions and Stills at Perepravnaya Met Station

Months	Points								Still
	N	NE	E	SE	S	SW	W	NW	
I	7	2	16	48	11	3	4	9	30
II	7	2	25	35	8	3	6	14	30
III	16	6	25	29	4	3	3	14	29
IV	46	8	25	24	5	5	5	12	32
V	12	9	25	28	9	4	5	8	37
VI	15	10	16	26	6	4	6	17	46
VII	13	8	19	21	9	6	8	16	37
VIII	11	10	24	19	12	4	7	13	32
IX	10	8	19	26	10	6	7	14	32
X	10	5	23	32	7	3	6	14	32
XI	10	2	17	36	11	4	6	14	31
XII	6	2	18	42	12	6	5	9	30
Winter (XII-II)	6	2	20	42	10	4	5	11	30
Summer (VI-VIII)	13	9	20	22	9	5	7	15	38
Spring (III-V)	15	8	25	27	6	4	4	11	33
Fall (IX-XI)	10	5	20	32	9	4	6	14	32
Year (I-XII)	11	6	21	30	9	4	6	13	33

Note: recurrence is calculated on the basis of total observations of stills; wind direction recurrence by points - on the basis of total observations of wind directions.

Based on Table 4.8 it is observed that 4% of the time the wind blows toward Perepravnaya which is the closest settlement. Correspondingly, the wind blows toward Mostovskoy 13% of the time.

In the area of the Krasnodar GRES site, mountain glen air circulation is observed. During a cold part of the day air mass descends from the mountains along the Laba River glen, consequently, after warming up the air mass ascends along the glen.

During rainfall and fog the wind blows in a predominantly northern or north-western direction, probably, due to origination of the fronts and cyclones coming in from the north-west.

During stable and neutral states of the atmosphere, prevailing winds are of south-eastern direction, and during unstable states of the atmosphere the prevailing winds are those of northern direction.

Actual observations at the Perepravnaya met/stn proved wind speeds to be somewhat lower than those observed at Labinsk meteorological stations. Correlation of wind speeds at Labinsk meteorological station and other surrounding stations with those at Perepravnaya meteorological station appears to be rather weak (correlation ratio of less than 0.6). Therefore, the observed wind speeds at the Krasnodar GRES site cannot be adjusted to long-term values using correlation methodology. Thus, mean values for the 5-year period (1981-1986) at the Perepravnaya meteorological station are used as mean long-term wind speeds at the Krasnodar GRES site. Wind roses are included as Appendices 1-7.

Mean monthly wind speed values at Labinsk meteorological station for the period of 1981-1986 are close to the mean long-term values which justifies mean long-term values for the Perepravnaya met station being based on these mean monthly values (see Table 4.9).

Table 4.9
Mean Wind Speeds (m/sec)
At Perepravnaya met/stn

Months												Year
1	2	3	4	5	6	7	8	9	10	11	12	
2.1	2.3	2.4	2.0	1.5	1.1	1.5	1.8	1.7	2.1	1.9	2.0	1.9

Maximum mean wind speeds were observed with eastern and western winds.

The observations at Perepravnaya met station proved maximum wind speed values to be less than and close to those observed at the Labinsk meteorological station. Therefore, maximum wind speed values of different probabilities for the two sites were based on the data of long-term observations at the Labinsk meteorological station (see Table 4.10).

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Table 4.10
Krasnodar GRES Site (Labinsk met/stn)

Probability (%)	Recurrence Rate: Once Per	Estimated Max Wind Speed (m/sec)
50	1 year	17
20	5 years	23
10	10 years	24
7	15 years	25
5	20 years	27
1	100 years	30
0.1	1000 years	35
0.1	10000 years	40

4.1.2.2 Duration and Thickness of Inversions

Inversions and isotherms (air strata with increasing or constant air temperature at higher altitudes) are frequent in the area of the proposed power plant site. By inhibiting vertical ascent of emissions from the stack, inversions and isotherms create unfavorable conditions for emission dispersion.

Short-term observations during the summer period at the Perepravnaya met station 20-25 km to the north-east of the Veselyi hail control station and the results of long-term observations at the Minvody aerological station 200 km to the east of the Perepravnaya met station site were used to study inversion phenomena at the proposed Krasnodar GRES site and its vicinities.

Table 4.11 and 4.12 are representative of the basic data on inversions and isotherms.

Table 4.13 summarizes the average long-term inversion (isotherm) rate.

Table 4.11
Inversion and Isotherm Observations at Veselyi for 1979-1981

Years	Months	Average Inversion (Isotherm) Thickness Beginning in 0-200 m Stratum (km)	Average Inversion Intensity[1] Beginning in 0-200 m Stratum (Centigrade)		
		6 hrs	12 hrs	6 hrs	12 hrs
1979	VI	0,30	0,21	2,67	0,48
1979	VII	0,20	0,30	1,82	0,98

Years	Months	Average Inversion (Isotherm) Thickness Beginning in 0-200 m Stratum (km)	Average Inversion Intensity[1] Beginning in 0-200 m Stratum (Centigrade)		
1979	VIII	0,25	0,29	2,79	0,57
1979	IX	0,25	0,26	2,23	1,14
1980	V	0,29	0,25	2,91	1,39
1980	VI	0,22	0,27	2,53	0,39
1980	VII	0,29	0,24	2,08	0,76
1980	VIII	0,25	0,31	2,20	0,53
1981	V	0,20	0,21	2,48	0,96
1981	VI	0,19	0,31	2,35	0,25

Note: 1. Inversion intensity is an air temperature difference at the upper and lower boundaries of inversions.

Table 4.12
Average Long-Term Thickness of Inversions and Isotherms (km) (Minvody met/stn)

Months	Altitude of the Lower Boundary of Inversions (Isotherms), km		
	Earth	0,01-0,19	0,19-0,99
I	0,55	0,57	0,48
II	0,52	0,52	0,55
III	0,41	0,54	0,50
IV	0,36	0,46	0,30
V	0,33	0,33	0,36
VI	0,30	0,29	0,32
VII	0,31	0,29	0,34
VIII	0,31	0,37	0,27
IX	0,31	0,37	0,33
X	0,41	0,57	0,44
XI	0,50	0,59	0,46
XII	0,52	0,58	0,57

Table 4.13
Average Long-Term Intensity of Inversions (Isotherms), Centigrade (Minvody met/stn)

Months	Altitude of the Lower Boundary of Inversions (Isotherms), km		
	Earth	0,01-0,19	0,19-0,99
I	6,2	6,3	3,1
II	5,7	5,7	4,3
III	3,6	5,9	2,4
IV	2,9	4,4	1,4
V	2,5	1,8	2,2
VI	2,2	1,4	1,3
VII	2,2	1,3	1,0
VIII	2,1	1,7	1,0
IX	2,6	3,0	1,2
X	4,3	3,9	2,6
XI	5,6	6,4	3,0
XII	6,2	6,8	4,1

Elevated inversions that may occur above the stack at the proposed Krasnodar GRES power plant at 200-500 m and inhibit air ascent have the average recurrence of 10-15%. The average thickness of such inversions is 300-400 m with intensity of 1-4 degrees.

Temperature sounding tests at the Perepravnaya meteorological station Veselyi hail control station agree with the data of the Minvody aerological station accepted as long-term values for the Krasnodar GRES site.

Average inversion recurrence rate, starting at the ground level, for the Krasnodar GRES site will be 30-50%. The thickness will be 300-500 m with intensity of 2-6 degrees.

In winter, inversion thickness and intensity is greater than in the warm period of the year.

During temperature sounding at the Perepravnaya met station in the summer of 1987 at 0-200 m altitude, a 30% occurrence of inversions and isotherms were observed. Of those cases, approximately 60% were observed in the morning hours. Their intensity was insignificant - 0.0 to 5 degrees, thickness - 50-100 m.

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4.1.3 Air Quality Impact by Nitrogen Oxides

The background concentrations of emissions into the atmosphere in Mostovskoy are based on the data of the Krasnodar hydrometeorologic regional center. These concentrations take into account the emissions of motor transport vehicles and heating boiler houses.

4.1.4 General Air Quality Impact Including Radiation

General air quality in terms of pollutants is based on their background concentration and is independent of solar radiation.

Table 4.14
Background Concentration of the Main Air Pollutants for Mostovskoy Village the Krasnodar Territory

Pollutants	Concentration		
	Mostovskoy Background Value, mg/m³	Average Daily Maximum Permissible Concentration, mg/m³	
		Russian Standards[1],	World Bank Standards
Suspended matter	0.3	0.05	0.1
NO_2	0.03	0.085 in 30 min.	
Ñî	0.8	1.0	---
SO_2	0.05	0.05	0.1

4.1.5 Main Sources of Nitrogen Oxides

As seen from the background concentration values (Table 4.14), nitrogen oxides in the atmospheric air of the power plant construction site are not in excess of the maximum permissible concentration values.

Table 4.15 summarizes air pollution by the enterprises in the Mostovskoy and Labinsk Districts

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Table 4.15
Air Pollution by Stationary Sources in Mostovskoy and Labinsk Districts in 1993-1994

Mostovskoy District	1993	1994
Total emissions to atmosphere, incl.	1061.1	463.3
solids	344.2	175.6
soot (dust, coke ash)	3.8	1.4
nitrogen oxides (based on NO_2)	153.1	36.8
SO_2	39.1	18.2
CO	510.6	218.1
Wood dust	251.7	105.1
gases and liquids	716.9	287.7
gasoline (natural or sweet)	3.2	7.4
gypsum dust	32.3	32.3
non-organic dust	37.7	29.1
volatile organic compounds	7.6	11.1
Labinsk District (Labinsk)	1993	1994
Total emissions to atmosphere, incl.	914.4	1034.2
solids	217.3	136.7
soot	61.9	0.4
non-organic dust	16.8	21.1
granular dust	113.4	91.4
volatile dust	21.6	10.8
gasses and liquids	697.1	897.4
nitrogen oxides (based on NO_2)	98.6	221.0
Mostovskoy District	1993	1994
SO_2	22.4	115.4
CO	384.8	259.6
volatile organic compounds	189.3	299.2
gasoline (natural and sweet)	174.0	280.7

4.1.5.1 Pollution Sources

The main pollution sources in the Mostovskoy District are: motor transport vehicles, asphalt and concrete-mixing plant (ABZ), crushing and grading plant (DSZ), "Yug" production furniture wood-working association (PMDO), and flares in the western vicinity of Mostovskoy Village.

Appendices 8 and 9 are indicative of air pollution by industrial enterprises of the Mostovskoy and Labinsk districts.

4.1.6 Map of the Sources of Pollution

The map in Appendix 10 is indicative of the location of the pollution sources.

4.1.7 Potential Air Pollution

In the area of the proposed power plant site, no special observations of air quality impact were made by Goskomgidromet (State Committee on Hydrology and Meteorology) or Sanepid (Sanitary-epidemiological Station). There are no indications of any new potential air pollution sources.

4.1.8 Comparison of the Russian Criteria and the World Bank Criteria

Comparison of the Russian criteria and the World Bank criteria was shown above (Table 4.14)

4.2 Water Resources

4.2.1 Surface Water

4.2.1.1 Location

The Laba River is the largest tributary of the Kuban River in both basin area and water volume. It is 214 km long with a watershed of 12,500 km^2. The Laba River is formed by the confluence of the Bolshaya Laba and the Malaya Laba rivers originating in the mountainous part of the Caucasian ridge at an altitude of 3,700 meters.

From the confluence of the Bolshaya Laba and the Malaya Laba rivers, the Laba River runs to the north, and crosses the railroad Armavir-Tuapse. Elevation difference within this section of the river is 292 m with an average slope of 0.0037. The valley is wide, the river channel is branched, the banks are low. The river channel at Kaladzhinskaya is 60-70 wide, flow depth at leveled surface is 1,0-1,10 m; the bottom is pebbly upstream and sandy in the river mouth.

Table 4.16 is representative of the main tributaries of the Laba River.

Table 4.16 Main Tributaries of the Laba River

River	Side of Inflow	Distance From the Mouth, km	River Length, km	Watershed Area, km^2
Malaya Laba	left	214	95	1620
Bolshaya Laba	right	214	127	1730
Khodz	right	180	88	1250
Labenok	right	91	133	870
Chamlyk	right	91	231	2830
Fars	left	72	197	1450
Ulka	left	48	100	402
Gryaznukha	left	42	53	217
Psenafa	left	15	101	460

Appendices 11 and 12 are representative of the hydrographic network of the Krasnodar Territory and that of the Mostovskoy district.

4.2.1.2 Sources and Receivers of Water Flow

The water source comes either from the Laba river or its underflow (30% of the long-time average annual flow).

The source of the Laba basin rivers are of a mixed type. Surface flow of the plain and piedmont parts of the basin is formed by melting snow, rainfall, and groundwater with a higher rainfall water share for piedmont rivers and a higher snow melt share for plain rivers. Glacier water is of a significant role for the water flow of the mountain and high mountain rivers originating from glaciers at 1500 m and higher which makes up for more than 30 % of the annual water flow. The sources of the Bolshaya Laba are the glaciers of the Abinka Mountain. The Malaya Laba originates from the snow top of the Ashikha Mountain and Pseashko glacier. Total area of glaciers feeding these rivers is 15 km^2. The piedmont part of the basin begins with the Laba reaching the wide valley at Kaladzhinskaya settlement.

Table 4.17 representative of the Laba River annual water flow components by source.

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Table 4.17
The Laba River Annual Water Flow Feed Components

River	Point	Water-Shed, km^2	Average Water Intake Altitude,m	Freezing Ratio, %	Annual Water Flow Components			
					Ground-water	Snow Water	Rain-fall Water	Glacier Water
Laba	Doguzhi-yev	12000	730	0,13	39	7	27	27
Malaya Laba	Burnoye	1090	1960	0,86	22	8	36	34

Runoff receptors:

- The Laba river - for municipal effluents after their purification at water treatment facilities
- The Kurchidskaya ravine (then the Khodz or Laba rivers) - for storm runoff collected from the power plant site during rainfalls.

4.2.1.3 Water Use

There are no potable water surface intakes downstream of the Laba river from Mostovskoy

There are no potable water intakes downstream from the Krasnodar GRES river section. The water resources of the Laba River and its tributaries are used for:

- irrigation farming
- fishing industry
- industry
- residential users.

At present, within the Laba basin there are 6 water reservoirs with a total capacity of 11,1 million m^3, 286 ponds with total capacity of 36.6 million m^3, 8 large channels (Labinsky, Konstantinovsky, Rodnikovsky, Mikhailovsky, Temirgoyevsky, Khodz-Nevol'ka-Chekhrak, Yelenovsky, trunk channel for Adygeya irrigation system), and many irrigation channels, weir channels, and subsurface water intakes.

Total volume of water withdrawn from surface sources of the basin amounts to 486.5 million m^3 per year, of those 478.5 million m^3 per year are for irrigation and flooding farm land of 33,000 hectares.

Largest withdrawal of surface water is made by:

- Labinsky channel - 57.2 million m^3 per year;
- Konstantinovsky channel for irrigation, flooding and fish breeding - 169.8 million m^3 per year;
- Trunk channel of the Adygeya irrigation system - 104.7 million m^3 per year.

Water intake from the Laba river is carried out primarily in the section downstream of the proposed water intake of the Krasnodar GRES site. In the section upstream of the Krasnodar GRES, the current water consumption is insignificant, it is only 1.54 million m^3 per year. In the future no increase in water consumption in this section is envisaged.

In addition to water withdrawal from the surface sources in the basin, water is also taken from groundwater sources, hydraulically connected with river water. The total groundwater consumption is equal to 12.9 million m^3 per year.

Part of the used water, collector-drained water and waste waters of large channels are discharged into the river system. The volume of water discharge amounts 305.9 million m^3per year.

The volume of consumptive water use in the Laba river basin at present is 293.5 million m^3 per year.

4.2.1.4 Dimensions, Hydraulics, Levels, Morphometry, Boundaries

A rise of the water level in the Laba river begins in mid March. The intensity of flood is 20-80 mm/day. The flood run-off accounts for 75-80 % of the annual run-off. Due to a considerable contribution of glacier alimentation, the high water lasts the whole summer. The flooding starts to abate at the beginning of August. A sharp fall of the water level ends late in August or in September, but a general decrease in the level also continues after flooding, approximately until late November. The low water period is close to that of high water, but the run-off accounts for 20-25%.

In fall, the base water level is interrupted by rain floods. The lowest discharge and levels are observed in the fall-winter period. The winter period is characterized by a steady low water level which can be interrupted by short increases in the levels, frequently up to 1 m due to ice jams or ice gorges. The highest annual amplitude of the water level in the Laba river near Kaladzhinskaya is 2.92 m., average is 1.81 m and the lowest 0.95 m.

Table 4.18 summarizes data on the characteristic levels and dates when these water levels are observed in the Laba river. The planar and depth deformations of the Laba bed in the section of the proposed water intake have not been studied. No previous field work has been done.

The valley of the Laba river is trapezoidal, 9 - 10 km wide, the banks are straight and gently sloping, the right bank is 200 to 300 m high, the left is 90-100 m, covered with steppe vegetation, in some places with bushes and forest. The Laba river channel is highly ramified, featuring a system of branches and islets, with a total width of 1000 m. The main branch during the low water period is divided into a number of branches. The main branch is located next to the left bank, with the runoff in the low water period. The bed of the main branch and islets are covered with pebbles. The main channel and branches have a distinct transverse slope. After floods, the channels and branches are deformed both in planar and vertical positions.

Table 4.18
Characteristic Water Levels in the Laba River Near Kaladzhinskaya
(Elevation of Zero of the Graph is 431.34 m, Base Channel)

Characteristic	Highest Annual Level	Lowest Annual Level	Annual Amplitude of Level Fluctuation, cm/y		
	Level	Date	Level	Date	
Average level	566		425		1,81
Highest level	593	25,26,29 30/V-1968	460	14,19/II -1964	292/1 958
Lowest level	538	19/VI-1973	381	27/II-1973	95/19 73
Average date		21/III		2/I	
Early date		31/III		1/X	
Late date		25/X		15/III	

In terms of channel deformations, the Laba river at the site of the proposed water intake is close to the type of rivers with a multibraided stream. The banks are predominantly steep, prone to washout, 1.5 to 10 m high.

The computed cross sections of the Laba river near the Krasnodar GRES are presented in Appendices 13 - 16.

Table 4.19 summarizes the main hydraulic parameters of the characteristic cross sections in the Laba river near the Krasnodar GRES.

4.2.1.5 Ice Regime, Duration, Thickness

Icing phenomena in the Laba river near Kaladzhinskaya are observed every year, basically in the form of shore ice and ice slush

The first ice formations usually occur in mid December. In some years with the early advent of cold weather, icing phenomena emerge earlier (November 12,1956), and with a lingering warm fall - in the first half of February (February 9, 1938).

The first ice formations appear to be shore ice and ice grease. The shore ice persists until the beginning of freeze-up, and if there is no freeze-up it stays the whole winter.

The fall ice drift, partly in the form of ice sludge, begins 3-5 days after the emergence of steady shore ice and is observed almost every year. The average duration of the freeze-up is 5 days, in some years (1953/54) up to 64 days. With long and warm fall there is practically no freeze-up.

During fall ice drift, ice jams occur, sometimes they are observed in mid or at the end of winter during thaw periods.

The ice jam level has been observed to range from 7 to 113 cm, and the ice jam period from 4 to 39 days. The maximum ice thickness near Kaladzhinskaya was 27 cm in 1954.

Table 4.19 Hydraulic Parameters of Cross Sections

Section [1]	Í, m BS	Â, m	F, m^2	h_{st}, m	$\sqrt{h}$ st,	i	$\sqrt{i}$	n	$\sqrt{h_{cí}}$	C	V, m/s	Q, m^3/s
[1] 1												
1	414.0					0.004	0.063	0.065				
	414.2	25	5	0.20	0.45				0.04	8.2	0.23	1.2
	415.0	35	29	083	0.91				0.05	15.0	0.86	20.9
	415.2	40	36	0.90	0.95				0.05	15.5	0.94	34.2
	416.0	40	68	1.70	1.30				0.08	19.5	1.6	102
	417.0	40	108	2.70	1.69				0.08	22.1	2.28	246
2	414.0											
	414.2	10	2	0.20	0.45				0.04	6.2	0.23	0.96
	415.0	45	24	0.53	0.73				0.04	12.6	0.39	13.3
	415.2	50	33	0.66	0.81				0.05	13.8	0.70	23.1
	416.0	50	73	1.46	1.21				0.08	18.0	1.37	100
	417.0	50	123	2.46	1.57				0.09	21.6	2.14	263
3	413.4											
	414.2	180	108	0.70	0.84				0.06	14.2	0.75	81
	415.0	200	268	1.34	1.16				0.07	18.0	1.31	351
	416.0	200	368	1.84	1.36				0.09	19.9	1.71	629
	417.0	200	468	2.34	1.53				0.1	21.2	2.03	950
4	413.6											
	414.2	40	24	0.60	0.77				0.05	13.2	0.63	15.
	414.5	100	45	0.45	0.67				0.042	11.7	0.49	22.0
	415.0	255	168	0.66	0.81				0.05	13.8	0.70	118
	416.0	295	443	1.50	1.22				0.07	18.7	1.99	638
	417.0	415	798	1.92	1.39				0.09	20.1	1.77	1412

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Section [1]	Í, m BS	Â, m	F, m^2	h_{st}, m	$\sqrt{h}$ st,	i	$\sqrt{i}$	n	$\sqrt{h_{cl} i}$	C	V, m/s	Q, m^3/s
[1] 1												
Sum	H, m BS	413.6		414.2	415.0	416.0	417.0					
	Q, m^3/s	0.0		97.1	508	1476	2771					
1	410.0	20	0			0.04	0.063	0.065				
	410.5	70	22.5	0.32	0.56				0.035	9.9	0.35	8.0
	411.0	140	127.5	0.91	0.95				0.06	14.7	0.88	112
	411.5	180	207.5	1.15	1.07				0.067	16.1	1.00	208
2	409.9	30										
	410.5	80	27.5	0.34	0.58				0.036	10.2	0.36	10.0
	411.0	100	72.5	0.72	0.85				0.053	13.4	0.71	51.5
	411.5	140	132.5	0.95	0.97				0.061	15.0	0.91	120.6
3	410.0	40										
	410.5	70	27.5	0.39	0.58				0.036	10.5	0.38	10.5
	411.0	110	72.5	0.66	0.81				0.051	13.1	0.67	48.6
	411.5	150	137.5	0.92	0.96				0.06	14.7	0.88	121
4	409.5	30										
	410.0	80	27.5	0.34	0.58				0.036	10.2	0.37	10.2
	410.5	130	80	0.61	0.78				0.05	12.7	0.62	49.6
	411.0	170	155	0.91	0.95				0.06	14.1	0.85	132
	411.5	20	252.5	1.15	1.07				0.07	16.1	1.08	273
5	411.5	700	730									
	412.0	730	1087	1.48	1.21				0.076	17.6	1.33	1445
	412.5	800	1469	1.83	1.35				0.085	19.1	1.62	2380
	413.0	860	1884	2.20	1.48				0.093	20.4	1.90	3550
Sum	H, m BS	409.5	410.0	41.5	411.0	411.5	412.0	412.5	413.0			

Section [1]	Í, m BS	Â, m	F, m^2	h_{st}, m	$\sqrt{h}$ st,	i	$\sqrt{i}$	n	$\sqrt{h_{ci}}$	C	V, m/s	Q, m^3/s
	Q, m^3/ñ	0.0	10.2	98.2	442	722	1445	2380	3550			
1	406.0	5	0			0.004	0.063	0.065				
	406.5	50	12.5	0.25	0.5				0.032	9.2	0.29	3.6
	407.0	50	37.5	0.75	0.87				0.056	13.6	0.76	10.3
	407.5	80	70.0	0.87	0.93				0.060	14.3	0.86	60.3
	408.0	80	110	1.37	1.17				0.076	17.0	1.29	142
2	406.2	100	0									
	406.5	110	31.5	0.29	0.54				0.035	9.6	0.34	10.7
	407.0	120	89	0.74	0.86				0.056	13.7	0.76	68.0
	407.5	150	156.5	1.04	1.02				0.066	15.3	1.01	157
	408.0	170	236.5	1.39	1.18				0.077	19.2	1.48	238
3	407.5	50	0									
	408.5	120	42.5	0.35	0.59				0.038	10.4	0.39	16.5
4	408.5	490	389	0.79	0.89				0.056	14.0	0.78	303
	408.5	550	649	1.18	1.09				0.068	16.4	1.11	720
	409.0	650	949	1.46	1.20				0.076	17.6	1.23	1167
	409.5	740	1296	1.75	1.32				0.083	18.8	1.56	2024
	410.0	900	1706	1.89	1.37				0.086	19.3	1.65	2831
Sum	H, m BS	406.0	407.0	407.5	408.0	408.5	409.0	409.5	410.0			
	Q, m^3/ñ	14.3	78.0	217	303	720	1167	2034	2831			

Table 4.20 summarizes basic information on the duration of icing phenomena in the Laba river

Table 4.20
Duration of Icing Phenomena in the Laba River Near Kaladzhievskaya

Characteristic	Dates		Number of Days	
	Beginning of Ice Phenomena	End of Ice Phenomena	With Ice Phenomena	With Freeze-Up
Average	15.12	8.03	41	1
Early (highest)	12.11.56	20.01.62	97-1931/32	64-1953/54
Late (lowest)	9.02.38	6.04.65	6-1965/66	0-91%

Occasionally, hanging dams are observed in the Laba river, but they are less frequent than ice jams. A rise in the level may last more than 1 to 2 days, and sometimes only a few hours, but sometimes ice jams can occur continuously for up to 10 days.

4.2.1.6 Discharge

The flow of the Laba river is formed by melting ice, snow melt, glacial thaw, rainfall and groundwater.

The high water flow accounts for 75-80% of the annual flow. The low water period lasts almost as long as the high water period, but its flow accounts for 20-25% of the annual flow.

The characteristics of the Laba river annual flow at the proposed water intake is compiled from data published in the cadastral literature (Surface water resources in the USSR, hydrological yearbooks, etc.)

The Laba river cross section near Kaladzhinskaya is accepted as a reference section, characterizing the Laba river flow at the Krasnodar GRES site.

Table 4.21 summarizes the average discharge of various probability.

Table 4.21
Average Annual Water Discharge of Various Probability in the Laba river - Kaladzhinskaya Settlement

Average for Entire Period of Observation	Coefficients		Average annual discharge, m^3/s, Probability, %				
	Variations Ñv	Asymmetry Cs	25	50	75	95	97
83.1	0.18	0.36	92.6	83.1	72.5	60.2	57.5

The Laba river is characterized by spring-summer high water and floods throughout the year. The maximum discharge of spring-summer flooding is the highest during the year and usually occurs in May-June, occasionally in July-August, and only on two occasions (1941, 1972) the maximum discharge of rain floods was higher than those of spring-summer floods.

The hydrograph of the Laba river is of a multistage form with distinct peaks.

Table 4.22 summarizes the parameters of spring flood, high water and highest annual discharges.

Table 4.22
Parameters and Calculated Maximum Water Discharges of Spring-Summer, Rain and Highest Annual floods

	Parameters			Computed Values, with Probability %						
Designation	Avg	C_v	C_s	0,0.1 with g.c.	0.01	0.1	0.5	1	5	10
Maximum spring flood discharge (m^3/d), standard obs.	428	0.32	5.5C_v	1985	1720	1251	990	890	685	599
Maximum rain flood discharge (m^3/d), standard obs.	185	0.65	5.5C_v	1800	1500	934	655	557	370	302
Maximum annual water discharge (m^3/d), standard obs.	444	0.32	5.5C_v	2050	1780	1300	1030	924	709	622

Note: g.c. - guaranteed correction

The minimum water discharge in the Laba river is usually observed at the end of the fall-winter low water period.

Table 4.23 summarizes information on the characteristic mean daily and monthly water discharge, and Table 4.24 shows the parameters and computed values of the minimum water discharge.

As seen from Table 4.23, the lowest daily water discharge falls to 2.20 m^3/s. However, upon analysis of the reference materials on the daily water discharge in 1945 revealed that the discharge results were attributable to ice jam formation at the site between gauging stations at Burnoe and Kaladzhinskaya.

Table 4.23
Characteristic Minimal Daily and Monthly Water Discharge in the Laba River Near Kaladzhinskaya Over the Entire Period of Observations

Minimum Water Discharge	Highest		Lowest		
	m^3/s	Date	Average	m^3/s	Date
Daily average	22.0	7.11; 5-18.02, 1968	13.2	2.20	25.02.1945
Monthly average	41.5	1979	19.4	9.83	1939

Table 4.24
Parameters and Computed Values of Minimum Water Discharge in the Laba River Near Kaladzhinskaya

Designation	Average Period of Observations, m^3/s	Number of Years	C_v	C_s	Computed Values of Minimum Discharge, m^3/s, Probability %				
					50	75	90	95	97
Daily average	13.3	49	0.30	$1C_v$	13.2	10.5	8.35	7.14	6.4
Monthly average	19.4	60	0.35	$4C_v$	19.3	14.6	12.2	11.0	10

Table 4.25 Parameters of Annual Runoff

				Average for Long-Term Period			Coeff.		Annual Runoff of Various Probability, mln.m^3			
River	Site	Catch-ment Area, km^2	Average Altitude of Catchment Basin	Water Discharge (m^3/s)	Volume (mln. m^3/s)	Runoff Modulus l/s km^2	C_v	C_s	75%	95%	97%	99%
Laba	Kaladzhinskaya	3370	1600	83.1	2622	24.7	0.18	0.36	2289	1901	1814	1657
Laba	Doguzhiev	12000	730	95.4	3009	7.95	0.20	0.40	2580	2094	1987	1788
Malaya Laba	Burnoe	1090	1960	35.2	1110	32.3	0.22	0.0	947	709	650	540
Bolshaya Laba	Downstream of Aziatsky bridge	1180	1970	40.2	1268	34.1	0.16	0.32	1113	956	918	848
Fars	Dondukovskaya	1240	400	4.6	145	3.71	0.40	0.80	103	65	57	44
Chamlyk	Voznesenskaya	554	590	1.39	43.8	2.51	0.40	0.80	30.9	19.6	17.0	13.2

4.2.1.7 Regime of Surface Runoff

The characteristic of surface runoff in the Laba river at the Krasnodar GRES site was drawn from reference materials published in the cadastral literature (Surface water resources, hydrological yearbooks, etc.)

The data from the Kaladzhinskaya gauging station was accepted as characteristic of the annual runoff in the Krasnodar GRES region, since the difference in the areas of the cross sections under consideration is insignificant.

Tables 4.25, 4.26, 4.27, and 4.28 summarize the parameters of the Laba river runoff.

Table 4.26
Annual Distribution of Runoff in the Laba River Near Kaladzhinskaya in Years Differing in Water Content (m^3/s)

MONTHS												
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Average												
17.3	17.9	28.9	86.7	170	214	171	107	75.7	44.8	36.9	26.9	83.1
Dry, with probability 75 %												
15.7	15.7	23.4	71.3	150	189	150	94	67	38.3	32.2	23.5	72.5
Dry, with probability 95 %												
11.2	11.9	17.3	52.7	129	166	129	81.6	51.3	30.3	24.6	17.3	60.2

Table 4.27
Average Long-Term and Computed Values of Seasonal Runoff in the Laba River Near Kaladzhinskaya

Seasons	Average for Long-Term Period		Coefficients		Computed Values, m^3/s			
	Dis-charge m^3/s	Volume ,mln. m^3	C_v	C_s	25%	75%	95%	97%
Wet, summer (V-VIII)	157	1672	0.22	0.44	1901	1409	1120	1055
Limiting fall-winter (IX-II)	39.3	614	0.30	1.50	706	485	387	368
Spring (III-IV)	63.8	336	0.30	0.60	397	263	190	174
Limiting period (IX-IV)	45.5	950	0.25	0.50	1099	781	600	560

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Table 4.28
Annual Runoff in the Laba River Near Kaladzhinskaya

Dimensionality	Monthly Runoff												Year	Seasonal Runoff			
	Summer (V-VIII)			Fall-Winter (IX-II)							Spring						
	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV		Summer V-VIII	Fall IX-II	Spring III-IV	Lim Per IX-IV
Wet Ð=25%																	
â %	16.7	21.2	16.8	10.6	7.7	4.5	3.7	2.7	1.8	1.8	3.1	9.4	100	65.3	22.2	12.5	34.7
mln. m³	448	619	491	309	225	131	108	78.9	52.7	52.7	90.7	275	2921	1907	648	366	1014
Average (normal)																	
â %	17.0	21.5	17.1	10.7	7.6	4.5	3.7	2.7	1.8	1.8	2.9	8.7	100	66.3	22.1	11.6	33.7
mln. m³	446	564	448	281	199	118	97.0	70.8	47.1	47.1	76.0	228	2622	1739	579	304	883
Dry Ð=75%																	
â %	17.2	21.7	17.3	10.8	7.7	4.4	3.7	2.7	1.8	1.8	2.7	8.2	100	67.0	22.1	10.9	33.0
mln. m³	394	497	396	247	176	101	84.7	61.8	41.3	41.3	61.9	187	2289	1534	506	249	755
Dry Ð=95%																	
â %	17.9	22.9	17.9	11.3	7.1	4.2	3.4	2.4	1.55	1.65	2.4	7.3	100	70	20.3	9.7	30
mln. m³	340	434	340	215	135	80	65	46	29.5	31.5	46.0	139	1901	1329	387	185	572

4.2.1.8 Water Quality

Table 4.29 summarizes the chemical composition of the Laba river upstream of Labinsk (data by North-Caucasian UGKS).

4.2.1.8.1 Bacterial and Viral Indices

E. Coli index - is not higher than 1000.

4.2.1.9 Sediments

4.2.1.9.1 Transport of Sediments

Water erosion in the Laba basin is widespread, particularly in the upper and middle reaches, where the main tributaries combine and there are favorable conditions for the formation of sediment runoff (large slopes, rapid flow, presence of weak fragmentary material).

The Laba river near Kaladzhinskaya is characterized by considerable fluctuations in the maximum discharge of suspended sediments. The highest daily average discharge of river suspended sediments varies from 44 kg/ s to 2400 kg/s. In the Laba river basin, the sediment runoff of the summer season accounts for 52-55%, that of spring up to 40%. The sediment drift in fall and winter is reduced and accounts for only 7% of the annual runoff of suspended sediments.

The highest turbidity in the Laba river is observed in the spring-summer flood period. The highest annual turbidity of the Laba river water near Kaladzhinskaya over the period from 1931 to 1980 changed from 300 g/m^3 (1934) to 17000 g/m^3 (1954). Table 2.16 shows monthly average water turbidity, averaged over a long-term period of observations.

Table 4.30
Monthly Average Water Turbidity in the Laba River Near Kaladzhinskaya (g/m^3)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
12	33	99	280	360	380	210	150	84	78	63	38	230

Table 4.31. displays the particle size distribution of suspended sediments, and Table 4.32 shows their discharge rate.

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Table 4.29
Chemical Composition of the Laba River

Sampling Dates	Temp	Ph	O_2	BOD_5	COD	Ca^{2+}	Mg^{2+}	$Na^+ + K^+$	HCO_3	SO_4^{2-}
22.01.80	0.0	7.70	13.57	0.88	n/a	n/a	n/a	n/a	n/a	n/a
17.04	3.0	7.95	11.67	1.16	n/a	n/a	n/a	n/a	n/a	n/a
10.07	20.0	8.33	7.76	0.40	n/a	n/a	n/a	n/a	n/a	n/a
25.08	22.2	7.60	9.66	n/a	n/a	28.5	2.7	n/a	81.7	n/a
2.10	6.0	8.00	9.66	0.98	n/a	n/a	n/a	n/a	n/a	n/a
4.10	12.2	7.60	10.50	0.91	n/a	40.9	6.8	2.8	105	37.5
4.04. 83	9.8	7.58	15.57	n/a	51.0	40.4	2.4	5.0	95.2	30.7
29.07	17.4	7.59	11.33	n/a	50.7	22.8	2.1	3.0	59.2	15.4
02.12	5.4	7.17	11.68	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5.03.84 1	5.0	7.59	13.55	n/a	17.7	30.5	4.1	14.0	93.4	31.2
19.04	11.6	7.00	12.68	n/a	58.9	36.7	1.5	17.2	103	37.9
2.08	17.2	7.59	11.20	n/a	n/a	25.3	2.4	5.0	72.0	18.3
30.11	1.0	7.59	14.44	n/a	23.3	49.1	6.9	4.8	119	51.4
21.03.85	8.2	7.20	10.52	n/a	33.2	32.3	5.2	n/a	83.0	45.6
Russian Water Quality Criteria						180 Fishery	50 Drinking Water	200 (Na^+) Drinking Water		500 Drinking Water

Water Quality Criteria	Cl	Su	NH_4	NO_2	NO_3	Pmm	Ptot	Phenols	f/imp	Fe tot
7.05	12.2	7.61	11.69	n/a	36.4	23.6	2.1	n/a	79.3	17.8
22.01.80	n/a	254	n/d	0.013	0.84	0.005	n/a	n/d	n/d	0.18
17.04	n/a	238	0.10	n/d	0.20	0.015	n/a	0.009	0.02	0.50
10.07	n/a	n/a	0.07	0.032	0.30	n/a	n/d	n/d	n/d	n/d
25.08	3.1	n/a	0.19	0.003	0.32	0.002	n/a	0.002	n/a	n/a
2.10	n/a	157	0.09	0.007	0.35	0.025	n/a	n/d	n/d	n/d
4.10	55	202	0.62	0.024	0.72	0.006	n/a	n/d	0.38	n/a
4.04.83	6.0	184	n/d	0.002	1.13	n/d	n/a	n/a	0.25	n/a
29.07	4.3	110	n/d	0.008	0.30	n/d	n/a	n/a	n/a	n/a
02.12	n/a:n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
15.03.84	6.4	183	n/d	n/d	0.84	n/d	n/a	n/a	n/a	n/a
19.04	3.5	204	0.01	n/d	0.10	n/d	n/a	n/d	n/a	n/a
2.08	2.5	128	0.14	0.006	0.47	n/d	n/a	n/d	2.95	n/a
30.11	1.3	233	n/d	0,018	n/a	0.004	n/a	n/a	n/a	n/a
21.03.85	3.5	178	n/d	0.008	1.25	n/d	n/d	n/d	0.13	n/a
7.05	2.5	139	n/d	0.008	0.60	n/d	n/d	n/d	0.17	n/d
Russian Water Quality Criteria	300 (as Cl_2) Fishery		0.05 (as NH_3) Fishery	0.08 Fishery	40 Fishery			0.001 Fishery		0.05 Fishery

Table 4.31
Particle Size Distribution of Suspended Sediments in the Laba River Near Kaladzhinskaya

Regime Phase	Characteristic of Sediment Composition	Measurement Date	Particle Content (% by Weight) with Diameter mm						
			1-0.5	0.5-0.2	0.2-0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001
Spring flood rise	Large	27.V.74	0.5	30.9	33.3	9.3	21.8	2.0	2.2
	Medium	9.V.74	0.2	20.9	54.5	8.5	26.8	0.4	8.7
	Small	21.VI.73	4.2	5.1	21.4	18.5	29.2	21.5	
Spring flood drop	Large	14.VII.71	0.6	32.9	40.4	14.6	8.4	3.1	
	Medium	2.VI.71		8.4	32.0	20.7	23.9	15.0	
	Small	27.VIII.71		3.3	2.0	9.7	44.2	40.8	
Floods		23.IX.71		1.9	19.3	39.4	30.1	9.3	

Table 4.32
Sediment Discharge Rate in the Laba River Near Kaladzhinskaya

Sediment Runoff	Unit of Measurement	Parameters of Probability Curve			Probability, %						
		Ave.	C_v	C_s	1	5	10	25	75	95	97
Suspended	kg/s	22.8	0.53	1.06	60.0	45.6	39.0	31.8	14.0	7.2	6.0
Suspended	thou.tons	720			1900	1440	1230	1000	442	228	190
Carried on bottom	kg/s	6.85			18.0	13.7	11.7	9.5	4.2	2.2	1.8
Carried on bottom	thou. tons	216			568	433	369	300	133	69	57
Total carried on bottom and suspended sediments	thou.tons	936			2468	1873	1599	1300	575	297	247

Table 4.33
Bottom Sediments in the Laba River Near Kaladzhinskaya

Sampling Date	Particle Diameter (mm) and Their Content (in % by Weight)													Largest Particle Diameter	Unit Weight
	200-100 >100	100-50	50-20	20-10	10-5 <10	5-2	2-1	1-0.5 <1	0.5-0.2	0.2-0.1	0.1-0.05	0.05 - 0.01	<0.01		
1 9 7 8															
14.V	5.0	19.0	18.0	8.0				0.3	20.9	15.7	6.8	6.3		180×110 ×80	
15.VI	21.2	26.2	25.0	17.5	1.2	2.2	0.7	1.4	2.6	1.1	0.4	0.5		180×120 ×80	1.55
2.8	13.0	24.0	20.0	29.0	1.3	2.0	0.4	0.7	5.7	2.3	0.7	0.9		250×180 × 120	
1 9 7 9															
20.V	12.0	43.0	15.0	7.0	0.9	0.7	0.1	0.3	2.9	8.5	4.3	3.2	2.1	380 × 290 × 200	1.7
29.V	13.0	42.0	13.0	9.0	1.2	1.5	0.3	2.0	8.1	4.1	2.2	3.6		350 × 290 × 110	1.88

4.2.1.10 Water Consumers Downstream of the Laba River

Information can be found in "A list of water consumers, using the surface runoff in the Laba river Basin." In view of its large volume, this table is not presented in this report. A discussion of primary users of the Laba river can be found in Section 4.2.1.3 of this Chapter.

4.2.1.11 Drinking Water Intake

There is no drinking water surface intake downstream of the Krasnodar GRES cross section in the Laba river In the Labinsk region, 20 km downstream of Mostovskoy there is a groundwater intake. Disposal of purified water from water treatment facilities in Mostovskoy is in accordance with maximum permissible disposal limits and will not affect groundwater intake quality downstream.

4.2.1.12 Basic Pollutants

This information can be obtained in the manual "A list of enterprises disposing treated water into the hydrographic network".

Data on several pollutants are summarized in Table 4.34.

4.2.1.13 Map of Pollution Sources

The map of the main pollution sources is presented in Supplement 4.

4.2.2 Groundwater

Groundwater of the region under consideration is confined to subsurface channel deposits of the Laba river The subsurface channel flow accounts for up to the total runoff of the Laba river.

4.2.2.1 Water Quality

Groundwater in the region under consideration is confined to underflow deposits of the Laba river. The underflow runoff accounts for 30% of the total Laba river flow. Mineralization concentrations are discussed in Section 4.2.2.2 of this Chapter.

Table 4.34
Recorded Disposals into Rivers from Data of a Statistical Report (According to Form No. 2 - TP (Hydroeconomics) for 1994).

Enterprises	Waste Water Disposed			Capacity of Treatment Plants	Mass of Disposed Substances					
	Without Treatment	Insufficient Treatment	Normal Treat-ment		BOD	Ca/Mg	Dry Residue	Susp. Matter	SAS	Phosphorus
Mostovskoy "Yug" Comp. Khodz river	40.8	2657		2562	8.1			13.3		3.62
Shedoksky Gypsum Works Laba river		388.1		511	1.78	/10.3	319.2	2.34	0.07	0.5
"Shcheben" Co. Labinsk Laba river	120.3				0.1		0.9	3.0		0.001
Intersectoral balneo-hospital Nevolka river	9	7		36.5	0.12		11.3	0.22		0.004
Voznesenskaya Labinsky Dairy Plant, Chamlyk river		24		116.8	0.2	2.4/ 0.14	14.6	0.2		0.002
Labinsk PUVZKK Co. Laba river		7934		6205	127.8		3452	186.8	1.62	4.0

Table 4.34
Recorded Disposals into Rivers from Data of a Statistical Report (According to Form No. 2 - TP Hydroeconomics for 1994) (continued)

Enterprises	Mass of disposed substances								
	Oil products	Phenoles	Formaldehyde	SO_4	CL	NH_4	NO_3	NO_2	Fat
Mostovskoy "Yug" Comp. Khodz river	0.01		0.065	249.2	159.5	1.215	4.6	0.2	
Shedoksky Gypsum Works Laba river	0.04			46.58	15.05	0.09	0.25		
"Shcheben" Co. Labinsk Laba river	0.27			0.4	1.0	0.03	0.011	0.001	
Intersectoral balneo-hospital Nevolka river				0.132	3.55	0.025	0.032	0.008	
Voznesenskaya Labinsky Dairy Plant, Chamlyk river				0.09	2.9	0.006	0.035	0.032	
Labinsk PUVZKK Co. Laba river	1.0		3.01	378.1	440.1	26.4	17.01	3.10	8.30

4.2.2.2 Thickness and Occurrence of Aquifers

In the artesian basin, two hydrological floors are identified:

- the upper one with free and impeded water exchange;
- the lower with rather impeded water exchange.

Within the Mostovskoy region, the following aquifers and complexes of the upper geological floor are identified:

Water of alluvial-deluvial, eoliandeluvial, eluvial-deluvial and colluvial upper quaternary recent formations (Q_{III} - Q_{VI}) occurs sporadically. Water holding rocks (loams, sandy loams, detritus) occur at a depth of 0.5 to 14.5 m (more frequently from 2.0 to 5.0 m). The water level in river valleys and ravines is 0.2-3.0 m; on slopes 5-12 m. The discharge of sources varies from 0.001 l/s, mineralization up to 1 g/l.

Since recent alluvium along the Laba river has no distinct boundaries with the earlier quaternary alluvial deposits due to similar lithological composition, a single alluvial aquifer (a Q_{I-IV}) is differentiated here. The filtration coefficient of gravel-pebbly deposits is up to 60 m/d, mineralization up to 1 g/l. The average thickness of this horizon is 15 m. These deposits are widely used for water supply.

No water-bearing complex of deposits of undivided Pliocene exists at the construction site. The gravel-pebbly deposits of the Pliocene terrace (N_2) can possibly contain subsurface waters at a low depth from the surface. These are fresh hydrocarbonate waters with mineralization of 0.6 g/l.

The water-bearing complex of deposits with a typically middle Sarmatian fauna and layers of the upper Sarmatian substage (N_s + N_s) occurs farther to the north of the region under study.

Waters in the kryptomacro-layers of the middle Sarmatian substage (N_s) with sporadic occurrence, are contained in sandy interlayers, under pressure, and are usually slightly brackish. The filtration coefficient is 0.1 m/d.

The water-bearing complex of the Trotonian (N) is linked to the interlayers of limestones, sandstones, and sandy lenses in the Karangatian and Chokrackian deposits. The thickness of the interlayers is up to 12-14 m. The water is pressureless, drained by sources with a discharge from 0.01 to 2.8 l/sec. It is fresh (with mineralization 0.4-0.6 g/l), the filtration coefficient of sands is 0.4-2.6 m/d, and is used for water supply.

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Deeper aquifers of the upper hydrogeological floor are disregarded here. The basic groundwater direction of flow in all the aquifers is downstream along the Laba river, that is to the north-west.

4.2.2.3 Thickness of Confining Beds

There are two uniform regional confining strata in this region:

- Clays of the lower Sarmatian substage;
- Clays of the Maikopian series.

A sketch of the hydrogeological section is displayed in Fig. 4.1.

Hydrogeological Section

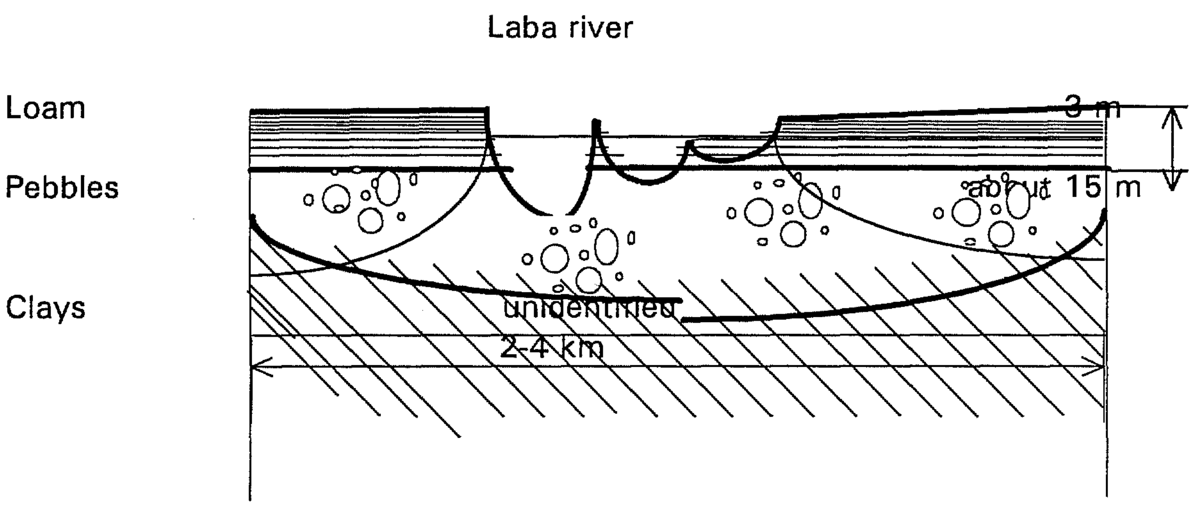


Fig. 4.1

Water-holding rock are represented by boulders and pebbles of various sizes, well rounded. The content of silty-clay fractions is not in excess of 9.4%. The well-washed nature of a filler (sand) for boulders and pebbles considerably increases their collection properties. The aquifer is encountered at a depth of 3.0-5.0 m. Its level is closely related to the period of the year. Clays and sands of the upper Paleocene and lower Sarmatian serve as a confining bed for the aquifer. The surface of the confining stratum is uniform with a slope in the northern direction (along the valley), being equal to 0.004. The groundwater flow coincides with the direction of river flow. The slope of groundwater surface is equal on the average to 0.005.

4.2.2.4 The Regions of Groundwater Formation and Leakage

The Krasnodar GRES site is located in the region of Azov-Black Sea artesian basin groundwater formation.

4.2.2.5 Service Water Intake

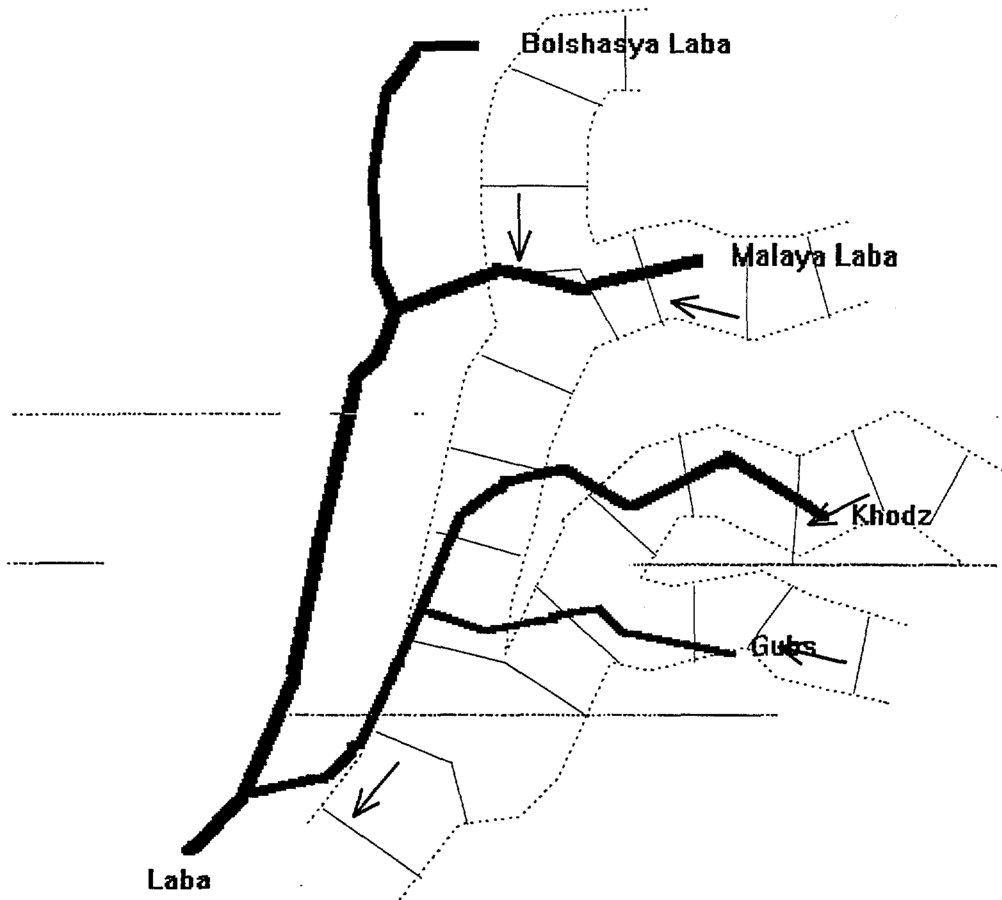
The nearest downstream mechanical water intake from the Laba river is located 15 km downstream and is intended for irrigation of 398 hectares of the orchard in Mostovskoy fruit-growing state farm; it operates from April to October. The nearest upstream mechanical water intake is located at the Kurgansky UOS of the Suvorov collective farm which is located 13 km upstream in the Labinsk region and operates from April till September to irrigate 218 hectares of plow land.

More detailed information can be found in the manual "A list of water consumers, currently (1985) utilizing groundwater, hydraulically connected with surface water, and long-term (up to 2005) prospects of water use." Due to its size, it is not presented in this report.

4.2.2.6 Hydrogeological Map

A sketch of the hydrogeological conditions on the Krasnodar GRES site is displayed in Fig. 4.2. The hydroisohypses run perpendicular to the Laba river flow at a depth of about 3 m. The width of the underflow varies from 2 to 4 km.

A Sketch of Hydrogeological Situation.



Legend:

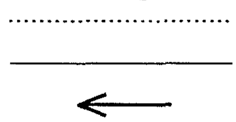


Figure 4.2

4.3 Land Resources

4.3.1 Geology

4.3.1.1 Stratigraphy

In the Caucasian region, exposed rock is of Jurassic, Cretaceous, Paleocene, Neogene and quaternary deposits, lying with a slight inclination (3.7) to the north. Meso-Kainozoic formations are predominantly composed of clay rocks; sandstones, limestones and marls and are of subordinate importance; a section of upper Jurassic sediments shows gypsum, anhydrides and interlayers of rock salt.

The Meso-Kainozoic cover of the Sythian plate in based on folded and consolidated rocks of Paleozoic and in some cases Triassic, represented by clay and crystalline slates, phyllites, and gritstones. The base of the sedimentary cover is exposed by deep holes to a low depth.

Jurassic deposits of the lower and middle series are exposed only in the southern region of the North-Caucasian marginal massif. This section is predominantly composed of argillites; the layers of aleurites and sandstones are sharply subordinate. The depth of low-middle Jurassic sediments ranges from 1000 to 2500 m, increasing in the north; on the Krasnodar GRES site its depth is 2150 m.

The section of upper Jurassic deposits is characterized by a great variety of rock types. The upper part is composed of clays with interlayers of sand, gypsum and anhydrites with interlayers of rock salt. The lower part is represented by limestones with interlayers of clays, limy sandstones and aleurolites, the section base shows gritstones and sandstones. The thickness of the upper Jurassic layer varies from 950 to 2300 m; in the region of the Krasnodar GRES site it is nearly 2000 m.

Cretaceous formations are noted for interstratification of clays with layers of aleurolites and sandstones; the upper part of the section shows an interloper of limestones with interlayers of marls several dozens meters deep; the base of the section is predominantly composed of sandstones. The thickness of rocks varies from 200 to 800 m; in the region of the Krasnodar GRES site its thickness is 250 m. Cretaceous rocks are exposed mostly on the North-Caucasian marginal massif and partly to the north of the Cherkess fracture, in the southern wing of the East-Kuban trough.

Paleocene deposits are exposed in the southern wing of the East-Kuban trough. They are represented by clays in the upper section, clays with interlayers of sandstones, aleurolites, and less frequently by sandstones in the lower half of the

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section. The section center is noted for a marking stratum about 200 m thick. The total thickness of the Paleocene section is 650-700 m.

Neogene sediments, consisting of a clay layer with interlayers of aleurolites and less frequently marls about 350 m thick, occur on vast areas of the East-Kuban trough. In the region of the Krasnodar GRES site, under the quaternary formations there are the lowest horizons (lower + middle Miocene) of Neogene, represented primarily by clays. The total thickness is 350 m.

The quaternary deposits in the region are composed of deluvial loams of marginal thickness (1-3 m) as well as alluvial pebble, sand, sandy loam and clay, with a total thickness of 30 to 60 m.

The total thickness of the sedimentary cover in the region of the Krasnodar GRES site is 5250-5300 m.

According to drilling data (reference materials of Ukrgidroproekt), the section of quaternary deposits within the construction site is as follows:

From deep to shallow: low-middle quaternary:

Layer 1 - pebble and gravel with inclusions of boulders, water saturated, with thickness of 4-10 m.

Layer 2 - pebble and gravel with inclusions of boulders, dry, with thickness 0-4m.

Recent deposits:

Layer 3 - hard and semihard clays with limy concretions, dry, with thickness 0-12m.

4.3.1.2 Seismology

The Krasnodar GRES site is located in the western part of the North-Caucasian seismic region and pertains to the 8 point zone according to the map of seismic regionalization of the Russian Federation.

Analysis of earthquake catalogs, obtained from the Bank of Geophysical Data on prediction of Earthquakes, and I.V. Ananin's macroseismic findings show that data on seismic phenomena in the North Caucasus began only at the end of the XVIII to the beginning of the XIX centuries. Instrumental data on the earthquake epicenters are available from 1912.

An earthquake closest to the Krasnodar GRES site occurred on November 12, 1954 with M=4.6-0.5 and the quake layer in the epicenter 6-0.5 points at a focus depth 17 km (14-21 km). The epicenter was located about 50 km to the south of Mostovskoy, within the area of the northern slope of the Main Caucasian Range. In the region of Krasnodar GRES site the shock intensity was estimated at 5-6 points.

Thus, analysis of seismicity in the North Caucasus according to I.V. Ananin (1977) provides evidence that no earthquake epicenters directly in the region of the Krasnodar GRES had been recorded. No historical evidence of local shocks was found.

In 1983-84, "Gidroproekt" Institute carried out special studies for defining seismic conditions in the region of the Krasnodar GRES site, including detailed studies on the materials provided by "Krasnodarneftegeofizika" (regional seismic prospecting work by MOB, OGT and KMPV in the region of "Gubskaya" and "Perepravnaya" sites, seismotectonic studies of the locality, decoding of space photographs, seismic prospecting by the method of refracted waves and recording of local earthquakes, explosions and composite waves by highly sensitive prospecting seismological stations "Zemlya").

These investigations made it possible to define the location and parameters of zones of possible earthquake foci and correct the previously obtained values of computed seismicity for the site of Krasnodar GRES with due regard for local conditions: characteristics of seismic signals and angles of their approach, the effect of sedimentary stratum and seismicity of ground properties.

Theses studies led to the following results:

The Krasnodar GRES site is located approximately in the center of a single rather large (1570 km^2) crustal block, confined to tectonic deformations of the 2-nd and 3-rd order: Cherkessky, Voznesensky, Koshekhablsky, Chugushsky and Mid-Labinsky fractures.

Seismic conditions at the Krasnodar GRES site is dependent on earthquakes which can occur both in tectonic deformations, outlining the indicated block and large fractures of the 1-st and 2-nd order, located in the radius of 100 km from the site. At the present stage of work, it is accepted that all these tectonic deformations are WHO zones.

Observations with highly sensitive stations "Zemlya" show that the most active seismic WHO zones in the region under study appear to be those which are confined to Chugushsky and Voznesensky fractures, where a number of earthquakes of class 6-7 were recorded over the period of observation (November 1983 - March 1984) at minimum distances of 15-20 km from the "Gubskaya" site.

These studies show that Mid-Labinsky fracture is a deformation of the 3rd order and is limited by the active Chugushsky deformation, and within this block, where the site is located, it does not extend. Seismic hazard stemming from this fracture is considerably lower (approximately by 1 point) than that of the more active zones listed above.

The main power plant structures on the Krasnodar GRES site are situated on a pebble base with a low (20-25%) content of sandy filler. In terms of their characteristics these grounds pertain to the 2-nd grade and consequently the seismic effect of the defined WHO zones within the Krasnodar GRES site will not exceed 8 points for dry and flooded grounds.

A sketch of the seismic zones in the Krasnodar GRES region is presented in Supplement 17.

4.3.1.3 Topography

The Krasnodar GRES site is located on the piedmonts of the North Caucasus in the south-west of the Krasnodar region in the Laba river valley (left tributary of the Kuban river) 5 km to the south of Mostovskoy (regional center).

Bus routes connect this region with the city of Maikop (50 km) and the territorial center Krasnodar (180 km). A railway branch Labinsk-Shedok runs at a distance of several kilometers from the Krasnodar GRES site.

Settlements Mostovskoy, Shedok, Perepravnaya, Zassovskaya and Kaladzhinskaya are large populated areas in this region.

The main water artery of the region is Laba river 1.6 m deep and up to 70 wide. Upstream of the site the river is branched (Malaya and Bolshaya rivers), and downstream on the left the tributary Khodz flows into it. The feeding rivers are mixed, the surface runoff is formed primarily by the thawing of snow and glaciers in the northern slope of the Main Caucasian Range. Spring-summer floods and high water during the year are typical of the Laba river. The Laba and Khodz rivers pertain to fish breeding water bodies of the 1-st and 2-nd grade.

4.3.1.4 Relief

In a geomorphologic respect, the region of Krasnodar GRES belongs to the piedmont zone of the northern slope of the Caucasus. The basic geomorphologic unit of the region appears to be an area of cuestic relief formed by three parallel cuestas of the Skalisty, Pastbishchny Ridges and Dzhemitmesskaya Chain, extended from north-west to south east. The division of a cuesta by depressions worked by secondary tributaries of the main rivers (Malaya and Bolshaya Laba, Khodz), which cross longitudinal ridges, forms narrow interstices, while at the outlet into depression zones their valleys become wider and turn into a lake-wise form.

In the region under consideration, two relief forms are identified:

- erosion-cumulative;
- cumulative (riverine).

They have the following characteristic features:

The erosion-cumulative relief occurs on the left bank of the Khodz river and on the right bank of the Laba river, and is characterized by a deeply cut river and ravine system. On the site, this type of relief mostly occurs in the strip of Paleocene and Neogene deposits which form one of the cuestas, the so-called Dzhemitmessakaya chain, and a flattened depression to the south, having a mildly wavy nature. The Dzhemitovskaya chain is characterized by smooth mountain tops, the highest of which in the region is 664.2 m. Watershed areas of the chain are relatively flat, poorly forested, where temporary rain and thaw waters flow. The rivers and ravines of this zone have a shallow cut of approximately 20-40 m. Less frequently the ravine slopes are asymmetric, but at the mouths they are flattened, as a rule. The erosion-cumulative form of relief is characterized by several distinct types at the Krasnodar GRES site.

Ia. Elevated hilly plain of old high terraces are located on the left bank of the Khodz river. They are characterized smoothed relief forms, their surface gently sloping upwards to the north, turning into a flat plain.

Ib. The valley-ravine relief of the Dzhemitmessky chain stretches along the left bank of the Laba river. This form of relief basically occurs to the south of the described territory on the right bank of the B. Laba river. In the north-east side it borders on a high steep slope, cut by small very steep ravines. While the elevation of the upper brow varies from 630 to 680 m, the elevation at the foot of the slopes vary from 550 to 600 m. This slope is recorded on the topographic map and aerial photographs. Falling abruptly in the east, it turns into a low, slightly hilly valley characterized by numerous land slides, resulting from the occurrence of water impermeable Maikop deposits on confining beds of the same age.

II. The cumulative (riverine) relief forms include alluvial deposits of the Laba and Khodz rivers as well as their tributaries. The basic accumulation of deposits include pebble, conglomerates and cover loams of terrace plantation surfaces. Classic material, which forms the pebble terraces of the Laba and Khodz rivers, is transported from a zone of the Main Caucasian Range and Caucasian piedmont ridges, cut by these rivers (Peredovoy, Skalisty, Pastbishchny Ridges).

Dzhemitmesskie Heights and Pastbishchny Ridge make up the area, from where the clastic material of small rivers and gullies is carried off in this region.

IIa. The flood plain of the Laba and Khodz rivers is composed of sandy-pebble formations, ranging from sandy-clay particles and pebbles of medium size to large boulders and separate blocks. Terrace benches are most widespread along ravine valleys and tributaries of the main rivers. Terrace benches are observed, as a rule, in the lower stream and as an exception in the central. On the whole, terraces in the valleys of deeply cut gullies are observed only as separate spots. Preserved in the areas of river basin expansion. The height of the flood plain in the valleys of the Laba and Khodz rivers varies from 0.5 to 2 m and up to 3 m of the high flood plain. The flood plain surface is almost level with a slight slope towards the river channel and is covered with a poorly developed soil layer.

Oxbows and marshes are often observed on the surface of a high flood plain.

IIb. The first terrace above the flood plain of the Laba and Khodz rivers. Within the area under consideration, the first terrace above the flood plain plays the basic role in the structure of the valleys of these rivers. It is universal in this area. And only on the left bank of the Khodz river it is observed in the form of separate spots due to the fact that in some areas the river washes off bed rock outcrops of Maikop and Torkhasky as well as Chokraksky horizons. The surface of these terraces have small hills and mounds up 2.7 m high. A number of secondary forms of relief encountered in different morpho-genetic types also occur in this region.

4.3.1.5 Mineralogy

The deposits of the terrace described (valleys of the Laba and Khodz rivers) contain primarily well rounded and semirounded rock waste of granite, gneiss, granodiorite, crystalline slates, quartz, limestone, sandstone and other rocks, but with distinct predominance of rock, composing a zone of the Main Caucasian Range. The terrace surface during high floods and abundant rainfalls is covered with water, resulting in partial washout of the accumulated debris material and its redeposition in lower areas.

The basic rock-forming minerals are quartz, acid plagioclases, biotite, hornblende, pyroxene, and olivine.

4.3.1.6 Lithology

A schematic section of the earth crust in the region of Krasnodar GRES is shown in Table 4.35

Table 4.35
Schematic Section of the Earth Crust in the Region of Krasnodar Power Project

Layer	Age	Lithological Composition	Thickness, km	Density, t/m^3	Stratal Rates
Sedimentary cover	J_1-N	Clay, sandstone, limestone, dolomite,gypsum	5,3	2,0-2,6	2900-4800
Folded base	Ò	Slate, sandstone, effusive rock, limestone, conglomerate, granite intrusion	2,5-3,0	2,6-2,7	4800-5800
Granite	AR-AR_1?	Old foundation of crystalline crust. Granitogneiss	15	2,7-2,9	5800-6400
Basalt		Granulite	18	2,8-3,1	6500-7500
Upper mantle				3,2-3,3	7600-8000

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4.3.1.7 Permeability

The base of the Krasnodar GRES site is represented by a combination of sedimentary non-cemented detrital-pebbly, sandy, silty and argillaceous grounds of the Kainozoic (Quaternary and Neogene-Paleocene), characterized by a wide range of fluctuations in physico-mechanical and filtration properties.

The physico-mechanical properties of grounds were studied in compliance with the existing State Standards (GOST) and procedures of Gidroproekt (of Glavniiproekt).

Quaternary loams, less frequently clays of alluvial-deluvial land-slide origin are characterized by a broad range of water permeability. The filtration coefficients range within 0.0005 - 1.17 m per day. The average value is equal to 0.4 m per day. The recommended computed value K_f = 0.01 - 0.5 m per day (the lower limit characterizes clays, the upper one - loams).

Boulder-pebbly depositions of the flood plain and above flood plain alluvial terraces of the Laba river have differing degrees of water permeability, depending on the particle size distribution of the filler. Water permeability varies from 3.0 m per day to several hundreds m per day. The highest filtration coefficients K_f (up to 500 m per day) are confined to the upper part of the boulder-pebbly layer or to the areas where their thickness is smaller. The filtration coefficient of boulder-pebbly deposits with sandy loam filler varies from 1 to 4 m per day. The average value obtained in 16 tests was equal to 140 m per day. The recommended computed value K_f = 300 - 100 m per day.

Boulder-pebbly deposits of the upper Pliocene terrace are characterized by a broad range of water permeability, depending on the particle size distribution of the filler. The filtration coefficients vary from 0.33 to 7.0 m per day (according to 6 tests). The recommended computed value K_f = 1 - 5 m per day.

Clays of the Sarmatian and Tortonian stages as well as those of Maikopian series make up a relative confining bed with a filtration coefficient 1.10 (-4) - 1.10 (-5) m per day. Interlayers of sand, sandstone and marl in a clay mass are characterized by increased water permeability. The filtration coefficient according to 17 tests varied from 0.03 - 4.4 m per day with the average value of 1.9 m per day. The eluviated zone of Neogene clay on exposed slopes contains groundwater due to its thinning and crumbling. The approximate filtration coefficient of the eluvial zone, including landslide bodies, is 0.01 - 0.05 m per day.

4.3.1.8 Frozen-State Regime

Climate in this region is noted for a mild winter, increased humidity and a great number of cloudless days. The average annual air temperature is 10°C. The coldest month is January with temperature, reaching sometimes minus 32 °C, the hottest month is August with the highest temperature plus 42 °C.

The region under consideration is characterized by the fact that there is no steady soil freezing in mild winters. The greatest depth of soil freezing is about 40 cm.

Table 4.36 shows freezing depth.

Table 4.36
Soil Freezing Depth (cm)

Station	XII	I	II	III	IV	Of Maxim in Winter		
						Average	Minimum	Maximum
Labinsk	0	6	8	2	0	15	3	36

4.3.1.9 Soil Erosion and Land Degradation

The region under consideration shows intense processes of water and wind erosion. For instance in the Labinsk region, wind erosion affects or is likely to affect 77.5 thousand hectares or 53.1% of the total area of agricultural lands, water and wind erosion simultaneously- 28 thousand ha; 48.1 thousand ha located on slopes 3 ° steep, of them 19.7 thousand ha is arable land, including 8.3 thousand ha with a slope of more than 5 °. For example in 1985, according to the state report, 0.6 thousand ha of land was turned into natural pastures and hay fields as a result of fertile soil washout. Similar processes took place in the subsequent years.

The economic crisis in the past few years influenced land condition in this region in two ways. On the one hand, the condition of soil microflora has slightly improved due to a reduction in the use of herbicides and pesticides, and on the other hand, a decrease in the volume of applied fertilizers, violation of crop rotation and agricultural production technology has led to a considerable deterioration of soil due to depletion of nutrients and trace elements.

4.3.1.10 Geological Processes and Anomalies

The Krasnodar GRES site has a dip towards north-east at an angle 4-7 degrees. The site is composed of thick (10-20 m) alluvium, occurring on clays of Maikopian series.

The right bank of the Laba river shows distinct slide masses of ground 10-45 m thick, containing clay with detritus of bed rock. The development of land sliding phenomena arises from water erosion of the Laba river slope. The most intense destructive processes took place in the upper quaternary period. At a later period, the erosion processes gradually abated due to a retreat of the river from the bank. At present, landslides are stabilized, being in a steady state.

On the left bank of the Laba (where the Krasnodar GRES construction site is located) no landslide phenomena have been observed.

Anomalous phenomena include the following:

- Hail. The number of days with hailstorms varies from 2 to 8, and the duration - from several minutes to a quarter of an hour, predominantly in the afternoon and evening hours. In 1971, in the Labinsk and Mostovskoy region there were storms with hail having a diameter of 50 mm. A hail control station is operative in the Labinsk region (Vesyolyi).

- Ice covering. The duration of ice covering processes may span 7-12 days.

- Dust storms. They were recorded in 1967 and 1969. The visibility in this case dropped to 200-500 m. The probability of storms in this region is once every 50 years. Strong winds in the region of the Krasnodar GRES are rare, but in squalls wind velocity can reach over 25 m/s, resulting in fallen trees and posts.

- In the Krasnodar region (near Starominskaya settlement) there was a hurricane on land, which lasted 20 min. The wind velocity in this case reached 300 m/s. The probability of such hurricane in the Krasnodar GRES region is only 1%.

4.3.1.11 Soil Types

The main area within agricultural farms is composed of chernozems (See Figure 4-1). Leached and leached compressed chernozems account for 25% of the total studied soils, and compact chernozem for 5%.

Humic-gley soil constitutes 17% and gray forest-steppe soils 13%. They are located in the area of hilly piedmonts and low mountains.

Dark-gray and gray forest soils account for about 10% in this part of the region.

Meadow-steppe and meadow soils were formed in flood plains and river valleys.

Meadow-chernozemic and alluvial-meadow soils are the most widespread.

Meadow-marshy and humic-gley soils were formed in depressions in the valley of the Laba river.

Described below is a brief characteristic of the four most widespread soil types in terms of those properties which are of interest from the viewpoint of assessing the environmental effects of pollution by Krasnodar GRES (within the boundaries of Krasnodar GRES effects).

Leached Chernozems

Leached chernozems occupy 34488 ha in the region. They were formed on loess-like clays and heavy loams; compact chernozems were formed from deluvial clays, fibrous chernozems were formed on Tertiary clays.

These types of chernozems boil up upon adding hydrochloric acid below the humus horizon. In terms of thickness of the humus horizon, deep (80-120 cm) and superdeep (more than 120 cm) chernozems are predominant, while in terms of humus content, low-humus (4-6%) and medium-humus (more than 6%) are prevailing.

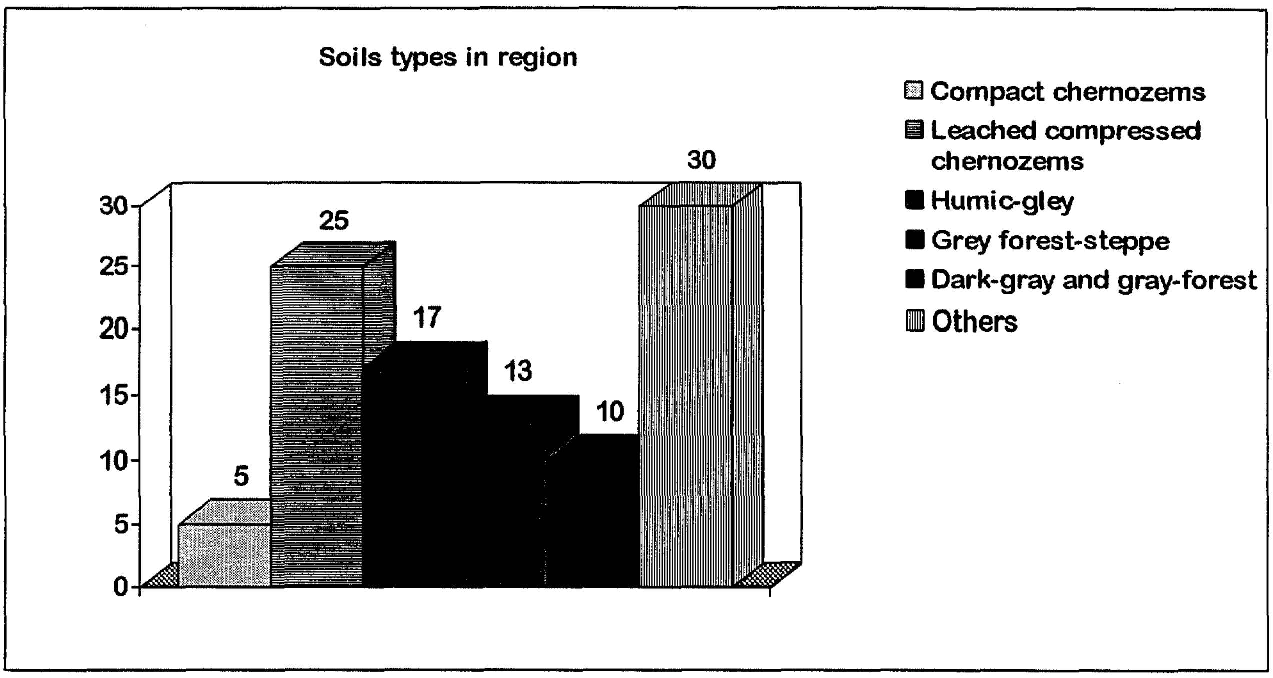

Figure 4.3

The mechanical composition is argilacious across the entire profile. The central part of the soil profile is often observed to have a layer where silt content is 6.8 - 17.2% higher, and especially noticeable in compressed chernozems. The presence of such a layer reduces the water permeability of soil.

The reaction of soil solution is neutral, aqueous pH is 6.5-6.9. The sum of absorbed alkalis is 37.3-47.7 mg-eq per 100 g of soil. Calcium is predominant in the composition. Relative magnesium content is increased in compact chernozems. This imparts to the soil a higher density, reaching 1.61-1.68 g/cm^3 at a depth of 50-100 cm, in alkalized chernozems it is much lower and equals 1.3-1.5 g/cm^3.

Meadow-Chernozem Soils

Soils of this type are identified in the valleys of the Laba, Malaya Laba, Khodz, Shedok and Chekhrek rivers. The total area in the region of these soils is equal to 13342 ha. In terms of relief, these soils are attributed to the II terrace above the flood plain of the Laba river or the valleys of the indicated rivers.

Alluvial deposits of various mechanical composition with underlying pebble make up soil-forming rocks for them.

In terms of humus horizons, they are divided into deep (80-120 cm), medium (40-80 cm) and shallow (20-40 cm) soils. Their texture is loose or slightly compressed.

In terms of leaching degree, they are divided into the following types: calcareous soils, which boil up across the entire profile, their area is 1380 ha; low leached soils, which boil up at 40 cm or in horizon C, the area is 584 ha; leached soils, which boil up in rock, the area is 11378 ha. The level of groundwater is 2-3 m. The mechanical composition is predominantly medium and high loamy. The content of physical clays in the arable layers in medium-loamy soils is 1.2-48.2%, high-loamy - 47.6%, and in clay soils - 64.7-70.7%. The calcareous types in the arable layer contain 0.23% of calcium carbonates, their content increases to 12.3% down the profile.

Forest-Steppe Soils.

Their area in the region is 18186 ha. They mostly occur on flat tops of water catchment areas, slopes in the transient zone from piedmont plain to low mountains. They were formed under forest canopy on deluvial clays.

The following subtypes were identified:

1. Dark-gray with humus content above 3% - 17558 ha.;

2. Gray with humus content 2-3% - 639 ha. Apart from this, several other subtypes were identified, depending on to what extent they are podzolized, fibrous and washed-out. The soil profile shows an illuvial (second) horizon, usually highly compacted. In dark-gray soils, this horizon occurs on the average at 68 cm from the surface, on the average it is 38 cm deep with its lower boundary at 90-120 cm. In washed-out soils this horizon lies slightly closer to the surface. In gray forest-steppe soils, this horizon occurs at 53 cm, on the average it is 42 cm deep.

All forest-steppe soils are characterized primarily by a heavy mechanical composition. Physical clay content in the upper layer A amounts to 54.2-70.4%. Physical clay content in horizon C and lower reaches 37.7%.

All forest steppe soils are leached of carbonates, they boil up from hydrochloric acid only in rock.

Soil density increases down the profile with heavier mechanical composition and reaches a maximum in the compact horizon - 1.6 g/cm^3.

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Very low water permeability of these soils is conducive to water stagnation, especially on flat slopes, where the surface layer is least inclined and fibrous soils are formed.

The illuvial horizon is characterized by the highest indices of moisture wilting 21.4-25.2. Aeration in this layer is very low.

General porosity here is the lowest in the compact horizon - 39.8-48.5%. On fibrous and podzolized types of forest-steppe soils the water-physical properties deteriorate in a large measure.

Humus content varies on the average from 3 to 5.5 %. Podzolized and fibrous soils are less rich in humus (3.8-4.8%), gray forest-steppe soils contain the least amount of humus (3%). The decrease in humus content down the soil profile is rather drastic. Even at a depth of 40 cm, the average humus content is 1.7-2.5%. Accordingly, nitrogen content also changes with humus. Its average content in the plowing layer is 0.26-0.28%.

The sum of absorbed alkalis is on the average 26.91 mg-eq per 100 g of soil. It reaches maximum values in the illuvial horizon - 49.1 mg-eq per 100 g of soil. Calcium is prevalent in absorbed alkalis (80-90%), however fibrous types contain much magnesium (29%), which deteriorates its physico-chemical properties.

Soil reaction is acidic and low acidic (pH 4.9-6.1), with increasing depth, it shifts towards alkaline reaction and in rock equals 6.6-7.5. Podzolized soils show a slight increase in acidity in the subsurface layer (pH on average is 5).

The hydrolytic acidity of forest-steppe soils is rather high 4.37-7.7 mg-eq, with increasing depth it distinctly drops. Podzolized soils should be limes.

Assessment from the viewpoint of environmental pollution by Krasnodar GRES is described below.

Humus Carbonate Soils

Their area in the region is 23318 ha. They are mostly located on slope tops of various steepness. Limestones, marls and their alluvium serve as a soil overbed. Soil formation proceeds under conditions of alkaline reaction.

In terms of thickness of humus horizons, they are divided into the following types: 1. Deep with the average thickness of 71-80 cm, their area is 8898 ha; 2. Medium deep with the average thickness of 50 cm, the area is 51112 ha; 3. Shallow with the average thickness of 30 cm. The area is 9309 ha.

In terms of the leaching extent, they are divided into typical soils, boiling up on the surface with the area of 15699 ha, and leached, boiling up in soil overbed, with the area of 7519 ha. The humus is of a humic nature, the structure is grain-lumpy, the texture is loose. The mechanical composition is clayey, containing 60.9-82.2 % of physical clay. Its water-physical properties are favorable. The humus layer is characterized by loose texture and high porosity.

The characteristic (calcareous) types of humus carbonate soils contain in the upper 3.6-19.8 % of $CaCo_3$, the amount of which increases towards soil-forming rock (up to 65.8%). This is not the case with leached types. In view of this, the reaction of the typical soils is low- and medium-alkaline, whereas that of leached types is neutral and in rock - alkaline.

The sum of absorbed alkalis is characterized by high indices - 44.9-47.5 mg-eq in the arable layer. The share of absorbed calcium accounts for 61 to 95 % of the sum of absorbed alkalis.

Nitrogen oxides, which fall on soil surface with precipitation, are not absorbed by the absorbing complex, since the soils of this region have a negative charge and absorb only cations. Anions, including nitrates, are found in soil solution and can be readily washed out together with surface and intrasoil layer.

Mountain and piedmont relief in the southern and central part of the region with large slopes, which turns into an inclined plain in its northern part, dense network of rivers and creeks, water containing gullies, high water erosion are conducive to intense surface rainfall runoff. Depositional nitrogen is washed off together with this runoff, flowing through a network of rivulets and gullies into the Laba and Kuban rivers and finally into the sea.

The amount of surface runoff increases during the period of heavy rains in May, June and July, when their intensity surpasses the filtration coefficient of soil. The filtration coefficient for soils in the valley of the Laba river is 0.1 m per day, making it possible to identify them as semipermeable (0.001-1 m per day according to Savarensky, impermeable 0.001 m per day).

The annual soil wetting on leached chernozems was found to vary from 0.6 to 3 m per day, depending on the amount of rainfall and specific features of topography. The hydrological regime is of a periodically washing type. Moisture is accumulated from October to March. The soil is wet within a 2-meter layer up to the least moisture capacity (LMC).

Precipitation during this period will permeate down to the groundwater table, since the moisture entering the soil, saturated to the least moisture capacity, is not retained by the soil and under the action of gravitational forces moves downwards into groundwater.

4.3.1.11.1 The Character of Land Use - Grain Crops, etc.

Owing to the natural features in the Labinsk and Mostovskoy regions, agriculture is one of the leading production sectors. These regions are noted for the greatest agricultural development in the Krasnodar territory.

Plowed fields account for the largest share in the structure of agricultural lands (73% in the Labinsk and 58% Mostovskoy regions). Pastures and natural hay fields account for about 30 % of the agricultural lands.

The productivity of dairy cattle and fowl is very low. On the average the regional indices of annual milk yield is 20 % below the indices of the entire Krasnodar territory. The egg yield is more than twice below the territorial index. The clip of wool corresponds to the average territorial level.

The main sectors of plant cultivation include the production of grain (about 70% of gross crops and 50% in the structure of the cultivated land and feeds (13 % and 37 %, respectively). Winter crops constitute the main part of grain crops. Plant cultivation also includes commercial sunflower and potatoes, grown for production purposes and seeds. Agricultural production in the districts is hampered by the development of erosion processes.

Over the past 5 years the average crop yield in the farms within a 10-kilometer zone is as follows (in centners per ha):

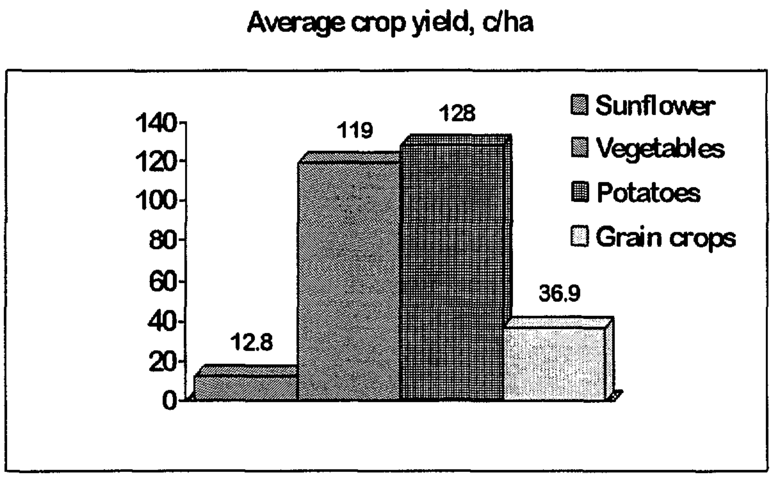

Fig. 4.4

Table 4.37
Structure of Crop Areas

Form of Use	Labinsk Region		Mostovskoy Region	
	Area, ha	In Per Cent of Yield	Area, ha	In Per Cent of Yield
Arable land	106482	73,1	60973	58,2
Perennial plants	2083	1,4	1454	1,4
Hay fields	1329	0,9	8002	7,6
Pastures	35798	24,6	34330	32,8
Total cultivated land	145692	100,0	104759	100,0

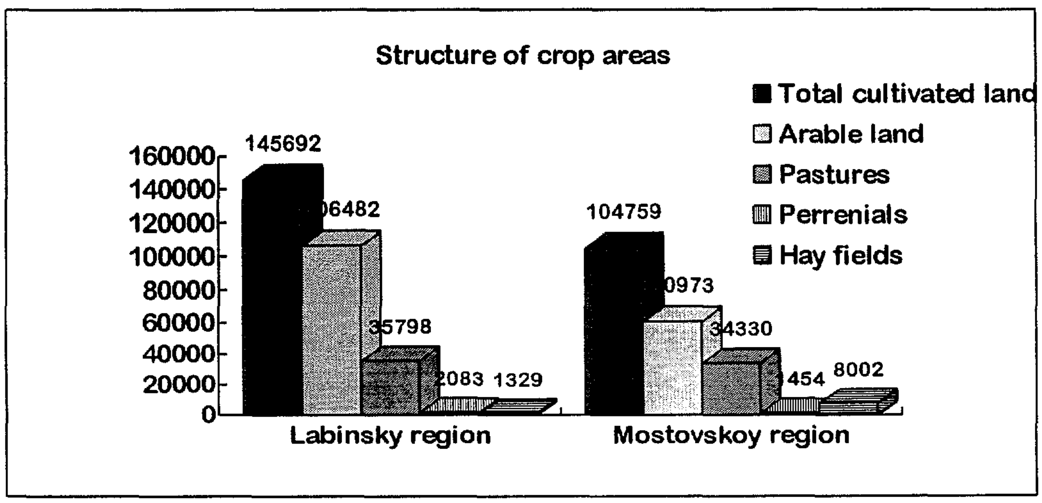

Fig. 4.5

4.3.1.11.2 Type of Pollutants, Location, Distribution

This item is described in detail in Appendices 8 and 9.

Table 4.38
Surface Runoff Regime in the Kaladzhinskaya Region

Season	Catchment Area, km^2	Water Discharge m^3/s	Runoff Module, l/s per 1 km^2	Layer, mm		Runoff Coefficient
				Runoff	Precip-itations	
Wet, summer (V-VIII)		155,0	46,0	487	366	1,33
Limiting, spring-winter (IX-II)	3370	39,5	11,7	184	307	0,60
Spring (III-IV)		64,0	19,0	100	96	1,04
Annual average		82,5	24,5	771	769	1,00

The hydrological regime of the rivers in the Laba river basin is determined by climatic, hydrogeological, orographic and hydrographic features of the area under consideration.

The feed water of rivers in the region is mixed. The surface runoff of plain and piedmont territory is formed by snow melt, rain, and groundwater. The share of rain water increases in the piedmont rivers and the share of snow water increases in the plain rivers. Glacial feed water plays an important role in the rivers of mountain and high-mountain areas with water catchment basins above 1500 m. It accounts for more than 30 % of the annual runoff in streams originating in glacier areas (Table 4.39).

Table 4.39
Annual Runoff Components

River	Water Catchment Area, km²	Average Altitude of Catchment Area, m	Components of Annual Runoff, %			
			Ground	Snow	Rain	Glacier
Laba	12000	730	39	7	27	27
Malaya Laba	1090	1960	22	8	36	34

4.4.1 Land Use

The main land users in the vicinity of the Krasnodar GRES site are 20 agricultural enterprises of different forms of ownership, which have formed the basis for creating farms. Land use maps are presented in Appendix 18 and Figure 4-2.

4.4.2 Land Owners

The main land owners in the region of Krasnodar GRES are agricultural enterprises and forestry farms.

4.4.3 Population Distribution

Table 4.42 reflects data of the latest census, where the population of the Mostovskoy region is distributed in the following way (Table 4.40).

Table 4.40.
A List of Rural Settlements in the Mostovskoy Region
As of January 1, 1995

Name	Number of Private Farms	Population
1. Andryuki	1112	3318
2. Solyonoe	611	1700
Administration of Andryuki	1723	5018
1. Bagovskaya	639	1600
2. Bugunzha	43	70
3. Uzlovoe	12	33
4. Kizinka	226	628
Administration of Bagovskaya	920	2331
1. Besleneyevskaya	616	1665
Administration of Besleneyevskaya	616	1665
1. Benokovo	696	2043
Administration of Benokovo	696	2043
1. Gubskaya	1038	3079
2. Barakaevskaya	315	916
3. Khamketiskaya	220	602
Administration of Khamketiskaya	1573	4597
1. Kostromskaya	832	2195
2. Ulyanovo	24	47
Administration of Kostromskaya	856	2246
1. Vostochny	472	1363
2. Krasny Kut	99	290
3. Mikhailovsky	6	9
4. Severny	80	160
5. Stantsiya	63	147
6. Ulyanovsky	5	5
Administration of Vostochny	725	1914
1. Vesyoly	69	195
2. Vysoky	39	101
3. Pervomaisky	61	300
4. Proletarsky	101	152
5. Sadovy	19	41

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Name	Number of Private Farms	Population
Administration of Mostovskoy	289	789
1. Makhoshevskaya	672	1725
Administration of Makhoshevskaya	672	1725
1. Burny	53	86
2. Nikitino	24	23
3. Kirovsky	14	15
4. Uzlovoe	308	592
Administration of Psebai	404	716
1. Perepravnaya	1238	323
2. Dyatlov	42	114
3. Krasny gai	35	88
4. Svobodny Mir	74	235
5. Tsentralny	126	320
Adminstration of Perepravnaya	1515	3997
1. Unarokovo	750	2226
2. Slavyansky	296	876
Administration of Unarokovo	1052	3110
1. Shedok	1071	2746
2. Zarechny	80	174
3. Izvestkovy	33	109
4. Kuibyshev	171	497
Administration of Shedok	1355	3526
1. Yaroslavskaya	1975	5987
2. Novotritsky	20	28
Admistration of Yaroslavskaya	1995	6015
Total rural area	14391	39676

4.4.4 Existing Infrastructure

The infrastructure in the region is characterized by the following indices:

a) medical facilities:

- number of hospitals - 9
  - number of beds (total) - 830
- number of physicians and medical personnel - 1182;
  - physicians - 131;

- number of polyclinics - 3;
- number of obstetric stations - 88;
- territorial tuberculosis hospital - 1
    - number of personnel - 82

b) preschool facilities

c) available secondary schools:

- number of places - 6475
- number of children 11329
- number of teachers - 947

d) housing space available:

- total housing space as of January 1, 1994 - 1169.4 thousand m^2;
- number of those needing housing space and improvement of living conditions - 500 families;
- state municipal housing space - 56.5 thousand m^2;
- private housing space - 1112.9 thousand m^2;

e) social and recreational sphere:

- movie theaters and movie projectors - 19;
- libraries - 25
- art schools - 2 in Mostovskoy and Psebai;
- post offices - 30

Table 4.41
Preschool Facilities in the Mostovskoy Region
As of January 1, 1995

N	Designation	Location	Places	Children
1	Kindergarten N3	Mostovskoy	100	100
2	Kindergarten N2	Mostovskoy	95	104
3	Nursery N4	Mostovskoy	75	75
4	Nursery N5	Mostovskoy	55	56
5	Nursery N8	Andryuki	51	74
6	Nursery N13	Bagovskaya	40	69
7	Nursery N16	Bagovskaya	90	69
8	Nursery N17	Bagovskaya	32	34
9	Nursery N19	Solyonoe	110	67
10	Nursery N20	Kostromskaya	115	54
11	Nursery N21	Vosnochny	70	52
12	Nursery N22	Yaroclavskaya	100	114
13	Nursery N23	Yaroclavskaya	100	20
14	Nursery N24	Slavyansky	50	27
15	Kindergarten N 26	Mokhashevskaya	40	40
16	Nursery N27	Psebai	46	46
17	Nursery N30	Mostovskoy	46	46
18	Nursery N25	Unarokovo	81	81
19	Nursery N35	Uzlovoe	35	35
20	Nursery N32	Perepravnaya	110	110
21	Nursery N34	Mostovskoy	280	280
22	Nursery N41	Mostovskoy	76	84
23	Nursery N10	Psebai	110	149
24	Nursery N29	Psebai	20	24
25	Nursery N39	Psebai	150	150
26	Kindergarten N40	Mostovskoy	280	140
27	Nursery N14	Beslenevskaya	35	35
	TOTAL		2392	2135

f) transport facilities:

- motor roads - of Republican importance, class III - Maikop- Giaginskaya-Psebai- Kehdzhinovo - Karachaevsk, and a road with hard covering of local importance - Mostovskoy - Barakaevskaya; there is a bus service along these roads.

- Railroads - single truck railroad Kurganinsk - Shedok, equipped with railroad signaling system; no passenger transportation on this railroad is provided.

A sketch of the road network is presented in Appendix 19.

4.5 Biological Resources

4.5.1 Flora and Fauna, Permanently Living and Migrating in the Area.

In accordance with the decree of the Council of Ministers of the RSFSR dated June 16, 1959 No. 4292 and the decree of the Council of Ministers of the RSFSR No. 11-79 P dated July 30, 1976, the forests with an area of 12407 ha were identified as group I. The remaining forests with an area of 60798 ha were referred to group II by the decree of the Council of Ministers of the RSFSR of December 17, 1956. The decree of the Council of Ministers of the RSFSR No. 554 of October 25, 1973 identified forbidden strips 1 km wide along the Kuban river and 100 m wide along its first order tributaries.

4.5.1.1 Vegetation

All the forests of the region under consideration are primarily under the direction of the Mostovskoy logging and sawmill operation, located on the territory of three administrative regions - Mostovskoy, Labinsk and Koshekhablsky. In terms of forest vegetation regionalization, the area of the sawmill operation is referred to as the zone of beech and beech-fir forests. They perform mountain-soil protective, antierosion, water controlling, sanitary-hygienic and esthetic functions.

The predominant plantations include forest areas of grade II and III, covering 38.5 % and 39.1 %, respectively. The highest quality index is identified for plantations of false acacia (1.0%), fir (1.4%) and gray alder (1.5%).

The plantation with low quality indices (Va) account for only 0.4%. These are mostly birch plantations, growing on soil with stony and rocky exposures along the edge of subalpine meadows.

The most productive plantations, which satisfy the conditions of growth locations, appear to be pines, beeches, firs, and alder sand oaks.

The average age of forests under the direction of the sawmill operation is 96 years, including beech - 126, fir - 236, oak - 45, hornbeam - 55, alder - 18. The average stock on 1 ha area covered with forest - 192, mature and overmature - 237, beech - 114, hornbeam - 173, oak - 107, alder - 147 m^3/ha.

The average annual increase of plantations on 1 ha area covered with forest is 2.6 m^3.

Table 4.42
Forestation Extent in Administrative Regions

No	Administrative Region	Total Area in Land Balance, Thou. ha	Forest Covered Area in Land Users, in Thou. ha				Forestation %
			State-Owned Forest	State Reserve and Oth.	Collective and State Farms	Total	
1	Mostovskoy	359.9	109.3	41.7	20.7	71.7	46.5
2	Labinsky	189.3	13.1	---	3.9	22.0	12.0

4.5.1.2 Animal Kingdom

The Mostovskoy hunting grounds (84.5 thousand ha), Solakovsky hunting grounds (49 thousand ha) and Psebai sanctuary (37.4 thousand ha) are located in the region of the Krasnodar GRES on the territory belonging to the logging and sawmill operation.

The forests of this zone are good habitats for many types of game animals: deer, European bison, wild hog, roe deer, chamois, marten, Altai squirrel, raccoon dog, European hare, bear, otter, mink, European wildcat, badger, and others.

4.5.1.2.1 Fish Breeding Characteristics of Natural Water Streams

The Laba river is identified as a valuable fish breeding first-grade water body, while the Khodz and Gubs rivers as valuable fish breeding second-grade water streams. After the Kuban river had been dammed the fish-breeding importance of the Laba river and its tributaries decreased, because only a small part of migratory spawning fish shoals can now reach this part of the Laba river.

The Laba river is a permanent habitat of *Alburnoides*, barbel, chub, white bream, gudgeon, pike, catfish, trout, carp, bream, silver carp, perchpike, while true sturgeons, vimba and royal fish come here for spawning.

In the section of the Laba river upstream of Mostovskoy, two tributaries flow into the river - the Bolshaya and Malaya rivers with glacier feed and rapid flow. The most valuable representative of the ichthyofauna here is trout, it is also inhabited by *Alburnoides*, chub and gudgeon.

4.5.1.3 Rare and Endangered Species

Relic and narrow endemic plants, listed in the Red Book, are confined primarily to the piedmonts far upstream of the Laba and Hodz rivers. On the developed territory within the Krasnodar GRES site they are not encountered.

Among rare and endangered species of animals, included in the Red Book of the USSR in the region under consideration, the following species inhabit the zone under consideration: brown bear, Caucasian tur, axis deer (aborigine population), European bison, black stark (in passing), little bustard, golden eagle, falcon, Caucasian black cock, and snow cock. Their habitats are confined to the territory of the Caucasian state Biosphere reserve and to areas in the south of the Krasnodar territory with difficult access. The north boundary of the Caucasian state Biosphere reserve is located 48 km to the south of the Krasnodar GRES site.

4.5.1.4 Flooded, Overgrown River Banks, National Parks, Reserves, Places of Wild Nature

Information about reserves and sanctuaries is summarized in a sketch, see Supplement 18.

4.5.1.5 Forests and Farms/Location and Distribution

Information about forests can be found in section 4.5.1.1, vegetation. Private farms are located within agricultural lands of the main land users (agricultural enterprises, joint stock companies).

4.5.1.6 Types of Commercial Use - Land and Water Based

The commercial use of animals is described in section 4.5.1.7. "Game, Hunting". There is no commercial fishing in the Laba river due to the presence of spawning places of particularly valuable species of fish. There is no commercial tourism in this region.

The Krasnodar pharmaceutical board procures medicinal vegetative raw materials in the territory of the Mostovskoy region.

4.5.1.7 Game Animals, Hunting

The territory of the Mostovskoy region includes Mostovskoy regional hunting grounds, where controlled hunting for hares and some other animals is permitted.

Data on record keeping of ungulate and fur animals in the Mostovskoy Region as of March 1, 1995 are summarized in Table 4.43

Table 4.43
Record Keeping of Ungulate and Fur Animals in the Mostovskoy Region

Animals	Area Suitable for Habitats, Thou. ha	Area on Which the Species are Recorded	Number of Recorded Animals	Animal Population Density Per Thou. ha, Where Recorded	Total number of animals in region
1. Elk	90	90	2	0.02	2
2. Deer	30	10	8	0.8	24
3. Wild hog	100	10	8	0.8	80
4. Roe deer	100	10	7	0.7	70
5. Chamois	-	-	-	-	-
6. European bison	50	10	13	1.3	65
7. Bear	30	-	-	-	-
8. European hare	130	15	128	8.5	1109
9. Fox	130	15	10	0.66	86
10. Mask rat	-	-	-	-	-
11. Squirrel	100	10	64	6.4	640
12. Wild cat	120	15	10	0.66	89
13. Common raccoon	-	-	-	-	-
14. Mink	15	15	12	0.8	12
15. Marten	60	10	12	1.2	12
16. Otter	10	10	4	0.4	4
17. Raccoon dog	80	-	-	-	-
18. Badger	80	-	-	-	-
19. Marmot	-	-	-	-	-
20. Lynx	-	-	-	-	-
21. Jackal	130	15	6	0.4	60
22. Wolf	120	120	37	0.3	37

4.5.1.8 Unique Habitats

Unique habitats are represented by the Caucasus biosphere reserve and a number of sanctuaries.

A sketch including the location of particularly protected territories in the region of the Krasnodar GRES is presented in Appendix 20.

4.5.1.9 Animals Causing Harm

Except for nuisance animals (rats, mice, mosquitoes, cockroaches, etc.) no harmful animals are encountered in the region of the Krasnodar GRES site.

4.5.2 Caucasian Biosphere Reserve

4.5.2.1 Formal Status and Actual Situation

4.5.2.1.1 Physico-Geographic Conditions

The western Caucasus is divided into northern and southern parts, the Main and Watershed ranges make up a boundary between them.

In the northern part, the Main Range extends within a reserve from the town of Fisht in the north-west to the town of Adzhar in the south-east. This is a region where high relief is prevalent with abundant old glacier forms: glacial troughs in the upper reaches of rivers, kars, cirques, moraines, and roche moutonnee (glacier-warn rock). Sharp peaks and snow banks tower above them, avalanches are frequent. There are 60 glaciers (cirque, hanging-cirque and hanging glaciers) with a total area of 18.2 km^2. They are not large in size (0.1-1.8 km^2). The largest of them is located on the Pseashkha mountain- 1.8 km^2.

The height of the ridge rises from Chugush mountain, reaching in the south-east more than 3000 m (the highest top is Takhvoa mtn., 3346 m). On the western side, in the upper reaches of the Belaya river, the Main Ridge is considerably lower and does not exceed 1800 m. Only lime stone massifs Fisht and Oshten belong to high mountains geomorphologically. The side ridge stretches 2-5 km more to the north than the Main Ridge. It is characterized by a combination of medium and high mountain relief with predominance of the first. Between the Main and side ridges there is a zone of South slate depression. Matching this depression are the longitudinal areas of the Zakan, Achipsta, Umpyrka, Alous, Aspidnaya, Turovaya, Gefo, and Bezymyannaya rivers, separated from each other by saddles. Along the northern slope of the Boevoy ridge is the Northern slate depression, which is also divided into separate massifs by the valleys of the Belaya, Laba rivers and their tributaries.

The Caucasus Biosphere reserve is located approximately 48 km south/southwest of the Krasnodar GRES on the boundary of temperate and subtropical climatic belts. The warm and humid climate in the low mountains is of a subtropical nature with positive average temperatures in January (4.2°C) and high average temperatures in July and August (20-21 °C). In the medium mountains the annual temperature varies from 1 to 6 °C, the average temperature in January from - 4 to - 6 °C; winter is usually temperate with abundant snow. The snow cover persists for over 5 months. Summer is mild and warm (average temperature in July is 16-22 °C), the annual sum of precipitation is 700-1200 mm, with the maximum rainfalls early in summer. From an altitude of approximately 2000 m, the leading role belongs to the western transfer of air, therefore the climate in the high mountains is more humid and in some characteristic features it resembles sea air. However winter here is noted for persistent frosts. For instance, at a level of approximately 200 m the average temperature in January varies from -6 to -8 °C, and at 3000 m it reaches - 10 °C.

The territory of the Caucasus Biosphere reserve is separated by 3 climatic provinces within the boundaries of 3 climatic regions. Its northern microslope is included into the province Western part of the North slope region of the Major Caucasus; its southern slope - into the province of the South-Western slope of the Major Caucasus in the Western Transcaucasian Region; the high mountain part of the axis zone - into the province Western high mountains of the Major Caucasus in the High Mountain Region.

Soils are formed on crystalline (granites, gneisses, syenites, porphyrites), metamorphic (crystalline slates, red conglomerates) and more often on sedimentary rock (argillites, sandstones, limestones, etc.). The territory of the Caucasus Biosphere reserve covers almost the entire profile of natural landscapes, characteristic of the Western Caucasus.

Nivalic landscape - kingdom of permanent snow and ice - does not form a continuous strip, it is fragmented on the highest mountain tops and ridges above 3000 m. This is an area of physical weathering with minus air temperatures all the year round and completely frozen soil-vegetative processes.

Overgrowth of gigantic grasses, which are called "subalpine high mountains" are sometimes found in troughs, forest meadows and forest edges near the upper boundary of forest at altitudes of 1600 to 2000 m under conditions of increased humidity and thick soils.

Caucasian subalpine tall grass communities are noted for an exceptional species diversity - 90 species, more than 50 of them can be found in the reserve. These communities contain predominantly Umbelliferae and Compositae families, less frequently cereals (cowparsnip, multiflowered companula, ragwort, heart-leaved oxeye, Kuprianov's rye, etc.)

4.5.2.1.2 Vegetation

Aquatic plants in high mountain lakes of the reserve contain only 7 species; all of them are boreal (lesser duckweed, spring starwort, spiral wild celery, etc.). The boundary of their growth is 2400 m. The total number of marsh species is 41. The greater part of them (65%) pertain to the Cyperaceae and Juncaciae families. Florogenetically, this group is rather uniform: 85% of its species have a boreal form of areas. Some marsh species are relicts of the Pleistocene period (mud sedge, sheathing cotton grass, marsh cinquefoil, small gentian, etc.). Most of the march plants grow at an altitude from 1900-2400 m.

More than 720 fungal species are known in the Caucasus Biosphere reserve. Algae, lichens and mosses still remain to be studied. Water-marshy and overmoist habitats of high mountains have been found to contain 48 species of moss, belonging to 15 families and 17 genera. The sphagnum family is the most representative (14 species).

Among rare plants listed in the Red book of the USSR, 32 species grow in the reserve. Among woody plants and shrubs, these are: common yew, Kolkhid boxwood, hop hornbeam, bladder nut, and others; among grass plants these are: Caucasian deadly nightshade, gentian, harebell, and many Orchidaceae (pyramidal orchid, spurred coral root, and others).

The territory of the reserve is located within the boundaries of two botanico-geographical provinces - North Caucasian and West-Caucasian, where 9 geobotanical regions are identified. Intraregional differences of the plant cover are particularly distinct in the forest belt.

Broad-leaved forests grow at an altitude up to 1300 m. Oaks occupy a small area (2%) predominantly around the periphery of the reserve. They are confined to southern slopes at an altitude up to 900 m. These forests consist mainly of 4 species of oak: pedunculate, sessil, Iberian and Gartvis. They are mixed with hornbeam, Caucasian pear, oriental apple, wild myrobala, common and Norway maples, Caucasian common linden, common ash. The most widespread among shrubs are pontic azalea, hazel nut, briars, and common elder.

Forests with a predominance of oriental beeches grow within 500-1500 m.

4.5.2.1.3 Animal Kingdom

The Caucasus Biosphere reserve is inhabited by 18 species of fish, 9 - amphibian, 16 - reptiles, more than 200 species of birds, including 109 species of nesting birds, more than 60 species of mammals. 23 species of vertebrates, encountered in the reserve, are listed in the Red Book.

The kingdom of insects in the reserve is extremely rich and diverse. It is represented by more than 20 orders. The number of species has not been identified exactly. 38 species of entomolofauna living in the reserve are listed in the Red Book

4.5.2.1.4 Fish

The background species of the central and lower reaches of rivers is brook trout. The background species in the lower river streams is Kuban Alburnoides, Caucasian barbel, Kolkhid Chonostoma genus and loach. The reserve, protecting the upper reaches of rivers, is not capable of preserving the entire complex of endemic fishes on the piedmont area due to the fact that the ichthyofauna of this region is gradually being depleted.

4.5.2.1.5 Reptiles and Amphibian

Their species and subspecies of endemic nature is equal to 30.7% for reptiles and 66.6% for amphibian (Tuniev, 1985). Those listed in the Red Book, on the territory of the reserve and its protected zone, include banded newts, Caucasian mud divers, Grecian tortoises, Aesculapian snakes and Caucasian vipers.

The background species of amphibian include common newts, tree frogs, green and common toads, red-spotted fire-bellied toads, and toad frogs. The most widespread among reptiles are lizards - rock, sand and green lizards, as well as the grass snake.

4.5.2.1.6 Birds

Species diversity and population of birds reaches a maximum in the lower forest strip, particularly along river valleys. Blackbirds, chaffinches, blackcaps, and robin redbreasts are dominant in population numbers both in river valleys and on slopes. Many birds of low mountains (buzzard, sparrow hawk, black woodpecker, great spotted woodpecker, black bird and thong thrush, common sandpiper, and chaffinch) are widespread in the central strip of the forest belt.

River valleys and mountain brooks are mostly unsuitable for water birds. These are inhabited by dippers, common sand pipers; in winter mallards, teals, ospreys, and green sandpipers can be encountered in passing. Running along the valleys of large rivers (Malaya Laba, Urushten, Belaya Shakhe, Mzymta) are the migration ways of water birds , sparrow hawks, hobbies, black kites, and lesser spotted eagles.

Vultures nest in river valleys in low and medium mountains, on high rocky cliffs: crows, griffon vultures (the most numerous in this group), golden eagles, bearded vultures, and black vultures.

4.5.2.1.7 Mammals

The share of small mammals account for over 60% of the fauna of mammals in the reserve. Insectivorous mammals commonly include hedgehogs, moles and three species of shrews, pygmy, common and Radde's shrews, as well as Shelkovnikov's water shrews.

The fauna of the Chiroptera order lists 20 species. Lesser and greater horseshoe bats inhabit predominantly karst caves of the Kolchid Caucasus. The Red Book includes giant noctules and the Macrochires family. The population number and seasonal migrations of bats are not known.

European hare is the only representative of double toothed rodents which inhabit mountain-forest and mountain-meadow landscapes. Wood rodents- common squirrel, fat dormouse and forest dormouse - are numerous in the forest belt.

4.5.2.1.8 Carnivorous Animals

The carnivorous animals in the reserve in terms of species diversity are second only to small mammals. Lynx is common for all the reserved territory. Leopard in the late XIX century was regarded as a common animal in the Western Caucasus. Subsequently the traces of its vital activity has decreased.

Caucasian wild cats prefer broad-leaved forests, less frequently dark coniferous forests, sometimes climbing as far as 1500-2000 m.

Brown bears are concentrated mostly in the upper part of the forest belt.

The Caucasian reserve is a sanctuary for many fur animals, primarily for pine and stone martens. Badgers are encountered in the high mountains very rarely. Otters inhabit the tributaries of the Bolshhaya and Malaya rivers, as well as the rivers of the Southern slope. European minks are also encountered in these habitats. The smallest among carnivorous animals is the weasel.

Foxes can be found everywhere, especially on the northern slope up to 2400-2700 m, but most often in the forest belt. Jackals are mostly encountered on the coast (especially in winter) up to 500-800 m, as well as in the northern piedmont regions. About 10-11 wolf families, that is 65-75 animals, permanently live on the reserved territory

Caucasian red deer is very common in the reserve within 600 to 2500 m.

The most typical inhabitants of rocks and meadows are mountain goats. Chamoises also keep rocky-meadow habitats . Their population numbers in the reserve is slightly lower than for mountain goats. In broad-leaved forests at an altitude from 600 to 2300 m roe deer is very common. Wild hogs are encountered more often in oak and chestnut groves.

4.5.2.1.9 Current State of Reserve Ecosystems

The traces of natural calamities - windfalls, windbreaks, mud flows, etc. - are found everywhere, but they of a local character. On the whole, cluttered and dry forest account for 0.4% of the total forest area. Fires in the reserve have never been large in area and always have ceased unaided. The state of forest and some other high mountainous ecosystems depends in a large measure on the extent to which the background plant species are affected by various diseases and pests. The total infectiousness of forests amounts on average to 30%. The most hazardous are bacterial diseases: blight, and trunk rot.

Human interference (pasturing, mowing, forest felling, etc.) with natural ecosystems have been felt from the time when Adygea tribes settled here. Presently, these also include general air pollution and recreational infringement. Irreversible changes in soil and plant covers mostly occur near the boundaries of the reserve or near the protection corridors.

On the whole the dynamics observed in the reserve does not show degradation of ecosystem components, and the ecosystems themselves do not need any form of control.

The ecological situation differs drastically on the adjacent territories. The most vulnerable high mountainous landscapes to human interference turned out to be lake ecosystems: only in 35% of lakes located in the zone of economic activity, aqueous and littoral phytocenoses are under normal conditions. Soil erosion is disastrous, the level of groundwater is dropping (this has entailed a decrease in water balance in mountain rivers), large areas have been affected by replacement of main tree species (oak, beech, fir) by less valuable species (hornbeam, aspen, birch). Apart from this, unjustified introduction of plants and animals create a real danger to the cleanliness of the gene pool in the reserve:

European beech -was introduced by the Pseibai logging and sawmill operation;
European deer was bred by the Krasnodarsky hunting grounds management;
American mink and other animals and plants were brought in a disorganized manner.

To maintain the reserve ecosystems at least at the present level, it is necessary to:

- stop uncontrolled pasturing on the adjacent territories and ban it in the reserve itself;
- stop felling trees for the main use in forests of group I;
- include into the reserve the Fisht-Oshnet massif, the upper reaches of Tsitse river, chestnut forests preserved on the Southern macroslope and oak forests of the Northern slope;
- stop the work of introductory breeding.

4.6 Cultural Values

4.6.1 On the Construction Site, Along Gas Pipelines and Power Transmission Lines

There are no objects of cultural value on the construction site, along gas pipelines and power transmission lines.

4.6.1.1 Demography - Current and Expected

The demographics in the Mostovskoy region are summarized in table 4.40.

4.6.1.2 Permanent and Seasonal Population

At present the population in the Mostovskoy region is represented primarily by permanent population.

4.6.1.3 Labor and Occupation Market

Able-bodied population (according to 1989 census)

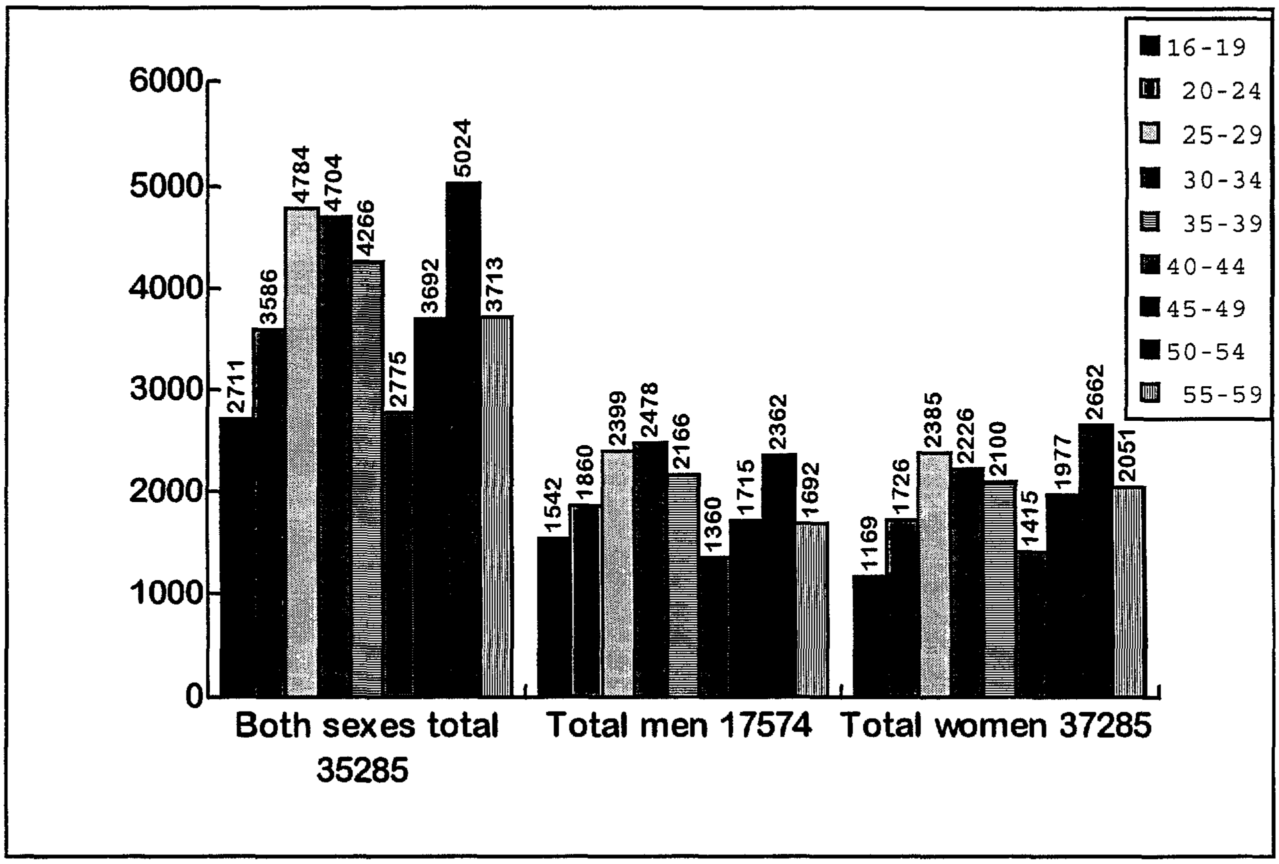

Fig. 4.6.

4.6.1.3.1 Distribution of Profits

Table 4.44
Labor Remuneration in Economic Sectors in the Mostovskoy Region in 1994

Economic Sectors	Average Recorded Number of Employees	Labor Remuneration (Recorded, Unrecorded, Holding More Than One Positions), Thou.Rubles
Industry	5274	8 005 800
Agriculture	6227	4 264 085
Construction	2083	5 578 845
Transport	413	488 494
Other facilities	7660	10 661 793
TOTAL IN REGION	21657	28 999 017

4.6.1.3.2 Products, Services, Recreation, Public Health

Information can be found in section 4.5.2.

- Total housing space as of January 1, 1994 - 1169.4 thousand m^2;
- Number of those needing housing space and improvement of living conditions - 500 families;
- State municipal housing space - 56.5 thousand m^2;
- Private housing space - 1112.9 thousand m^2;

Information on children preschool facilities can be found in Table 4.41.

4.6.1.4 Local Population and Their Culture

The local population in the Mostovskoy region consists of 90 % Slavic (Russians, Ukrainians etc.) and 10 % non-Slavic population characteristic of the former USSR (Adygies, Georgians, Jews, etc.)

In the past several years in the Mostovskoy region and in the Krasnodar territory, there has been a tendency for the regeneration of Cossacks traditional for Kuban.

4.6.1.5 Aesthetic, Cultural and Religious Places

There are no officially recognized aesthetic, cultural and religious places in the Mostovskoy region except for the Caucasus Biosphere reserve and sanctuaries. There is a group of mounds in the region of the Krasnodar GRES construction site, which was explored by the Transakuban expedition of Volgograd State University in 1987 and by the expedition of the Culture Board of the Krasnodar Local Executive Committee in 1990 which found that these mounds were not culturally valuable.

There are no officially recognized cultural and religious places in the Mostovskoy region, except for natural landscapes (forests, meadows, flood plains) which are used by local and visiting people for recreational purposes.

4.6.1.6 Sanitary and Hygienic Characteristics

The sanitary and hygienic situation in this region is characterized by morbidity with certain groups of diseases. Analysis of morbidity, mortality and invalidity is summarized below (Table 4.45 and Fig. 4.7).

Table 4.45
Analysis of Morbidity in the Mostovskoy Region

	Mortality of Abs. Number			
	Total	of them able-bodied	Total children	Children, incl. up to 1 year
Total	1215	280	22	14
Disease of circulation organs, total	820	83	2	2
Atherosclerosis without hypertension	495	33		
Vascular infliction of brain with hypertension	73	18		
Vascular infliction of brain without hypertension	63	1		
Myocardial infarction	9	5		
Rheumatism, all stages	2	2		
IDH	166	19		
Malignant diseases	116	39	1	
of stomach	24	5		
of lungs	24	10		
of mammary gland	7	1		
of other organs	61	23	1	
Traumas, all types	144	101	9	3
Disease of intestinal tract	40	20		
including liver	28	17		
Respiratory diseases	29	8	4	4
Tuberculosis of respiratory organs	8	6		
Others	58	25	6	5

5. IMPACT ASSESSMENT

Energy is essential for any country's economic growth. Even though electricity at the point of consumption is a clean form of energy, generation of electricity is accompanied by gaseous emissions and liquid effluents which can have a direct impact on the environment. The associated development of infrastructure like roads, housing, and transmission lines can also impact the environment. The activities and sources (during construction as well as operation) which are likely to induce an impact are identified and assessed in this Chapter. Alternatives and mitigation measures which will eliminate and reduce the identified impacts are presented in Chapters 7 and 8, respectively.

It is demonstrated in Chapter 7 and Chapter 8 that the Krasnodar GRES will cause no long-term, deleterious, irreversible or permanent environmental or health impacts, and will cause several positive impacts.

5.1 Construction Stage

Table 5.1 is representative of the summarized direct and indirect impacts and respective preventive or mitigation measures. Sections of this Chapter provide a detailed description of these impacts which makes it possible to better realize positive and negative environmental impacts of the project under discussion.

5.1.1 Impacts on Local Population

Construction and fitting activities will not have negative impacts on the local population due to the considerable distance to populated areas. A potential nuisance to the population of Mostovskoy may be caused by daily delivery to the site of 1 - 2 trains of construction materials (17 railcars). Such deliveries will be performed during daytime with a possible total maximum intensity of 2 to 4 shipments per day. Impacts by automobile transportation will be insignificant due to low scope of transportation automobile use directly associated with the project.

Prior to construction of the power plant a new school, recreation center, and new residential houses will be built, the streets will be coated with asphalt and illuminated, and these activities will have a positive impact on the local population.

5.1.2 Environmental Impacts

Construction and fitting activities will be performed in accordance with the specified construction design. No environmentally hazardous activities, accidents and waste with negative impacts on the environment outside the construction site are anticipated.

Table 5.2 is representative of major construction activities and impacts thereof.

Table 5.1
Potential Impacts During construction

Direct Impacts	Damage Prevention/Mitigation Measures
Sediment accumulation increase in run-off caused by soil erosion at construction sites due to land excavation. Soil removal, waste accumulation.	Protection of sensitive surfaces by ground cover. Planting on surfaces subject to erosion.
Soil and water pollution by fuel, grease and other lubricants, from vehicle garages and at the units for bitumen and asphalt preparation.	Collection and treatment of lubricants. Prevention of accidental fuel and lubricant spills by following regulations and safety rules.
Air pollution caused by the units for asphalt preparation.	Fitting and use of air treatment equipment.
Dust accumulation. Noise.	Periodic watering of temporary roads or sprinkling of bitumen emulsion for dust agglutination. Mounting mufflers on equipment.
Air pollution and noise caused by traffic passing through densely populated urban and rural areas.	Planning mounting of noise shields. Mandatory observation of rules, regulations and schedules of maintenance (or use of alternate fuel) to decrease air pollution. Effective traffic and passenger transportation organization.
Waste accumulation along the roads	Cleaning activities using technical means. Assist in adoption of laws and resolutions stipulating imposition of littering fines.
Poor sanitary conditions, lack of collection and disposal of solid waste in compounds and at the construction sites.	Proper location and maintenance of lavatories.
Formation of temporary mosquito propagation areas (for example, in water reservoirs with stationary water warmed up by the sun). Mosquitoes can be carriers of infections.	Determination of infection carriers' ecology and preventive measures against favorable conditions for their habitat and propagation.
Poaching by workers.	Urge employees against poaching at hiring stage.
Unrelated construction activities: construction of industrial facilities, service facilities and other buildings along the roads "town spreading".	Involvement of land use planning agencies (at all levels) in project development and EA, planning controlled urban development.
Increase of traffic intensity (and possible increase of dependence of national economy on import of engine fuel).	The project should include components to encourage use of non-mechanical drive vehicles.

Table 5.2
Potential Impacts During Construction

	Construction Stage Number	Construction Activities	Potential Environmental Impact
1.	Preparation	I. Exploration	It is not associated with the construction stage, since this was performed at preliminary stage 1
		II. Temporary structures workshops, access roads, sanitary equipment, etc.) III. Earthwork, including excavation, leveling, trenches IV. Foundation construction, piling, water flow lowering	Pollution by dust, soil compression, changes in traffic intensity. Soil erosion and drainage Pollution by dust, visual and noise
2	Permanent structures (including buildings and warehouses)	I. Temporary site leveling (grass planting) II. Construction of permanent structures III. Station and engineer network fitting	Soil erosion improvement Noise and visual impact Noise, visual impact and security
3	Final construction stage	I. Removal of temporary structures, leveling and ground preparation completion, etc.	Pollution by dust and construction waste

By the beginning of the construction exploration activities, site preparation and leveling will have been completed, fertile layer of soil will have been removed and taken to farms. Drainage of dewatering pits will need to be performed. Foundation work will include ground excavation, loading, and concrete work, which will cause noise and dust pollution. During construction a substantial amount of water shall be required. Water will supplied from existing water intakes using temporary pumps. Construction and fitting activities will cause noise and dust pollution.

Table 5.3 is representative of the principal types of activities at construction stage and their environmental impacts.

The primary environmental impacts at the construction stage will be noise, dust (air pollution), construction waste and sanitary waste. Means of transportation to deliver materials will cause pollution by dust, air pollution and noise. To mitigate pollution by dust, watering trucks and dust collectors will be used. Environmental impacts by construction activities will be temporary and will not have substantial residual environmental impact.

Table 5.3
Environmental Impacts During Construction

Existing Environment Conditions	Proposed Types Of Activities							
	Ground Excavation	Site Cleaning	Road Construction	Foundation Construction	Concrete Works	Construction Work	Fitting Work	Water Consumption	Storage Of Materials
Land use	Ï		Ï	Ï		Ï	Ï		Â
Water quality								Â	
Air quality		Â	Â	Â	Â				Â
Soil quality		Â	Â	Â					
Noise		Â	Â	Â	Â	Â	Â		
Ground ecology		Â	Â	Â	Â	Â	Â		
Employment		Â	Â	Â	Â	Â	Â		
Infrastructure			Â			Â		Â	
Emergency response team								Â	

Convention signs:

Â - temporary impact Ï - permanent impact

5.1.2.1 Work Force

480 local construction workers will reside in the adjacent populated areas. The rest of the workers (the number varies with different construction stages, see Chapter "Project Description") will reside in permanent and temporary compounds, equipped with trailers of "Berlin" and "Brandenburg" type. Heat will be supplied from temporary boiler rooms. Water, power, roads, and means of transportation required at the construction stage will be easily accessible because the site is located 2 km from Perepravnaya village and 5 km from Mostovskoy village. And, as described in Section 5.2.1.8, infrastructure improvements including housing, schools, and a hospital will accomodate the expected increase in population.

5.1.2.2 Noise and Dust

Noise will be one of the major types of environmental impacts at all construction stages. It will be caused by operation of construction and fitting equipment, and vehicular traffic with deliveries of construction materials and equipment. The construction design documents do not stipulate sources of permanent noise impacts greater than 90 dB and sources of pulse noise impacts greater than 120 dB. Taking into account that the nearest populated area is situated 2 km from the site, there will be no detrimental impact on human health.

Dust will be caused by the traffic and earthwork at the site, however taking into account that the nearest populated area is situated 2 km off the site there will be no detrimental impact on human health.

5.1.2.3 Waste Gases

During construction and fitting activities many units and vehicles will be operated using diesel fuel which will cause emission of waste gases. Pollutants can also be generated during welding. However, due to the distant location of the populated areas from the site there will be no hazardous impact on human health.

5.1.2.4 Earthwork

At the site preparation stage, the following earthwork will be performed at the construction site: ground preparation, leveling, earth moving and excavation. Major environmental impacts will be noise, dust, and exhaust gasses. Open pits present a danger to visitors of the site after hours. To mitigate this impact temporary fencing and lighting will be provided.

5.1.2.5 River Crossing by Transmission Lines and Pipeline

The routes of above ground transmission lines for the proposed power plant will cross numerous rivers of the piedmont area of the Caucasus. Table 5.4 is representative of the most significant crossing of large rivers and tributaries.

Table 5.4
River Crossings By Transmission Lines

#	Direction	Voltage, KV	Rivers and Tributaries Crossed by Transmission Lines
1	Tsentralnaya	2 - 500	No river crossings till Psebaj village
2	Zelenchuk		The routes of existing lines are used
3	Majkop	220	Khodz, Fars with tributaries
4	Kurganinsk	2 - 220	Khodz

Most of the listed rivers listed above are valuable fishery water reservoirs of grade 1. Fish species are listed in section 2.3.1. Appendix 21 includes the map depicting location of the listed areas.

The results of this study reveal that both the intensity of the electromagnetic field and the current density in water under the transmission lines (accounting for existing standards of minimum conductor sagging above water reservoirs) are considerably less than hazardous levels for freshwater fish.

5.1.2.6 Erosion and Landslides

Earthwork involving removal of fertile soil and ground excavation can lead to soil erosion. During precipitation events, this soil can collect in depressions and either accumulate there or continue on to the Kurchidskaya gully and the Laba river and cause temporary negative impacts.

To minimize erosion, a number of mechanical controls will be implemented such as raising the ground in the upper section of the site, provision of a drainage system for surface water, and planting unvegetated areas with grass and sod.

In the area of the project site the grade is insignificant, therefore landslides are not expected. Intensive shifts of deluvial deposits can however occur along the routes of the transmission lines and gas pipelines. To mitigate this possibility, bored piles will be used as foundations of transmission line supports and routings will be planned to account for landslide concerns. Since landslide mitigation activities are determined for each case individually, they will be specified during the final stage of project design.

5.1.2.7 Impacts on Land Resources

Within the area of the power plant site and the location of the transmission lines, there are no known significant natural resources. Within close proximity to the site, there is a number of inert construction material deposits (designated geologically as Zasovskoye ($A + B + C_1$), Central-Labinskoye ($A + B + C_1$), Dyatlovskoye ($A + B + C_1$) and other deposits of sand-gravel mix) which can be used during construction.

A specific source for quarried materials for the Krasnodar power plant will be determined by the successful bidder at the preliminary construction stage. In accordance with existing Russian legislation, the quarried resources will be identified and licenses for necessary deposit development will be obtained.

5.1.2.8 Storage of Construction Materials

According to Version 4 of the Project Feasibility Study, construction of the power plant will be completed in four years. Major construction materials will be stored at the construction base located next to the industrial site - precast concrete and metal structures, inert materials, etc. Their storage will have no negative environmental impacts.

Diesel fuel, oils and other potentially hazardous materials will be stored in small quantities in specially equipped warehouses located within the compound and construction base. Storage requirements will correspond to the Russian standards. Negative environmental impacts may be caused by these materials only during accidents, such as a fire or spill. The impact of such accidents will be mitigated by standard safety measures. Environmental pollution will be confined to storage areas and cleaned up by the construction companies.

5.2 Operation Stage

Figure 5.1 is representative of the power plant flow process "raw materials-product-waste" during operation.

Table 5.5 is representative of methods of waste utilization.

"Raw materials--product--waste" diagram for power plant operation stage.

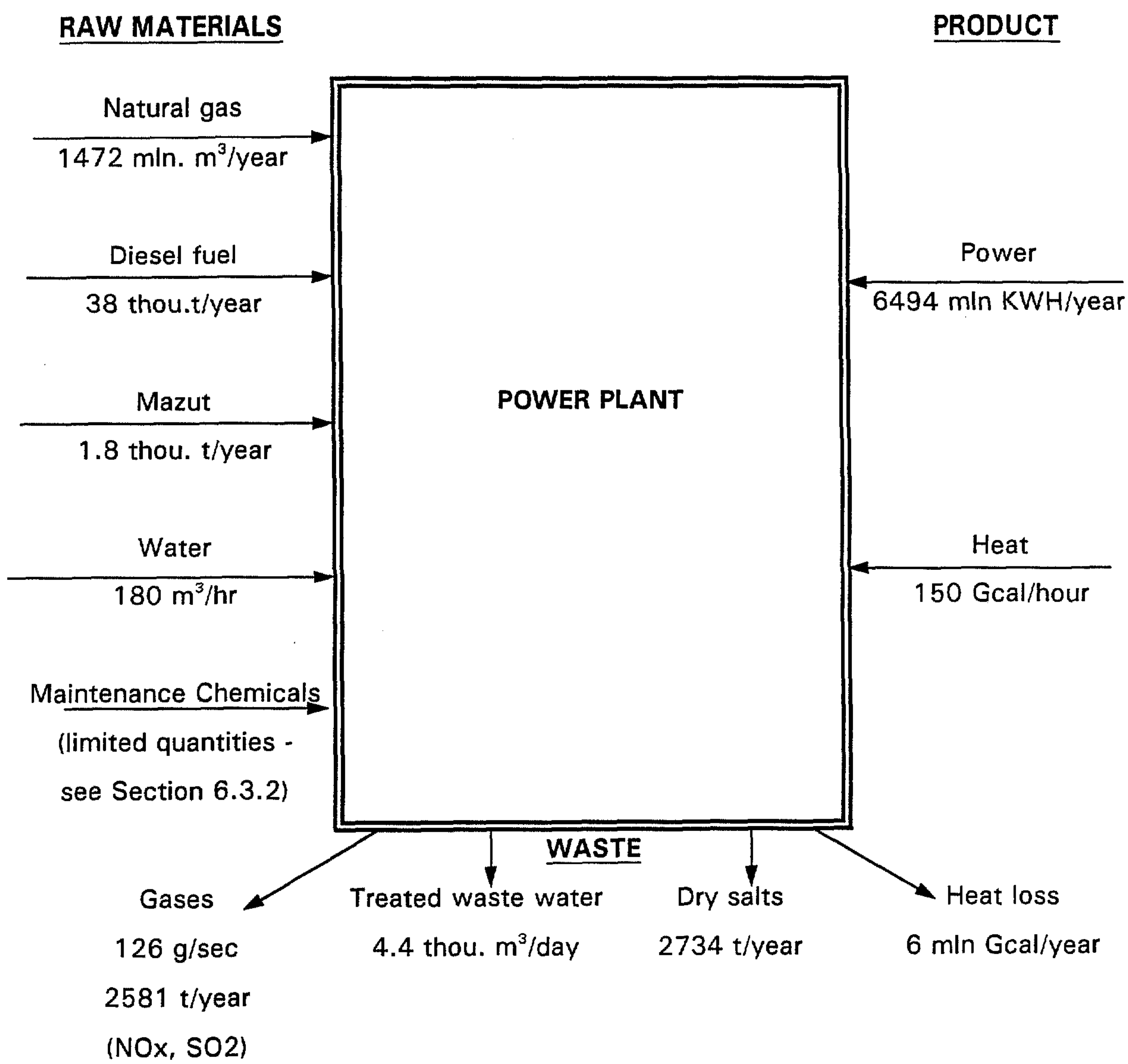

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Table 5.5
Power Plant Waste Methods of Discharge

Waste	Volume	Utilization Methods
Waste gases	2581 t per year	Dispersion in atmosphere from 150 m stack
Sanitary waste	4.4 thou.m^3/day	Discharge to the Laba River after treatment
Dry salts	2734 t/year	Storage (25 years)
Heat loss	620 MW	Dispersion in atmosphere

5.2.1 Power Plant

5.2.1.1 Air Impact

According to Russian OND- 86 requirements KSAU performed calculations of nitrogen oxides concentration accounting for background pollution and summation effect with sulfur dioxide for adjacent populated areas and the Caucasus biosphere reserve during gas emission from the power plant stack under unfavorable meteorological conditions. All the results have been achieved without using computer software and in accordance with OND - 86 requirements. Appendix 22 and the Archives of KSAU contain the results of these estimates. Emissions from all existing stationary sources (PMDO "Yug" and others) as well as public and private transportation sources have been accounted for in the background concentrations, which according to section 7.6 of the OND - 86 are more preferable than calculations on the basis of emissions inventory data for individual sources of pollution.

Models of atmospheric dispersion in the Russian Federation have been strictly determined. These models have predetermined unfavorable meteorological conditions which are mandatory.

Calculations for the normal mode of the power plant operation have been performed using the following initial data (see Table 5.5):

1. Stack height - 150 m;
2. Stack mouth diameter - 14.4 m;
3. Mean gas emission rate - 23.4 m/sec;
4. Weight of NO_x emitted - 126.49 g/sec;
5. Gas temperature - 120°C;
6. Ambient air temperature - 28°C.
7. Unfavorable meteorological conditions have been determined according to the OND - 86 requirements.

Maximum concentration of nitrogen oxides accounting for background pollution and summation effect with sulfur dioxide Ñm = 0,59 of maximum permissible concentrations shall be reached at a distance of Õm = 3324.1 meters. According to the OND - 86 requirements summation effect from pollutants should not exceed 1.0.

Table 5.6
Above Ground Concentrations Accounting for Background and Summation Effect with Sulfur Dioxide

Populated Areas	Nitrogen Dioxide, mg/m^3 Contributed by Krasnodar GRES	Background NO_2 mg/m^3	Total NO_2 During Operations of Krasnodar GRES	MPC NO_2, mg/m^3	Background SO_2, mg/m^3	MPC SO_2, mg/m^3	Total Shares of MPC (MPC SO_2 plus MPC NO_2)
Mostovskaya, 7 km	0.0082	0.03	0.0382	0.085	0.05	0.5	0.55
Perepravnaya, 3 km	0.0114	0.03	0.0414	0.085	0.05	0.5	0.59
Power Plant Compound, 5 km	0.0099	0.03	0.0399	0.085	0.05	0.5	0.57
Benokovo, 12 km	0.0048	0.03	0.0348	0.085	0.05	0.5	0.51
Kaladjinskaya, 6 km	0.0091	0.03	0.0391	0.085	0.05	0.5	0.57
Biosphere reserve, 48 km	0.0011	0.008	0.0091	0.04	0.02	0.3	0.29

Table 5.6 indicates that the maximum pollutant concentration (MPC) of nitrogen oxides calculated account for a background pollution level of 0.0114 mg/m^3, and the summation effect with sulfur dioxide, will be 0.59 shares of MPC in the area of Perepravnaya which is below the regulatory limit of 1.0 shares.

Appendix 22 to this report (the map of Mostovskoy district) is representative of nitrogen oxide concentration versus distance from the power plant stack curve (accounting for background concentrations).

The Territory environmental committee has outlined the following standards for the Caucasus biosphere reserve:

- Background pollution by nitrogen oxides - 0.008 mg/m^3;

- MPC for nitrogen oxides - 0.04 mg/m^3;
- Background pollution by sulfur oxides - 0.02 mg/m^3;
- MPC for sulfur oxides - 0.3 mg/m^3

RoTEP performed calculations of air pollution under the "Efir-6.03" program, approved by GGO named after Vosejkov (Russian regulatory division), with the following results (shown in parentheses are the results of manual calculation):

- Nitrogen oxides emissions - 126.1 (126.49) g/sec;
- Maximum above ground concentration Ñm = 0.55 (0.59) shares of MPC;
- Distance to maximum above ground concentration Ñm, Xm = 4.5 (3.3) km
- Nitrogen oxides concentration accounting for background and summation
- Effect with sulfur dioxide in the Caucasus biosphere reserve Ñ = 0.30 (0.29) shares of MPC.

Calculation of concentrations of air pollutants have been performed for the following modes of power plant operation:

1. Startup (operational are the stack, $H_1=150$ m, and four bypass pipes, $H_2=45$ m. The weight of nitrogen oxides emitted per time unit from the bypass pipe is $M_1=M_2=42.163$ g/sec). In this case maximum concentration of nitrogen oxides accounting for the background and summation effect with sulfur dioxide Cm=0.983 shares of MPC is reached at a distance of Xm=1885.2 m.

2. Accident (operational are the stack and two bypass pipes $M_1=84.327$ g/sec and $M_2=21.081$ g/sec). In this case Cm=0.785 shares of MPC at Xm=2176.47 m.

Table 5.7 is representative of the calculation results.

During calculations maximum single-time concentration levels established in the Russian Federation with 20-30 minute averaging have been used. MPC values for maximum single-time concentrations are less than average daily and annual values, established by the World Bank. Therefore, if the Russian requirements to MPC's for maximum single-time concentrations during unfavorable meteorological conditions are observed, the World Bank requirements are observed as well.

Table 5.7
Concentrations of Air Pollutants During Startup and Accidents

Distance From the Power Plant, km	Startup		Accident	
	NO_x Concentrations, mg/m^3	NO_x Concentrations Acc. for Background NO_2 and SO_2, Shares of MPC	NO_x Concentrations, mg/m^3	NO_x Concentrations Acc. for Background NO_2 and SO_2, Shares of MPC
1	0.03293	0.840	0.01762	0.660
2	0.04437	0.975	0.02816	0.0784
3	0.03826	0.903	0.02557	0.0754
4	0.03208	0.830	0.02215	0.0714
5	0.02656	0.765	0.01891	0.0675
6	0.02195	0.711	0.01604	0.0642
7	0.01821	0.667	0.01360	0.0613
8	0.01522	0.632	0.01157	0.0589
9	0.01283	0.604	0.00989	0.0569
10	0.01092	0.581	0.00851	0.0553
11	0.00937	0.563	0.00738	0.0540
12	0.00811	0.548	0.00644	0.0529
13	0.00708	0.536	0.00565	0.0519
48	0.00110	0.294	0.00092	0.290

Table 5.7 indicates that above ground concentrations of pollutants in the emissions of the proposed power plant for startup and accidents will not exceed the MPC's either in the Caucasus biosphere reserve or in populated areas. The map included in Appendix 23 is representative of the impacts on specially protected areas, represented by isolines of NOx concentrations, with wind blowing in the direction of the Reserve and under unfavorable meteorological conditions. Similar isolines are shown in the map of Mostovskoy district, included in Appendix 22, with wind blowing in the direction of populated areas and under unfavorable conditions.

Additionally, it should be added that construction of the power plant will make it possible to provide a central heating system for adjacent populated areas, thus avoiding low efficiency small boiler rooms and wood and coal burning for heating private houses. This will lead to a decrease of background concentrations during winter by approximately 15-20 % and will have an overall positive environmental impact.

During atmospheric inversions, the amount of pollutants getting to above ground tier is greater than the amount stipulated by the OND-86. Though this impact can not be strictly rated now, it is not mandatory for study within the EIA. KSAU has nonetheless made a mathematical model of air pollution under such conditions and the results can be summarized as follows:

- During atmospheric inversions at 300 to 500 m and 4°C to 6°C rate with emissions temperature of 120°C and vertical movement of inversions, such inversions can be easily neutralized by the high temperature of the outgoing gasses.

- During dangerous wind velocities calculation of above ground concentrations accounting for inversions is a complicated scientific problem with few findings on the subject, however this impact is not rated.

- With certain modification of the OND - 86 above ground concentrations can be calculated accounting for inversions, then the role of inversions will appear insignificant because according to the dimensional theory concentration scale is proportional to the scale of temperature difference of outgoing gasses and ambient air accounting for inversions to power 3/2.

- Detailed calculations of inversion potential were performed at KSAU in 1992, formatted as a computer film and are kept by the management of the power plant under construction.

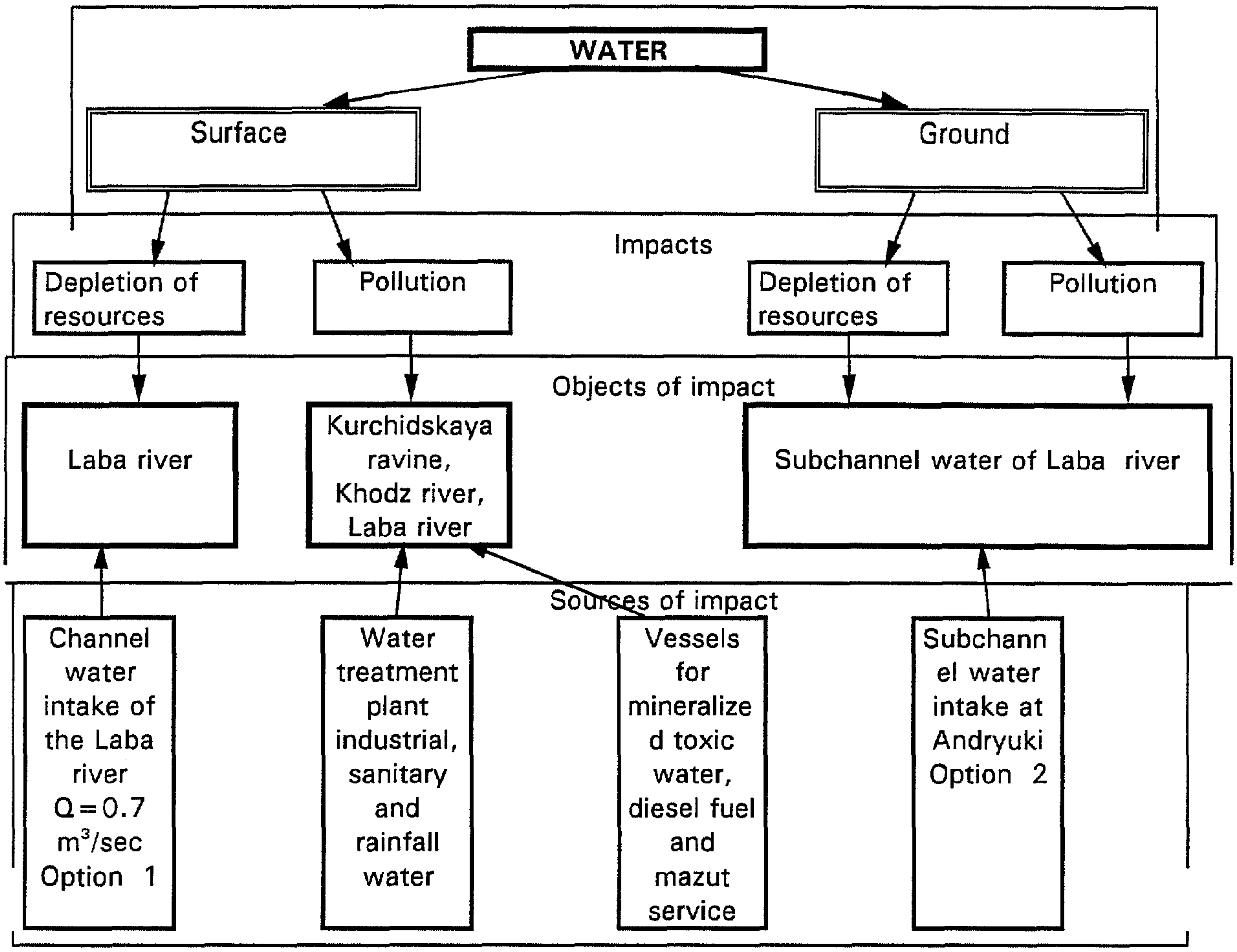
5.2.1.2 Impact on Surface and Groundwater

The Krasnodar power plant will be equipped with dry cooling towers, therefore water intake will be approximately 10 % of the value shown in the Version 4 Feasibility Study Report. The water intake requirements of the Krasnodar GRES will be 180 m^3/hr accounting for loss and construction site needs. A new infiltration water intake planned for construction at Andryuki will provide adequate amount of water for the power plant, compound and adjacent populated areas. The estimates performed during evaluation of resources revealed that the sanitary zone for this water intake can be of the same size as for other water intakes in the area. Due to incomplete design, detailed information on well design, well length, and related parameters was not available at the time of development of this EIA.

The flow of the Laba River is characterized by considerable unevenness. For low flow periods, the calculated water discharge is accepted as 2.2 m^3/sec, when the river ecology is most vulnerable. In most cases water discharge is ten to hundred times greater. Minimum water discharge of the Laba river per year at 95 %

probability is 7.14 m^3/sec and this minimum flow is sufficient to prevent any deleterious impacts during normal plant operations.

Figure 5.2 Impacts of the proposed Krasnodar power plant on surface and groundwater



During operation of the Krasnodar power plant, potential negative impacts on surface and groundwater can be caused in the following instances:

1. depletion of the source (water intake exceeds water replenishment)

2. change of dynamics of channel processes and hydrology conditions

3. underflooding of the power plant site

4. temperature increase of the groundwater

5. change of chemical composition of groundwater

6. accidental leakage of storage reservoirs for toxic waste

7. accidental leakage of fuel tanks

8. accident at treatment units

9. accidental leakage of sewage pipeline

10. accidental spill of chemical compounds at the power plant.

Depletion of surface water resources

The power plant water demand can be satisfied by either surface water or subchannel water of the Laba River.

The cooling system using dry cooling towers has a low water demand and makes it possible to use subchannel water intake.

Channel change

With the use of dry cooling towers, the water intake requirement is less than 3 % of the minimum water discharge of the river and it can not be accurately measured using existing methods (5 % accuracy), no significant change in dynamics of channel processes is expected.

Depletion of groundwater resources

The subchannel water intake at Andryuki includes a series of wells along a 4 to 5 km line. During low water runoff, zones of depression with a 300 to 500 m radius shall be formed around each well. Depressions of the adjacent wells shall form the zone of low level subchannel water. During floods, rivers infiltrate into the subchannel and subchannel water levels shall be restored. Water intake discharge meets the requirements to water resources and will not cause depletion of subchannel water.

Residual impact shall consist of well sliming. Judging by the experience of operation of the subchannel water intakes of Sochi and Tuapse rivers well sliming shall occur after 7 to 10 years of operation. To restore well productivity pebble sediment between river flow and well mouth shall need to be loosened.

Appendices 21 and 24 include figures depicting impacts of the proposed Krasnodar power plant on surface and groundwater.

Underflooding of the power plant territory

Irreversible water loss will amount to 165 m^3/hr, with major portion of water retained at the industrial site which could lead to an increase in the level of local groundwater. The estimates were performed in accordance with the Building Code 2.06.15 - 85 Engineer protection of territories against flooding and underflooding with the following assumptions:

1. there is only one aquifer within the site - pebble sand, with filtration rate of 60 m/day
2. the aquifer is 12 m thick
3. groundwater is located 1 m deep
4. the aquifer has a hydraulic connection to the Laba river
5. river bed has no grade (worst option)
6. the site has a rectangular shape

The estimates revealed that during power plant operation, the level of groundwater can rise to 0.5 m deep and higher. Accounting for high background level and underflooding, scope designing at the next stage will include a number of measures to protect structures and communications against groundwater, and after performing detailed calculations, parameters of the storm drainage system can be specified (during groundwater level rise it can serve as an underdrain system). Thus, due to design methodologies and parameters to be employed, no site flooding is anticipated.

Temperature increase of the groundwater

Judging by the operation of the existing Krasnodar City heating and power plant under the main building of the plant local temperature increases of the groundwater by 40 to 50°C can occur, possibly resulting from water or steam leakage. The measurements made by the Krasnodar geological crew (Report on geological evaluation of the conditions of the territory of the Krasnodar heating and power plant and adjacent town outskirts. - NPGT Geoekologiya Kubani, 1995) revealed that thermal pollution is of a local nature and has not been detected anywhere outside the territory of the heating and power plant (it has been operated since 1954). Approximate calculations for conditions of the Krasnodar power plant prove similar results with initial groundwater temperature of 60°C. At

100 m from the source it will cool down to background temperature. Therefore, there will be no offsite negative impacts on the groundwater in the area of the power plant.

Change of chemical composition of groundwater

Process water utilized at the Krasnodar GRES can become a source of chemical contamination of groundwater. The measurements made by the Krasnodar geological crew (Report on geological evaluation of the conditions of the territory of the Krasnodar City heating and power plant and adjacent town outskirts. - NPGT Geoekologiya Kubani, 1995) revealed that during long-term operation, a system of local sources of pollution can be formed on the territory of the power plant (mainly heavy metals, which is characteristic of the entire town) with concentration of substances greater than MPC values. Pollutants can infiltrate 10 m deep into the ground and then be dispersed by the groundwater, however no pollutants have been detected outside the industrial site. Basically, such local sources of pollution are associated with:

- faults of the process flow and accidental spills of substances
- use of environmentally harmful fuels: coal, fuel oil, diesel fuel
- numerous reconstruction's with movement of facilities.

Judging by the operation of the Krasnodar City heating and power plant there is a possibility of formation of local pollution sources within the industrial site during operation of the Krasnodar GRES. However, it can be stated that such pollution will be comparatively low, because:

- the power plant design utilizes modern technologies;
- the power plant uses the environmentally cleanest fuel - natural gas;
- the design specifies a sophisticated automatic control system for both process flow and environmental conditions;
- the power plant uses modern modular component layout which makes it possible to reasonably occupy limited space during the placement of all the systems of the power plant according to their functions, to take necessary protection measures and avoid movement of certain structures to other sites.

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Water pollution at the water intake

The proposed water intake shall be located on the right bank of the Malaya Laba river 100 m from the rivers edge as a lined series 4 to 5 km long, upstream from the southern part of Andryuki which is approximately 33 km from the Krasnodar GRES site.

Boundaries of sanitary protection zone (SPZ) belts were delineated by Kubangiprovodkhoz Institute in accordance with Building Code 2.04.02-84.

The second belt of the SPZ shall include river bordering strips 750 m wide from the river edge of the summer-fall valley along the entire length of the river from the water intake to the river source.

The third belt of the SPZ is as long as the second belt, the distance between side boundaries of the belt shall be 3 km, according to paragraph 10.11 of the BC 2.04.02-84.

Study of the sanitary protection zone (SPZ, 300 m wide) of the Laba river in the vicinity of the Andryuki well field resulted in the identification of the following sources of pollution (see Appendix 24):

The SPZ covers territory where the following populated areas are located: Perevalka, Burnoye, Nikitino, Kutan, Kirovskij, and the Caucasus biosphere reserve. Potential sources of pollution are:

1. Perevalka village is situated on the left slope of the M. Laba valley; there is no municipal sewage system.

2. Forest range, mechanical shops, souvenir shop, Perevalka. Potential pollution during floods.

3. Burnoye village - one-storied buildings; no sewage system. It is situated on the left slope of the M. Laba river valley.

4. Nikitino village - one-storied buildings; no sewage system. Potential pollution by sanitary waste.

5. Psebaj village - one-storied buildings; no sewage system.

The following stock breeding farms are situated within the SPZ: stock breeding farms of the collective farm named after Kujbyshev, MTF # 6 1 to 1.8 km south of Psebaj, MTF # 4 on the right bank of the Andryuk river and STF 1.5 km south of Andryuki village.

Territories of the farms are polluted with agricultural waste. There are no utilities. There are no manure storage facilities, outdoor grounds and bases are not concrete. The farms are the source of biological and organic pollution to the M. Laba river.

No enterprises or sources of industrial pollution of the M. Laba river within the SPZ were identified.

Upstream of Kirovskij village the M. Laba river, within the SPZ, crosses the Psebaj state reserve with no sources of pollution.

Water quality of the M. Laba river is characterized by the indices exhibited in Table 5.8. Sanitary and hygienic conditions are considered to be acceptable.

Table 5.8
Contents of Effluent Discharge to the Laba River at Mostovskoy Village

Analyte	Measured Values 500m Upstream, mg/L	Concentration in the Control Section, mg/L	Maximum Permissible Concentration mg/L
Suspended substances	8.37	0.377	2.000
BPC total.	1.07	1.088	2.000
Toxicological LPD*			
Ammoniac nitrogen	0.067	0.068	0.250
Iron	0.000215	0.0003	0.010
Copper	-	0.000013	0.001367
Nitrates (nitrogen)	0.0049	0.0049	0.002
Fluorine	0.000172	0.0023	0.230
Sanitary-toxicological LPD			
Nitrates (nitrogen)	0.19	0.2026	1.500
Sulfates	12.87	13.37	64.90
Phosphates (Đ)	0.0115	0.014	0.2973
Chlorides	15.95	16.1	32.00
General sanitary LPD			
Dry residue	61.96	64.01	340.0

* - LPD = grouping of hygienic indicators and methodologies for institutional control generated by different Ministries. Differences between LPDs are due to the variability of analytical methodologies and sampling distance from the source which is dependent upon the Ministry in charge of the respective LPD.

Biological pollution and chemical pollution by oil products resulting from operation of the forest range, mechanical shops, and the souvenir shop at Perevalka can cause potential pollution discharges during floods.

To prevent pollution of surface water of the M. Laba river - source of water supply for the water intake for industrial and household consumption by Krasnodar power plant - it is recommended to perform the following sanitary measures:

1. Prior to commissioning of the water intake the farms, situated within Ï belt of the SPZ, should be equipped with utilities, manure storage facilities, concrete outdoor grounds and bases.

2. To provide and properly maintain required utilities for populated areas, agricultural facilities and stock breeding facilities.

3. To prevent pollution by sewage waste - garbage, manure for the second belt of the SPZ.

4. Activities that should be prohibited within the territory of the second belt of the SPZ:

   - Location of POL warehouses, chemicals and fertilizers, ponds - potential sources of chemical pollution of the river.
   - Location of cemeteries, cattle burial grounds, garbage fields. Filtering of water ponds, forage trenches, poultry breeding and stock breeding farms with potential biological pollution of surface water.
   - Use of fertilizers and chemicals.
   - Location of pasture lands within 300 from the river.

Pollution by effluent discharge from treatment units

Rain water from the power plant shall be cleaned of oil products and disposed of to the Kurchidskaya gully.

Silty and toxic waste water of the power plant shall be stored in metal vessels and shall not be discharged to waterways (see section 3.1.7).

Sanitary waste from the power plant and Mostovskoy village will be supplied to treatment units. Maximum permissible discharge of 0.115 m^3/sec has been established by the Territory committee on conservation of environment. Treated waste will be discharged to the Laba river. Table 5.8 is indicative of background concentrations and concentration of pollutants in the treated waste.

Established waste water composition requirements:

Floating pollutants - none.
Odor - 2 points at most.
Color - no.
Water temperature - should not exceed water reservoir natural temperature by more than 5 °C.
pH level - 5.5 to 8.5.
Oxygen - at least 4 mg/L.
E. Coli index - 1000 at most.

The proposed design will conform to the effluent discharge quality of the established standards and will have no significant impact on surface water.

5.2.1.3 Impacts on Land Resources

Impacts on land resources within the affected area will be determined by:

- agricultural land allocation
- impacts of emissions from the power plant on soils.

Chapter "Project description" is indicative of the areas allocated for construction. Land transfer is properly documented and is in agreement with land use structure of the Mostovskoy district. Table 5.12 is indicative of the repayment rates to compensate for agricultural production loss.

Impact of power plant emissions on soil is covered in section 5.2.1.7 of section "Impacts on agriculture".

5.2.1.4 Noise

Judging by the experience of construction and operation of thermal power plants, as well as previous studies and measurements of noise levels at existing thermal power plants performed by NIIISF, MEI and other organizations, modern power plant equipment causes noise above permissible levels inside buildings, at the industrial site and to the adjacent development territories.

Major sources of noise inside buildings are combustion and steam turbine units, pumps, steam pipelines, ventilation units, valves and other equipment. All the noise sources mentioned are continuous, except exhaust valves, with 24-hour operation.

Noise range in the engine room falls within a wide frequency range of 100 to 8000 Hz. During the normal mode of operation of equipment, noise is steady and of wide band.

Maximum permissible noise levels at the work stations were defined by Sanitary Code 3223-85, and those within the compound by SC 3077-84 and corresponding GOST 12.1.003-89 and GOST 12.1.036-81.
These standards limit the constant noise level at work stations to 80 dB. Maximum acoustic level $L_{à\ max}$ of non-constant noise (except pulse noise) at the work stations should not exceed 110 dBÀ. Maximum acoustic level of pulse noise is 125 dBÀ (GOST 12.1.003-89).

Maximum level of non-constant noise within the compound should not exceed 60 dBÀ; within the territory of hospitals 50 dBÀ (SC 3223-85).

Figure 5.3 is indicative of marking and location of noise sources.

ÈØ (NS) - 1 (6 pcs)
A group of air intake chambers. Noise is generated by CT compressor and by release of excessive air through fire safety valves into suction channel. Acoustic intensity of one chamber is Lõ =145 dBÀ (see Diagram 1 and Table 3). All noise sources may work simultaneously. Total acoustic intensity of the group is - Lõ =154 dBÀ.

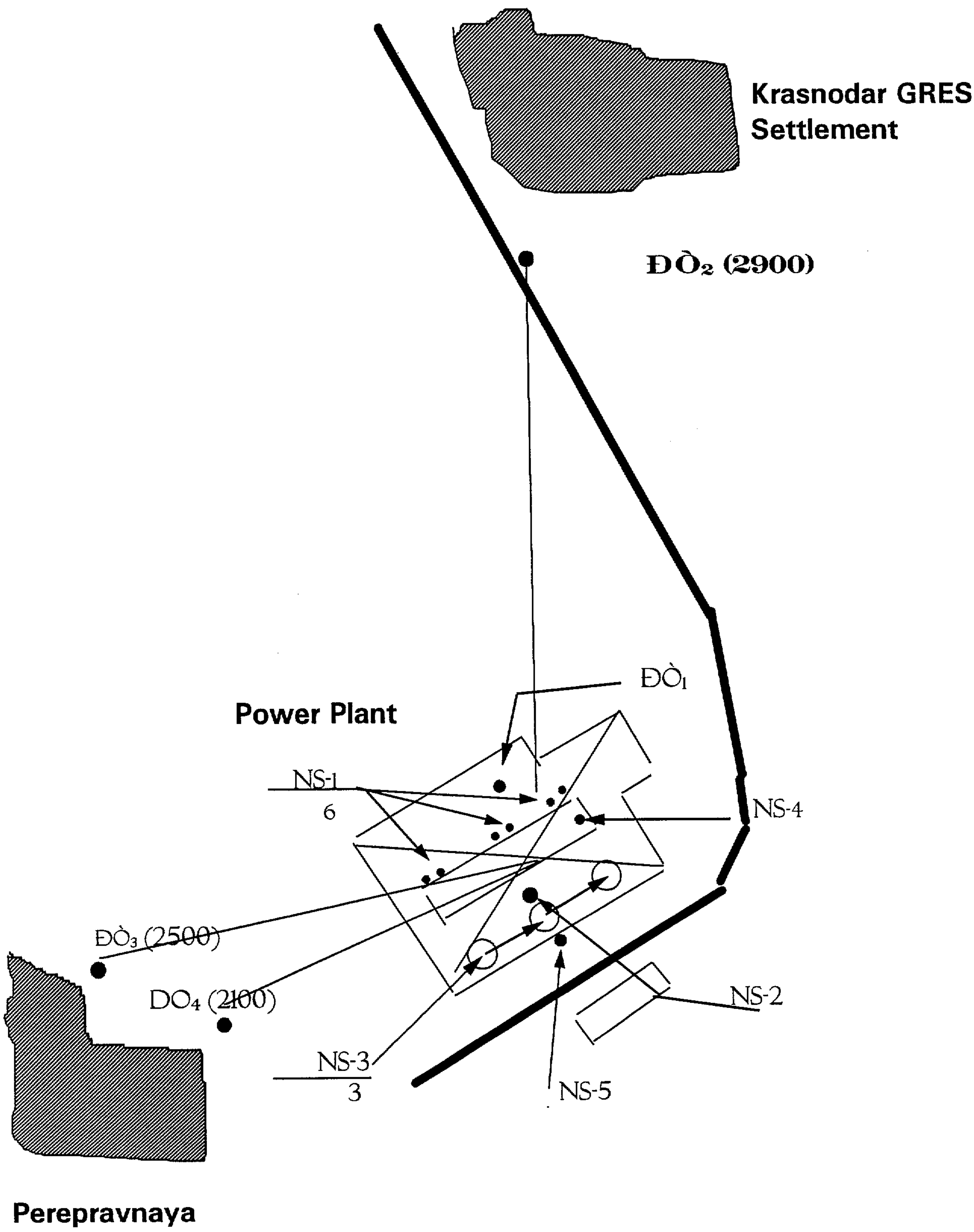
ÈØ (NS) - 2 (1 pcs)
Ferro-concrete stack Í=150 m Lõ =110 dBÀ with one unit operational. Acoustic intensity level generated by stack mouth shall be equal to the sum of intensity values of the units operated simultaneously disregarding acoustic intensity decrease in heat recovery steam generators Lõ =119 dBÀ.

ÈØ (NS) - 3 (3 pcs) Cooling towers. Acoustic intensity levels of the cooling towers Lõ =115 dBÀ.

ÈØ (NS)- 4 Steam pipeline of emergency steam release Lõ =130 dBÀ simultaneous release - 1 noise source.

ÈØ (NS) - 5 (1 pcs) Gas pipeline on the rack. Lõ =115 dBÀ.

The plant layout plan indicatives the location of the above reference points. Reference point ÐÒ1 is located on the industrial site 50 m from the group of air intake chambers.



Krasnodar GRES
Settlement
ÐÒ2 (2900)
ÐÒ1
Power Plant
NS-1
6
NS-4
ÐÒ3 (2500)
DO4 (2100)
NS-2
NS-3
3
NS-5
Perepravnaya

Figure 5.3

Reference points ÐÒ2 through ÐÒ4 are located on the development territory at the closest distance to the industrial site.

For the purposes of these estimates, the following assumptions were made:
Noise propagation from sources is direct through air.
There are no noise shields or other obstacles between industrial site and development territories.

Table 5.9 is representative of expected acoustic pressure levels in reference points caused by individual noise sources (RoTEP estimates).

Table 5.9
Noise Sources and Noise Levels

Noise Sources	L (dBÀ)	Reference points			
		ÐÒ1	ÐÒ2	ÐÒ3	ÐÒ4
ÈØ-1* (NS)	154	116	68	72	75
ÈØ-2 (NS)	119	61	35	36	42
ÈØ-3 (NS)	105	52	25	26	22
ÈØ-4* (NS)	130	102	48	49	55
ÈØ-5 (NS)	115	shielded by main building	40	41	47
Total Lp (without NS 4)		117.0	68.0	72.0	75.0

Explanations to the Table:

1. Most unfavorable combination of existing noise sources with 6 gas units operating at full capacity and exhaust from the stack Í=150 m.
2. Calculation of acoustic pressure levels caused by ÈØ-4 (NS), as an emergency source, was calculated separately.

Conclusions: Expected acoustic pressure levels in all reference points exceed the permissible values mainly due to noise sources ÈØ-1 (NS) and ÈØ-2 (NS).

Table 5.10 is representative of calculation of required acoustic pressure level decrease in reference points (Lst=L-Lb).

Table 5.10
Calculation of Expected Noise Levels

Noise Levels dBÀ	Reference Points			
	ĐÒ1	**ĐÒ2**	**ĐÒ3**	**ĐÒ4**
Expected levels				
of acoustic pressure L	117.0	68.0	72.0	75.0
Lb	80	45	45	45
Lst	37.0	23.0	27.0	30.0

NOISE MITIGATION MEASURES FOR THE WORK STATIONS:

The following mitigation measures are planned:

- mounting of noise reduction covers on noise generating equipment and turbine units. Special enterprises of Minenergo (VPSMO "Sojuzenergozashchita", TSETI and JUZHETI complexes) developed heat and noise insulation materials for steam and gas turbines of 200, 300, 500, 800 and 1000 MW and implemented at a number of thermal power plants (Lithuanian, Surgut, Perm, Rovno, etc.)

- noise reduction insulation for steam pipelines and valves;

- use of noise reduction devices in ventilation and air conditioning systems;

- installation of fencing structures for control stations (located in service points), equipment of inspectors' rooms, supervisors' room, etc. with appropriate noise insulation; tested wall structures, door windows, sealing, etc.;

- use of noise absorption lining for control stations, and other rooms with special requirements to production;

- installation of noise insulated booths for continuous monitoring and communication in production area and other places. Typical noise insulated booths were developed by VTSNIIOT VTS SPS in cooperation with NIISF of 2 by 2 m to 3 by 5 m dimensions. Noise insulation capacity of the booths was determined by tests under GOST 23426-79 and equals 30 to 40 dB at 1000 Hz;

- installation of noise insulation shields for maintenance work stations;

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- use of individual noise reduction means when working close to equipment generating excessive noise or when noise covers are removed from the equipment (GOST 12.1.029-80).

NOISE MITIGATION MEASURES ON POWER PLANT SITE AND ADJACENT TERRITORIES:

- Reasonable facade orientation of major noise generating facilities and directional noise sources.

- Use of effective heat and noise insulation for gas and air ducts, made of noise absorbing material (ZPM 80 mm basalt or fiber glass) and 20 to 25 mm thick asbestos layer reinforced by metal grid. Effect of this layer is 25 to 30 dBÀ.

- Improvement of noise insulating capacity of fencing structures for noise generating facilities (main building, GRP, etc.) by sealing door and gates shutting, proper packing of fitting voids and passes for means of communication.

- Installation of heat and noise insulation of steam pipelines and gas pipelines.

- Installation of plastic noise reduction devices in air intake chambers for all combined cycle units (PGUs).

- Installation of mufflers in gas exhaust ducts in accordance with the GOST recommendations. After commissioning of heat recovery boilers it is necessary to measure acoustic intensity levels at heat recovery boiler outputs and, if required, to mount ring packing on the lower part of the stack. Acoustic effect of 20 to 30 dB at all frequency bands can be reached with packing height of 7 m.

- Installation of noise reduction devices for steam safety valves and direct steam exhaust pipeline. The noise reduction devices were developed by SKBT VKT, YuVTI in cooperation with NIISF. Acoustic effect of the mufflers is 25 dBA.

The noise mitigation activities listed above shall ensure meeting the sanitary requirements.

Detailed calculation of noise reduction for each noise source shall be performed at the next design stage accounting for frequency specifications of the noise sources. Design of modern power plants reveals that with distance to development areas of 2 km and greater noise mitigation activities can provide noise reduction by 70 dB and greater and will meet both Russian sanitary standards and the World Bank requirements.

5.2.1.5 Impacts on Aquatic and Terrestrial Biota

Aquatic biota. Water quality of the Laba river will not decrease because disposed waste shall be treated and meet the required specifications. Maximum permissible disposal requirements to the Laba river were reviewed and approved by the Territory committee on conservation of environment.

The subchannel water intake of the power plant will not cause harmful impact on aquatic biota because water discharge does not exceed replenishment of the aquifer.

River crossings by transmission lines will not cause negative impact on fish migrations.

Terrestrial biota. Air quality shall be within MPC and shall have no negative impact on animals.

Noise impact on animals will be insignificant, because there are no habitats of wild animals and game within the power plant site. Certain disturbance of domestic animals and small rodents will occur during their foraging close to the power plant.

Human impact on environment shall not have a significant increase: population of Mostovskoy - 22 thousand people, number of the power plant employees - 183 people.

Appendix 25 is indicative of environmental impacts of the power plant in the Krasnodar Territory.

Vegetation. Rare and endangered plants can be found within the Kuban Region. Such plants have been described by Kuban botanists:

- Jurinea (Goryachij Klyuch, Majkop, Yaroslavskaya settlement, Laba r. basin. Recommended for local protection)
- Lousewort (Balysh, Bolshoj Bambak, Laba r. basin. Recommended for local protection)
- European needle grass (Taman peninsula, Armavir, Urup and Laba upstream. Recommended for local protection)

- European feather grass Anapa, Laba river. Included in the list of rare and extinct species of the Russian Federation)

- Jacob's rod (from the Laba river to Pyatigorye. Included in the list of protected flora species of the Russian Federation)

These species are not found within the construction site or transmission line corridors.

Impacts on environmental systems of the Caucasus biosphere reserve. The northern boundary of the reserve is 48 km from the construction site. Water quality impacts, electromagnetic field impacts, and noise will not reach the reserve.

The existing NO_x background concentration within the biosphere reserve is 0.008 mg/m^3. The estimated NO_x emissions attributable to the Krasnodar GRES is 0.0011 mg/m^3. Therefore, the combined NO_x level within the biosphere reserve is estimated to be 0.0091 mg/m^3 which is well below the MPC of 0.04 mg/m^3.

Nitrogen oxide concentration increases in the atmosphere of the reserve are within measurement accuracy limits and will show a minor difference from the background values. MPC for the reserve are much lower (see section 2.1.1) compared to MPC for populated areas. Environmental impact on the reserve can be caused only through acid rains.

In Russia there is no established methodology to predict acid rains. Therefore, this type of impact is considered to be an unregulated impact. Mathematical modeling of acid rains conducted for a previous site study indicate that:

1. With existing wind velocities and directions, nitrogen oxides, given their 30 to 70 hour atmospheric residence time may reach the reserve;

2. Majority of acid fallout shall fall on north-western stepped part of the Krasnodar Territory;

3. Probability rate of the oxides fallout in the reserve is 0.01 and that of acid rains is even less.

In accordance with the International convention on trans-boundary transfer, acid rain mitigation measures include a decrease of total emissions of sulfur oxides and nitrogen oxides (tons per year). According to the Environmental Report of the Krasnodar Territory in 1994 the Territory met the Convention requirements as of 1993. Decrease rates of total emissions are ahead of schedule by 23.8 %, i.e.

4.79 tons per year (page 23 of the Report). With commissioning of the power plant NOx emissions shall increase up to 2.58 tons per year, i.e. total emissions level for the Territory shall remain within the Convention requirements. However, with commencement of power plant operation reconstruction of the units of the existing Krasnodar City thermal power plant and switching to modern combined cycle mode shall become possible with consequent cessation of use of sulfur containing fuels which will contribute to a decrease of total nitrogen and sulfur oxides emissions and will improve the acid rain situation. With the power plant commissioning, the probability rate of acid rain in the reserve shall be decreased.

The Environmental Report of the Krasnodar Territory in 1994 (see page 105) points out "increasing impact on biota of the reserve by chemical and radiological pollution associated with global transboundary transfer of pollutants, however the consequences of this process require further study".

5.2.1.6 Impact on Human Health

Impact on human health is rendered through air, potable water, water reservoirs, soil, labor conditions and living standards.

Water quality shall be improved due to commissioning of a new subchannel water intake at Andryuki.

Water reservoir quality shall not be deteriorated because waste water shall be processed at the treatment plant, and withdrawal of fresh water shall be minimized due to use of dry cooling towers. Silty and toxic industrial waste is not discharged to water reservoirs but held within the power plant site in special vessels.

There will be no soil pollution or degradation (see section 5.2.1.7).

Due to construction of the residential compound, recreation center, school, asphalt covering of the streets, central heating, lighting of the streets, and other planned infrastructure development projects, living conditions will improve.

Medical care shall improve due to construction of a new clinic.

Air quality shall be nominally impacted but will remain within permissible concentrations. Previously conducted mathematical modeling (accounting for changes of meteorological conditions disregarded by OND-86 methodology) states that more than 90 % of the time, above ground concentrations of air pollutants in adjacent populated areas shall not differ from the background values (see Table 5.11).

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Table 5.11
Time Period When Above Ground Air Pollutant Concentrations Differ From the Background Values

Populated Areas	Time Period When Above Ground Air Pollutant Concentrations Differ From the Background Values % of Days of the Year
Mostovskoy	8.5
Perepravnaya	2.5
Kaladjinskaya	1.45
Zasovskaya	3.5
Benokovo	3.6

5.2.1.7 Impacts on Agriculture

Waste calculations of the Krasnodar GRES emissions indicate the domination of nitrogen oxides and absence of toxic gases, heavy metals, dust and other components, which could have a hazardous impact on soil and agricultural vegetation.

Nitrogen oxides belong to short-term compounds (30 - 70 hours). During their existence they are distributed within the area of a 150 km radius. Their concentration decreases with distance to the point of emission from 1.9 down to 0.15 kg/hectare (adjusted to nitrogen 0.15-0.6 kg/hectare) with 0.9 kg/hectare mean value (0.258 kg/hectare when adjusted to nitrogen). Low concentration nitrogen oxides solutions shall be transformed in the soil.

In the spring-summer period the major portion of NOx that reaches the ground shall be utilized by agricultural vegetation and shall be expelled from the soil with yield. To make up for the expelled nitrogen, the soil needs to be fertilized by 40 to 90 kg/hectare dosage of nitrogen as recommended by the Agrotechnical Engineer's Reference Book of Kuban, Krasnodar, 1987, page 85. Therefore, vegetation demand is satisfied by NOx emissions only at a 0.2-0.3 % level.

In Kuban, nitrogen loss due to erosion is 12.5 kg/hectare, and due to dealkalinization - 5 kg/hectare/ (Agrotechnical engineer's reference book of Kuban, Krasnodar, 1987, page 84), consequently with mean nitrogen fertilizer dosage of 65 kg/hectare the loss will be 26.9%. With nitrogen dosage of 0.258 kg/hectare per year the loss will be 0.069 kg/hectare.

Part of the nitrogen passed to soil returns to the atmosphere. During denitrification this figure is 20% (Agrotechnical engineer's reference book of Kuban, Krasnodar, 1987, page 84), i.e. 0.057 kg/hectare.

Part of the nitrogen can be absorbed by root and free bacteria and thus, take biological form. Potential absorption capacity of bacteria under optimum and non-optimum conditions is 70 to 300 and 5 to 15 kg/hectare, respectively. Upon bacteria death nitrogen is utilized by vegetation.

The soil studies proved monthly, annual, and 5-year period dosage of nitrogen passed to the three most common types of soil in the region to have no significant impact on hydrolithical pH, salt content, or soil biological effectiveness (for more detailed information see EIA of Krasnodar Power Plant, 1992).

Nitrogen entrained in Krasnodar power plant emissions shall not have significant negative impact on soil properties due to low concentration. Annual amount of emissions is 400 to 500 less than the recommended nitrogen fertilizer dosage in the region. Favorable drainage conditions and soil properties in the region prevent accumulation of toxic quantities of nitrogen in the soil and its acidulation.

The power plant emissions shall have a negligible impact on biota through the atmosphere, water and fodder. The power plant impact on atmosphere shall consist of decrease of oxygen content, which will be used for fuel combustion, and of emissions of nitrogen dioxide - 86 g/sec. Previously conducted calculations proved ("EIA", 1992, section "Vegetation") annual consumption of 21×10^7 m^3 of oxygen for fuel combustion. In addition, use of agricultural lands for technogenic purposes shall decrease oxygen supply to atmosphere. Certain decrease of oxygen contents in atmosphere shall not have negative impacts, because it will be compensated by tremendous reserves of oxygen in atmosphere. Constant oxygen contents in atmosphere is determined by vegetation and phytoplankton absorbing carbon dioxide and evolving oxygen during photosynthesis.

Fodder and forage crops in the natural meadows and pasture lands shall not accumulate nitrogen oxides, emitted by the power plant, of toxic effect for the stock. These oxides shall be 0.3 to 0.4 % only of the recommended dosage of nitric fertilizers (60-90 kg/hectare).

Contents of nitrates in the Laba river shall not change with power plant emissions. The increase will be slight - 0.0003 mg/L (with MPC adjusted to nitrogen of 10 mg/L).

Operation of the power plant shall not have a significant negative impact on agricultural production in the Mostovskoy district.

Table 5.12
Estimate of Agricultural Production Loss Due to Land Allotment for the Krasnodar Power Plant Facilities

#	Construction Facility and Land Allotment Type	Land Type	Area, in Hectares	Standard Rate, in Thou Rubles Per Hectare	Index to Standard Rates and Coefficients	Agricultural Production Loss, in Thou Rubles	Land Tax as of August 1, 1995	
							Rate Thou Rubles Per Hectare	Amount Thou Rubles
1	Main industrial site, reclamation project	Arable	65.00	3891.00	37, 6, 0.5	4754802.0	160.0	10400.00
2	Construction base, reclamation project, appropriation	Arable	71.66	3891.00	37, 6, 0.5	5241986.3	160.00	11859.20
3	Protective structures, reclamation project	Arable Arable	30.00 8.00	3891.00 3891.00	37, 6, 0.5 37, 6, 0.5	2194524.0 585206.40	160.00	6080.00
4	Residential compound, reclamation project	Arable Pasture	164.00 28.00	3891.00 3123.00	37, 6, 0.5 37, 6, 0.5	11996731.2 1643947.20	200.00	38400.00
5	Access road to construction base, reclamation project, appropriation	Arable	1.69	3891.00	37, 6, 0.5	123624.80	160.00	270.40
6	Water intake facilities for the compound, reclamation project	Arable	0.6	2714.00	37, 6, 0.5	30613.90	160.00	12896.00
		Pasture	80.00	2176.00	37, 6, 0.5	6545408.00	160.00	12896.00
7	Access road # 4 to treatment units, reclamation project	Arable	0.42	3891.00	37, 6, 0.5	30723.30	1300.00	546.00
8	Sand and gravel quarry	Pasture	10.00	3123.00	37, 6, 0.5	587124.00	160.00	1600.00
9	Construction sand quarry						160.00	800.00

#	Construction Facility and Land Allotment Type	Land Type	Area, in Hectares	Standard Rate, in Thou Rubles Per Hectare	Index to Standard Rates and Coefficients	Agricultural Production Loss, in Thou Rubles	Land Tax as of August 1, 1995	
							Rate Thou Rubles Per Hectare	Amount Thou Rubles
10	ORS base, reclamation project	Arable	12.00	3891.00	37, 6, 0.5	877809.60	160.00	1920.00
11	Access road to the industrial site, reclamation project	Arable	13.00	3891.00	37, 6, 0.5	950960.40	160.00	2080.00
12	Railroad station development and rail sideline	Arable	9.00	3891.00	37, 6, 0.5	658357.20	160.00	1440.00
13	Movement of 110 KV TL switchyard for 220-110 KV TL	Arable	5.00	3891.00	37, 6, 0.5	365754.00	160.00	800.00
		Arable	0.84	3891.00	37, 6, 0.5	61446.70	160.00	155.20
14	Heat pipeline, reclamation project	Arable	3.5	3891.00	37, 6, 0.5	256027.80	160.00	1440.00
		Pasture	5.5	3123.00	37, 6, 0.5	322918.20		
	TOTAL	Arable Pasture	384.71 124.4			37280806.2		90686.8

In accordance with the district Administration resolution land sections were allocated, with specification of land type and cost, as well as amount of agricultural loss compensation. Shown below are estimate of agricultural production loss and land tax on the basis of Land Application # KK - 233000 - 290 (Attachment to the State Certificate on land allotment).

5.2.1.8 Sociological Impacts

Resettlement of the population

No resettlement of the population is expected due to the remote location of the power plant from the populated areas.

Concerns of the population

The Krasnodar GRES thermal power plant is an alternative to a nuclear power plant opposed by the public opinion of the Krasnodar Territory. According to the Public Hearing conducted on 26 December 1996 and other previously held public meetings, construction of the Krasnodar combined cycle power plant is acceptable to the local population. Additional information regarding public involvement in the Krasnodar GRES project can be found in Chapter 11 of this document.

Change of traditional forms of occupation

Employees of the former collective farm named after Frunze (currently - AAO Perepravnoye) have no objections against location of the power plant on the land of the collective farm, provided a:

- new recreation facility is built;
- new school is built;
- gas supply for the village individual consumers is organized.

Residents of the district are interested in the opportunity of new, more sophisticated and well paid employment which would assist in keeping the younger generation in the area while getting an education.

Change of traditional mode of life

At the site preparatory stage, the management of the power plant has made a considerable contribution to improving the welfare of the district.

The following facilities shall be built in the Mostovskoy district:

1. School with swimming pool;
2. Hospital for 250 patients with a clinic;
3. Sanitarium for 100 people;
4. Highways;
5. Housing for the power plant personnel;
6. Streets will be upgraded (asphalt cover).

The power plant construction shall assist in improving living standards and utility services.

Influx of a great number of highly qualified specialists to the district shall have a positive impact on cultural development.

A facility as big as the power plant shall have direct and indirect positive impact on revenues and living standards of the resident population.

Power generated by the Plant shall contribute to the economic, industrial and agricultural development of the Krasnodar Territory.

The above mentioned infrastructure improvements have been planned to accomodate the population increase due to power plant staffing and construction.

<u>Health care and safety of the resident population</u>

During operation of the power plant none of the Sanitary Code standards will be exceeded (see respective sections), therefore environmental changes will not cause a worsening of the health of the population or place human life at risk.

5.2.2 Impacts Caused by Accidents

The Krasnodar Territory committee on conservation of environment places a great emphasis on potential accidents. Out of 22 major environmental priorities in the Territory, accidental waste disposal is the second most important priority. Annual reports of the Territory contain official data on the number of accidents. Annually, approximately 40 accidents occur in the Territory with environmental impacts. Approximately 50 % of the accidents are associated with marine areas polluted during oil transportation. The other 50 % of accidents occur as railroad accidents, oil and gas pipeline accidents and accidents associated with operation of treatment plants below standards. No accidents at energy facilities of the Territory were registered. The proposed power plant shall be a highly reliable modern facility and, despite the lack of data on accidents for similar facilities, this EIA contains a scenario of possible environmental impacts caused by accidents.

With uncertainty about the sources of impact and their intensity, scenarios of accidents with reasonable impacts only are presented in this report. Faults of the personnel, breakage, subversive activities, natural disasters (earthquakes) as well as combinations of the causes mentioned may lead to two major accidents:

1. All facilities of the power plant are on fire. All facilities containing volatile compounds have leakage. All volatile compounds proliferate into the atmosphere. The power plant personnel should follow the emergency response plan procedures which are currently being developed for the Krasnodar GRES facility. Since there are no radioactive or poisonous substances at the power plant facilities and since populated areas are located 5 km (Mostovskoy village) and 2 km (Perepravnaya village) from the plant, the resident population of Mostovskoy and Perepravnaya shall not subject to dangerous impacts. Impacts in the form of smoke, fire and noise shall be temporary and shall be terminated with cessation of the fire. The air will be temporarily polluted by the products of combustion. Administrations of both Mostovskoy and Perepravnaya should take measures to prevent housing construction in the direction of the power plant and adopt corresponding resolutions. Consequently, the development plan of Mostovskoy village needs to be created with depiction of an industrial zone and the power plant; the established Russian and district regulations should be observed.

2. All facilities of the power plant containing liquid agents have leakage, liquid agents spill on land and proliferate into water reservoirs and groundwater. The power plant personnel should follow the emergency response plan procedures. There will be no direct impact on the local population. There will be a residual impact in the form of soil pollution, groundwater pollution, Kurchidskaya gully pollution, Khodz river pollution and Laba river pollution. In accordance with the project description pollution sources and pollution extent that were accounted for are described in Table 5.13 and Appendix 26.

Table 5.13
Sources and Extent of Pollution of Soil, Ground and Surface at the Power Plant Site During Accidents

Pollutants	Source	Extent
Mineralized waste	3 ferro-concrete vessels	30 000 m^3
Toxic rubbish	Ferro-concrete vessel with inner watertight lining	10 000 m^3
Mazut	2 on-surface metal reservoirs	4 000 m^3
Diesel fuel	2 on surface metal reservoirs	20 000 m^3
Mazut	Mazut (oil fuel) pumping station	
Oils	Oil yard	-
Diesel fuel	Diesel oil pumping station	-
Diesel fuel or mazut	Fuel rack for 8 tanks	

1. To avoid harmful discharges getting into groundwater and water reservoirs, the project documents stipulate the following measures:

   Tanks for diesel fuel, fuel oil and oils are installed inside bermed areas up to 2.5 m high, each with the capacity to contain the tank contents plus 10%.

   The underlying site geology is such that the existing dense cover of clay will retard infiltration of oil products to groundwater.

   After localization of an accident, liquid fuel will be pumped into intact tanks or mobile tank systems.

2. Drainage units for oil products are equipped with oil-tight sleeves; oil products are drained to a receiving tank and further to storage tanks.

3. Prior to treatment, silty waste is collected in tanks located inside areas with anti-spill equipment.

4. Concentrated highly mineralized residue from evaporative units are stored in underground ferroconcrete tank with a special inner and outer waterproof lining with a 25-year service life.

5. Rainfall runoff from oil product storage facilities and from storm drains along roads (with continuous curbing) are directed to a receiving tank and

are then directed to an oil/water separator. Reclaimed water is utilized in the process flow of the power plant, oil products are returned to the fuel oil storage tanks.

Pollution of groundwater can occur during various accidents. Based on a mathematical model of pollution of groundwater the following can be theorized:

1. pollutants can reach the river bed by overland flow in one day (average depth of river bed is 12 m);

2. proliferation of pollutants towards Laba river via groundwater is 0.6 m per day;

3. the elevation difference of the subchannel flow varies in value and direction depending on Khodz and Laba water levels;

4. change of levels of subchannel flow at the power plant site occurs 30 to 60 days after level change in rivers;

5. predicted pollution extent shall not cause pollution outside the power plant site for several years after the accident, and this will allow sufficient time to begin to remediate and contain any contaminated areas.

The following local-scale accidents can occur at the proposed power plant:

a) fire during breakage of the gas pipeline within the power plant site, in GRP building and GTU room of the main building;

b) fire during explosion of gas-air mix in the turbine combustion chamber;

c) unit shutdown during low oil pressure in combustion or steam turbine lubrication and control system;

d) pollution of soil and water during fire or breakage of vessels at the diesel fuel yard, oil yard or of mazut vessels of the power plant POK;

e) accident during fire in cable ways, turbine oil supply system, central and other control stations;

f) similar accidents at POK.

Operating instructions at each PGU-450 unit at each auxiliary shop for major and auxiliary equipment shall be formulated in accordance with the plant operating

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instruction and existing "Safe Operation and Safety Regulations for power plants and grids" and "Safe Operation and Safety Regulations for consumer power plants" of the Russian Federation. Such instructions shall describe emergencies and appropriate response measures. Operation personnel shall undergo training, practice, training at the simulator and take respective credit tests. All accidents shall be localized within the territory of the power plant, unit, shop, section, etc.

With respect to accidents associated with transmission lines, the following accidents may occur:

- Breakage of the line caused by icing or wind storm;

- support tower collapse caused by landslide, avalanche, soil erosion, earthquake, etc.;

Possibility of such accidents is slight, because transmission lines are designed to account for normal conditions and emergencies. Specifications of high voltage wires stipulate multi-time reliability, and transmission line supports on slopes greater than 12 degrees are mounted on pier foundations (usually, drilled pier foundation to minimize cutting of mountain slopes and stabilize existing landslide threats).

During described accidents, environmental impacts will be insignificant. In places of line breakage or support tower failure, trees can be damaged. Disruption of grass cover and upper layer of soil can instigate erosion processes.

5.2.3 Associated Facilities

5.2.3.1 Gas Pipelines

5.2.3.1.1 General Evaluation of Gas Pipeline Routes

A separate Gas Pipeline EIA Report has been generated by Acres International Limited for RAO Gazprom. The information contained within this Section (i.e., 5.2.3.1) is of a general nature regarding the gas pipeline. Therefore, the reader is instructed to review the Acres/Gazprom EIA Report for a complete discussion of the gas pipeline associated with the Krasnodar GRES project.

At present there are no specific local restrictions on construction of gas pipeline.

Construction of gas pipeline will not impede extraction of natural resources (according to BC 2.05.06-85 laying of gas pipeline through quarries is prohibited).

Biological reclamation - bogging and reforestation will be performed in accordance with the BC-14-89 requirements to an extent agreed upon with the land user (owner).

In all routing options presented in the Gas Pipeline EIA, vegetation habitats will be affected to a minor extent. Forest ranges will be detoured. According to the data available there are no habitats of rare and endangered species within the gas pipeline protected zone.

Land allotment for gas pipeline routing is done outside habitats of valuable animal species.

The proposed gas pipeline land allotment crosses the Laba river. However, during above ground pipeline laying with lower component pipe mounted 1 m above maximum flood level at 1 % probability there will be no impact on fishery. Other water reservoirs (canals, ponds) within the gas pipeline affected area will be detoured by the pipeline. Crossing of the raised ground around irrigation canals (2 m above adjacent land sections) by pressing on the raised ground with no negative impacts on water biota.

There are no historic monuments within the right-of-way zone (5 - 6 m to the sides from the pipeline axis).

5.2.3.1.2 Environmental Impacts During Construction

There will be the following negative impacts during construction of the gas pipeline:

- disruption of the fertile soil layer

- air pollution by combustion products during operation of construction equipment and pipeline welding, and soil and water pollution by construction waste.

Table 5.14 is representative of the expected emissions during construction. Taking into account construction period and length of the pipeline it can be stated that there will be no significant environmental impact.

Table 5.14.
Composition and Amount of Emissions

Substances	Total Amount, t
Dust	0.78
Mn2	0.04
Fluorides	0.112
Silicon compounds	0.04
HF	0.04

The proposed pipeline construction process will provide for maximum conservation of the fertile soil layer and along with the agrotechnical measures to restore its original structure: aggregate negative effect of lowering of natural soil fertility can fall from 20 - 25 points to 0 - 5 points.

During construction, certain river side erosion and washout is possible. No significant changes in flood potential is expected.

To perform hydraulic tests of the pipeline, a water intake will be used equipped such that aquatic biota does not get into the intake pipe.

The water used in gas pipeline tests does not contain harmful substances but some dirt remaining inside the pipeline after its fitting of 0.07 kg/m^3 concentration, and insignificant amount of soot, corrosion products and welding grit of 0.003 kg/m^3 concentration. The test water will be drained into special temporary storage tanks located within the gas pipeline right-of-way zone.

The capacity of the storage tanks equals the volume of the water drained from the gas pipeline tested. Upon drying the tanks are filled with soil from the raised sections with further restoration of vegetation.

With designed capacity of the gas pipeline of 31.2 thousand m^3 amount of the fed and drained water will be:

- 4.68 thousand m^3 - flushing water (accounting for use of cleaning piston)
- 31.2 thousand m^3 - testing water (including possible leakage during testing).

5.2.3.1.3 Environmental Impacts During Operation of the Gas Pipeline

The following impacts may occur during operation of the gas pipeline:

- direct impact on vegetation, forest ranges and biota caused by possible leakage of natural gas through microflaws and imperfect tightness of on-line valves;

- air pollution and pollution of soil and vegetation caused by pipeline cleaning and extraction of liquid and solid pollutants from the pipeline;

- air pollution by emissions of combustion products from mechanized equipment used during pipeline operation and service;

- possible soil erosion, especially on the slopes caused by imperfect soil conservation measures during filling of the trenches;

- possible soil subsidence (rise) under (above)gas pipeline due to imperfect pipeline mounting and earthwork;

- direct impact on vegetation, forests, and biota by emissions of process natural gas.

As a source of air pollution, natural gas can cause negative environmental impacts during operation of the gas pipeline during scheduled and accidental purging of the pipeline.

To promptly shutdown the pipeline (disconnect it from the trunk line during accidental leakage of the pipeline) control valves are equipped with remote control shut-off, which minimizes emission of gas to atmosphere.

Emission of natural gas to the atmosphere during cutting-in of the proposed pipeline into the existing trunk line will be determined by gas volume and pressure between point of cutting and the nearest on-line control valve.

If the distance between on-line valves is 60 km and the pressure is P=5.5 MPa, the volume of the gas to be released will be 132 thousand m^3 at the most (1.8 % of daily demand by the power plant).

To expel air during commissioning of the proposed pipeline blowdown using natural gas is performed until natural gas content in gas-air mix becomes 20 %. The volume of the gas released in this case is 6.5 thousand m^3 , maximum.

Maximum possible leakage of gas from the proposed pipeline through microflaws and imperfections of on-line valves will be 100 thousand m^3 per year (4.6 m^3 per day from each kilometer of the pipeline) which will not have a significant impact on atmosphere.

A closed system of gas treatment products collection will be provided. From gas filters gas treatment products will get to the high pressure storage tank of the reduction unit, then based on the accumulated level they are automatically released to the 10 m^3 underground tank. Consequently, the treatment products are pumped to a tank car to be withdrawn to the utilization facilities.

During the first year of operation liquid gas treatment products will consist mainly of water remaining in the pipeline after hydraulic testing - 85 %, mechanical substances (sand, dirt, soot, corrosion products, welding rubbish, etc.) - 5 % - 10 % and stable gas condensate - 1 - 2 %. The mentioned liquid gas treatment products will be collected during the first year of operation and will be approximately 2 tons.

During the second year of operation, the amount of gas treatment products will decrease and become 0.2 m^3 at the most, with lower water and mechanical substances content and greater gas condensate content (up to 20 - 30 %).

During consequent years of operation, gas treatment products will consist of gas condensate only of 0.05 tons per year, which will be accumulated in an underground storage tank.

A water supply system is not used in the gas distribution system because water is not required for technological purposes.

5.2.3.1.4 Pipeline Accidents

Gas transported through the pipeline is dry, consisting of methane (90-98 %), with a negligible content of gas condensate. In the event of an unpredictable accidental pipeline break, emissions of gas to atmosphere is possible in the amounts equal to the volume of gas contained between two control valves.

Transported gas is lighter than air. It will not accumulate in ground depressions but will disperse into the atmosphere. Dispersion estimates for accidental emissions reveal that even during large accidents in the gas distribution system there will be no excess methane MPC in the atmosphere at a distance of 1.5 to 2 km.

A separate Gas Pipeline EIA Report has been generated by Acres International Limited for RAO Gazprom. The reader is referred to that Report for a complete review of the gas pipeline portion of the Krasnodar GRES project.

5.2.3.2 Transmission Lines

5.2.3.2.1 Electromagnetic Field Intensity and Noise

Biological effect of EMF depends on frequency band, intensity of exposure, duration of exposure and type of exposure (permanent, occasional, intermittent).

During electric discharges, 50 mcA current leakage of 50 Hz EMF can cause pain in the human body. Constant exposure to low frequency EMF can cause headache, depression, sleepiness, insomnia, irritation, and pericardial pain. Functional disruption of central nervous system, cardiovascular system, endocrine system and peripheral blood.

Permissible levels of 50 Hz EMF intensity are calculated for uninterrupted exposure by the main electric field. Electric field intensity is measured at 1.8 m height from the ground and from the floor.

To prevent negative impacts of EMF from transmission lines on human health, sanitary protection zones are used. The sanitary protection zone of a transmission line is that territory along the route of the transmission line with an EMF intensity greater than 1 KV/m.

Table 5.15 is representative of the boundaries of the sanitary protection zones of the proposed transmission lines and the minimum distances from the transmission line axis to populated areas. Dimensions of the sanitary protection zone are determined by the distance from projections on the ground of the leftmost and rightmost phase wires on both sides of the transmission line at right angles to the high voltage line.

Table 5.15
Boundaries of the Sanitary Protection Zone and Distance to Populated Areas

Voltage of Above Surface Lines, KV	Boundaries of the Sanitary Protection Zone, m	Distance to Populated Areas, m
220	15	—
330	20	—
500	30	—
750	40	250
1150	55	300

The transmission line project for the Krasnodar power plant designed by Yuzhenergosetproekt Institute meets all the requirements of the regulatory documents.

Study of the impact of EMF on animals shows that different EMF intensities can affect movement activity, sensitivity to irritants, disrupt formation of conditioned reflexes and suppress memory. During impact of EMF on fish, birds and mammals their movement activity increases 1.5 to 5 times depending on their individual features. It was found that sensitivity to impact of permanent EMF is high for birds, medium (20 % less) for mammals and somewhat less for fish. However it is suggested that all classes of the vertebrates are equally sensitive to EMF because there is evidence that movement activities of fish, birds and mammals grows with changes of EMF close to the geomagnetic field value. Higher movement activity of animals was observed during magnetic storms. During forced decrease of the existing EMF down to 0.1 mcTl movement activity of animals slows down.

Geomagnetic orientation of birds during long distance migration has been under study for many years. According to the latest findings, this orientation is determined by a number of factors, it is used when there are no other references, it is not there when a bird is placed in a screened room. Disruption of the orientation of doves and gulls occurs during magnetic storms. In addition, it was found that the geomagnetic field is sensed by electroreceptors of electric fish and is used by them for orientation.

There is no data available to the authors on impact of EMF on birds. However fish are sensitive to EMF but, depending on the species, the impact threshold varies from 0.001 to 10 V/m.

Detrimental impact on aquatic fauna can be caused by both EMF intensity and electric current in water. According to the studies performed, river crossing by high voltage transmission lines (under existing standards) does not create artificial barriers to fish migration. As a rule, fresh water fish are affected by EMF intensities of 1 to 6 V/m.

Normally, operation of transmission lines is not associated with noise effects and causes no environmental impact by noise. High humidity around high voltage transmission lines can lead to formation of crown discharges producing low humming. However, the resultant generated noise level is insignificant and is much less than the MPL. Therefore, no special mitigation measures are required.

5.2.3.2.2 Impacts on Bird Migration Routes

In the area of location of the proposed power plant and transmission lines there are habitats of various species of birds. Additionally, this area is crossed by the routes of migration of birds that do not nest in the Krasnodar Territory. Species composition of birds of the area can be found in a description of the feathered fauna of the Caucasus biosphere reserve situated approximately 48 kilometers to the south.

In the biosphere reserve, species diversity and quantity of birds is highest in the lower zone of the forest belt, especially in the river valleys. Dominating species both in river valleys and on the slopes are black thrash, chaffinch, blackcap, robin. Many species in the lower part of mountains (buzzard, tawny owl, black and song robins, blackcap, chaffinch) are also widely spread in the middle zone of the forest belt.

River and mountain stream valleys are mainly unfavorable for water birds. They are inhabited by dipper, sandpiper; mallard, teal, osprey, green sandpiper in winter during migration. In the valleys of big rivers there are migration routes of water birds, quail, corncrake, swallows, swifts, followed by birds of prey: sparrow hawk, hobby, black kite, lesser spotted eagle, etc.

Some bird species of the area under study are rare and are included in the Red Book of the Russian Federation or the Territory. Table 5.16 is representative of a species list of such birds with comments relating to the area. The table and other sources [2, 3] show that bird migration occurs both longitudinally and latitudinally with domination of latitudinal migration of local birds. No matter how small the population of birds included into the Red Book is, it is possible that they will fly over the area crossed by the proposed transmission lines.

The specific impact of the proposed transmission line EMF on behavior and migration of birds has not been studied yet. However, the following conclusions can be made on the basis of general studies of impact of geomagnetic and electric fields on behavior and migration routes of birds that are described in section 5.2.3.1.

As was mentioned in section 5.2.3.2.1 geomagnetic fields are one of the major bird orientation factors. At the latitude of the Krasnodar Territory the intensity of the geomagnetic field is approximately 40 A/m (corresponds to magnetic induction of 50 mcTl). A separate above surface transmission line of 500 KV with 1200 A electric current creates a magnetic field of 382 A/m 0.1 m from the axis of the line which is about 10 times higher than the natural background value. However, at a distance of 5 m from the line axis, intensity of the magnetic field of the transmission line decreases down to 38 A/m and becomes commensurate with the geomagnetic background field value. At long distance from the transmission line impact of the geomagnetic field prevails. Accounting for multiphase transmission lines under study and alternating current used, it can be stated that the resulting magnetic field of all the wires of the transmission line during superposition of the fields shall be considerably less than the value mentioned. However, it is obvious that even the 5-meter zone around the transmission line shall not cause disorientation of the birds during migration, because the transmission line magnetic field vector runs sideways rather than along the wires, therefore a migrating bird caught within the 5-meter zone of electromagnetic field impact shall move sideways and will soon fly out of the zone. Besides, it is predicted that birds would differentiate between impacts of permanent geomagnetic field and variable transmission line field. It also needs to be accounted for that bird mass migration occurs at altitudes much higher than that of the transmission line, and that apart from the geomagnetic field migration orientation of birds is affected by other factors too.

A 220 KV transmission line shall render even lower impact on migrating birds than the 500 KV line discussed above.

Many bird species sometimes use the wires and supports of transmission lines for rest. In this respect, impact on the bird body by the electric field of the line is of certain significance. Intensity of the electromagnetic field of 500 KV transmission lines can be dozens of MV/m around the wires. There are no scientific data on impact by such powerful electric fields on the bird body, but the international practice of use of high voltage transmission lines for many years proves that such impacts do not lead to death of birds and do not cause genetic changes in the bird body.

Proposed transmission lines shall be connected to the existing 500 KV transmission line that passes by Psebaj village. This existing 500 KV line is located much closer to the Caucasus reserve than the transmission lines proposed for the Krasnodar GRES project.

Therefore, proposed transmission lines shall not have hazardous impact on the body of either resident or migrating birds of the area nor shall they affect the routes of bird migration.

5.3 Conclusions

An analysis of potential environmental impacts can be summarized as follows:

Positive Impacts

- Additional facilities (associated with construction) shall contribute to general development of the district and will have direct and indirect positive impacts on revenues and living standards of the population.

- Electricity generated by the plant will contribute to economic, industrial, and agricultural development in the entire Krasnodar Territory and further increase employment opportunities.

- The quality and reliability of the water supply for Mostovskoy village will improve due to the commissioning of a water intake in Andryuki village associated with the project.

- The construction of housing, sports facilities, medical centers, transportation, and other facilities associated with the project will cause considerable socio-economic improvement due to increased employment opportunities and improved living standards.

- There will be no resettlement of the population.

Insignificant Impacts

- The power plant facilities are estimated to have no to an insignificant impact on the ecological system of the Caucasus biosphere reserve and will not disrupt its preservation regulations.

- Impacts on surface and ground water, accounting for the mitigating measures to be taken, shall be insignificant.

- Impacts on aquatic and terrestrial biota shall be insignificant.

- Impacts caused by noise are not anticipated due to the noise mitigation measures to be taken; however site personnel may have some noise exposure.

- The proposed routings of the transmission lines are far enough away from population centers such that EMF exposure will not exceed regulatory limits.

- As no known flight paths intersect proposed transmission line routings, there will be no impact on bird migration.

- There will be no impact on general topography and land use in the area.
- Disposal of silty wastes from the process water treatment plant is considered to be an insignificant positive impact on the local population due to the agricultural benefits of land application of the silty wastes.

Minor Impacts

- Concentrations of SO_2 and NO_x in the atmosphere due to power plant emissions will increase slightly but will have an insignificant impact on air quality. The expected concentration increase will be within permissible limits.

Major Impacts

- No major impacts are predicted.

The environmental impact assessment performed in accordance with Section 1.4 of the existing Russian Regulations for EIA shows that the proposed Krasnodar GRES project meets the environmental requirements of the legislation of the Russian Federation.

6.0 WORKER HEALTH AND SAFETY

Health and safety of employees is a major state concern. The rights of citizens for health protection of labor is ensured by the Labor Legislation of the Russian Federation. The Code of Laws on Labor of Russia makes an enterprise's management responsible for the provision of healthy and safe operational conditions in the work place.

6.1 Plant Safety Engineering

With respect to the Krasnodar GRES, the plant management and each supervisor of its structural units (i.e., shops, departments, sections) are made responsible to instruct employees on work place health and safety regulations, sanitary rules, and fire protection. They also determine and approve company regulations on labor protection, and the rules for the performance of work and employee behavior within the plant. The management is obliged to ensure that the proper equipment is present in the work place and to create labor conditions that would meet the requirements of safety regulations, sanitary norms, and fire safety rules.

Since the mid 1970s, "The System of Labor Safety Standards" has been implemented in the Russian Federation in order standardize and document labor safety and industrial sanitation into a coordinated system. In compliance with this system, starting from the engineering stage, up-to-date safety facilities are going to be introduced into the Krasnodar GRES to prevent injuries and unsanitary conditions that could cause occupational illness.

Labor legislation of the Russian Federation apart from the detailed description of the laws on labor, of safety regulations, and of workers' duties, implements an oversight system of control and supervision of labor laws. The system of institutions supervising the observance of labor regulations and safety regulations includes:

- specially authorized state bodies and inspectors which are not dependent in their activities on the enterprises management;
- local state authorities;
- Trade unions that have their own technical and legal inspections.

With respect to the Krasnodar GRES, there will be the services (or departments) of supervision for the observance and monitoring of labor regulations. In the draft list of staff of the Krasnodar GRES there are: an inspector-engineer on labor protection and safety regulations, an inspector on fire safety, and an engineer for equipment supervision. All buildings and facilities of the power plant are being erected in compliance with the System of Labor Safety Standards.

The employees of the power plant, directly involved in the operation and maintenance of the power plant equipment, are obliged to take a training course and pass a test on the safety regulations in force before they are allowed to work independently. Training of personnel is done in compliance with "The Rules of Work Management with the Personnel at the Enterprises and Organization of Power Generation" Document Number 34.12.102-94. For Krasnodar GRES, it is stipulated that the new employees will be trained and those transferred from other power generating facilities will take an upgrading course.

The preliminary training of the personnel comprises:

- theoretical study, needed for the work on new machinery and technologies, and theoretical study of advanced labor and production management;
- practical training, including training on operating enterprises (with possible overseas training);
- participation in start-up works of the particular equipment.

The duration of training is dependent upon how sophisticated and powerful the equipment will be and on how new and complex the technologies being introduced are. Training of employees for the new positions is carried out according to the curricula approved by the head technical supervisor of the enterprise for each position. The amount of time at each stage of training will be identified individually depending on the skills and experience of the trainee and on the technical sophistication of the object of study. The curriculum shall stipulate the following with regard to the category of an employee: practical training, tests, mutual replacements, test training, and short-term work on the subordinate personnel work place.

Practical Training

After theoretical study for the new position, the workers who have no special technical education, operational, maintenance, operation-maintenance and start-up experience, shall be trained in the work place. Practical training shall be supervised by an instructor. Permission for the practical training is done by a written order or instruction, in which the period of practical training is stated from 2 up to 20 shifts, with the names of instructors in charge. The period of practical training will be set individually, depending upon relevant experience.

In the course of practical training, the trainee should learn the following:

- rules of technical operation, safety regulations, fire safety regulations and their practical use in the work place;
- to learn diagrams, technological and position instructions, safety regulations, the knowledge of which is obligatory to work in this position;
- to obtain relevant knowledge of technological operations;
- to learn the skills and methods of safe and cost effective operation of the equipment serviced.

Assessment of Knowledge

All employees, apart from those who do not participate directly in technological processes, are obliged to pass tests on regulations, limits, instructions, labor safety, industrial and fire safety. Assessment will be conducted by the commission of an enterprise (power plant) of a structural unit (a shop, department, or section), as well as regional and central examination boards. The list of persons free from assessment, or the list of professions for which assessment of skills is not required will be approved by a power plant manager.

The Assessment Commission of the enterprise and of shops is assigned by a supervisor's order. The Commission's function is to obtain the license for assessments of skills. Assessment of skills can be initial, periodic and urgent.

Initial assessment is conducted when a worker applies for the job after theoretical study or when a candidate is trained for a new position, or when a worker has been transferred from another job (position) or another plant. Initial assessment of skills must be carried out in terms defined by individual curricula, but not later than one month since the date of taking the job (assignment to the position).

Periodic assessment of all employees must be carried out not less than once in three years. For operational staff, both engineers, technicians and workers, and maintenance personnel, the assessment of knowledge of the limits and labor safety regulations are once a year.

Urgent assessment of employee's knowledge is carried out in the following situations:

- when employees fail to observe limits, regulations and rules;

- at the demand of supervisory technical institutions and also on the basis of summaries made by investigating commissions;

- by the decisions made by the higher ranking institutions supervisors, if it turns out that the employee does not have complete knowledge of regulations and limits or if the employees' operations are not correct in ordinary and average situations;

- when new or revised regulations are being introduced;

- when new equipment is being installed or old equipment is being renewed and when the main electric and technological charts are being changed by the decision of the head technical supervisor of the plant;

- when the assessment of the repeated test training (accident and safety protection or fire safety) was not satisfactory. The volume of regulations and limits and duration of training for the urgent assessment of knowledge is identified by the manager of the plant (or shop, department, or section) and also by the acts of supervisory or higher ranking institutions.

Urgent assessment does not cancel the terms of periodic assessment.

During an assessment of knowledge, the Commission will determine the following:

- knowledge of the enterprise safety regulations, technological operation regulations, fire safety;

- knowledge of inter-enterprise safety regulations and other special regulations, if the work being done requires the above knowledge;

- knowledge of a position and technological regulations, and plans of normal situations and normal modes of operation;

- knowledge of devices and operation of technical safety appliances, means of accident and safety protection;

- knowledge of specifications and operation of the equipment, measuring instruments and control appliances;

- knowledge of technological charts and power generation processes;

- knowledge of power generator's safe operational conditions, of the facilities supervised by the State Technical Supervisory Committee of the RF
- skills needed to use personal protective equipment and the ability to provide first aid to the injured;
- skills needed to control a power generator (on simulators and other training facilities).

The list of guiding documents, the knowledge of which is obligatory for the particular employee, is identified by his position studies, approved by the plant manager. The assessment of knowledge of each employee must be done individually, orally, or in written form. The use of computers will be allowed. Knowledge and qualifications will be assessed according to the following marks: "excellent," "good," "satisfactory," "unsatisfactory." The employee who receives an "unsatisfactory" will have to be assessed again within one month. If the employee does not pass the test the second time, the employee's contract may be canceled.

Backing Up (Understudy)

Understudy assignments must be taken by employees involved in operational/operational-maintenance activities after the initial assessment, after a long period of absence, and in some special cases based on the discretion of the plant manager or shop supervisor (unit supervisor). Admittance for understudy is identified by an instructing document, in which terms of understudy and the person in charge of the understudy's main training are indicated. During the period of understudy, both the instructor and the understudy are held responsible for observing labor safety and operational safety regulations. During understudy an employee, after initial assessment, should take part in test accident and safety protection and fire safety individual training. These subjects are defined by the plant manager, or a unit supervisor.

If during the understudy period, an employee did not obtain the operational skills required, or the employee received unsatisfactory marks on accident and safety protection training, it is allowable to prolong the understudy period by a separate order for the term not longer than the main understudy period (i.e. 12 working shifts).

Admittance to Independent Work

Admittance to independent work of a new worker or a worker who had had a non-work interval of 6 months can be done only after instruction, practical training, assessment, understudy and test training of maintenance and start up personnel. An employee can be admitted to work on his own by an administering document (an order).

All employees including managers are obliged to take instruction on labor and fire safety, which consists of:

- introductory instruction
- initial instruction on a work place
- periodic instruction
- urgent instruction
- target (current) instruction

The Inspector-Engineer on Labor Safety of the plant has to instruct each new employee. This introductory instruction is carried out on a special curriculum in compliance with the standard documents, labor safety regulations and peculiarities of the plant. The curriculum is generated at the plant and is approved by the plant manager.

Introductory instruction is carried out at the safety regulations office with the use of visual aids and training facilities and is registered in the "Journal of Introductory Instruction," signed by the instructor and the trainee.

Initial instruction on a work place is conducted with: all new employees, employees transferred from one unit to another, employees who came to the plant temporarily from another plant, trainees, and workers doing a new job. The aim of initial instruction is to make an employee familiar with the particular conditions of his job, hazardous and harmful factors that may occur in the position, and to instruct the employee as to the protection measures against these factors. Initial instruction is carried out on the approved curriculum in compliance with the requirements, corresponding standards, and labor safety regulations. Initial instruction is carried out individually with every worker with practical demonstration of safe ways and techniques of work.

Periodic instruction is given to all employees regardless of the type of equipment, qualifications, length of service and the character of work performed. Periodic instruction is carried out not less than once a month. It is done individually, or with a group of workers servicing similar facilities and within one work place, and involves questions on labor and fire safety.

Urgent instruction is carried out in the following cases:

- changes in labor and fire safety regulations;
- changes in technological processes when the equipment is being modernized or replaced;
- when employees fail to observe labor safety requirements;
- absence from work longer than one month;
- if the institutions of technical supervision demand it.

The volume and subjects to be covered by urgent instruction are identified in each particular case based on the reasons for conducting it.

All the above types of instruction are registered in the book Registration of Instruction, which is signed by the instructor and trainee. The book is kept by the instructing person (shop supervisor, chief of lab, foreman).

Target instruction is carried out in the following cases:

- one time operations, not connected with the usual duties;
- contractual works.

Target instruction is registered in the admittance order. Instruction on the work place should be finalized by an assessment of knowledge, i.e. oral test and by demonstration of the obtained skills in safe operational technique. Those employees who had shown bad test results are not admitted to work on their own and must take the instruction again.

Accident and Safety Protection and Fire Safety Test Training

Operational and servicing personnel must take accident and safety protection training not less than once every three months. It is allowable to combine accident and safety protection and fire safety training. The training courses can be expanded for the personnel to obtain skills in prevention of hypothetical accidents and fire. Lists of hypothetical accidents and fires are worked out by the plant and unit management.

Accident and safety protection training is carried out either in work places, or the training areas; the test results are registered in special books. Those employees who did not take training in due time without good reasons are not admitted for independent work. Those employees who got bad marks should take a course again within 10 days. If the results are unacceptable, an employee is removed from independent work and must be urgently assessed.

Health and Labor Safety of Krasnodar GRES Employees

1. Labor safety management on the erected Krasnodar GRES will include:

   - Training of workers in labor safety, promotion of labor safety subjects, introductory instruction, safe operational technique training, initial labor safety and fire safety regulations assessment, initial instruction on work places, repetition of planned instructions on accident and safety protection and fire safety training, planned training of employees in safe operational technique, periodic assessment of operational safety regulations, labor safety, fire safety regulations, knowledge of safe operational technique.

   - Organizing and equipping labor safety rooms.

   - Designing of information displays on labor safety.

   - Providing shops with posters and glass displays on labor safety.

   - Study tours to similar plants to gain advanced experience in labor safety.

Governing Standard: Training Management of Employees on Labor Safety (Documentation on Standards GOST 12.0.004-79). Basic premise of the Standard: Regulations on the assessment of knowledge of standards, regulations and instructions on technical operation, labor safety, industrial and fire safety of managers and specialists at power plants and related institutions.

2. Safety of technological equipment ensured by:

   - compliance of equipment to labor safety requirements;

   - compliance of technical standard documentation of equipment with labor safety regulations requirements;

   - technical certification of the equipment via standardized tests;

- preventive maintenance of the equipment;

- current and general maintenance of the equipment;

- replacement of malfunctioning equipment.

Governing Standard: Production Equipment, General Safety Requirements (Documentation on Standards GOST 12.2.003-74 and GOST 12.2.049-80). These Standards address: Technological equipment, general requirements on environment, and regulations on technical operation of power plants and transmission lines.

3. Safety of technological processes, reached by:

   - availability of technical documentation for all kinds of operation;

   - compliance of technical documentation with labor safety requirements;

   - layout of work place according to labor safety regulations and standards;

   - compliance of technological processes with standard requirements and other scientific and technical documentation;

   - storage, transportation and use of explosive and fire hazardous materials in conformity with labor and fire safety regulations and standards.

Governing Standard: Technological Processes, General Safety Requirements (Standard document: GOST 12.3.002-75).

4. Safety of buildings and structures, reached by:

   - compliance of the designed, commissioned and operating buildings, structures and premises with labor, fire safety regulations and with other labor safety documentation;

   - maintenance of buildings and premises in compliance with sanitary standards during operation;

- examination and current and general maintenance of buildings and premises in fixed terms;

- identification of factors and hazards for further operation of buildings, structures and premises with the intention of reconstruction.

Governing Standard: Sanitary Standards of Industrial Enterprises Engineering (Standard documents: Construction Standards and Regulations including CH-245-71).

5. Standardization of sanitary-hygiene labor conditions made by:

   - identification of hazards (noise, vibration, dust, inadequate electric light, high temperature etc.)

   - reduction of materials and structures which are the sources of harmful and hazardous conditions;

   - maintaining ventilation, air conditioning, light, and heating in proper condition, protection from noise, vibration, fire, explosions.

Governing Standard: Air in the Zone of Operation, General Sanitary Requirements (Standard Documents GOST 12.1.005-76) and Harmful Substances, Classification and General Safety Regulations, and others (GOST 12.1.007-76).

6. Workers are provided with means of individual protection in the following order:

   - the actual requirement of individual protection means (I.P.M) is identified in compliance with the standards and instructions in force;

   - the actual requirement of I.P.M. used for the operation with electric generators is identified;

   - making up applications for I.P.M. used when handling generators and completely meeting these requirements;

   - distribution of I.P.M. to the personnel, providing the right sizes;

   - laundry, repairing and dry cleaning of I.P.M.

   - testing I.P.M. used for the operation of generators.

Governing Standard: "Regulations in Testing and Applying I.P.M. Used for the Operation with Generators" M 1983, and others.

7. Ensuring optimum work schedule and leisure time for employees, achieved by:

   - identification of work place and sectors of operation with harmful labor conditions;

   - observation of the fixed work schedules and rest intervals (especially for duty personnel of heat generating shops);

   - alternating of work and rest schedules;

   - ensuring breaks in operation or its complete termination depending on the wind force and outside temperature;

   - identification of employees with regard to who should be granted privileges and compensated for harmful labor conditions.

8. Medical - preventive health service of employees provided in the following ways:

   - constant examination and identification of those employees who need medical or preventive treatment;

   - provisions for complete medical -preventive service;

   - provisions for employees working in harmful conditions with special medical-preventive meals, milk and other similar food products in compliance with medical examination results and standards in force;

   - generally keeping an eye on the health of employees potentially affected by harmful factors.

9. Sanitary service and food service, including:

   - identification of need and location of sanitary facilities, food service, and drinking water in conformity with the standards in force at the stage of construction and operation;

   - arranging for provision of the above;

- keeping the sanitary and food service areas in proper technical and sanitary working condition.

10. Professional selection of employees comprises the following:

    - initial medical examination (job admittance) and periodic exams;

    - verification of employees practical skills and compliance with the professional requirements according to: The Order of the Minister of Health Service (dated 19 June 1994, No. 700).

6.2 High Risk Jobs and Plant Areas

According to Russian standards, the following plant facilities are considered as fire hazards and can therefore be considered as high risk areas:

- Gas Distribution Area;
- High Pressure Gas Control Center;
- Diesel Fuel Handling Facility;
- Lubricating Oil Handling Facility.

The areas listed above cross a broad range of explosion and fire hazard classifications.

The following areas inside the plant have been classified as danger zones and can therefore be considered as high risk areas:

- Areas below the operating mark of the Steam Turbines;
- The Deaerator;
- Areas around the HRSG drums and Boiler Safety Valves, including the entire length of exhaust pipelines down to noise silencers;
- Boiler steam heater and Superheater collectors drainage and ventilation pipelines.

The following areas have been classified as high voltage zones and can therefore be considered as high risk areas:

- The Plant Substation;
- Fenced-off areas around open-air Switchgear Units.

High risk jobs would include regular workplace assignments in any of the above high risk areas as well as routine maintenance activities in any of the above areas.

6.3 Occupational Safety

6.3.1 Heat and Noise

Ambient air temperatures above 30^0 C are expected in the following areas:

- Areas below the operating mark of the steam turbine;
- Deaerator areas;
- HRSG drum areas;
- Steam turbine areas;
- Gas turbine areas.

The Krasnodar GRES shall employ specific protocols and procedures to limit worker exposure to areas of extreme heat in compliance with SNiP 2.01.01-82 which mandates that the average work place air temperature not exceed 26.8 C at 1300 hours during the hottest month.

The main noise sources inside buildings of the main block of the Krasnodar GRES and noise parameters for the main outside sources have been included in Section 1.3.3.5 of this report.

The Krasnodar GRES shall employ specific protocols and procedures to limit worker exposure to extreme noise.

6.3.2 Hazardous Chemicals Used

Krasnodar GRES will use sulfuric and hydrochloric acids, caustic soda, ammonia water, hydrazine, ferrous sulfate, lime and chlorinated lime. All the above chemicals will be kept in a chemical storage facility equipped with vessels and casing in compliance with statute standards and regulations. Chemicals in required concentrations will be pumped by electric pumps from the storage facility to the plant via pipelines.

The Krasnodar GRES shall employ specific protocols and procedures to limit worker exposure to hazardous chemicals.

6.3.3 Storage of Hazardous Materials

In addition to the hazardous chemicals mentioned in Section 6.3.2, acetylene and other compressed gases will be stored at the Krasnodar GRES site in compliance with statute standards and regulations.

6.3.4 Airborne Exposure Levels

Air pollution inside the plant and in the work place will meet the standards specified in "The Sanitary Design Standards for Industrial Enterprises SN-245-71," GOST 12.1.005-88. Work place air standards are shown in Table 6.3. NOx concentrations inside the plant perimeter and in the machine and boiler buildings are assumed to be close to zero, as NOx will be released from combined cycle units through a stack 150 meters high.

Table 6-1

WORK PLACE AIR TLV-TWA/STEL (mg/m³)							
CONTAMINANT		RUSSIA	WORLD BANK	RANGE IN EUROPE	USA		
					ACGIH	NIOSH /OSHA	OSHA
CO	TWA	-	29.0	20.0-57.0	29.0	40.0	55.0
	STEL	20.0	-	40.0-458.0	-	229.0	-
NO_2	TWA	1.0	6.0	4.0-10.0	5.6	-	9.0
	STEL	2.0	-	1.8-20.0	9.4	1.8	-
SO_2	TWA	-	5.0	3.0-20.0	5.2	5.0	13
	STEL	10.0	-	6.0-13.0	13.0	10.0	-
Particulates	TWA		10.0				
	STEL		-				
O_3	TWA			0.1-0.2	0.2	0.2	-
	STEL			0.2-0.6	-	0.6	-
PCBs	TWA	-		0.01-1.0	1.0 (42%Cl) 0.5 (54%Cl)	-	-
	STEL	1.0		0.03-1.5	-	-	-

TWA = Time Weighted Average
STEL = Short Term Exposure Limit

7.0 ANALYSIS OF ALTERNATIVES

This section of the EA identifies and evaluates reasonable alternatives to the Krasnodar GRES location, design, operation, and other parameters in order to meet the ultimate objective of providing additional electrical power in the Krasnodar Krai and alleviating the current power deficit. The purpose of this analysis is to determine any options that may be more sound or beneficial from an environmental, sociocultural, or economic perspective than the originally conceived and proposed power plant. The specific, meaningful alternatives evaluated for the Krasnodar GRES include:

- The No Action Alternative,
- Alternative Power Generation Technologies,
- Alternative Plant, Water Pipeline and Transmission Line Locations,
- Alternative Plant, Water Pipeline and Transmission Line Designs,
- Alternative Fuel Utilization,
- Alternative Water Supplies and Intakes,
- Alternative Sanitary and Plant Wastewater Disposal,
- Alternative Solid Waste Disposal, and
- Alternative Pollution Control Systems and Equipment.

Each of these alternatives, which is described and discussed below, is evaluated for its advantages and disadvantages according to its overall effectiveness, feasibility, implementability, cost, and regulatory and community acceptance as appropriate and consistent with this project's objectives and the environment and infrastructure in the Krasnodar Krai and Mostovskoy areas.

7.1 No Action Alternative

The Krasnodar region of southern Russia, which is part of the North Caucasus Unified Power System (UPS) has been experiencing electricity shortages and disruptions for the past several years. The UPS has a combined installed capacity of 10,557 MW, including 2,180 MW of hydro and 8,377 MW of fossil capacity. However, a considerable portion of this installed capacity has been de-rated due to age and deterioration in available fuel quality. Also, since some of the units burn agricultural wastes for fuel, this power is only available seasonally and has resulted in an effective available thermal capacity of 6,597 MW. The maximum effective capacity, wet season, of the hydro units in the North Caucasus is 1,969 MW as some of these units have also been de-rated, and the available hydro capacity during the winter months is 1,790 MW. This results in an overall effective system capacity of 8,387 MW during winter, which is when peak loading occurs.

Peak demand in the year 2000 is estimated to be 9,212 MW which results in a required capacity of 10,502 MW to meet a 14% system reserve margin. Thus there is an estimated energy deficit of 2,115 MW expected in the year 2000. It is also anticipated that this deficit will increase as older plants retire, have more frequent shut-downs due to equipment age, and the demand for electricity increases. Thus the frequency of electrical shortages and disruptions, brown-outs and black-outs, will increase, particularly in the Krasnodar Krai due its power deficit and need to import energy.

The Krasnodar Krai has the greatest local power deficit in the North Caucasus, and relies on imports from neighboring Energos for approximately 60% of its electrical consumption. Because the local utility, Kubanenergo, has equipment that is generally 20 to 40 years old, the deficit will continue to increase as the aging units become less reliable and must ultimately be retired, and the Krasnodar Krai will have to import ever increasing amounts of electrical power. To begin to address this deficit Kubanenergo is planning to install 900 MW of combined cycle capacity near Mostovskoy, which still leaves an estimated deficit of 1,215 MW. Other and future plans call for additional 160 MW of hydro capacity, 550 MW of firm capacity from a 500 kV transmission line to the UPS, and adding 450 MW to the existing Krasnodar central heating plant. This still leaves a small power deficit, 55 MW, and the Krasnodar GRES is being designed and built to easily add an additional 450 MW of generating capacity.

Since the proposed Krasnodar GRES can supply either 43% or 64% of the estimated power deficit in the North Caucasus, and the Krasnodar Krai has the largest local power deficit, the plant must be built. If the No Action Alternative was accepted and the plant was not built, the citizens of the Krasnodar Krai would not have sufficient electrical power, and power shortages and disruptions will continue to escalate and lessen the quality of life for the citizens of the Krasnodar Krai. Thus the No Action Alternative is not a viable option and no further consideration should be given to its implementation.

7.2 Alternative Power Generation Technologies

Other alternative power generation technologies which may be available include hydro power, wind energy, solar thermal, photovoltaics, and biomass energy. Each of these technologies is renewable and sustainable; however, given the current conditions in the North Caucasus, and the Krasnodar Krai specifically, none of these technologies are appropriate to alleviate the current and projected power deficit. Additionally, as described below by technology, none of these alternatives will be truly effective, nor will they be truly implementable or feasibile. And, due to the land area needed for production of similar amounts of power by these technologies, the Krasnodar GRES requires approximately 130 hectares of land, they necessarily have a greater potential for deleterious, permanent, and irreversible environmental impacts.

7.2.1 Hydro Power

The currently available hydro power, during winter, in the North Caucasus has been estimated at 1,790 MW, and there are future plans to increase this capacity by 160 MW by the year 2000. There are no known plans for further increases in hydro power capacity, and there are no known run-of-river sites available to increase the planned generating capacity of 1,950 MW. Thus the only feasible and implementable alternative is to construct large reservoir storage areas and this will lead to two significant, unmitigatible, irreversible, environmental impacts. It has been estimated that approximately 93,600 hectares of land will be needed to generate 900 MW of electrical power utilizing reservoir technology(1), and this is totally unacceptable in the Krasnodar Krai due to its high level of agricultural activity. In addition, vast amounts of water for the reservoir would have to be taken initially, and periodically, from the Laba River, and this too is unacceptable. Thus, hydro power is not a viable alternative.

7.2.2 Wind Energy

Average annual wind velocities in the Mostovskoy area at 50 meters elevation have been estimated at 3.5 meters/second with calms 33% of the time, based on meteorological data from the Perepravnaya and Gubskaya sites. Data from these same sites also noted that calms ranged from 29% of the time in March to 46% of the time in June. Thus the ability afforded by wind power to generate electricity is highly variable and unreliable, since 33% of the time, on average, no electricity can be generated, and there is no truly feasible or reliable method to store the required amounts of electricity during calm periods. It has also been estimated that a wind farm of sufficient size to produce 900 MW would require approximately 84,000 hectares.(1) Thus, given the high variability of energy production and the large land area required, wind energy is not a viable alternative.

7.2.3 Solar Thermal

The number of overcast days with 8 to 10 points of total cloudiness in the Mostovskoy area has been estimated at 114 days per year, based on meteorological data from the Perepravnaya and Gubskaya sites. In addition, these same data indicate that the winter season, that period of peak power demand, has the greatest number of cloudy days, averaging 13 days per month. Thus solar power, even with appropriate energy storage, will not likely produce or store sufficient energy to meet the power demands during winter, since approximately 43% of the time essentially no power can be produced. And, on an annualized basis, power can not be generated approximately 31% of the time. It has also been estimated that a solar power and storage facility, capable of producing 900 MW of electricity would require approximately 37,400 hectares of land.[1] Thus, given this technology's capability to produce and store sufficient power to meet demand, and the land required, solar thermal is not a viable alternative.

7.2.4 Photovoltaics

The estimated production cost per kilowatt hour for the proposed Krasnodar GRES is approximately 160 rubles; the cost of producing power photovoltaicly has been estimated to be between 1,250 and 1,750 rubles per kilowatt hour in the year 2000. A photovoltaic facility, including battery storage, capable of producing 900 MW would require approximately 19,400 hectares of land.[1] Thus, given this technology's cost and land requirements it is not a viable alternative.

7.2.5 Biomass Energy

There is currently some biomass energy production in the North Caucasus region; however, since agricultural wastes are used, this power is only available seasonally. A sustainable more reliable source of biomass energy is trees, and in order to develop this technology fuelwood plantations would have to be established in close proximity to the power plant due to transport economics. Fuelwood plantations generally take upwards of ten years to establish and develop, prior to the first meaningful harvest. Generally, biomass energy is used for commercial power production in rural areas with small power demands since a 900 MW biomass energy facility would require approximately 1,440,000 hectares of arable land for the fuelwood plantation.[1] Thus biomass energy is not a viable alternative.

7.3 Alternative Plant, Water Pipeline, and Transmission Line Locations

Eighteen sites within the Krasnodar Krai were considered as possible locations for the proposed power station. Each of these sites was evaluated by the Krasnodar GRES Joint Stock Company Ownership Group with respect to:

- Land ownership, availability, and access,
- Topography and ground conditions,
- Pollution and potential environmental impacts,
- Availability of makeup water,
- Transportation of equipment,
- Proximity of a natural gas pipeline,
- Interconnection with regional transmission systems, and
- Local infrastructure.

As a result of these evaluations the Mostokskoy site was determined to be the most suitable for construction and operation of the Krasnodar GRES. The major results and considerations of the site investigations and evaluations which led to the selection of the Mostovskoy site included:

- The Mostovskoy site meets or exceeds all Russian Federation environmental, health and safety requirements,
- The plant elevation will be located above the flood plain,
- The site soils will provide adequate structural support,
- Water sources for the site include an existing well field 33 kilometers distant, the Laba River which is 2 kilometers distant, and the potential for on-site water wells,
- The site is 5 kilometers from the settlement of Mostovskoy and thus the citizens of Mostovskoy will experience little to no inconvenience due to plant construction and operation,
- Natural gas will be piped from an existing trunk line 60 kilometers distant,

- Interconnection to the existing transmission system is readily facilitated,

- The site is located far enough distant from any biosphere and animal reserves so as to have no measurable impact on these resources,

- No resettlement of indigenous peoples is anticipated either during construction or operation of the plant, and

- The existing and projected transportation needs can be met by the current roadways and rail line.

And, in addition, The electric transmission lines and water pipelines will not pass through, under or over any sensitive ecological zones such critical habitats, bird nesting areas, animal feeding areas, or migratory bird flight pathways. And, there are no known rare, threatened or endangered species present at or on the site of transmission and water pipeline routings.

Thus the Mostovskoy site is an environmentally optimal site for construction and operation of the Krasnodar GRES, and in addition has been generally accepted for a previous thermal power plant by the Russian Federation.[2][3][4]

7.4 Alternative Plant, Water Pipeline and Transmission Line Designs

The Krasnodar GRES at Mostovskoy is to be a combined cycle natural gas plant of 900 MW capacity with future provision for expansion to 1,350 MW. The plant will consist of two modular blocks of 450 MW, each containing two combustion turbines of 150 MW capacity, two heat recovery steam generators, and one 150 MW steam generator. Dry low-NO_x burners, best available control technology for NO_x control, will be utilized by the combustion turbines, and steam or water injection will not be necessary for additional NO_x control. The exhaust gas from each combustion turbine will be routed to an individual heat recovery steam generator and thence to the steam turbine. Each heat recovery steam generator will be provided with a metal by-pass stack and will discharge into a common stack, 150 meters high and 15 meters in diameter for maximum air dispersion of NO_x. Combined cycle natural gas plants, by their very nature and design, emit essentially no other air pollutants such as oxides of sulfur or particulates. Air pollutant emission and dispersion analyses, presented earlier in this EA, noted that all applicable Russian Federation and World Bank air quality requirements will be met or bettered.

The plant will use a dry cooling tower system to eliminate the need to withdraw large quantities of water from the Laba River and to prevent the formation of any fogs or plumes that may be associated with wet cooling towers. Drinking water will be supplied from an off-site well field. Thus no deleterious impacts or exceedances of any Russian Federation or World Bank requirements are anticipated on ambient water quality and quantity.

There will be a process wastewater treatment system, including oil-water separators, installed on-site next to the cooling tower area. All process wastewater, as described earlier in this EA, will be treated and will meet or exceed all appropriate Russian Federation and World Bank standards. Sanitary wastewater will be directed to the Mostovskoy Village treatment plant which will be upgraded and modernized to meet any increased demand.

As was noted in 7.3 above, the electric transmission lines and water pipelines, which are being designed in conformance with International Standards acceptable to the Russian Federation and the World Bank, will not pass through, under or over any sensitive ecological zones such critical habitats, bird nesting areas, animal feeding areas, or migratory bird flight pathways. And, there are no known rare, threatened or endangered species present at the site or transmission and water pipeline routings. Thus no deleterious environmental impacts are anticipated as described earlier in this EA.

In summary then, the Krasnodar GRES is a state-of-the-art combined cycle natural gas power plant whose design, which by its very nature is environmentally benign. Subsequent environmental analyses, as presented in this EA, indicate that all Russian Federation and World Bank requirements will be met, and that no long-term, deleterious, irreversible, or permanent environmental or health impacts would occur. And, in addition, the plant will have many positive impacts including the provision of needed power to the Krasnodar Krai, thus improving the quality of life of the citizens in the Krai. Therefore, there is no compelling need to consider any design alternatives to the plant, and associated transmission line and water pipeline systems.

7.5 Alternative Fuel Utilization

Fuels, other than natural gas, which can realistically power the Krasnodar GRES include oil, lignite and coal. Of these fuels natural gas is the cleanest burning most environmentally acceptable fuel; use of any other fuel would lead to increased air pollutant emissions and other potential deleterious environmental impacts. Also, there are sufficient gas reserves to power the plant and the gas delivery system is in place, it remains only to construct a pipeline to the plant from an existing trunk line. Diesel fuel will, however, be used for up to ten days per year if natural gas is unavailable. Thus, no alternative fuels should be considered as viable alternatives to natural gas.

7.6 Alternative Water Supplies and Intakes

The current plant design requires that process water be taken from the Laba River, approximately 2 kilometers distant, and that drinking water be taken from an existing water well field, approximately 33 kilometers distant. Withdraw from the Laba River has been estimated at 0.03 cubic meters per second, or 0.036% of the River's average annual discharge of 83.1 cubic meters per second at the plant intake for the dry cooling tower design. Drinking water utilization is estimated at 0.7 cubic meters per hour.

An alternative to the above process and drinking water supplies is the utilization of on-site wells, and this may be preferable due to the fragility of the Laba River and the distance of the well field from the plant. It is believed, but unproven, that the quality and quantity of ground water and underground sources at the plant site are sufficient to fulfill both process and drinking water requirements. The use of groundwater would eliminate any possible environmental impacts on the Laba River and lower the cost of supplying drinking water to the site.

Thus, this alternative is recommended for further analysis and this recommendation is currently being implemented. Test wells are being drilled at the plant site to establish the quantity and quality of the groundwater, and this information will be used to determine the appropriate costs for drilling and installation of production wells, pumping equipment and water treatment. A decision will then be made as to the viability, feasibility, and implementability of this alternative, and whether or not it is appropriate.

7.7 Alternative Sanitary and Plant Wastewater Disposal

The current design for plant wastewater disposal includes an on-site wastewater treatment system, including oil-water separators, installed next to the cooling tower area. Upon completion of treatment these effluents will be discharged to the Laba River downstream of the plant intake. The chemical and thermal quality of these effluents will meet or exceed all appropriate Russian Federation and World Bank standards, and both the disposal point and discharge have been approved by the Ministry of Conservation of Environmental Authorities at Mostovskoy.[4][5] Other potential disposal options, such as release to the Khodz River or the Kurchidskaya Ravine, have been judged unacceptable.[5] Sanitary wastewater will be discharged to the Mostovskoy wastewater treatment plant, which will be able to handle the flow volumes anticipated.

Site rainfall runoff will be controlled by an existing, rerouted site ditch, and will be treated in the on-site wastewater system prior to disposal.

Thus, there are no viable alternatives to the current sanitary and wastewater disposal systems that should be considered.

7.8 Alternative Solid Waste Disposal

Silty and other solid wastes will be generated as a consequence of plant operations. These wastes will be held on site, dewatered as appropriate, and disposed in an environmentally safe manner according to all Russian Federation requirements. Alternatively, depending on the chemical and biological quality of the silty waste residues, they may be recycled and reused as clean fill, a positive and beneficial environmental impact. Effluent water from the silty wastes will be treated in the on-site system prior to discharge. Thus, there is no need to consider any additional alternatives to the current solid waste disposal protocols and options.

7.9 Alternative Pollution Control Systems and Equipment

The Krasnodar GRES will be equipped with best available control technology for air emissions, an on-site on-site wastewater treatment system, including oil-water separators, and an on-site packaged sewage treatment system. These systems will cause all liquid and gaseous plant effluents to meet or exceed all Russian Federation and World Bank requirements, and there are no long-term, deleterious, irreversible, or permanent environmental or health impacts predicted due to plant operations. Thus, the pollution control systems and equipment planned are more than sufficient, and there is no need to consider any additional alternatives.

References

1. Goodland, R. "Sectoral Environmental Assessment is Needed for the Power Sector". Incomplete Draft, World Bank. Washington, D.C. 6 October 1994.

2. "Report on Selection of a Construction Site for the Krasnodar Thermal Power Station". Krasnodar Territorial Executive Committee and Ministry of Power and Electrification of the USSR. December 1989.

3. "Expertise Conclusions on Section 'Environmental Protection' of the Feasibility Study for the Construction of the Krasnodar State Regional Power Station". USSR Ministry of Energy and Electrification. December 1991.

4. "Report No. 256". Krasnodar Territorial Committee for Nature Protection. 31 January 1992.

5. Data from Dr. V.S. Anikin of Kuban State Agricultural University.

8.0 ENVIRONMENTAL IMPACT MITIGATION MEASURES

This chapter discusses the proposed measures for mitigation of the environmental impacts idnetified in Chapter 5. The impacts discussed in Chapter 5 are segregated into two main categories; impacts associated with construction and impacts associated with operation. Therefore this chapter will present the proposed mitigating measures in a similar orgianization.

8.1 Mitigation of Construction Related Impacts

Although the first power unit is planned to be on-line within 2 years, it is expected to take approximately 6 years to complete construction of the Krasnodar power plant. The general phases of construction that will occur are:

- preparation of contractors area,
- site preparation,
- temporary and permanent road construction,
- temporary and permanent building and utility construction,
- equipment installation,
- services connection.

Each phase of the project will involve specific activities each of which have the potential to generate environmental and socio-economic impacts. Targets of the environment at risk to impact include air quality, surface and ground water quality, vegetation, soil quality, soil erosion, dust, and noise levels. Socio-economic impacts may include land use, jobs, and overuse of limited public services. Table 8-1 indicates types of construction activities that will cause impacts, what targets may be affected, and the potential type of impact which may result i.e. none, insignificant, moderate, severe, positive, or negative. A discussion of each impact is presented in Chapter 5 of this report.

8.1.1 Mitigation Measures for Impacts Related to Construction

The proposed mitigative measures are intended to either minimize an impact or whenever possible prevent the impact completely. Table 8-2 presents specific impacts and the mitigating measures that have been implemented or are proposed.

Table 8-1
Cause and Targets of Impacts Associated with Construction Activities

Target of Impact	Cause of Impact						
	Site Clearing	Site Earth Work	Road Const.	Site Building Const.	Equipment Maint.	Labor Housing Const.	Labor Transport.
ENVIRONMENTAL							
Air Quality	I(-)	I(-)	I(-)	I(-)	I(-)	0	I(-)
Surface Water Quality	M(-)*	M(-)*	I(-)	0	0	0	0
Ground Water Supply	0	0	0	0	0	0	0
Vegetation	I(-)	0	I(-)	0	0	0	0
Soil	M(-)*	M(-)*	I(-)	0	0	0	0
SOCIO-ECONOMIC							
Land Use	0	0	0	0	0	0	0
Jobs	M(+)	M(+)	M(+)	M(+)	M(+)	M(+)	M(+)
Local Population	0	0	I(-)	0	0	I(-)	0**
Construction Workers	I(-)	I(-)	I(-)	I(-)	0	I(-)	0**
Public Services	0**	0**	0**	0**	0	0**	0**

Key:
- 0 = No Impact
- I = Insignificant
- M = Moderate
- S = Severe
- + = Positive
- - = Negative
- * = Insignificant with proper erosion control measures.
- ** = No Impact with planned infra-structure improvements.

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Table 8-2
Impacts and Mitigating Measures

Impacts	Mitigating Measure
Reduced air quality due to emissions from construction equipment, trucks, earth moving machinery, asphalt production, and temporary boilers, etc.	The chosen location of the construction site is approximately 2 km away from the nearest populated area which effectively eliminates the impact of reduced air quality on the local population. All diesel and gasoline powered equipment used on site will be properly maintained to ensure efficient operation.
Increased turbidity in surface waters due to erosion from site clearing, earthwork, and road and building construction.	Silt fences and/or hay bales will be erected in the areas of soil disturbing activities. Vegetation will be maintained and/or replaced as necessary.
Pollution of surface waters from sanitary sewage, construction waste disposal, and site stormwater runoff.	Sanitary sewage will be collected and removed by tank truck until an onsite treatment plant is constructed and operating properly. Construction waste will be disposed according to local regulations. Site stormwater runoff will be directed to an onsite stormwater retention pond intended to reduce siltation and allow for floating oil to be skimmed.
Pollution of surface waters from fuel or other hazardous material spills.	Fuel storage tanks will have secondary containment sufficient to hold the volume of the largest tank plus 10%. Hazardous materials will be stored in approved structures providing fire prevention and secondary containment capabilities. An Emergency Response Plan will be prepared detailing the procedures to be followed by the contractors onsite emergency response team to prevent spilled material from reaching surface waters. In the event spilled material reaches a surface water body procedures to minimize the impact by rapid containment prior to cleanup will be implimented.

Impacts	Mitigating Measure
Water supply shortages due to over drawing the regional well field in excess of the groundwater recharge rate during drought periods.	An emergency water management plan will be prepared which will direct the implemetation of use of emergency water supplies and mandatory conservation measures.
Destruction of vegetation during site preparation, earth work, and road, building, and housing construction.	Vegetation on offsite areas will be restored to its condition prior to construction.
Erosion of destabilized soils during storm events as a result of site clearing, earth work, and road, building and housing construction.	Use of erosion control devices such as silt fences, hay bales, and riprap in stormwater conveyances. Replacement of vegetation with perennial grasses along road sides and in construction areas no longer subject to earth moving activities.
Excessive noise levels from construction activities, vehicular traffic, and heavy equipment.	The chosen location of the construction site is approximately 2 km away from the nearest populated area which effectively eliminates the impact of excessive noise levels on the local population. Onsite workers will be required to wear hearing protection when around activities producing sound levels in excess of 85 dba, such as pole hammering.
Excessive dusting created by site clearing, vehicular traffic, earth work, and construction activities.	The chosen location of the construction site is approximately 2 km away from the nearest populated area which effectively eliminates the impact of excessive dusting on the local population. The use of water spray may be provided as necessary.
Loss of agricultural productivity from the use of agricultural land for construction of the power plant.	Compensation to the collective farm for the value of the land to be used for the power plant addressed in the Resolution on Power Plant Location of 1989, and the District Administration Resolution. Compensation includes construction of a new school, recreation facility, and provisions made to supply natural gas to individual consumers in the village.

Impacts	Mitigating Measure
Sudden, large, increase in local population by construction contractors will create unprecidented demand on all types of public services.	Provisions will be made for temporary housing outside of Mostovskoy for construction workers. Additional measures such as infrastructure improvements, hiring additional police officers, etc. will be implemented as necessary.
Physical dangers of the construction site to unauthorized persons trespassing on the site after hours.	Specific onsite hazardous areas, such as open excavations, will be enclosed with temporary barricades. The contractor will provide personnel to maintain onsite security during non-construction hours.

8.2 Mitigation Measures for Impacts Related to Operation

Impacts related to operation will differ from construction related impacts primarily due to the temporary nature of most construction activities. However, temporary operational impacts may also occur as a result of an accident, or unusual operating or weather condition. A discussion of operational impacts is presented in Chapter 5 of this report. Table 8-3 indicates operation processes that will cause impacts, what targets may be affected, and the potential type of impact which may result i.e. none, insignificant, moderate, severe, positive, or negative.

As indicated in Table 8-3, any impacts related to routine plant operation are either insignificant or actually have a positive effect. Further reduction to negative impacts are either technically not feasible at this time, are not necessary, or are cost prohibitive for the amount of potential impact reduction. Existing design parameters which are included in the Krasnodar GRES design and which may be viewed as mitigation measures are the inclusion of low NO_x burners, a dry cooling tower system, and improvements to the Mostovskoy wastewater treatment plant. Therefore, no further mitigative measures beyond those included in the design plan are proposed or recommended.

Table 8-3
Cause and Targets of Environmental Impacts Associated with Routine Plant Operation

Target of Impact	Cause of Impact							
	Stack Emissions	Water Usage	Process Water Discharge	Plant Sewage Discharge	Noise Level	Solid Waste Disposal	Hazardous Waste Disposal	Electro-Magnetic Frequency
Air Quality	0	0	0	0	0	0	0	0
Surface Water Quality & Quantity	0	I(-)	0	0	0	0	0	0
Ground Water Quality & Quantity	0	0	0	0	0	0	0	0
Flora and Fauna	0	I(-)	0	0	I(-)	I(+)	0	0
Land Use	0	0	0	0	0	I(+)	0	0
Plant Personnel	0	0	0	0	M(-)*	0	0	0
Local Population	0	M(+)	0	0	I(-)	I(+)	0	0

Key: 0 = No Impact
I = Insignificant
M = Moderate
S = Severe

+ = Positive
- = Negative
* = Insignificant with proper protection

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9.0 MONITORING PLAN

In compliance with an agreement between the project ownership group and Regional environmental authorities, the environmental monitoring program for the Krasnodar GRES power plant shall be developed by the Dzerzhinsky research institute in two stages (power plant construction and power plant operation) and this plan shall be approved by the local committee for environmental control and conservation of natural resources.

9.1 Ecological Control During Construction

The basic adverse effects during construction will be noise, dust and air pollution by exhaust gases of motor vehicles. The Krasnodar GRES ownership group shall arrange for environmental monitoring of noise, dust and exhaust gases of motor vehicles (CO, C_nH_m). For this purpose, a mobile station for environmental monitoring shall be set up at the construction site to measure dust and noise once a month. In addition, CO and hydrocarbon emissions will be measured only for on-site motor vehicles which lack an official exhaust inspection certificate.

The primary documents of environmental monitoring (data and official monitoring reports) will be archived and submitted to the appropriate officials of the Ministry of Environmental Protection and Natural Resources (MEPNR) and to the representative of the Public Environmental Control Commission (PECC). The PECC shall be formed by a special decree of the Mostovskoy Region. In addition, one time background monitoring will be conducted prior to construction activities.

9.2. Identification of Basic Ecological Conditions

Prior to commencement of construction activities, the following areas shall be evaluated in order to establish up-to-date baseline conditions:

- Background air pollutant concentrations shall be measured within the probable impact area of the Krasnodar GRES;

- Water quality parameters shall be measured in the Laba River 0.5 km upstream from the discharge point of the Mostovskoy wastewater treatment plant;

- Drinking water parameters shall be measured from the potable water intake at Andryuki;

- Noise levels shall be measured at and beyond the Krasnodar GRES facility boundaries;

- The World Bank recommends that baseline monitoring of NO_x begin in the Caucasus biosphere reserve as soon as possible and continue through the operational phase of the power plant.

9.3 Continuous Monitoring of Emissions

A continuous air emission monitoring system will measure basic parameters of plant operation (discharge velocity, temperature, etc.) as well as concentrations of NO_x, SO_2, CO, C_nH_m, O_3, and particulates in the flue gas in compliance with the Russian regulatory documents for environmental control. An automated on-site meteorological station will measure and record the following: wind direction; wind velocity; temperature; and humidity. Both the continuous emission monitoring system and the meteorological station will be connected to a central data receiving station at the facility which will archive average values of the data for 3 minute, 30 minute, and 24 hour intervals.

Air Quality Monitoring System

The air quality control system will have onsite measuring stations for air quality monitoring.

Air quality monitoring shall use standard methods of measurements and analysis, which fully comply with the requirements of legislation and current levels of science and technology. The following measuring methods shall be used:

SO_2	-	ultraviolet fluorescence or wet catalysis method
NO/NO_2	-	chemical luminescence
CO	-	infrared absorption
O_3	-	ultraviolet absorption
C_nH_m	-	flame ionization detector
particulates	-	beta-radiation absorption, absorption spectroscopy

Water Quality Monitoring System

The water quality control system provides the power plant with measuring stations to monitor water quality.

Special hydrological systems record deviations of water qualitative parameters. These systems respond both to biological processes (for instance algae propagation) and physico-chemical processes in a water body.

The following table presents the methods used for hydrological measurements.

Table 9.1
Indices and Methods of Hydrological Measurements

Index	Method
O_2	Reference gas analysis (three-electrode system)
pH value	Differential temperature compensation method
Conductivity	Electric solution resistance measurements
Turbidity	Photometric two-beam method
Toxicity	- daphnia test - fish test - algae development - bacterial toxicometry - determination of acute toxicity to mussels
Adsorption	Accumulation of organic pollutants
Temperature measurements	Thermometric

The Krasnodar GRES data processing center will process and store all the measured parameters and reports from the measuring stations. The data will be downloaded from the stations automatically at certain intervals. In addition, the data can also be downloaded manually. When the values exceed certain limits, the measuring station sends this information to the data processing center, which retrieves data from the stations and responds.

Potential Air Pollution Sources:

- main stack (NO_x, SO_2, CO, solid particles). Monitoring is carried out automatically by using a system of detectors; the information is of an operative nature and can be integrated for determining annual gross emissions. Input signals are recorded every 5 seconds. Average values are formed from the recorded data for 3 and 30 minutes as well as for 24 hours, which are then turned over to the archives. The recorded data on emissions are kept for 5 years in compliance with the regulations.

- mobile sources (trucks, loaders, etc.) - NO_x, SO_2, CO, CH, lead, benz(a)pyrene, soot. CO and C_nH_m content in the exhaust gases of engines shall be monitored at intervals determined by the local bodies of the MEPNR.

- warehouse for fuels and lubricants (hydrocarbons).

- auxiliary facilities (repair shops, etc.) - potential sources of emissions of a broad range of pollutants. Pollution sources are monitored according to the schedule approved by the territorial committee for environmental control and conservation of natural resources.

Potential Laba River Pollution Sources:

- waste water after biological treatment.

Potential Groundwater Pollution Sources:

- sewage header and service lines.

Potential Soil Pollution Sources:

- accidental leakage of industrial waste water;

- accidental leakage of oil products at the warehouse for fuels and lubricants;

- depressurization of reservoirs and service lines for storage of toxic compounds - control is carried out by specialized laboratories (Maikop soil laboratory, "Kubanenergo" laboratory, etc.).

9.4 Ambient Air Monitoring

Air quality in the breathing zone of the power plant will be monitored by a system of detectors being designed by the Dzerzhinsky research institute. If necessary, the environmental control laboratory of the power plant will optionally check air quality for dust, NO_x, CO, and SO_2.

9.5 Environmental Impact Monitoring

The potential effects of the power plant will be monitored in air, surface water, groundwater, and for noise.

9.5.1. Regions of Potential Effects

The primary region of potential environmental effects is defined as a circular territory with a radius of 3 to 5 km from the power plant, including the:

- residential area of the power plant;
- southern vicinity of Mostovskoy settlement;
- northern vicinity of Kaladzhinskaya settlement;
- western vicinity of Perepravnaya settlement.

Air. The greatest impact on the atmospheric air is exerted along a northwestern line 3-5 km from the power plant between Mostovskoy and Perepravnaya based on modeling.

Surface water. The Laba river area from the water treatment facility outfall to the section located 0.5 km downstream (along the left bank of the Laba r.).

Groundwater. Near the Kurchidskaya ravine along the routing of sewage pipeline between the water treatment facilities and power plant.

Soil. In case of accidents or leaks, the areal extent of affected soils will be delineated.

9.5.2. Ecologically Monitored Regions Identified by Legislation

Air pollution. According to the All-Union State Standard (GOST) SEV-1925-79 "Nature Protection. Atmosphere. General requirements for sampling", air shall be sampled in an areal circumference with a radius equal to 20 times the height of the smoke stack (20 x 150m = 3 km). In the case of detailed studies, the radius can be increased to 20 km. The number of stations is determined by recommendations of regional environmental authorities as follows:

- 1 station - 50,000 residents;
- 2 stations - 100,000 residents.

Surface water pollution. According to the "Rules of Surface Water Protection from Pollution", the area of water quality monitoring should be located 0.5 km downstream of the waste water disposal location (section 9.5.1)

Groundwater pollution. Groundwater monitoring and control is achieved through the delineation of sanitary protection zones (SPZ) (see section 5.2.1.2), restriction of economic activity in these zones, and periodic sampling of the source water.

9.5.3 Regions of High Ecological Sensitivity

In addition to the populated areas of Mostovskoy, Perepravnaya, and the residential area of the power plant, the Caucasus State Biosphere reserve and the Pseibaisky sanctuary are considered to be regions of high ecological sensitivity.

9.6 Plan of Measures for Mitigation of Adverse Effects

The supervisor of engineering and technical personnel of the power plant shall be appointed by an order of the Director of Krasnodar GRES to be responsible for fulfilling the plan of measures aimed at mitigation of adverse environmental impacts (Chapter 6).

The supervisor of engineering shall make reports on the fulfillment of the plan at a general meeting of the power plant stockholders.

9.7 Required Monitoring Equipment

Continuous air pollution monitoring equipment is to be supplied along with basic electrical hardware. It shall include a set of detectors for measuring all the parameters of exhaust gases (which are installed at all the key points of the flue gas lines up to the smoke stack) and one meteorological monitoring station. The system shall be capable of measuring and recording the concentrations of NO_x, SO_2, CO, C_nH_m, and particulates in compliance with the Russian regulatory documents for environmental control.

In addition, ambient air monitoring shall be conducted at the following measuring sites for NO_x, SO_2, CO, C_nH_m, and Vanadium:

- Mostovskoy settlement
- Perepravnaya settlement
- Psebai settlement

- Cordon of the Caucasian biosphere reserve.

Establishment of an ambient air monitoring station at the Caucasus biosphere reserve has an estimated capital cost of approximately $250,000.00 and an annual operation and maintenance cost of approximately $15,000.00.

Waste water disposal monitoring shall be provided by the use of one mobile water quality monitoring station with automatic measuring of concentrations with regard to MPC indices (section 5.5.1.2).

Surface Water Locations

- Laba River - 0.5 km downstream of the Krasnodar GRES (i.e., approximately 9 km upstream of the Mostovskoy wastewater treatment plant);

- Laba River - 0.5 km downstream of the Mostovskoy wastewater treatment plant;

Monitoring Well Locations

- Potable water intake;

- Adjacent to the mineralized waste storage tanks;

- Outside the fenceline of Krasnodar GRES and within the SPZ.

Observations shall be carried out periodically at intervals established by the local environmental control bodies of the MEPNR and the sanitary-epidemiological inspectorate of the Russian Federation.

10.0 ENVIRONMENTAL MANAGEMENT AND TRAINING

As described in other Sections of this Report, a number of safeguards shall be built in to the Krasnodar GRES during the design phase to eliminate or minimize potential adverse environmental impacts. In conjunction with engineering and administrative controls, effective environmental management and planning during the construction and operation of the Krasnodar GRES is required to prevent any adverse impact on the surrounding environment.

10.1 Management Capabilities

Construction Phase Management

During the construction phase of the project, Krasnodar GRES will appoint a Project Manager who will have the overall technical and project management responsibility for administering the turnkey EPC contract. Figure 10-1 identifies the Project Manager's organization. All functions of the project namely, purchasing, contract administration, engineering, construction, project control, schedules, costs, and quality control and assurance will report to the project manager. The project manager will have the authority to negotiate and make commitments for the company. This is essential for the successful execution of a large turnkey project. The EPC contractor and any other contractors will be responsible for their work to the project manager. The project manager will be the sole point of contact for the contractors and will be responsible for resolving all contractors' issues relating to schedule, cost, change orders and will be responsible for controlling the budget. All correspondence from and to contractors will be by the project manager only.

The project management team will be responsible for review of design, engineering, procurement specifications submitted by the contractor for Owner's review, and oversight of construction to ensure that engineering, construction, and procurement are in compliance with the contract documents, applicable codes and standards, local and federal government regulations and conditions of environmental permits. It is recommended that Krasnodar GRES use the services of an engineering consultant with international experience to assist in the process. The project management team will interface with the utility, the gas company, the oil supply company, the water supply company, the local government and the environmental authorities. The project manager will act as the Owner's representative in all matters.

The project manager will hold monthly meetings at the site with the contractor personnel and will be responsible to Krasnodar GRES for overall progress and control of the project.

The project manager will periodically review progress and critical issues of the project and request assistance in personnel and services from the Krasnodar GRES management as required. The project management team will also act as coordinators between the contractor and the utility's operating personnel who will work closely with the contractor's start up organization and will be responsible for taking over the plant equipment and components from the contractor.

Operations Phase Management

Krasnodar GRES will be structured to take over from the project development organization at the close of construction and to transition smoothly into an organization representative of power utility operations. Figure 10-2 is a preliminary organization structure proposed for ongoing operations. The organization structure and functions depicted here would enable the performance of such duties. Figure 10-3 is indicative of allocation of responsibilities based on such an organization and process flow.

In order to set an example for future projects, the Krasnodar GRES staffing should be kept to the minimum level necessary. Primary emphasis should be to contract for services, rather than direct hiring. The operation and maintenance of the plant is a good example where it is recommended that Kubanenergo, being the neighboring utility, should be given a contract to perform this function. Kubanenergo, with their human resources already oriented and trained in the utility business, is likely to provide the needed personnel and service with additional enhanced training for initial staffing and replacement. Figure 10-4 is a preliminary staffing structure for ongoing operations.

Prior to plant startup, and before staffing is in place, programs must be established to provide the necessary training to all operating, maintenance, technical, and clerical employees. If an Operation and Maintenance Contract is awarded to Kubanenergo, the majority of these will apply to Kubanenergo. However, as the Administrator of Contract, Krasnodar GRES personnel need to be trained in aspects of supervision of these activities.

Detailed training programs must be developed to insure all members of the various crafts are tested to be competent in their respective work areas. These should include:

- Operator Training

- Maintenance Training
  - Electrical
  - Mechanical
  - Welding
  - Instruments and Controls

- Chemistry

- Equipment Operators

- Industrial Safety

- Management Information Systems

- Inventory Control

- Environmental Control

- Fuel Handling

Training facilities should be installed at an early stage in construction to provide for adequate training time of personnel prior to startup. The training facilities should include:

- Classrooms

- Operations Simulator

- Welding Training and Testing Facilities

- Chemical Laboratory*

- Machine Shop*

- Electrical Shop*

- Instrument and Controls Shop*

*Chemical laboratory, machine shop, electric shop, and instrument shop could be the working shops constructed for the ongoing operations and maintenance of the facility.

The contract for the plant should contain a provision for the equipment supplier(s) to develop the training programs, and provide all training for the initial staff members.

Subsequent to the start of operations, ongoing refresher and re-qualification training should be provided to all members of the staff. This program could also be designed by the equipment supplier(s) as a part of the construction contract.

10.1.1 Power Generation

Krasnodar GRES will have a Health & Safety Department and a separate Environmental Department. The Environmental Department may be organized as a service as part of the Production and Technology Department. The number of personnel will be based on the power plant staffing structure. Department personnel responsibilities will be assigned based on statute laws, standards and regulations and will be described in the Department Regulations and appropriate operating instructions which are currently being developed by Krasnodar GRES.

Water Management - Cooling/Process Water

The design of the dry cooling towers provides an inherent method of reduced water requirements. An onsite treatment system will ensure that all process waters which may be discharged will conform to permitted water quality parameters.

Water Management - Surface Water

Management mechanisms within Krasnodar GRES shall ensure that any storm water discharge to Kurchidskaya gully will conform to permitted water quality criteria. Engineering controls such as oil/water separators and institutional controls such as correct labeling of drains shall be employed to reduce the likelihood of an unplanned discharge to surface water.

Emissions Monitoring

A continuous emission monitoring system shall be installed at several predetermined points within the Krasnodar GRES to ensure that the plant is operating within permitted limits.

Training

Environmental training programs in the areas of air and water quality monitoring, solid waste management, noise abatement, and health and safety monitoring will be conducted. In addition, staff will be trained in the operation and maintenance of environmental monitoring equipment so that all releases to the environment are of known quality and quantity and are within permitted limits. Wind speed, wind direction, temperature, relative humidity, and other parameters as required will be monitored at a suitable location on the Krasnodar GRES site.

Emergency Response

An emergency response plan with appropriate staff assignments is currently being developed by Krasnodar GRES.

10.1.2 Power Transmission

Transmission lines from the Krasnodar GRES will be operated by the Labinsk Electric Network. Labinsk Electric Network has a Health & Safety Department employing two people. The Department's responsibilities are based on statute legislation, industrial standards and regulations. Environmental issues will be the responsibility of the manager of the Labinsk Electric Network branch office. Environmental accountability, interaction with regulatory authorities, environmental inspections and meteorology are the responsibility of the Head of the Production and Technology Department of Labinsk Electric Network.

Specific job responsibilities for the Health & Safety staff are based on the following:

1) Recommendations for Organization of Operation for Company Safety Services, enforced by RF Labor Ministry Resolution Number 6 of 30 January 1995.

2) Qualification Descriptions for the following staff positions:

- Labor Health & Safety Department Head;
- Health & Safety Engineer;

Enforced by Resolution Number 558/238 of 1 October 1987.

3) Standard Job Instructions for Senior Engineer for Network Operation, TK 34-70-060-86.

Since the transmission lines from Krasnodar GRES will be built to existing Russian Standards, no equipment-specific additional training is anticipated for members of the Labinsk Electric Network Environmental and Safety Departments.

FIGURE 10-1
PROJECT MANAGER'S ORGANIZATION

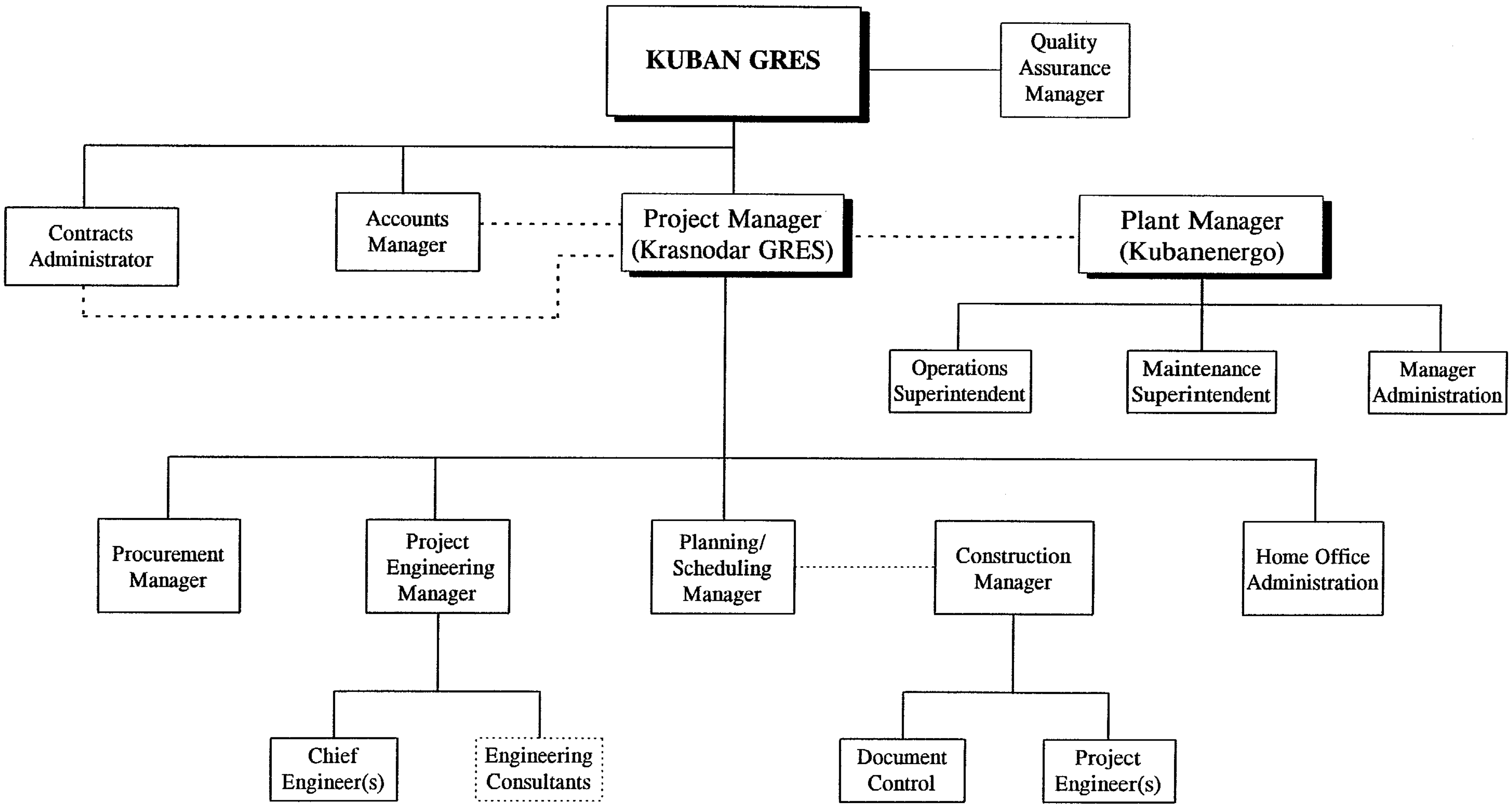
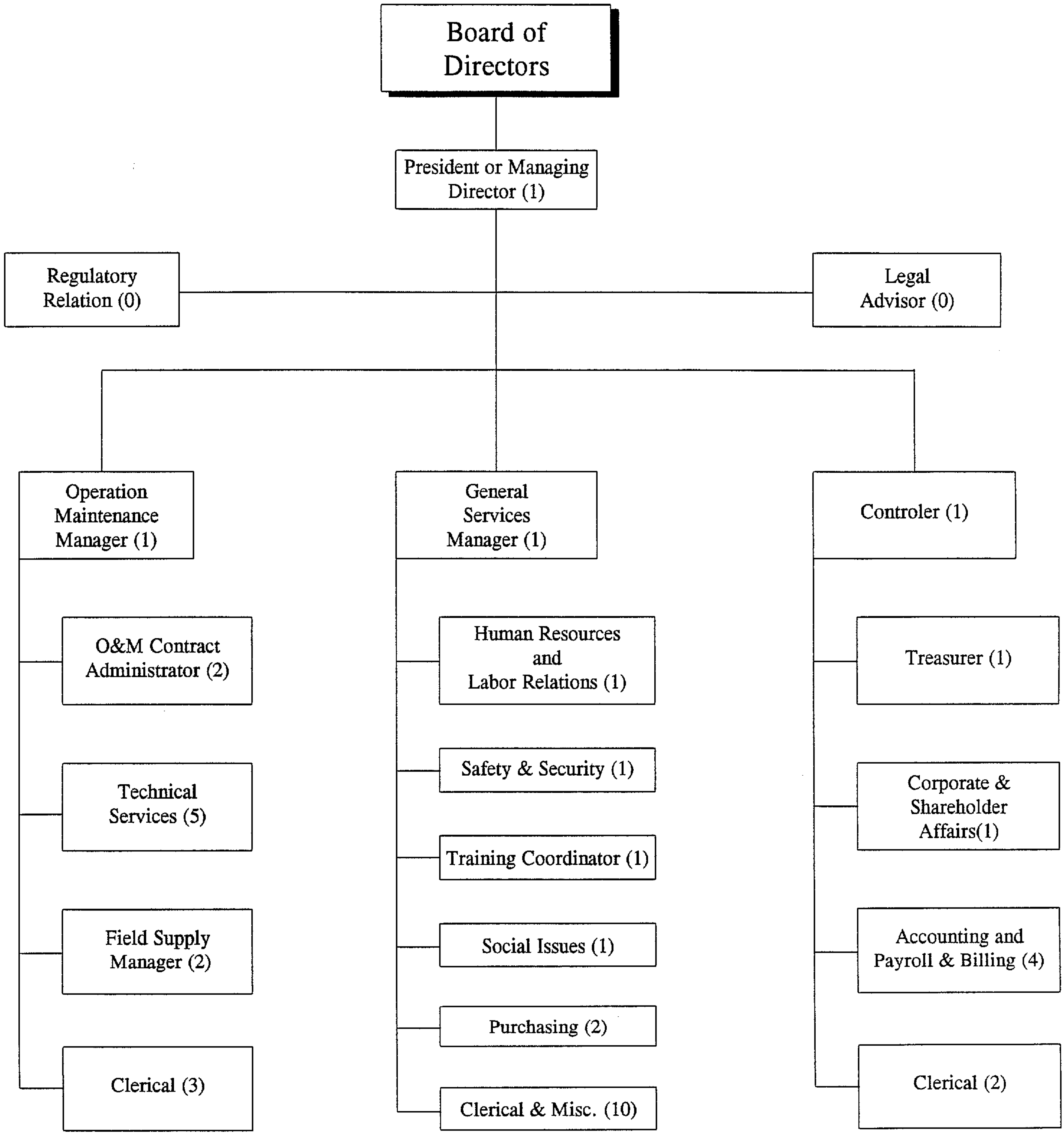


FIGURE 10-2
KUBAN GRES COMPANY LIMITED



(0) represents outside contracted services.
(1,2,3,etc.) indicates staffing level.

FIGURE 10-3: OVERVIEW OF RESPONSIBILITIES

	Strategic Planning	**Organizational Plans/O&M Budgets**	**Capital Planning & Budgeting**	**Load Forecasting**	**Generation Planning**
Primary Planning Responsibility	Chairman, President	Functional Departments	Operations Maintenance Technical Services	Load Forecasting & Markets	Budgets & Estimation (Technical Services)
Review and/or Approval	Board of Directors	Functional Directors or Managers	Functional Directors President Board of Directors	Functional Director or Managers	Functional Director President Operations
Analysis and/or Support	Relevant Special Management Committees;	Human Resources Administration Technical Services Budgets & Estim.	Financial Planning Technical Services	Ad Hoc Working Groups	Budgets and Estim. Operations Technical Services

FIGURE 10-4
PROPOSED ORGANIZATION FOR 2 X 450 MW
KRASNODAR GRES PROJECT AT MOSTOVSKOY

Plant Manager (1)

- Plant Engineer (1)
- Assistant Plant Engineer (1)
- Plant Performance Engineer (1)
- Env., Health & Safety Engr. (1)
- Plant Chemist (1)
- Lab Technicians (2)

- Operations Superintendent (1)
- Shift Supervisors (4)
- Control Room Operators (8)
- Auxiliary Plant Operators (8)
- Assistant Plant Operators (12)
- Demin Water/Waste Water Opr. (4)

- Maintenance Superintendent (1)
- Mechanical Supervisor (1)
- Electrical/I & C Supervisor (1)
- Mechanics (8)
- Electricians (3)
- I & C Technicians (2)

- DCS Technicians (2)
- Machine Shop/Instr., Shop (4)
- Warehouse Supervisor (1)
- Warehouse Assistant (1)
- Training Officer (1)
- Training Assistants (2)

- Controller (1)
- Accounts/Billings (4)
- Payroll/Benefits (2)
- Purchasing (1)
- Contract Administrator (1)

- Manager Administration (1)
- Assistant Manager Admin. (1)
- Officer Manager (1)
- Receptionist (1)
- Secretaries/Typists (8)
- Clerical (4)

- Public Relations Officer (1)
- Interpreter (1)
- Security Officer (1)
- Security Staff (12)
- Vehicle Supervisor (1)
- Drivers (6)
- Canteen Supervisor (1)
- Mail Room (2)
- Ground Maintenance Staff (3)
- Cleaning Staff (6)

Totals = 137 Personnel

Plant Manager:	1	Maintenance	37
Engineering:	7	Finance/Accounts	9
Operations:	37	Administration:	56

11.0 INTERAGENCY COORDINATION AND PUBLIC/NGO CONSULTATION

Guidance documents of the World Bank and the Russian Federation stress the importance of public participation in development projects. In accordance with Russian practice, preliminary meetings to discuss the Krasnodar GRES have been held with various governmental and nongovernmental organizations (NGOs). Both the World Bank and regulations of the RF require an official Public Hearing to air all views with respect to a project. The Public Hearing was organized and documented in accordance with World Bank guidance and regulations of the RF.

11.1 Previously Held Meetings

Preliminary meetings to discuss the Krasnodar GRES have been held as follows:

1. Ownership Group, Regional Environmental Committee, Consultants, 23 February, 1995.
2. Krasnodar Regional Environmental Committee (KREC) 18 April and 24 August 1995.
3. Kuban Folk Peoples Academy of Environment (NGO) 25 May 1995.
4. KREC Department of Regional Environmental Expertise, September 1995.
5. Mostovskaya District Administration, 2 July 1995.
6. Mostovskaya District Representatives, 12 July 1995.

11.2 Meeting Notes

Meeting minutes and discussions (where available) for the above mentioned meetings are included below. Two of the above mentioned meetings were tape recorded. Transcripts of those meetings are also provided below.

11.2.1 Ownership Group, Regional Environmental Committee, Consultants, 02/23/95

Agenda: Review the scope and objectives of the project and to interface with likely Russian participants

Attendees:

USAID
R. Leasburg
M. Stepanov

Burns and Roe
S. Gerges
D. Shikar

Hagler Bailly
C. Cooper

IIE
E. Ramsey

Kubanenergo
V. Afansyev - Director of Construction
Mr. Yudosky - Director Krasnodar Construction
Mr. Sinkovsky - Dept. of Construction Preparation

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Mr. Kireer - Chief of Construction Specialist
Mr. Evstratovsky - Construction Specialist
Mr. Ryabokon - Chief of Capital Construction
V. Ptitzyn - Deputy Chief Engineer

Kuban State Agricultural University (KSAU)
V. Anikin - Doctor of Science

Rostosteploelectroproect
A. Shilov - Director
Y. Triger - Chief Project Engineer

Kuban State Technology University
Prof. G. Zarnitzky - Power Station Dept.

Centre Ecologice ("Ecoton") - Rostov University
V. Zakrutkin - General Director
M. Ryshkov - Vice Director

Regional Committee for Environmental Protection
Ms. Galina Neudakhina - Chief Specialist
Ms. N. Shmeltzer - Leading Expert

Summary

A brief overview of the six tasks to be performed was given by S. Gerges and R. Leasburg. This was followed by discussions which focused almost exclusively (on) environmental topics.

Discussions:

The following were the main items discussed during the meeting:

1. The Mostovskoy (site) was selected in 1982 as the site for a 4000 MW nuclear plant. Accordingly much information was collected regarding hydrology, geology, seismicity, socio-economics, fauna, flora, etc. Following Chernobyl, nuclear plans were scrapped and the plant site was then selected for combined cycle development. Some participants felt that environmental work done during nuclear planning could be adapted to current Russian and International standards for an Environmental Impact Assessment (EIA).

2. Burns and Roe indicated that Gennaddy Vassiliev of the World Bank provided copies of 18 documents dealing with environmental matters. A listing of these documents (in English) was given to Mr. Afanasyev. Burns and Roe agreed to provide a Russian translation of the titles of these documents so that Mr. Afanasyev could expand the list of reference material - which he did not believe was complete.

3. Mr. Shilov (Rostovteploelectroproject) indicated that an EIA for the Mostovskoy project was performed in 1991. He indicated that his document did not conform to current Russian or World Bank standards. Kubanenergo agreed with Mr. Shilov's statement indicating the need to revise, update and supplement the previously performed nuclear and fossil work.

4. Topics not addressed in the previously performed Russian work were identified to include Transmission Line EMF, gas pipeline impacts and highway and railway access.

5. Ms. G. Neudakhina of the Regional Committee for Environmental Protection gave an overview of their findings on the 1991 EIA. She indicated that the Committee was unhappy with the depth of analyses of previous environmental work - specifically human impacts and many observations were judged to be unreliable. She also indicated that wet cooling towers were proposed and were not found to be acceptable by the committee due to limitations of makeup water supply and evaporation effects on the dispersion of air pollutants. The Rostovteplo people seemed to agree with this finding.

   It was also indicated that background concentrations of No_x, SO_x and particulates of the Mostovskoy site had been monitored during the period 1980 to 1986 but not in more recent years. It was argued that because of the economic decline in recent years this background data may still be acceptable. Ms. Neudakhina seemed to accept this point of view.

6. Because of the deficiencies in the previously performed EIA work, Kubanenergo commissioned the North Caucasus Scientific Center (Rostov University) to redo an EIA for the Mostovskoy site. Note that a licensed organization is required to prepare an EIA, and they are apparently the only organization in the area which is licensed. Work on a new EIA was started but was stopped due to lack of funds. According to Mr. Zakruikin, the budget for the new EIA was 160,000,000 rubles, of which 10,000,000 rubles was spent before the work was halted.

7. The Mostovskoy site is located close to a National Park which may require additional assessments. It was not clear from the discussion whether this fact was adequately addressed in the previous EIA.

8. Dr. V. Anikin of Kuban State Agricultural University gave a brief computer screen presentation of air modeling work he performed for the Mostovskoy site. According to Ms. Neudakhina, Dr. Anikin's work was not reviewed by the Regional Committee for Environmental Protection.

9. Representatives of the Regional Committee for Environmental Protection stated that the region does not necessarily have its own environmental regulations but rather they follow the Ministry of Environmental Regulations (Moscow).

10. Representative of the Regional Committee invited Burns and Roe representatives to meet with them to expound on the process of reviewing the EIA.

<u>Action Items</u>

Item 1 Burns and Roe is to send Mr. Afansyev a listing in Russian of the titles of environmental documents provided to them by the World Bank (Action by: T. Gunusen) Done on 3/24/95.

Item 2 Mr. Afanasyev is to provide an expanded list of environment documents and information once he receives item (1). (Action by V. Afanasyev)

Item 3 Burns and Roe is to provide Mr. Afanasyev with preliminary list of other questions, documents and information needed to conduct the project tasks. (Actin by: D. Shikar)

Prepared by Dennis S. Shikar, Burns and Roe Company

11.2.2 Krasnodar Regional Environmental Committee (KREC), 04/18/95

Agenda: Krasnodar Power Generation Project Environmental Approvals

Attendees:	Environmental Commission	Kubanenergo	Burns and Roe
	Leonid Yarmak	V. Afanasyev	R. Edelman
	Svetlana Burakova	L. Yudovsky	K. Mittal
	Galina Neudohina	S. Yevrastovsky	A. Rachkov
	Nadezhda Smeltser	A. Sinkovsky	

Discussion:

1. The Regional Environmental Commission is a branch of the Federal Ministry of Environmental Protection and Natural Resources (MENPR). The Regional Commission provides a preliminary review of the Environmental Impact Assessment before passing it on to the Ministry. Comments are resolved first at the local level. If comments cannot be resolved, these are referred to the federal level.

2. Mr. Yarmak identified the following issues:

   - Previous Environmental Assessment was done a long time ago. The new one should not necessarily rely on the old one but meet the new requirements.

   - The local population wants an EIA prepared to international standards (including liquids, CO_2, etc.).

   - Dispersion of air pollutants to the Biosphere reserve is a critical issue. International models for dispersion should be used. These will need to be certified by the MENPR.

3. Mr. Yarmak provided the following information and guidance:

   - Environmental work consists of three stages:

     Stage 1 - data collection and analysis of existing background

     Stage 2 - Concrete impacts of the project are quantified - consumption of resources, noise levels, emissions, physical characteristics

     Stage 3 - modeling of impacts - forecast probable consequences on the environment for the construction period and the life of the project.

   - Public meetings should not be held until after the Commission has reviewed the project.

   - Interaction with the Environmental Commission should start quickly. A description of the project and identification of plant impacts would be helpful. An early meeting to describe emissions from combined cycle plants is suggested.

- Commission can use outside consultants to assist in the review. Some of these consultants may be critical of power plants.

4. Mr. Afanasyev pushed for a consensus by Commission on the use of Dr. Anikin to lead environmental work. Mr. Yudovsky stated that a new consultant would copy Dr. Anikin's work and take credit. Further, Rostov University may be opposed to the project. Mr. Yarmak stated that no single organization has had a positive EIA experience. Kubanenergo should use the best available.

5. Mr. Yarmak stated that he wants a new assessment - start from scratch. He expects that the American experts would produce the report. R. Edelman explained that the report will be prepared by the Russian consultants, and Burns and Roe will review the work.

6. Mr. Yarmak wants a single source responsible for the EIA. This is a credibility issue with the Commission and the local population. He would like to see Burns and Roe take the lead. R. Edelman noted that this is not the intent and further discussions are required.

7. Mr. Yarmak emphasized that the application of international standards is of highest priority.

8. Mr. Yarmak identified Ms. Burakova (Dept. Head) as the primary contact for Burns and Roe.

Prepared by R. A. Edelman, Burns and Roe Company

11.2.3 Minutes of a General Meeting at the Kuban Folk Academy (KFA), 05/25/95

Agenda: **Presentation and Review of the Report "Status of the Krasnodar GRES Project in Mostovskoy" by V.S. Anikin**

Attendees:

- G. M. Molokanov, President, KFA;
- N. V. Vitulskaya, Head Ecologist, KFA;
- A. G. Fisher, Head of Local History and Economy Study Department, KFA;

- V.V. Fedorovich, Editor and Publisher of the Environmental Boomerang, an independent newspaper;
- Serebryakov, an activist representative of the Cossack Community "Motorist";
- Mr. Frolov, a representative from the City of Gelendzik;
- V.S. Anikin, KSAU;
- S.E. Berlizov, KSAU;
- R.V. Teslenko, KSAU.

Total: 13 people

The meeting was chaired by Mr. Molokanov.

Molokanov: Now, I'd like to give the floor to Mr. Anikin.

Anikin makes his report.

Molokanov: Does anyone have any questions?

Vitulkaya: We keep criticizing the environmental committee, but now it turns out that they have rejected the Feasibility Study twice for reasons of atmospheric pollution. Within whose jurisdiction is Mostovskaya?

Anikin: The Armavir Committee.

Vitulskaya: What kind of gas will be used?

Fisher: Astrakhan, Tyumen or condensate?

Anikin: That I don't know.

Molokanov: What shape is the site in now?

Anikin: There is a construction settlement, about 20 buildings. They are assembled houses, people dubbed them Berlins or Brandenburgs because of the signs on them. There is no plant foundation yet, but there is a directorate and an operational construction team. They are standing by to start the construction. In the meantime, contact has been established between the directorate and the public. The nuclear power plant project left them the legacy of poor mutual relations. Now things have changed. The EIA has been revised a number of times. Whenever people said they did not trust the authors of the EIA, the director spared no money to invite experts chosen by the public rather than by the directorate. The head of the administration went abroad to examine similar facilities. My information is based on the local mass media. The administration head is all for the power plant. There will be no smoke from the stack, just some colorless shimmering. He saw it in Turkey, while in Italy such plants have no stack, there it is designed as a tower in Genoan style. The chieftain of the Mostovskoy Cossacks has also seen these facilities. He believes there is no danger, for the plant looks more like a scientific laboratory than a factory. His position, however, is unclear for two reasons:

1) Maybe they do it right, but in this country it will be just the opposite.
2) Social tensions: Strangers will come to earn high wages and to do as they please on our land.

Molokanov: What is the directorate doing now?

Anikin: They are getting ready to start construction. Or rather, they are building infrastructure for the district population, trying to preserve their personnel who have not been paid for three months.

Serebryakov: Another of those giant projects in Kuban. Do we really need it?

Anikin: Shall I tell you what happens if the project does not get constructed?

Serebryakov: There are dozens of local power plants in the Tihoretsk, Kurganinsk and other districts.

Anikin: Those plants burn diesel fuel, i.e., they add to car exhaust pollution of the atmosphere. Eighty-six percent of pollution in the district comes from cars, while only 14% emanates from stationary sources. It goes without saying that gas is a safer fuel than diesel fuel. Let me put the question another way. What is the current power deficit in the Krasnodar Region? As far as saving and renewable power sources, let's hear what the advocates of this point of view have to say. What it boils down to is this: savings in legal and administrative expenditure; 30 percent and another 45 thousand tons of standard fuel saved by using renewable power sources. But even if we implement all this today, the plant will be needed anyway.

Question: What is the power shortage in the Krai?

Anikin: 20 MW.

Frolov: I'd like to make some comments.

Anikin: If there are no more questions, let's go on to discussions.

Molokanov: Let's stick to the procedure. There are some more questions. How will the review of the EIA be arranged.

Anikin: It will be different from the way the World Bank does it, preparing a report on a agreed-upon schedule. First the directorate will prepare a statement of environmental impact which will then be discussed by all parties concerned. The statement will be made available to all interested individuals and organizations. Answering people's questions is the EIA. The Krasnodar GRES EIA has never been this way before. The committee now raises the question of introducing this kind of EIA methodology. This issue was also raised at the recent environmental conference for the Krasnodar Krai.

Question: How come you're so informed?

Anikin: In 1991, I prepared a previous version of the EIA. It included computer films, including films about acid rains. It is pleasant for the author to see these materials shown on all levels and not only in this country. Now I have been proposed to head a team that will prepare an EIA to meet the requirements of the World Bank which is planning to issue a loan for the construction project.

Molokanov: How do you see your environmental control over the project in future?

Anikin: If I am in charge, the work will be based on the principle of discussion in advance. Discussion not only with power engineers but also with local history experts, geographers, biologists and nature reserve employees. What they say will go on record and be reviewed to determine what is right and well thought out and what is "at the tip of the scientific pen". Then we will develop their considerations into forecast models. This will be a real EIA and it will meet the new requirements.

Molokanov: How do you see your participation in the work of the KFA public environmental committee to be done on this project? Would you be interested in heading the committee?

Anikin: It might be inconvenient for me now that I'm working on the EIA.

Fisher: What is needed for a public environmental review and approval?

Anikin: Here is an example. Law requires that environmental background data be made available to any individual, but the observatory, being a monopolist, demands a lot of money for providing background air pollution data. There is no NO_x monitoring in the Mostovskoy district, while the observatory has asked for one million rubles as a fee for a certificate including this data. I can understand the hydrologist and meteorologists; they have to survive. The same goes for water data. While it needs to be updated every other year, which means that 1992 data is no good, the river cadaster has not been updated for five years now. There is no one to do it. Which is not to say that they will do it for free. What shall we do about the initial data?

Fisher: Where do you get your information?

Anikin: As a prospective preparer of the EIA, I receive it from Kubanenergo and provide to you. I act in accordance with law and this situation is no violation of the law.

Serebryakov: What losses are estimated for the transmission lines?

Anikin: Let me see...14 percent.

Frolov: I'd like to make some comments.

Molokanov: Let's proceed with our discussion.

Frolov: (To Anikin) We will find an alternative option much better than your proposals. In Gelendzik, I'm talking about wind generators on the Markotk Ridge. They will be environmentally friendly. We need to start producing such installations.

Fisher: (To Frolov) We have been working on this issue for ten years now. Funding has been repeatedly requested, but the ministries have refused. So we have to agree to the Mostovskoy site, for want of a better option. This is the best option from the environmental standpoint. I'd like to ask Mr. Anikin...We will need a public environmental review and approval. Please make sure that the project is environmentally friendly. The designers have to be prodded all along. In case they fail to deliver, certain control over the project is required. Please select a team of competent experts and appoint an alternative commission, including those who work for the state environmental expertise commission. They will review the project on behalf of the KFA Environmental Council. Mrs. Vitulskaya would like to be excused from this responsibility.

Vitulskaya: Yes, I would.

Fisher: We have already discussed it with Mr. Molokanov. Let Mr. Anikin be in charge of our public review and approval. We will conduct it free of charge in mid-June, after we come back from the Environmental Congress in Moscow.

Molokanov: (To Vitulskaya) Please make sure a team of experts is appointed and a list of public environmental council. Provide the list to Mr. Anikin. (To Anikin) Agreed?

Anikin: It wouldn't be convenient for me, while I'm working on the EIA. Once I'm finished with it, yes [I'd be happy to oblige].

Molokanov: To sum up. We have been developing all kinds of power generation in the region. Small hydroes, geothermal sources, thermal pumps in Gelendzik and Mostovskoy...

Anikin: Thermal pumps in Mostovskoy? Interesting.

Molokanov: I'll bring you a book [on the subject] next time we have a meeting. In Novorossiysk there is a test site for unorthodox power sources. It is directed by Mr. Proselkov from the Polytechnical Institute. Saturn [a factory] manufactures solar panels.

Anikin: What about their production? Aren't there some environmental problems?

Vitulskaya: They use mercury and hydrogen fluorides.

Molokanov: We have our man in the administration, dealing with unconventional power generation technologies and another one working on conventional sources. There are quite a few knowledgeable and honest people both in the administration and Kubanenergo. There are also many people like this among the power engineers. We will select members of the new public environmental council among them. Mrs. Vitulskaya, could you please draft a resolution with regard to the new environmental council and Mr. Anikin.

Anikin: I'd like to repeat. I'm in no position now...

Molokanov: You have the right name for it, just right for a Cossack chieftain. You are a Cossack.

Anikin: I come from another city.

Molokanov: We will continue our discussion after the Congress. (To Anikin) I'll bring you some books on unconventional power generation, including my own.

Recorded by Mr. Berlizov and Mr. Teslenko, KSAU

11.2.4 KREC Department of Regional Environmental Expertise, 09/14/95

Agenda: General discussion of EIA, specific discussion of EIA Table of Contents

Attendees:

- S. Burakova, Head Dept. of Regional Environmental Expertise
- S. Yevstratovsky, Kubanenergo
- V. Anikin, KSAU
- O. Eshenko, KSAU
- D. Cooksley, Burns & Roe

Discussion:

1. Discussed the published Regional EIA requirements outline. D. Cooksley pointed out that the Regional outline is identical to the KRASNODAR GRES EIA Table of Contents except that the general sections are in a different order and that more overall information is contained in the KRASNODAR GRES Table of Contents. Went through the KRASNODAR GRES Table of Contents point by point. S. Burakova verbally approved the KRASNODAR GRES Table of Contents.

2. Burakova expressed concern regarding separating the EIA from the FS. D. Cooksley explained that many elements of the Russian FS are in the

KRASNODAR GRES EIA and that is why the proposed EIA has more information than KREC and MEPNR requires. D. Cooksley also pointed out that the Ministry has approved the separation of the EIA from the FS for this project.

3. The Expertise review period was discussed. S. Burakova requested 6 copies of the completed EIA. She recommended a simultaneous review of the EIA between the Expertise Committee and the Ministry.

4. S. Burakova would like to be kept informed on the progress of the EIA and when it is to be delivered. She stated that she would like S. Yevstratovsky to keep her posted. S. Yevstratovsky agreed to do so.

11.2.5 Meeting Minutes of Meeting Between Mr. Vassily Anikin and Mostovskoy District Administration and Experts, 07/02/95

Agenda: Status of the Krasnodar GRES Project in Mostovskoy

Attendees:

- Anikin, KSAU
- Andreychuk, Forestry Director
- Burtseva, Chief District Architect
- Lozov, Head, Environmental Service of PMDO UG
- Krasnenko, Forestry Scientist
- Abrosimov, Deputy District Administration Head
- Eliseev, Krasnodar GRES Directorate representative
- Galkina, Deputy Administration Head
- Mishenko, Head, Water Treatment Facilities

Anikin: The new EIA procedure provides for a prior polling of the public opinion to find out their concerns with regard to the proposed construction project. Everything you will say we will try to take account of. Please, you can now air your views on the power plant project to be constructed in the district.

Andreychuk Forestry Director, Ex-Chair of the District Executive Committee. Honorary Citizen of the Mostovskoy township:

Who canceled the construction of the Nuclear plant and why? A teacher wrote to the newspaper: "What do you know about the nuclear power industry to judge it?" It was Kondratenko's doing. Ponomarenko is all for it.

Anikin: Ponomarenko is a university lecturer, one of ours now.

Anreychuk: Well, we'll have to get him back!

Burtseva: Chief District Architect:

Is there an independent expert board to review the environmental section of the project?

Anikin: Everyone will be given a copy of the Statement of Environmental Impact.

Domkomstev: We need information first. Otherwise, why waste our breath? What emissions, why? You prepare and read it out for us.

LoZov: Former Sanitary Doctor of the Mostovskoy district, now a pensioner, head of the environmental service of PMDO UG.

I sat on the expert commission that reviewed the project in 1992, together with Nefedov and Zelinskaya. And now, all this talking, all over again. Sounds like some foul play afoot.

Anikin: The EIA procedure has been changed. Now it begins with asking the public opinion.

LoZov: Then, during our review, we staked out five sanitary issues. They are the water treatment system, water supply, baseline data for the district...Can't remember all of them. There were data on the Kaladzinskaya...

Director of the Housing Construction Service:

Why do they start building already?! Look at the bread and footwear prices! They promised to commission the first unit in 1996. But will electricity become cheaper? Every time, the fall comes and it's the same old story. No water, no sewage...Our service receives quite a log of flack over environmental issues. We need data on the power plant.

Domkomstev: They didn't exactly go out of their way to ask around. Twenty years ago the geological committee gave its go-ahead to develop a quarry on the Laba River. Five hundred hectares it is. But the gravel is just 10 to 12 meters deep. And they are not some quarries across the river, no, they are working slap in the middle of the riverbed. But what happens if the Laba changes its course and turns to Rassovskaya? The data about the power plant have got to be published in the media.

Anreychuk: There are no cherries anymore, nay. No gardens, No nothing. The Belorechensky chemical plant has turned us into a desert.

Lozov: The project has to be approached as seriously as possible. It must be all set up before the construction starts. And primarily, the water treatment. Make sure you put three...no, better make it four, exclamation marks. Otherwise...The housing is oft commissioned without waste water treatment. Americans came to visit and said that Kuban is the Valley of Death. None of those facilities should be here at all.

Anreychuk: There are geothermal waters in the area. Yaroslavskaya, Gubskaya, Kaladzinskaya...18 wells, 12 in Mostovskoy. Depth - 1600, 1700 meters. Temperature - 86 degrees. Flow rates are 3000 liters per hour. Kutepov uses them for vegetable gardens. There is fish in the Laba: the barbel, the blackbelly...There is Nina Stepanovna, she is in ecology.

Nina Stepanovna: A representative of the Inter-Regional Environmental Committee (Armavir Committee). Her office is located on the premises of the land committee. Its on the western outskirts of Mostovskoy, in a three-story building, next to the two flares of burning oil gas.

Anreychuk: The current water intake rate is 7000 cubic meters per day, up to 11 tops. We need 17. Write it down: provide water supply to the township. The township has no water. There is a water intake next to Hodzi Make sure we have enough water. We have 7 and we will have another 7 and 11.

Krasnenko, Forestry Scientist:

What resources will the plant require as far as the gas supply?

Lazov: There aint' any gas. The nuclear plant, that's the thing. It is under the International Atomic Agency and environmentally friendly.

Anikin: And what do you do with the hulls of facilities housing nuclear piles? The Lenin ice-breaker, for instance?

Anreychuk: The Lenin has to stay where it is, because it's a Lenin.

Abrosimov, deputy district administration head:

What about the 180 nuclear-powered subs, the decommissioned ones? What do you do with them?

Eliseev, a representative of the Krasnodar GRES Directorate, formerly worked at the Crimean Nuclear Power Plant:

Here are our requirements. Firstly, the entire range of recreation and community services. Secondly, make sure electricity costs less - by 20, 30%...even half the current price. Thirdly, a water pipeline from Andryuki. Fourthly, the water treatment facilities. Fifthly, medical service in the district, the whole set. Let them build as soon as possible. There is not enough housing, people wait for years. There are plenty of politicians, though, making a career at the expense of common people.

Lozov: And what the Americans will sell...Do you really believe it will be the best. No, it won't.

Galkina, deputy administration head:

Let them conduct a comprehensive medical study in the district as to the children's morbidity. There is no medical equipment. But here the administration and the health committee are to blame. While the power plant will increase the morbidity rate.

Abrosimov: Start constructing spas. We have to go all the way to Labinsk for treatment, while our local waters are a notch better than in Essentuki. Start industrial construction based on local mineral resources. A salt factory, a lime kiln...A sanatorium won't come amiss. Gas can be pumped out the wells in the Garakaycvskoye field.

Anreychuk: Let it be 8 pages, but pages one can understand: here is the standard, here's what the plant will emit, here's its impact radius.

Anikin: The directorate will present a statement like that in early July.

Mishenko, Head of the Water Treatment Facilities:

We don't need construction round here. Even saigaks (a rare species of animals) are better protected than us. What about us? Our women are always sick. Better build a dam and a hydro.

Donvovstev: If only they brought some civilization into the district. Promises, promises...They propose a shift basis. Construction site caravans and all that. The place will be flooded by strangers and we will have to work for them. What we need is recreation and services. Seventy percent of the construction staff will be outsiders, construction workers. Why have a power plant inside a nature reserve? Nowadays we receive electric power all the way from the Inguri Hydro Power Plant. I'll tell you why our district has been chosen for the construction project: there is a railway, there is rubble, there is sand here. It's cost-efficient. Lost of others have gone this way, and we will too. Economy is the prime concern rather than health. There is no one to stand up and say: "That's enough, guys. Lets start building already." We do not believe they will ever start building that power plant.

Correspondent of the Predgorye Newspaper:

How many places like Kuban are left? Kuban is a pearl. But it will become an old mare, not pearl.

Abrosimov: The population density is 7 people per squire kilometer.

Anikin: I hear there is a museum of hunting in the township.

Anreychuk: That's right up my alley. It'll be a pleasure to show you around. The idea was to make it a museum of the Caucasus Biosphere Nature Reserve. OK, so we will be looking forward to receiving a statement of the plant's environmental impact sometime in early July.

Prepared by V. Anikin, KSAU

11.2.6 Mostovskoy District Representatives, 07/12/95

Subject: Status of the Krasnodar GRES Project in Mostovskoy

Attendees:

- Approximately 12 District Representatives including Forestry, Transportation, Water Systems, Sanitary Systems, Housing, and Agriculture.
- V. Anikin, KSAU
- L. Yudovsky, Director of Construction, Krasnodar GRES
- D. Cooksley, Burns & Roe

Fairly brief meeting including a general discussion of the proposed facility and its benefit to the region as well as World Bank EIA requirements.

Prepared by D. Cooksley, Burns & Roe

11.2.7 Other Meetings

Public meetings to support the previously prepared 1991 Feasibility Study were held as follows:

1. 4 February 1991 - Meeting with the public of the Mostovskoy Township. Round Table "Construction of the Krasnodar GRES Power Plant". Speakers: N.F. Strokozov, G. E. Zarnitsky, V. A. Butuzov, N. G. Shmeltser, H.Z. Tazhetdinov. A report on the Round Table was published in the Economic Bulletin, February 1991.

2. 17 August 1992 - Meeting of citizens employed in Brigade #2 of the Frunze Collective Farm. Discussion of the Krasnodar GRES Power Plant Project and allocation of land owned by the collective farm for the power plant project. Collective Farm Chairman: N.Y. Mischenko.

3. May 1993 - Meeting in Mostovskoy. At the meeting, Mr. N. M. Vartanyan, the new Head of Krasnodar GRES Construction Department was introduced to the Cossack community. Discussion of the Krasnodar GRES Construction Project was continued.

4. 18 August 1995 - Meeting of citizens of the Frunze Collective Farm in the Perepravnaya Settlement. The meeting was chaired by Mr. N.I. Tazov. Agenda: Discussion of the Krasnodar GRES Power Plant Project to be Constructed on the Land owned by the Frunze Collective Farm.

11.3 Public Hearing

The public hearing held on 26 December 1995 was held in accordance with World Bank Guidelines. This public hearing was attended by Governmental and nongovernmental organizations as well as members of the mass media. The public hearing concluded with the generation of a signed decree stating that the Krasnodar GRES project has been found to be acceptable from a technological and environmental standpoint.

11.3.1 Minutes of a Public Hearing on the Krasnodar GRES Project in the Mostovskoy District and Environmental Impact Assessment of this Project 26th December 1995 at Mostovskoy, Krasnodar Krai

1. Attended by representatives of the following entities:

   a) Public Organizations, including:

   - Mostovskoy District Society for Environmental Protection;
   - District Society of Hunters and Fishermen;
   - Mostovskoy Cossack Community:

   b) Representative and legislative bodies of the [Mostovskoy] District and Settlement, and Townships of Perepravnaya, Gusbskaya, Benokovo, Shedok and Psebay;

   c) Administrative bodies of the [Mostovskoy] District and Settlement, and Townships of Perepravnaya, Gubskaya, Benokovo, Shedok and Psebay;

   d) Government control agencies, including:

   - Krasnodar Krai Environmental Protection Committee;
   - Regional Environmental Protection Committee;
   - District Sanitary and Epidemiological Inspection;
   - District Architectural Construction Inspection;

   e) Managers of local district organizations, companies and institutions of various forms of ownership;

   f) Power construction organizations and the Client;

   g) Project and EIA developers.

Having reviewed major project technologies proposed in design documentation developed for the Krasnodar GRES Project by the General Designer (RoTEP) in conjunction with materials on environmental impact assessment of the plant's construction and operation (developed by KSAU), the meeting of representatives of Mostovskoy District public movements and organizations hereby emphasizes the following:

Based on earlier specialist scientific research, field studies, expeditions, monitoring data and statistics, as well as project studies conducted independently by the Kuban State Agricultural University, a forecast of the Krasnodar GRES project environmental impact was prepared, the conclusion was reached that it is acceptable from the environmental standpoint for the said power plant to be constructed, and recommendations for environmentally-safe operation were developed.

The Krasnodar GRES construction feasibility study was developed in compliance with technological and construction design standards.

All technological, technical, design and construction options for plant main and auxiliary buildings and structures take into account local (regional) environmental conditions.

The design takes into account the following:

- Status of ecosystems, their stability in probable technogenic impacts and self-recovery potential;
- Prospects for social and economic development in the region;
- historical, cultural and ethnic interests of the local population.

In this connection, the meeting of Mostovskoy District representatives of public movements and organizations believes that it is acceptable that a thermal power plant for 1350 MW, the Krasnodar GRES Plant, be constructed on a site located on the left bank of the Laba River near the Mostovskoy Settlement.

Further design and cost documentation shall be developed in line with technological and environmental options proposed in the Krasnodar GRES FS and EIA as reviewed by this meeting.

[*Signatures*]

Approved by: V. M. Rylenko, Head of Mostovskoy District Administration

Signatures of representatives of public organizations, and institutions:

A. Scherbak, Chieftain of Mostovskoy District Cossack Community;

V. Gorodov, Deputy Head for Military and Cossack Affairs;

__________, Head of the Mostovskoy Settlement Administration;

N. Semenko, District Society for Environmental Protection;

Ms. Karaseva, "Rus" Television;

M. Alexeev, Deputy Head of Local Self-Government;

V. Fedorenko, Editor-in-Chief, MRT "Rus".

Attachments:
1) List of participants to a public hearing in the Mostovskoy District;
2) Summary of debates.

11.3.2 Attendees

List of Public, Corporate and Agency Representatives

1.	B. G. Tereshehenko	General Director, Gubsky Works, Gubskaya
2.	T. I. Pavlenko	Lawyer, Mostovskoy District Administration
3.	M. V. Scherbakov	Chieftain of the Mostovskoy District Cossack Community
4.	I. N. Zabaznov	Local Working People's Self-Government Party Organization
5.	A. A. Pashkov	Head of Administration, Township of Mostovskoy
6.	N. V. Dukhanov	Head of Administration, Township of Psebai
7.	E. V. Semlyanskikh	Chief Geodesist, Krasnodar GRES Construction Department
8.	N. A. Grechany	Head of Agricultural Department, Mostovskoy District
9.	O. V. Filin	District Branch of the RF Communist Party
10.	S. D. Dylev	Leading State Inspector, Predgorny Territorial Committee for Environmental Protection and Natural Resources
11.	V. A. Kashminov	Head of Administration, Kostromkaya
12.	A. R. Zanudina	Mostovskoy Statistics Department
13.	A. S. Salov	Editor-in-Chief, Predgorye, District Newspaper
14.	N. S. Semenko	Deputy Chairman, Society for Environmental Protection
15.	V. I. Karaseva	District Television Service "Rus"
16.	L. S. Gudyma	Head of RPUZhKKh
17.	M. T. Alexeev	Deputy Administration Head for Deputies' Affairs, Mostovskoy District
18.	V. I. Gorodov	Deputy Administration Head for Cossacks' Affairs, Mostovskoy District
19.	V. I. Lavrentyeva	Head of Gubskaya Administration
20.	V. V. Yarovenko	Head of Benokovo Administration
21.	V. V. Pologyants	District Heating Network Manager, Mostovskoy District
22.	E. V. Meleshko	Deputy Head for Economy, Mostovskoy District Administration
23.	A. V. Peskov	District Environmental Protection Society Chairman
24.	A. Baykov	Administration Head, Perepravnaya
25.	V. M. Sibirkin	Chairman of the District Society of War/Labor Veterans
26.	A. V. Kabanets	Deputy Chairman of the District Society of Hunters and Fishermen

KRASNODAR PUBLIC HEARINGS
LIST OF ATTENDEES
(In addition to Mostovskoy district public and institutional representatives)

1.	V. M. Rylenko	Head of Mostovskoy District Administration;
2.	L. A. Repko	Secretary of Mostovskoy District Administration;
3.	N. I. Vuynov	Deputy Head of Organization Department, District Adminsitration;
4.	A. M. Parhomenko	Deputy Head of Department for Capital Construction, District Administration;
5.	N. N. Reutskaya	Deputy Head Physician, District Sanitary Epidemiological Inspection;
6.	V. P. Burtseva	Head Architect of Mostovskoy District;
7.	V. P. Izmaylov	Editor-in-chief, Kubanskiye Zori;
8.	G. S. Chegasov	Burns and Roe representative;
9.	N. G. Shmeltser	Representative, Krasnodar Krai Environmental Committee;
10.	S. P. Yevstratovsky	Kubanenergo;
11.	O. Yu. Yeschenko	Assistant Professor, KSAU
12.	L. G. Yudovsky	Krasnodar GRES Plant Director ;
13.	Yu. O. Ponomarenko	Chief Engineer, Krasnodar GRES Plant;
14.	A. P. Sinkovsky	Head of Construction Preparation Department;
15.	N. G. Eliseev	
16.	L. N. Horoshilov	Geodesist, Krasnodar GRES Directorate;
17.	R. V. Bolshakov	Head of Production & Technology Division, Construction Department; Krasnodar GRES;
18.	I. M. Karasev	Deputy Head of Production & Technology Division;
19.	V. V. Solyonov	Deputy Head of Production & Technology Division;
20.	I. M. Kireev	Head of Automatic Control Systems Department, Krasnodar GRES Plant Directorate;
21.	V. P. Shandura	Chief Engineer, Krasnodar GRES Construction Division;

11.3.3 Agenda of Public Hearing

Public Hearings Program
for the Krasnodar GRES Plant EIA

1. Preparation of a Krasnodar GRES Project SEI by the Kuban State Agricultural University, EIA developer.

2. SEI publication in mass media in the Mostovskoy District and distribution in public places such as clubs and libraries by the Plant Directorate.

3. Implementation of public hearings to be held in the office of the Mostovskoy district administration. Organization is the responsibility of the Power Plant Directorate.

[Tr.: Agenda]

3.1 Report by a Directorate representative on the Krasnodar GRES Construction Project.

3.2 Report by a KSAU representative on the Krasnodar GRES Project EIA.

3.3 Questions from public representatives.

3.4 Answers by Directorate experts and KSAU.

DISCUSSIONS OF A PUBLIC HEARING
OF THE KRASNODAR GRES
POWER PLANT PROJECT

12/26/95 Mostovskoy

Subject: Assessment of Environmental Impact of the Krasnodar GRES Power Plant Project

The public hearing was opened with an introductory address made by Mr V. Rylenko, Head of Mostovskoy District Administration, who subsequently gave the floor to Mr Yu. Ponomarenko, a representative of the Directorate of the Krasnodar Power Plant. Mr Ponomarenko made a presentation to the assembled public of the Mostovskoy District, giving a brief summary of engineering and process options proposed in the Feasibility Study prepared by RoTEP for a combined cycle 1350 MW power plant, the most efficient and environmentally friendly.

Mr Oleg Yeschenko of KSAU , a Leading Developer of the Environmental Impact Assessment for the Krasnodar GRES Project, presented the results of a scientific study of potential environmental impacts. The study conducted by the KSAU team to meet the World Bank requirements and presented at the public hearings indicates that all potential impacts will be contained within regulatory limits.

Mr Chegasov, a Burns and Roe representative, made a report on similar power plants existing or under construction in Russia or abroad. In conjunction with RAO EES Rossii and Kubanenergo, Burns and Roe is preparing a package of support documentation for a project loan evaluation by the World Bank to finance the Krasnodar Power Plant Project. The EIA and the public hearings are critical components thereof.

Questions discussed:

Question: Mr I. Zabaznov. What potential benefits will be received by the local budget as a result of the construction and operation of the Krasnodar GRES Power Plant?

Answer: Mr G. Chegasov. It is premature to raise this issue before Kuban GRES is established. Don't count the chicken before they are hatched. But in any event, all local and federal taxes shall be paid.

Question. Mr V. Yarovenko. What are the emission levels? Chemical composition? Wind direction?

Answer: Mr O. Yeschenko. The plant will use natural gas as both the primary and the backup fuel. Therefore, ground emission concentrations inclusive of background levels will be 1.2 to 1.3 times below sanitary standards even under the most adverse weather conditions. Main pollutants will be NOx, SO2 and CO in infinitesimal quantities.

Question: N. Scherbakov. How does the design address the issues of seismic safety? Compensation payments?

Answer: Mr O. Eschenko. All equipment and buildings are designed to withstand an earthquake 7 points on the Richter scale. This baseline design value was developed as a result of detailed microseismic study. Statute law makes provisions for impostion of environmental damages for all economic activities.

Question: Mr N. Alexeev. What are the major fuel sources for the power plant?

Answer: L. Yudovsky. The plant will use fuel gas as the primary and backup fuel. The gas will be received from the gas pipeline system operated by Kubangasprom. We have developed technical requirements for gas supply for the Krasndar GRES Plant. Diesel fuel will be used as emergency fuel but at most 3 days in a row or 8 days a year.

Question. A. Gudyma. How is it planned to address the problem of providing a reliable water supply to the Mostovskoy District? Is it planned to complete the construction of sanitary treatment facilities in Mostovskoy?

Answer: L. Yudovsky. A water field for 20000 cubic meters has been discovered in Psebay. The project for a water pipeline to be built from Psebay to Mostovskoy is about to be finalized, including residential centers along the route. The problem will be solved given financing.

Question: A. Parkomenko. What impact mitigation measures are planned for Mostovskoy?

Answer: O. Eschenko. The operation of the plant will not lead to any significant increase in atmospheric pollution; the background concentration will be two times below the regulatory limits. 80% of air pollution in Mostovskoy is created by traffic and boiler houses burning liquid and solid fuel. A bypass circle motorway to be built will redirect the traffic around Mostovskoy, boiler houses using natural gas will improve rather than aggravate air pollution.

Question: M. Alexeyev. Are there plants similar to the Mostovskoy in Russia?

Answer: L. Yudovsky. Yes, a similar plant, the North Eastern, is under construction in St. Petersburg. The project is a year ahead of the Mostovskoy.

Question: V. Rylenko. How does the project address social development of the power plant settlement and the district in general?

Answer: L. Yudovsky. It is planned to build living quarters for 5000 people complete with infrastructure. The temporary settlement will include a kindergarten for 330 children. An 18-classroom school is all but completed. The Directorate has made significant investment into road system development in Mostovskoy, construction of new shops, and development of consumer services. A water duct and a water treatment plant will be built in Mostovskoy.

Question: E. Maleshko. Are there any contingencies made in the project for possible damages payments for environmental disaster accidents?

Answer: [fax garbled]. There is a complex of measures to liquidate accidents and to compensate damages.

Question: Mr Dukhanov. Will the plant use black oil (mazut) at all? Will there be particulates emissions? If so, what areas may be affected most?

Answer: O. Eschenko. Mazut will be used only as a backup fuel for the startup boiler house. The boiler house will be used for starting and running up the main plant equipment. Therefore, there will be no environmental pollution caused by particulates.

Question: N. Semenko. Will the Krasnodar GRES Project cause a general raise of ground waters in the Mostovskoy District?

Answer: O. Eschenko. Ground water table may go 0.5 meter up on the site. The project makes allowances for that. The impact area will extend 150 to 300 meters around the plant.

11.3.4 Newspaper Coverage of Public Hearing

Tr.: *What follows is the translation of an article published in Kubanskeye Zory [The Kuban Dawns], a regional weekly,, Issue #2 (161), 13th January 1996,*

ELECTRIC LIGHT AND.... CLEAR AIR
KRASNODAR GRES POWER PLANT: TO BE OR NOT TO BE?

The public hearings on the Environmental Impact Assessment of the Krasnodar GRES Power Plant Project became the most significant event that took place in the district on the home-run to New Year celebrations.

It was a competent gathering: local residents, public representatives, administration managers met in discussion with Mr Oleg Eschenko of the Kuban State Agrarian University, Mr Gennady Chegasov, a Burns & Roe representative and a former expert for the Ministry of Environment, Ms N. Shmelser of the Krasnodar Krai Environmental Committee, Mr Sergei Evstratovsky of Kubanenergo, and representatives of the Krasnodar Power Plant Directorate.

The problem of electricity supply in Kuban, a region where electricity prices are at their highest in Russia, has a long history and worsens virtually by the year. Not surprisingly, the ever recurring debates around the construction of a power plant in Mostovskoy never fail to attract a great deal of interest on the part of the region's denizens. Even more so because the time has come for the words to have some action to fall back on, viz. some financial guarantees. According Mr V. Rylenko, Head of the Mostovskoy District Administration, the World Bank will provide an investment loan in the amount of $500 million to finance the Krasnodar GRES Project. If this funding becomes available any time soon, there will be a chance to make good on a promise made a year ago when the construction site was initiated. Remember? "[To commission] Russia's first combined cycle unit in Kuban by 1997!"

The public representatives had all kinds of questions to ask. For instance, the locals were interested to know whether there were any other similar plants in Russia. Where would the balance of financing come from, to foot the hefty construction bill, for $500 million pays about half the price?

The first question was answered unequivocally - no, there are no similar plants anywhere in Russia. But there are some in Turkey, Italy, Japan, France, USA, etc. Russian investors include, but are not limited to, Gasprom and the Energy Machine Building Corporation. The Krai's and the district administration's contributions are yet to be finalized. Any profits derived from the project will be shared in proportion to contributions made by project members.

Our region is a seismic area. How is that issue addressed in the plant's design? - comes the next question.

The experts explained that the site is located in a 7-point [on the Richter scale] seismic area and that this value is incorporated to design all major facilities (buildings and structures). As far as the combustion turbines and other 'iron' machinery are concerned, they are hardly susceptible to seismic impacts.

The main emphasis of discussion was on potential environmental impacts to be expected from the Krasnodar GRES Power Plant.

The experts emphasized that in search for answers to that question they primarily focused on emergency situations such as fires, earthquakes, fuel spills, and explosions.

The plant's process makes an explosion impossible except as a result of a direct diversion. As a result of a thorough study to ensure compliance with Russian environmental requirements and those required by the World Bank as potential investor, the experts agreed that the Krasnodar combined cycle power plant would produce neither any irrevocable environmental changes nor any adverse impacts on human health and safety.

Life has taught us to always examine the worst case scenario, - the locals were not to be deterred. **Does the project make any allowances for potential damages to be paid in order to make up in the aftermath of an environmental accident?**

The answer was loud and clear: "If a given entity inflicts damage to the environment, the said entity is obliged to finance and implement the entire complex of measures that may be required in order to liquidate the accident and to compensate damages."

A reference to the investor followed: "The World Bank wouldn't finance an environmentally-hazardous project. Now, the proposed combined cycle plant is perfectly friendly as far as the environment is concerned. This is the best plant the money can buy, as far as the amount of associated trouble outside its site," - all experts said in one voice.

The public was also interested to know whether the plant would use mazut as fuel at all (even if for a very short time)? Is the plant's operation likely to lead to a fallout of particulates and, if so, what areas would be affected worst?

Mazut will be used during the startup phase only, to start up the heating boilers, the experts assured. The power plant will fire natural gas as both the primary and secondary fuels. It was initially planned to fire mazut but that project was scuppered by the environmental committee.

The plant will produce no particulates emissions during operation. The emissions will contain such components as NOx and sulphur compounds (in minuscule quantities). In a word, the potential damage that can be inflicted on the environment by the Krasnodar power plant will be 5 to 10 times less than that currently done by coal-firing boiler houses.

The locals who have to cope with ground water flooding every spring expressed their concern that the power plant might aggravate this situation.

The answer was unequivocal: construction will affect an area of 150 to 200 meters around the plant.

Some participants of the public hearing had specific questions to ask. For example, who will be worst affected by emissions from the plant, no matter how infinitesimal? This concern was particularly emphasized by Mr V. Yarovenko, head of administration in the Village of Benokovo. And it is understandable: the village is located 140 meters higher than Mostovskoy.

And again, the answer was straightforward. The wind changes its direction every two hours, the experts explained. But even in the worst case, e.g. a residential area with bad environmental background levels of its own, GRES emissions added to the background concentrations will result in backgrounds two times below maximum allowed concentrations.

The experts also emphasized that about 80% of atmospheric pollution in the area comes from automobile traffic. That is why a bypass will be built within the scope of the project and redirect transit traffic. Also, the coal-fired boiler houses will stop blackening the skies when the plant goes into operation and the environmental situation will be even improved.

There was no doubt either in the minds of those asking or the answering that the Krasnodar GRES plant is a must. The bottom line in the discussion was drawn by Mr A. Gudyma who said in his address to the experts:

'You'd have done a more impressive job in your environmental impact assessment, if you had compared future emissions from the Krasnodar GRES Plant with those we are breathing in this very moment thanks to AO Yug . The comparison results would have been so impressive that the locals wouldn't even dream of asking tricky questions about the plant.

The speaker went on to remind the plant promoters, duly and quite appropriately, about their promise made to the local community, i.e. to provide a reliable drinking water supply to Anryuki, Shedok and other small hamlets on route, as well as to build sanitary treatment facilities.

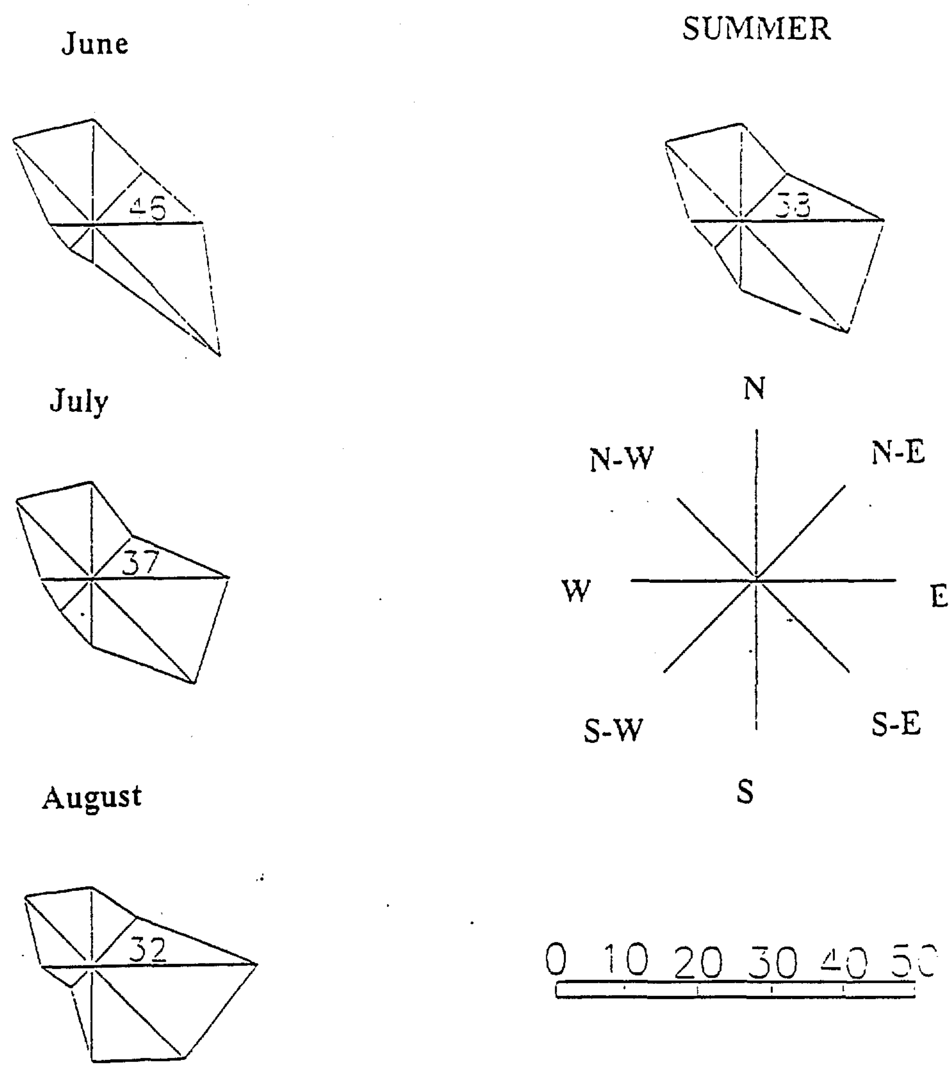
'The power plant site will be feed from the existing water intake, Mr Gudyma continued, - Therefore, it is a priority obligation for the power plant directorate to ensure development of critical public services, such as a bathhouse - it will be of use for everyone.

What started as a discussion of global environmental problems has boiled down to the mundane, a purist reader might chastise the author. Well, so what if it has? Coming down to earth a bit never comes amiss, whatever the nature of discussion.

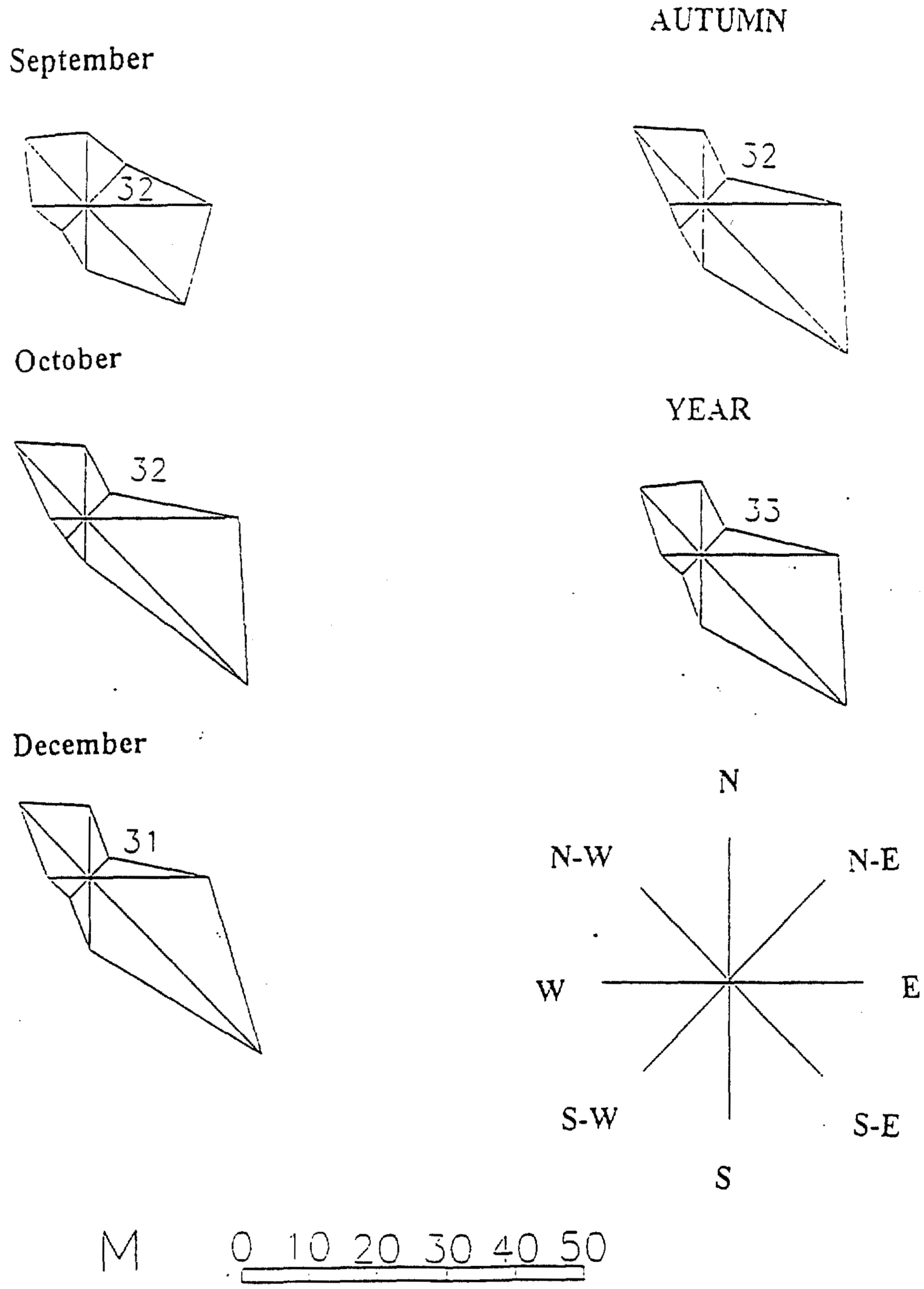
By [Ms] L. Olegova

Appendix 1

Wind rose
(summer period)

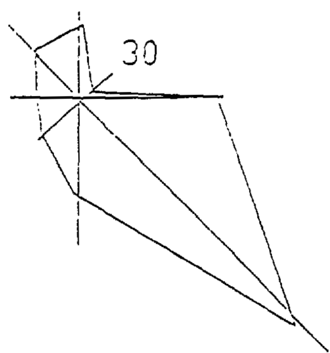


Wind rose
(autumn and a whole year period)

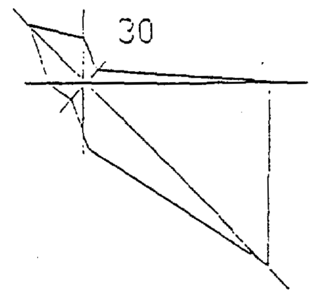


Wind rose
(winter period)

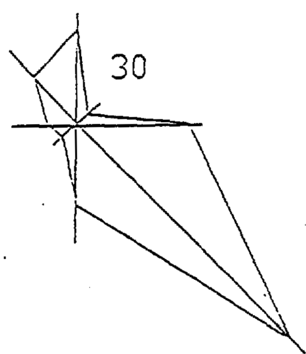
December

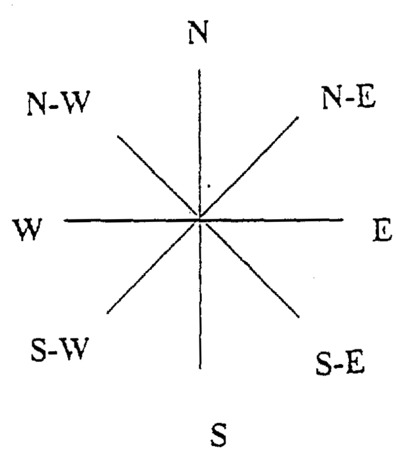


WINTER

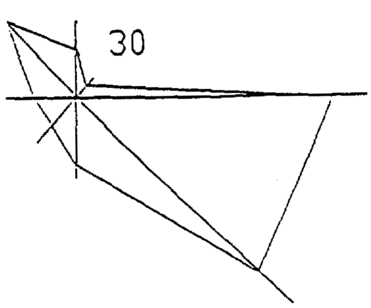


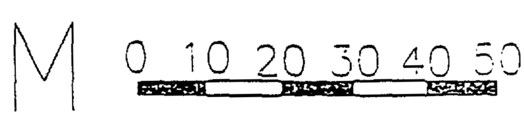
January





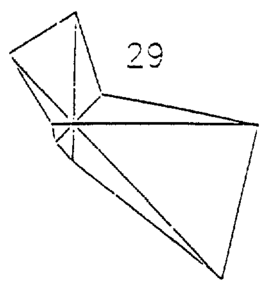
February



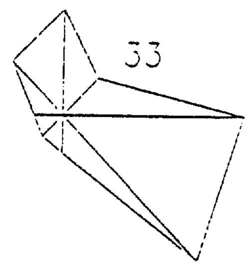


Wind rose
(spring period)

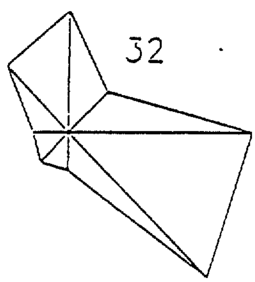
March

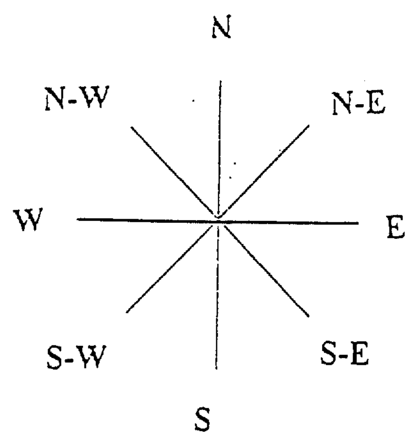


SPRING

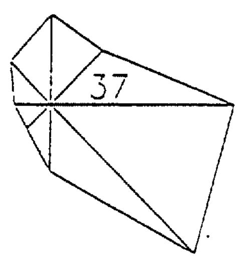


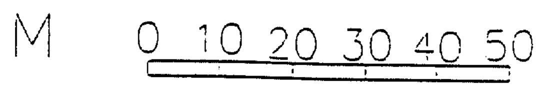
April



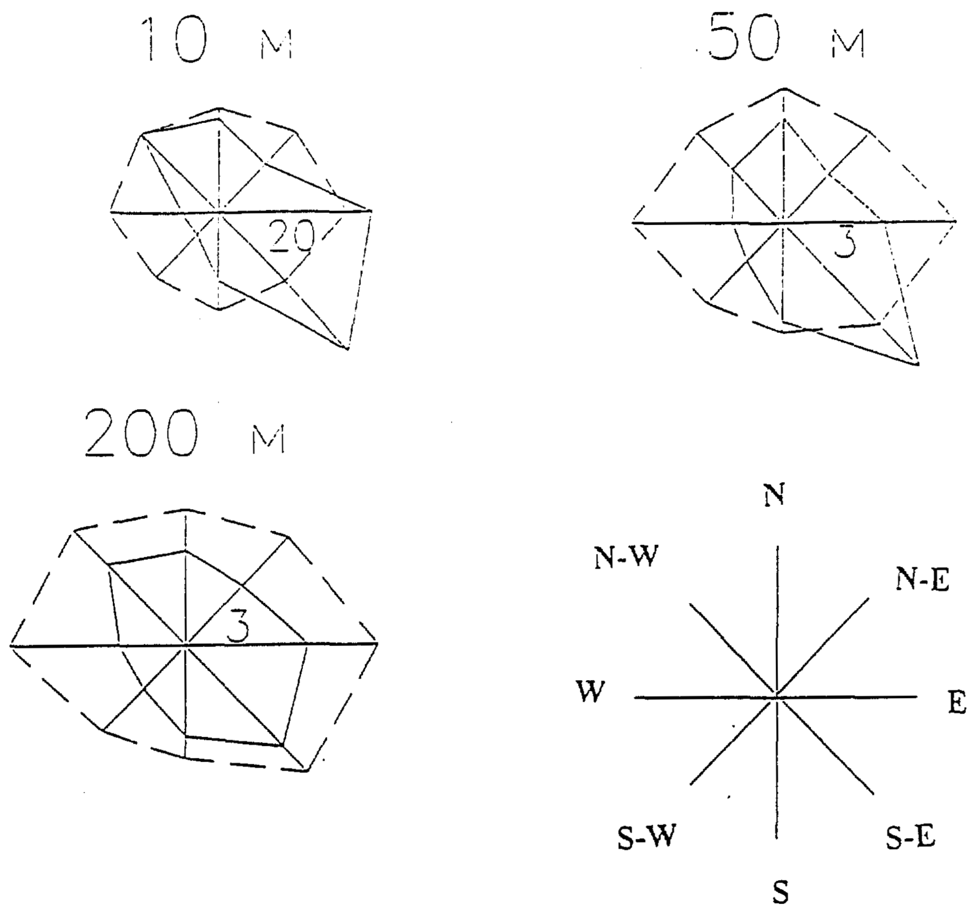


May





Wind rose at different altitudes



20 – calms recurrence, %

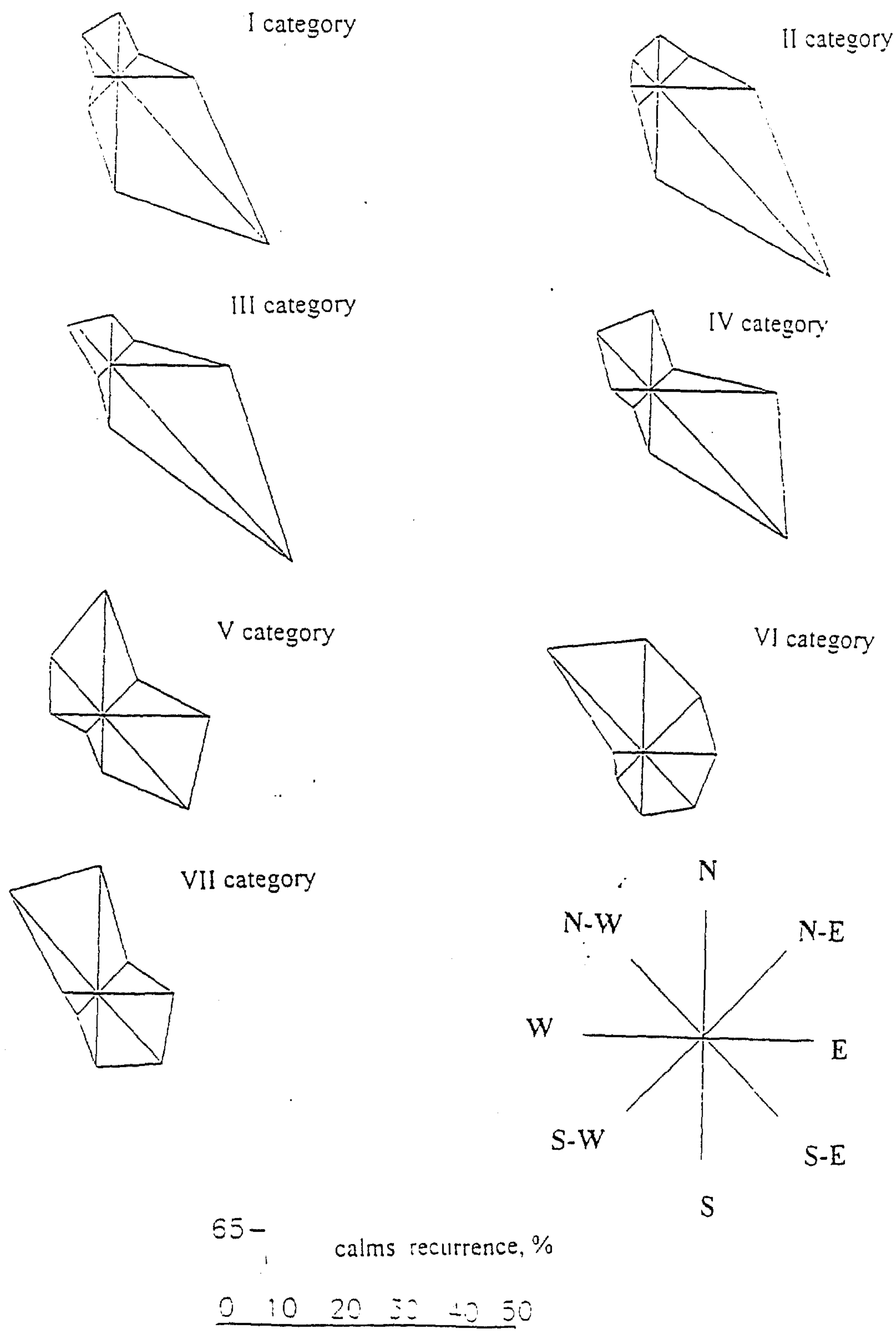
——— recurrence of wind directions,%

M 0 10 20 30 40 50

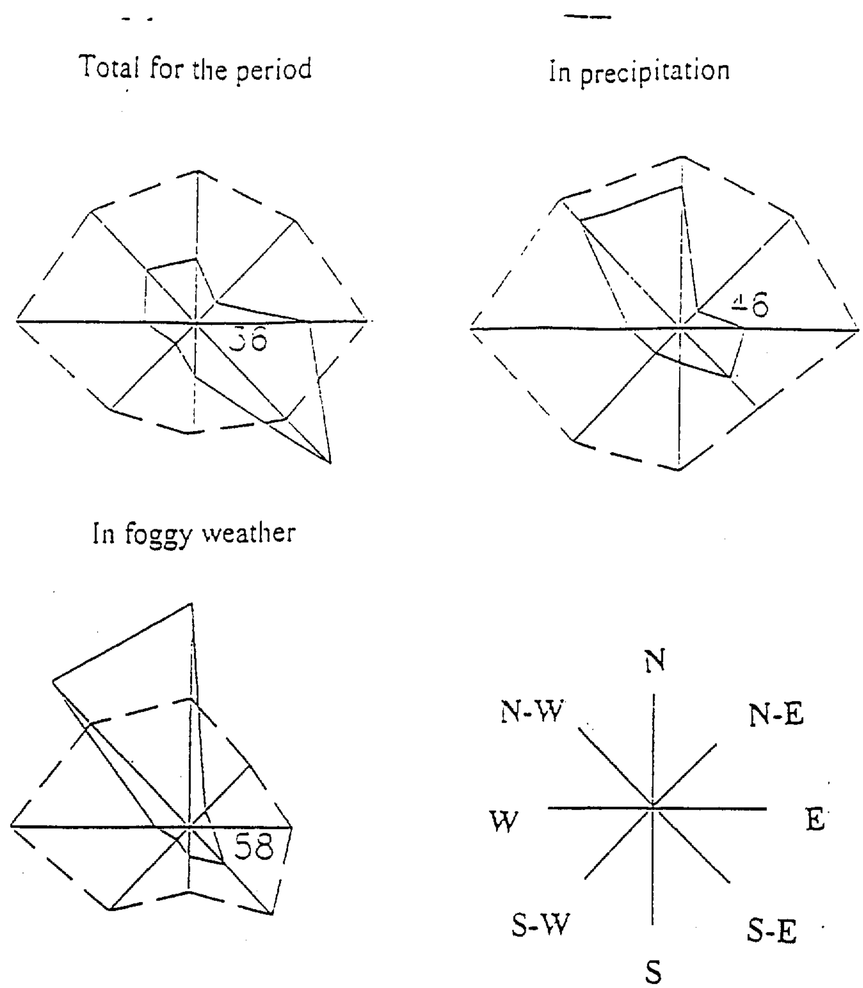
— — mean wind velocity by directions, m/sec

M 0 2 4 6 8 10

Wind rose under different categories of the atmosphere stability



Wind rose in foggy weather and in precipitation for the period from 09.1981 to 12.1986, m/cm. (Perepravnaja)



20 – calms recurrence, %

——— recurrence of wind directions,%

M 0 10 20 30 40 50

– – mean wind velocity by directions, m/sec

M 0 2 4 6 8 10

Appendix 8

Air Discharges of the Mostovsky District Enterprises.

Mostovsky District
1. 00253831 'Jyg' stock-company
1 Zavodskaja st., Mostovsky settl.

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	1571.4900000	1501.556000	1000.6770000	782.1890000	247.0733505000
1	untreated				561.2690000	145.1784085000
1	directed for treatment				12860.2800000	1133.9550000000
1	caught				12639.3600000	1032.0520500000
2	including solid agents	1369.4320000	1300.0370000	305.6210000	249.8460000	102.8360505000
2	untreated				28.9260000	0.933100500
2	directed for treatment				12860.280000	1133.955000000
2	caught				12639.360000	1032.052050000
110	vanadium (penta) oxide			0.6340000	0.0070000	0.005800000
123	welding spray			0.0480000	0.0480000	0.066100000
143	manganese and its compounds		0.1750000	0.0030000	0.0030000	0.000800000
184	lead					0.0003500000
328	carbon black (coke dust,ash)		4.5980000	4.4040000	0.4810000	0.1630000000
703	benzapyrene					0.0000005000
2930	abrasive dust			0.3380000	0.3380000	0.1580000000
2936	sawdust		1295.0900000	300.1930000	248.9690000	192.4420000000
4	gaseous and liquid agents	202.0580000	201.5190000	695.0560000	532.3430000	144.2373000000
4	untreated				532.3430000	144.2373000000
301	nitrogen oxides	19.2290000	19.2290000	139.8200000	137.8630000	21.1550000000
301	untreated					21.1550000000
330	sulfur dioxide	11.2630000	11.2630000	158.0550000	17.6370000	0.9480000000
330	untreated					0.9480000000
337	carbon monoxide	24.9070000	24.9070000	386.7680000	366.8520000	118.3340000000
337	untreated					118.3340000000
6	volatile organic compounds	135.6300000	135.4050000	3.9700000	3.5560000	0.5630000000
6	untreated					0.5630000000
620	styrol		5.2120000	0.0540000	0.0540000	0.0220000000
621	toluene		0.6510000			
1042	butyl alcohol		0.2490000			
1210	butyl acetate		0.1950000			
1213	vinyl acetate		115.6080000			
1240	ethyl acetate		0.1410000			
1325	formaldehyde		3.9360000	3.7680000	3.3690000	0.2360000000
1401	aceton		1.0740000			
2704	gasoline		8.3390000	0.1560000	0.1330000	0.3050000000
5	other gaseous and liquid agents	10.9240000	10.7490000	6.4350000	6.4350000	3.2365000000
5	untreated					3.2365000000
303	ammonia		10.7150000	6.4090000	6.4090000	3.2270000000
322	sulfuric acid		0.0340000	0.0260000	0.0260000	0.0095000000

2 0285004 'Kubansky Gypsum' stock company
Psebai settl., Mostovsky district

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	203.9240000	352.6390000	352.6400000	170.4360000	126.6886000000
1	untreated				142.2310000	91.4376000000
1	directed for treatment				2714.5400000	2514.5350000000
1	caught				2686.3850000	2479.2840000000
1	utilized				2614.3460000	
2	including solid agents	203.9240000	91.7690000	91.7690000	42.4860000	40.9261000000
2	untreated				14.2510000	5.6751000000
2	directed for treatment				2714.5400000	2514.5350000000
2	caught				2686.3850000	2479.2840000000
2	utilized				2614.3460000	
123	welding spray	0.5990000	0.0186000	0.0190000	0.0210000	0.0100000000
143	manganese and its compounds			0.0020000	0.0020000	0.0016000000
184	lead					0.0004000000
328	carbon black					0.2841000000
703	benzapyrene					0.0000000000
2902	dust of different origin					
2987	sand and gra··el dust	189.7180000	0.8461000	3.9660000	0.0460000	0.0250000000
2988	inorganic dust, containing		29.4323000	29.4590000		
2989	marble dust	40.2140000	3.9200000	3.9200000	2.9240000	2.1240000000
2914	gypsum dust		54.5410000	54.5410000	32.5550000	32.2510000000
2918	cement dust	54.3230000	0.0274000	0.0279000	0.0270000	0.0150000000
2936	sawdust		3.7816000	3.7816000	2.7030000	2.6940000000
5023	coal dust				0.460000	0.3240000000
5024	gypsum stone				3.668000	3.1890000000
4	gaseous and liquid agents		260.8680000	260.8710000	128.030000	85.7625000000
4	untreated				128.030000	85.7625000000
301	nitrogen oxides		25.8757000	25.8760000	12.3060000	11.5920000000
301	untreated					11.5920000000
330	sulfur dioxide		85.1675000	85.1680000	0.4340000	0.4694000000
330	untreated					0.4694000000
337	carbon monoxide		149.7560000	149.7560000	115.2200000	73.4355000000
337	untreated					73.4355000000
6	volatile organic compounds					0.1956000000
6	untreated					0.1956000000
2784	hydrocarbons					0.1956000000
5	other gaseous and liquid agents		0.0707000	0.0710000	0.0700000	0.0700000000
	untreated					0.0700000000
316	sulfuric acid			0.0710000		
342	hydrogen fluoride			0.0710000		0.0700000000

3 0864268

Jaroslavskaja RTP
184 Lenin st.,
Jaroslavskaja station,
Mostovsky district

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	8.8370000	8.8370000	6.6780000	0.1700000	
1	untreated				0.1700000	
2	including solid agents	0.8230000	0.8230000	0.6220000	0.0030000	
2	untreated				0.0030000	
150	sodium hydroxide		0.1980000	0.1490000		
328	carbon black			0.6220000	0.0030000	
4	gaseous and liquid agents	0.0140000	0.0140000	6.0560000	0.1670000	
4	untreated				0.1670000	
301	nitrogen oxides	0.4720000	0.4760000	0.3590000	0.0300000	
330	sulfur dioxide	2.8400000	2.8400000	2.1470000	0.8410000	
337	carbon monoxide	3.3110000	3.3110000	2.5030000	0.8960000	
6	volatile organic compounds	0.5000000	0.5000000	0.3780000		
2704	gasoline	0.5000000	0.5000000	0.3780000		
5	other gaseous and liquid agents	0.8910000	0.1980000	0.1490000		
2705	mineral oil		0.6890000	0.5200000		

4 1006354

Mostovsky mill-sorting plant industrial zone, Mostovsky settl.

agent code	agent descriptiom	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	145.0750000	141.3170000	81.2500000	33.3420000	25.7189262000
1	untreated				27.8800000	17.3859262000
1	directed for treatment				222.1340000	28.6120000000
1	caught				216.6720000	28.2790000000
2	including solid agents	67.1050000	72.7000000	50.7100000	17.5640000	13.7239262000
2	untreated				12.1020000	5.3989262000
2	directed for treatment				222.1340000	28.6120000000
2	caught				216.6720000	20.2790000000
110	vanadium (penta) oxide		0.0530000	0.0100000	0.0130000	0.0031690000
123	welding spray		0.2950000	0.2310000	0.1620000	0.0482900000
143	manganese and its compounds		0.0330000	0.0240000	0.0170000	0.0072060000
184	lead					0.0002600000
328	carbon black (coke dust,ash)		5.2140000	1.4000000	0.9800000	0.4490000000
703	benzapyrene					0.0000012000
2902	paint spray					0.0080000000
2903	ash					0.4140000000
2907	inorganic dust		67.1050000	57.8450000	16.3920000	12.5460000000
2918	cement dust					0.2480000000
4	gaseous and liquid agents	74.2450000	68.6170000	22.5400000	15.7780000	11.9950000000
4	untreated				15.7780000	11.9950000000
301	nitrogen oxides	1.8340000	1.8340000	0.6270000	0.4390000	0.9710000000
301	untreated					0.9710000000
330	sulfur dioxide	39.1860000	39.6170000	12.8100000	8.9670000	7.0480000000
330	untreated					7.0480000000
337	carbon monoxide	27.3990000	27.3990000	8.9360000	6.2550000	3.7570000000
337	untreated					3.7570000000
6	volatile organic compounds			0.1670000	0.1170000	0.2190000000
6	untreated					0.2190000000
1401	aceton					0.0080000000
2704	gasoline		0.1980000	0.1670000	0.1170000	0.2110000000
5	other gaseous and liquid agents					
5	untreated					

5 3091551

Psebaiskie GATP
1 Pervomajskaja st.,
Psebai settl.,
Mostovsky district

agent code	agent description	discharges, (tons per year)				
		1990	1991	1992	1993	1994
1	Total	10.5120000	9.8890000	12.8000000	17.3460483	3.1075647000
1	untreated				17.3460000	3.1075647000
2	including solid agents	1.7720000	1.4730000	1.9700000	8.7080003	8.4785367000
2	untreared				8.7080000	8.4785367000
110	vanadium (penta) oxide				0.0050000	0.0037000000
123	welding dust				0.0080000	0.000690000
143	manganese				0.0010000	0.000897000
184	lead				0.0010000	0.000056000
328	carbon black (coke dust,ash)				0.0680000	0.439000000
703	benzapyrene				0.0000003	0.000001000
2902	ash				8.6250000	0.835000000
2908	inorganic dust		1.4700000	1.9700000		
4	gaseous and liquid agents	8.7180000	8.4160000	10.8300000	8.6380400	2.629028000
4	untreated				8.6380400	2.629028000
301	nitrogen oxides	0.3000000	0.1330000	0.3000000	0.3360000	0.246000000
301	untreated					0.246000000
330	sulfur dioxide	7.1220000	6.8550000	8.870000	5.5400000	0.954000000
330	untreated					0.954000000
337	carbon monoxide	1.4800000	1.4280000	1.660000	2.2470000	1.243000000
337	untreated					1.243000000
6	volatile organic compounds				0.5150000	0.186000000
6	untreated					0.186000000
2784	hydrocarbons				0.5150000	0.186000000
5	other gaseous and liquid agents					0.0000280000
5	untreated					0.0000280000
322	sulfuric acid				0.0009400	0.0000280000

6 3504831

Mostovskoe PTS
32 Sovetskaja st.,
Mostovsky settl.

agent code	agent description	discharges, (tons per year)				
		1990	1991	1992	1993	1994
1	Total	2.5470000	24.8200000	24.3900000	24.4130000	24.5187595000
1	untreated				24.4130000	24.5187595000
2	including solid agents	0.9490000	3.1700000	3.0800000	3.0480000	3.0640095000
2	untreared				3.0480000	3.0640095000
123	welding spray					0.0842480000
143	manganese					0.0005520000
184	lead					0.0000450000
328	carbon black					0.0001645000
703	benzapyrene		3.1700000	3.0800000	3.0480000	3.0590000000
2903	ash	1.5980000	21.6500000	21.3100000	21.3650000	21.4547500000
4	gaseous and liquid agents				21.3650000	21.4547500000
4	untreated					
301	nitrogen oxides	1.3240000	1.5900000	1.5800000	1.5860000	1.4497000000
301	untreated					1.4497000000
330	sulfur dioxide	0.0820000	5.1900000	5.0700000	5.0110000	5.0994000000
330	untreated					5.0994000000
337	carbon monoxide	0.1920000	14.8700000	14.6600000	14.7600000	14.8905000000
337	untreated					14.8905000000
6	volatile organic compounds					0.0151500000
6	untreated					0.0151500000
2784	hydrocarbons					0.0151500000

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7 5132332

Mostovskoe DRSU
2 Nabereznaja st.,
Mostovsky district

agent code	agent description	discharges, (tons per year)				
		1990	1991	1992	1993	1994
1	Total	208.5800000	43.3810000	22.5340000	21.8114000	34.4456792000
1	untreated				21.8114000	34.4456792000
2	including solid agents	192.0470000	37.2880000	19.8020000	13.2722000	12.8662802000
2	untreared				13.2722000	12.8662802000
110	vanadium (penta) oxide				0.1460000	0.0064150000
123	metal dust				0.0300000	0.0165800000
143	manganese dioxide				0.0810000	0.0007896000
184	lead					0.0002800000
323	silicon compounds				0.0002000	0.0004900000
328	carbon black (coke dust,ash)	105.3200000	3.1400000	1.5700000	0.9840000	0.0720700000
343	fluorides				0.0010000	0.0003520000
703	benzapyrene					0.0000006000
2908	inorganic dust				12.1100000	12.7492200000
2909	inorganic dust, containing	86.7270000	34.1480000	18.2320000		
2930	abrasive dust					0.0281630000
4	gaseous and liquid agents	16.5330000	6.0930000	2.7320000	8.5392000	21.5793990000
4	untreated				8.5392000	21.5793990000
301	nitrogen oxides	2.7550000	1.0000000	0.5210000	0.5210000	1.4131700000
301	untreated					1.4131700000
330	sulfur dioxide	3.3060000	0.9500000	0.4930000	1.4180000	3.6612800000
330	untreated					3.6612800000
337	carbon monoxide	0.2660000	1.8470000	0.9620000	3.1450000	6.4570100000
337	untreated					6.4570100000
6	volatile organic compounds		2.2320000	0.5080000	3.4100000	9.9281930000
6	untreated					9.9281930000
602	benzene		0.0440000	0.0230000	0.0700000	0.2705790000
616	xylene		0.3500000	0.3500000	0.5060000	1.6877700000
621	toluene			0.1320000	0.4310000	1.4659770000
1871	phenol					0.0109980000
1325	formaldehyde					0.0101480000
1401	aceton		0.0060000	0.0030000	0.0130000	0.0492890000
2784	hydrocarbons				2.3820000	6.4255200000
5	other gaseous and liquid agents		0.0640000	0.0330000	0.0452000	0.1277460000
5	untreated					0.1277460000
333	hydrogen sulfide		0.0640000	0.0330000	0.0450000	0.1277460000
342	hydrogen fluoride				0.0002000	
2735	mineral oil		1.4440000	0.2150000		

8 5293816

**Psebai Plant of
Construction Materials
1 Privokzalnaja st.,
Schedok settl., Mostovsky
district**

agent code	agent description	discharges, (tons per year)				
		1990	1991	1992	1993	1994
1	Total	257.3500000	144.6410000	171.9150000	11.3640000	1.7458050000
1	untreated				11.3640000	1.7458050000
2	including solid agents	121.1660000	59.6020000	86.5420000	9.3160000	1.7227050000
2	untreared				9.3160000	1.7227050000
123	welding spray		0.0010000	0.0010000		0.0007000000
128	lime dust				1.6900000	
143	manganese					0.0000050000
328	carbon black (coke dust,ash)			26.9290000	1.2820000	
2908	crushed stone dust		35.4930000	35.4930000	6.3440000	1.7220000000
2909	inorganic dust, containing		24.1090000	24.1090000		
4	gaseous and liquid agents	136.1840000	85.0390000	85.3730000	2.0480000	0.0231000000
4	untreated				2.0480000	0.0231000000
301	nitrogen oxides	9.7800000	2.0250000	2.0250000	0.0010000	
301	untreated					
330	sulfur dioxide	95.7600000	41.4700000	41.4700000	0.0700000	
330	untreated					
337	carbon monoxide	30.6440000	41.5360000	41.5360000	1.9770000	
337	untreated					
6	volatile organic compounds			0.3330000		0.023000000
6	untreated					0.023000000
2704	gazoline			0.3330000		0.023000000
5	other gaseous and liquid agents			0.0010000		0.0001000000
5	untreated					0.0001000000
342	fluoride gaseous compounds			0.0020000		0.0001000000

Appendix 9

Air Discharges of the Labinsky District Enterprises.

Town of Labinsk

9 0237804 'Formetall' stock-company
10 Kotovskogo st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	27.7690000	25.9070000	23.0070000	4.3420000	13.4942421000
1	untreated				17.2570000	12.7762421000
1	directed for treatment				6.3830000	4.7860000000
1	caught				5.4250000	4.8680000000
1	salvaged				0.0250000	
2	including solid agents	1.6480000	4.3070000	3.9130000	3.6620000	2.7942621000
2	untreated				2.7640000	2.0762621000
2	directed for treatment				6.3830000	4.7860000000
2	caught				5.4250000	4.0680000000
2	salvaged				0.0250000	
123	welding spray	0.0130000	2.6130000	2.6130000	2.5110000	1.8820000000
143	manganese and its compounds	0.0610000	0.0650000	0.0610000		0.0450000000
150	sodium hydroxide	0.0150000	0.0150000	0.0090000		
184	lead					0.0000720000
283	chromium oxide		0.0003600			
328	carbon black (coke dust,ash)	0.0490000	0.0480000	0.0480000	0.0080000	0.0093900000
703	benzapyrene					0.0000001000
2907	non-organic dust, containing	0.3670000				
2930	abrasive dust	0.0220000		0.0040000	0.0040000	0.6030000000
2936	sawdust		0.3450000	0.3380000	0.3300000	0.2480000000
5016	sodium triphosphate		0.0170000	0.0170000	0.0010000	0.0000000000
5023	graphitic dust	0.0160000	1.1920000	0.0050000	0.0050000	0.0040000000
5041	titanium nitride		0.0440000	0.0440000	0.0030000	0.0020000000
4	gaseous and liquid agents	26.1210000	21.6000000	19.9740000	0.6000000	10.6999800000
4	untreated				14.4930000	10.6999800000
301	nitrogen oxides	6.8420000	4.2030000	4.2030000		3.1690000000
301	untreated					3.1690000000
330	sulfur dioxide					0.0046800000
330	untreated					0.0046800000
337	carbon monoxide	14.9920000	15.5710000	14.9910000		6.9780000000
337	untreated					6.9780000000
6	volatile organic compounds	0.0750000	0.2630000	0.2120000	0.1740000	0.1603000000
6	untreated					0.1603000000
1061	ethyl alcohol		0.0870000	0.0870000	0.00870000	0.0650000000
1325	formaldehyde	0.0080000	0.0140000	0.0050000		

1555	acetic acid	0.0670000	0.0750000	0.0330000		
2704	gasoline		0.0870000	0.0870000	0.0070000	0.0953000000
5	other gaseous and liquid agents	4.2070000	0.0640000	0.0530000	0.5060000	0.3880000000
5	untreated					0.3880000000
302	nitric acid	0.0020000	0.0020000	0.0020000	0.0020000	0.0015000000
316	hydrychloric acid	2.0030000	0.0040000	0.0040000	0.0040000	0.0030000000
322	sulfuric acid	0.0110000	0.0110000	0.0100000		0.0080000000
342	gaseous fluorides	0.0090000	0.0100000	0.0060000	0.0060000	0.0045000000
348	phosphoric acid	0.1010000	0.0050000	0.0050000		
2735	mineral oil	0.0090000	0.0100000			0.3710000000

10 0255383 "Labinsky wood-working plant" stock company 4 Mejdunarodnaya st., town of Labinsk

agent code	agent description	discharges (tns per year)				
		1990	1991	1992	1993	1994
1	TOTAL	50.7370000	50.7400000	7.2950000	29.6760000	13.5590573000
1	untreated				26.2140000	10.7250573000
1	directed for treatment				43.1020000	28.5240000000
1	caught				39.6400000	25.6900000000
2	including solid agents	30.4960000	30.4990000	19.1530000	12.1030000	6.4310573000
2	untreated				8.6410000	3.5970573000
2	directed for treatment				43.1020000	28.5240000000
2	caught				39.6400000	25.6900000000
123	welding spray					0.0000020000
143	manganese					0.0000003000
184	lead					0.0000530000
328	carbon black			3.2550000		0.0010028000
2902	ashes		2.8070000	15.8980000	2.4770000	0.8500000000
2936	sawdust		27.6920000		9.6260000	5.5800000000
4	gaseous and liquid agents	20.2410000	20.2410000	18.1420000	17.5730000	7.1280000000
4	untreated				17.5730000	7.1280000000
301	nitrogen oxides	1.4280000	1.4280000	1.1570000	0.9640000	0.4220000000
301	untreated					0.4220000000
330	sulfur dioxide	0.0590000	0.0590000	0.0480000	0.0010000	0.0006000000
330	untreated					0.0006000000
337	carbon monoxide	18.7540000	18.7540000	16.9370000	16.6880000	6.6860000000
337	untreated					6.6860000000
6	other gaseous and liquid agents					0.0194000000
6	untreated					0.0194000000
2704	hydrocarbons					0.0194000000

11 0335493 "Labinsky sugar refinery" stock company
4 Frunze st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	302.9000000	294.1980000	294.1980000	120.2778400	138.2280964000
1	untreated				118.4280000	128.7821964000
1	directed for treatment				102.6880000	86.5634000000
1	caught				100.8390000	85.1175000000
2	including solid agents	179.4000000	146.7430000	146.7430000	2.2590000	1.5281264000
2	untreated				0.4100000	0.0822264000
2	directed for treatment				102.6880000	86.5634000000
2	caught				108.8390000	85.1175000000
123	welding spray				0.0400000	0.0382000000
128	lime dust				0.2840000	0.0220000000
143	manganese				0.0040000	0.0047000000
184	lead		0.0004000	0.0004000		0.0001260000
328	carbon black			0.1080000	0.0820000	0.0172000000
703	benzapyrene					0.0000004000
2902	bagasse dust			146.3510000	1.8490000	1.4459000000
2908	inorganic dust, containing			0.2840000		
4	gaseous and liquid agents	623.5000000	147.4550000	147.4550000	118.0180400	128.6999700000
4	untreated				118.0180000	128.6999700000
301	nitrogen oxides	35.4000000	56.4900000	56.4900000	52.1080000	32.3165000000
301	untreated					32.3165000000
330	sulfur dioxide	113.2000000	90.0000000	90.0000000	63.0800000	16.0057000000
330	untreated					16.0057000000
337	carbon monoxide	474.9000000	0.8750000	0.8750000	0.1280000	80.1053000000
337	untreated					80.1053000000
6	volatile organic compounds				2.7020000	0.2721000000
6	untreated					0.2721000000
621	toluene				1.4810000	0.0888000000
1042	butyl alcohol				0.4950000	0.0296000000
1061	ethyl alcohol				0.4950000	0.0296000000
1119	ethyl Cellosolve					0.0158000000
1210	butyl acetate					0.0197000000
1401	acetone				0.2310000	0.0138000000
2704	hydrocarbons					0.0748000000
5	other gaseous and liquid agents		0.0020000	0.0020000	0.0000400	0.0003700000
5	untreated					0.0003700000
383	ammonia		0.0020000	0.0020000	0.0000400	0.0003700000

12 0336638 "Labinsky oil mill" joint-stock company" (oil mill No 5) 100 Krasnaja st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	228.2480000	432.5600000	168.1020000	167.9800000	100.5117882000
1	untreated				53.1320000	90.1957802000
1	directed for treatment				565.5750000	257.9260000000
1	caught				450.7270000	247.6180000000
1	utilized				450.7270000	
2	including solid agents	45.7410000	8.1330000	19.1200000	10.1650000	72.8666802000
2	untreated				5.7420000	62.5506802000
2	directed for treatment				110.5750000	257.9260000000
2	caught				106.1520000	247.6100000000
2	utilized				106.1520000	
118	vanadium (V) oxides					0.0010000000
123	welding spray					0.2650000000
143	manganese oxides					0.0460000000
184	lead					0.0001800000
323	silicon compounds					0.0003000000
328	carbon black		4.9550000	4.9520000		60.2230000000
344	fluoride compounds					0.0003000000
703	benzapyrene					0.0000002000
2902	ashes				4.8140000	
2908	inorganic dust	6.3250000				
2936	sawdust					0.1870000000
2937	grain dust	39.4160000	3.1780000	15.3150000	5.3510000	12.1439000000
4	gaseous and liquid agents	182.5870000	412.2700000	140.9820000	157.8150000	27.6451000000
4	untreated				47.3900000	27.6451000000
4	directed for treatment				455.0000000	
4	caught				344.5750000	
4	utilized				344.5750000	
301	nitrogen oxides	19.0280000	6.1960000	1.3300000	0.4130000	13.3410000000
301	untreated					13.3410000000
330	sulfur dioxide		12.2400000	0.1150000	0.0650000	0.1560000000
330	untreated					0.1560000000
337	carbon monoxide	57.0290000	52.5640000	13.7840000	42.2850000	5.9560000000
337	untreated					5.9560000000
6	volatile organic compounds	106.3930000	353.4270000	125.7530000	115.0520000	8.1916000000

6	untreated					3.1916000000
602	benzol		6.8240000	2.4290000	2.2440000	0.0050000000
621	toluene		0.5590000	0.1990000	0.1840000	0.0030000000
1301	acrolein		0.0900000	0.0280000		0.0004000000
1325	formaldehyde	14.9500000				
2704	gazoline	85.6930000	342.5830000	121.9500000	112.6240000	8.1680000000
2752	white spirit	5.7500000	3.3710000			0.0152000000
5	other gaseous and liquid agents					0.0005000000
5	untreated					0.0005000000
322	sulfuric acid					0.0003000000
342	hydrogen fluoride					0.0002000000

13 0337862 **Labinsky cannery**
108 Krasnaja st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	21.8000000	26.8840000	26.8860000	25.3431002	11.8738002000
1	untreated				25.3430000	11.8738002000
2	including solid agents	1.5800000	0.2790000	0.2810000	0.0441002	0.0708002000
2	untreated				0.0440000	0.0708002000
123	welding spray		0.0130000	0.0130000	0.0370000	0.0670000000
143	manganese and its compounds		0.0010000	0.0010000	0.0040000	0.0004000000
184	lead		0.0004400		0.0001000	0.0001000000
328	carbon black	1.5800000			0.0030000	0.0033000000
703	benzapyrene				0.0000002	0.0000002000
2902	organic dust			0.2670000		
2930	abrasive dust		0.2650000			
2936	sawdust		0.0001000			
4	gaseous and liquid agents				25.2990000	11.8030000000
4	untreated				25.2990000	11.8030000000
301	nitrogen oxides	17.8200000	6.0660000	6.0660000	5.0660000	3.2840000000
301	untreated					3.2840000000
330	sulfur dioxide					0.0050000000
330	untreated					0.0050000000
337	carbon monoxide	2.4000000	20.5350000	20.5350000	18.4160000	8.4550000000
337	untreated					8.4550000000
6	volatile organic compounds				1.8170000	0.0570000000
6	untreated					0.0570000000
621	toluene				0.7870000	
1042	butyl alcohol				0.2620000	
1061	ethyl alcohol				0.2620000	
1210	butyl acetate				0.1750000	
1240	ethyl acetate				0.1400000	
1401	acetone				0.1220000	
1555	acetic acid				0.0160000	0.0080000000
2784	fuel vapour				0.0530000	0.0490000000
5	other gaseous and liquid agents		0.0040000	0.0040000		0.0020000000
5	untreated					0.0020000000
342	gaseous fluorides		0.0040000	0.0040000		0.0020000000

14 0433667 **"Cheese-maker" stock company (Dairy) Northern industrial zone, town of Labinsk**

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	53.7060000	1.7230000	2.7460000	3.4487002	5.9121006000
1	untreated				3.4480000	5.9121006000
2	including solid agents		0.0040000	0.0040000	0.0233002	1.3246006000
2	untreated				0.0230000	1.3246006000
123	welding spray		0.0040000	0.0040000	0.0100000	0.0100000000
143	manganese and its compounds		0.0002000	0.0002000	0.0010000	0.0010000000
184	lead				0.0003000	0.0006000000
328	carbon black				0.0090000	1.2640000000
343	fluorides			0.0006000	0.0010000	0.0010000000
703	benzapyrene				0.0000002	0.0000006000
2902	organic dust				0.0020000	0.0400000000
2908	inorganic dust (Si 20 - 70%)			0.0034000		
4	gaseous and liquid agents	53.7060000	1.7190000	2.7420000	3.4250000	4.5865000000
4	untreated				3.4250000	4.5865000000
301	nitrogen oxides	15.7030000	0.4880000	0.9780000	1.0110000	1.0440000000
301	untreated					1.0440000000
330	sulfur dioxide	2.5000000			0.0300000	0.0080000000
330	untreated					0.0080000000
337	carbon monoxide	35.5030000	0.5340000	1.0690000	1.5700000	2.5210000000
337	untreated					2.5210000000
6	volatile organic compounds				0.1147000	0.3152000000
6	untreated					0.3152000000
616	xylene				0.0210000	0.0470000000
621	toluene				0.0020000	0.0020000000
1042	butyl alcohol				0.0010000	0.0010000000
1119	ethyl Cellosolve				0.0003000	0.0004000000
1210	butyl acetate				0.0004000	0.0004000000
1401	acetone				0.0050000	0.0004000000
2704	fuel vapour				0.0850000	0.2640000000
5	other gaseous and liquid agents		0.6960000	0.6950000	0.6993000	0.6983000000
5	untreated					0.6983000000
303	ammonia		0.6930000	0.6930000	0.6930000	0.6930000000
316	hydrogen chloride		0.0020000			
322	sulfuricic acid				0.0040000	0.0030000000
342	hydrogen fluoride		0.0010000	0.0001000	0.0003000	0.0003000000
349	chlorine			0.0022000	0.0020000	0.0020000000

15 0863992

Labinskaja RTP
20 Chalturina st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	1.8470000	6.8170000	5.1070000		0.6015541000
1	untreated					0.5484141000
1	directed for treatment					0.2461000000
1	caught					0.1929600000
2	including solid agents	0.0260000	2.4180000	1.8090000		0.0885241000
2	untreated					0.0353841000
2	directed for treatment					0.2461000000
2	caught					0.1929600000
123	welding spray	0.0150000		0.0150000		0.0013600000
128	calcium oxide					0.0027600000
129	calcium carbide					0.0274300000
143	manganese and its compounds		0.0180000	0.0030000		0.0001300000
184	lead and its compounds	0.0110000	0.0010000	0.0010000		0.0005730000
203	chromium oxide					0.0000010000
328	carbon black					0.0005100000
703	benzapyrene					0.0000001000
2902	paint spray	0.3000000		0.3000000		
2907	inorganic dust containing			0.0900000		
2930	abrasive dust		0.9750000	0.0900000		0.0027600000
2936	sawdust		1.4000000	1.4000000		0.0530000000
4	gaseous and liquid agents	2.8000000	1.8210000	3.2980000		0.5130300000
4	untreated					0.5130300000
301	nitrogen oxides	0.1800000	0.1810000	0.1810000		0.0270800000
301	untreated					0.0270800000
330	sulfur dioxide		0.3400000	0.0010000		0.0018900000
330	untreated					0.0018900000
337	carbon monoxide		0.5700000	0.5700000		0.3910300000
337	untreated					0.3910300000
6	volatile organic compounds	0.4300000	2.8380000	2.5420000		0.0938300000
6	untreated					0.0938300000
616	xylene					0.0513300000
621	toluene					0.0213000000
1042	butyl alcohol					0.0042000000

1061	ethyl alcohol				0.0064000000
1119	ethyl Cellosolve				0.0034000000
1210	butyl acetate				0.0042000000
1314	propionic aldehyde		0.4070000	0.4070000	
1401	acetone	0.1050000	0.1050000		0.0030000000
2704	gazoline		0.3250000	2.0300000	
5002	solvent R646 (by toluene)			0.1050000	
5	other gaseous and liquid agents	0.3010000	0.0010000	0.0010000	
5	untreated				
322	sulfuric acid		0.0010000	0.0010000	
2735	petroleum mineral oil			0.0030000	

16	0940673	"Labinsky elevator" stock company 177 Pobedy st., town of Labinsk				
agent code	**agent description**	**discharges (tons per year)**				
		1990	**1991**	**1992**	**1993**	**1994**
1	TOTAL	86.8760000	84.1689000	295.2100000	145.6830000	180.3630001000
1	untreated				79.3620000	114.0420001000
1	directed for treatment				893.0630000	893.0630000000
1	caught				826.7420000	826.7420000000
2	including solid agents	84.1140000	80.1720000	233.9030000	97.6540000	123.7560001000
2	untreated				31.3330000	57.4350001000
2	directed for treatment				893.0630000	893.0630000000
2	caught				826.7420000	826.7420000000
123	welding spray			0.0010000	0.0110000	0.0130000000
143	manganese and its compounds			0.0009000	0.0010000	0.0010000000
184	lead					0.0010000000
323	silicon oxides			0.0013000	0.0010000	0.0010000000
328	carbon black (coke dust, ashes)			0.0080000	0.0070000	0.0080000000
344	slightly soluble fluoride compounds			0.0014000	0.0040000	0.0040000000
703	benzapyrene					0.0000001000
2907	inorganic dust containing			0.1880000		
2930	abrasive dust			0.1880000	0.0960000	0.1880000000
2936	sawdust			0.7180000	0.6990000	0.7180000000
2937	grain dust	80.7040000	84.1250000	202.8750000	86.0630000	101.2800000000
5045	meal dust				10.7720000	21.5420000000
4	gaseous and liquid agents	3.9019000	3.9969000	61.3070000	40.0290000	56.6070000000
4	untreated				40.0290000	56.6070000000
301	nitrogen oxides	0.0510000	0.0340000	11.9720000	10.1630000	11.9720000000
301	untreated					11.9720000000
330	sulfur dioxide			0.6750000	0.5730000	0.6750000000
330	untreated					0.6750000000
337	carbon monoxide	0.0290000	0.0250000	41.1190000	34.9510000	41.1190000000
337	untreated					41.1190000000
6	volatile organic compounds			6.6380000	1.5160000	1.9350000000
6	untreated					1.9350000000
807	methyl bromide	0.3560000	1.7640000	1.0167000	0.0120000	0.0170000000
878	metallyl	0.5400000	0.5300000	1.7250000		

	chloride					
1722	tetramethylt hiuramdidis ulfide	2.9140000	0.0190000	0.0008000	0.0040000	0.0190000000
2110	Malathion insecticide	1.7720000	1.6400000	0.1450000		
2704	gazoline		0.0070000	3.7340000	1.5000000	1.8990000000
5	other gaseous and liquid agents	2.6760000	0.9030000	0.9030000	0.0260000	0.9060000000
5	untreated					0.9060000000
333	hydrogen sulfide			0.9020000	0.8220000	0.9020000000
342	gaseous fluorides			0.0013000	0.0040000	0.0040000000
2735	petroleum mineral oil			0.2100000		

18 2959728

"Chemist" stock company
(Chemical facility Labinsk)
64 Chimicheskaya st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	610.0870000	421.8400000	316.0280000	171.7790000	113.8500000760
1	untreated				171.5810000	113.4730000760
1	directed for treatment				2.9630000	6.0240000000
1	caught				2.7650000	5.6470000000
2	including solid agents	6.2330000	3.1150000	3.3510000	2.1350000	1.7890000760
2	untreated				1.9660000	1.4340000760
2	directed for treatment				2.8240000	5.9170000000
2	caught				2.6550000	5.5620000000
123	welding spray					0.0130000000
134	metal cobalt (spray)	0.0230000	0.0190000	0.0120000	0.0040000	0.0060000000
143	manganese and its compounds	0.0290000	0.0280000	0.0170000	0.0070000	0.0050000000
150	sodium hydroxide	0.0030000	0.0030000	0.0030000	0.0030000	0.0020000000
184	lead and its compounds	0.0190000	0.0100000	0.0080000	0.0040000	0.0030000000
207	zinc and its compounds (spray)	0.5730000	0.2040000	0.2370000	0.0770000	0.0330000000
328	carbon black (coke dust, ashes)	1.5990000	0.1470000	1.1950000	0.1880000	0.1400000000
344	fluorides					0.0010000000
703	benzapyrene					0.0000000760
2902	organic dust		0.4620000			
2907	inorganic dust					0.0010000000
2908	inorganic dust, containing	3.9900000	1.3520000	0.3620000	0.1700000	0.2500000000
2914	gypsum dust		0.1950000	0.5410000	0.9550000	0.7370000000
2936	sawdust			0.1740000	0.3010000	0.3550000000
5023	coal dust		0.6210000	0.0050000	0.4260000	0.2430000000
4	gaseous and liquid agents	603.0540000	418.7250000	312.6770000	169.6440000	112.0610000000
4	untreated				169.6150000	112.8390000000
4	directed for treatment				0.1390000	0.1070000000
4	caught				0.1100000	0.0850000000
301	nitrogen oxides	23.1650000	16.6040000	15.2950000	12.0480000	12.9970000000
301	untreated					12.9970000000
330	sulfur dioxide	174.2450000	112.1060000	73.0450000	46.4280000	2.9170000000
330	untreated					2.9170000000
337	carbon monoxide	368.1310000	266.3500000	195.0370000	98.4100000	76.4250000000
337	untreated					76.4250000000
6	volatile organic compounds	19.0930000	23.6610000	29.2960000	20.7280000	19.6990000000
6	untreated					19.6990000000

516	isoprene (2-methylbutadiene-1,3)	0.0970000	0.0530000	0.0950000	0.0350000	0.0480000000
1042	isobutyl alcohol	0.3410000	0.3370000	0.3410000	0.3410000	0.3410000000
1061	ethyl alcohol	0.0050000	0.0040000	0.0040000	0.0050000	0.0030000000
1301	acrolein	0.2470000	0.2280000	0.1300000	0.0040000	0.0600000000
2704	gazoline	0.3510000	0.3510000	0.3510000	10.4890000	6.4450000000
2748	turpentine	1.0750000	0.7950000	0.3430000	0.3210000	0.3540000000
2750	solvent-nahptha		6.9750000	8.8300000		
2752	white spirit	16.8070000	11.1480000	10.1500000	9.4530000	12.4480000000
5001	nephras (mixture of aromatic hydrocarbons)		3.7490000	9.0300000		
5	other gaseous and liquid agents	0.0250000	0.0040000	0.0040000	0.0220000	0.0230000000
5	untreated					0.0230000000
322	sulfuric acid	0.0010000	0.0010000	0.0010000	0.0010000	0.0010000000
342	hydrogen fluoride					0.0010000000
1078	ethylene glycol	0.0090000	0.0090000	0.0090000	0.0090000	0.0090000000
5022	glycerol	0.0120000	0.0120000	0.0120000	0.0120000	0.0120000000

19 3091180 "Krasnodaravtotrans" (a/c 1197)
91 Leontieva st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	7.7360000	14.3280000	13.1560000	6.7701340	8.9206591000
1	untreated				6.7700000	8.9206591000
1	directed for treatment					
1	caught					
2	including solid agents		0.5100000	0.8020000	0.1780078	0.2902025000
2	untreated				0.1780000	0.2902025000
2	directed for treatment					
2	caught					
123	welding spray			0.4650000	0.0570000	0.0520000000
123	metal dust			0.0020000		
143	manganese and its compounds		0.0070000	0.0050000	0.0060000	0.0062000000
184	lead and its compounds		0.0030000	0.0020000	0.0010000	0.0010000000
328	carbon black (coke dust, ashes)		0.2880000	0.2160000	0.0750000	0.1878000000
703	benzapyrene				0.0000078	0.0000025000
2902	paint spray		0.1470000	0.1070000	0.0330000	
2930	abrasive dust			0.0020000	0.0020000	0.002100000
2936	sawdust		0.0100000	0.0030000	0.0040000	0.04110000
4	gaseous and liquid agents	7.7360000	13.8180000	12.3540000	6.5921270	0.6304566000
4	untreated				6.5920000	0.6304566000
301	nitrogen oxides		1.6370000	1.1050000	1.1050000	1.1967000000
301	untreated					1.1967000000
330	sulfur dioxide		0.3840000	0.3170000	0.3170000	0.1330000000
330	untreated					0.1330000000
337	carbon monoxide	6.6310000	8.2270000	6.6310000	3.2860000	4.3169000000
337	untreated					4.3169000000
6	volatile organic compounds	1.1050000	3.5700000	4.3010000	1.8840000	2.9830000000
6	untreated					2.9830000000
621	toluene		0.6960000	0.5220000	0.6950000	0.6950000000
1042	isobutyl alcohol			0.3010000		
1061	ethyl alcohol			0.2190000		
1119	ethyl Cellosolve			0.0840000		
1218	buthyl acetate		0.4290000	0.3220000	0.4280000	
1401	acetone		0.1160000	0.9780000	0.1160000	0.0245000000
2704	gazoline	1.1050000	2.3290000	1.8750000	0.6450000	2.2630000000
5	other gaseous and liquid agents					0.0000566000
5	untreated					0.0000566000
322	sulfuric acid				0.0001270	0.0000566000

20 5142419

Labinskaya a/c 1492
18 Chalturina st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	6.1320000	11.3250000	2.2780000	7.0770457	6.4734071000
1	untreated				7.0770000	6.4734071000
2	including solid agents	0.4060000	1.1070000	0.1700000	0.0180027	0.4154071000
2	untreated				0.0180000	0.4154071000
123	welding dust		0.0330000		0.0080000	0.0480000000
143	manganese and its compounds				0.0010000	0.0070000000
184	lead and its compounds				0.0010000	0.0004000000
328	carbon black (coke dust, ashes)		0.3230000		0.0080000	0.0240000000
703	benzapyrene				0.0000027	0.0000071000
2902	welding spray					0.0200000000
2908	inorganic dust, containng		0.1470000	0.1700000		
2930	abrasive dust					0.3160000000
4	gaseous and liquid agents	5.7260000	10.2180000	2.1080000	7.0590430	6.0580000000
4	untreated				7.0590000	6.0580000000
301	nitrogen oxides	0.7440000	1.0730000	0.6880000	1.0710000	0.3580000000
301	untreated					0.3580000000
330	sulfur dioxide	0.3020000	0.0450000	0.0900000	0.1120000	0.1280000000
330	untreated					0.1280000000
337	carbon monoxide	4.6800000	7.3170000	1.3300000	5.3610000	4.7450000000
337	untreated					4.7450000000
6	volatile organic compounds		1.7830000		0.5150000	0.8240000000
6	untreated					0.8240000000
1042	butyl alcohol					0.0190000000
1061	ethyl alcohol					0.0190000000
1119	ethyl Cellosolve					0.0100000000
1218	buthyl acetate					0.0130000000
1401	acetone					0.0090000000
2704	hydrocarbons		1.783		0.5150000	0.7540000000
5	other gaseous and liquid agents					0.0030000000
5	untreated					0.0030000000
322	sulfuric acid				0.0000430	0.0030000000

"ZSM" company
(Construction materials plant)
Settlement of Brick works, town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	26.3310000	40.6360000	12.6610000	17.7254007	8.8600503000
1	untreated				17.7250000	8.8600503000
2	including solid agents	9.7190000	15.9510000	6.2720000	6.0924007	3.0449003000
2	untreated				6.0920000	3.0449003000
143	manganese and its compounds			0.0050000	0.0014000	0.0007000000
184	lead					0.0005000000
323	silicon oxides	0.0010000	0.0010000	0.0010000	0.0040000	0.0002000000
328	carbon black (coke dust, ashes)			0.1560000	0.0310000	0.0160000000
344	fluorides	0.0020000	0.0020000	0.0010000	0.0010000	0.0005000000
703	benzapyrene				0.0000007	0.0000003000
2907	inorganic dust, containing			0.0010000		3.0270000000
2908	inorganic dust, containng	5.0000000		6.2380000	6.0550000	
2909	suspended substances	3.1530000				
2936	sawdust	0.5780000				
5023	coal dust	0.9870000				
4	gaseous and liquid agents	16.6120000	24.6850000	6.3890000	11.6330000	5.8151500000
4	untreated				11.6330000	5.8151500000
301	nitrogen oxides	0.2500000	0.29990000	0.0430000	0.3850000	0.1920000000
301	untreated					0.1920000000
330	sulfur dioxide	5.9430000	10.4790000	4.7610000	4.8200000	2.4100000000
330	untreated					2.4100000000
337	carbon monoxide	0.0340000	11.5290000	1.3700000	6.3640000	3.1820000000
337	untreated					3.1820000000
6	volatile organic compounds		0.1420000	0.2140000	0.0610000	0.0310000000
6	untreated					0.0310000000
621	toluene		0.0660000	0.0430000		
1042	isobutyl alcohol		0.0190000	0.0013000		
1061	ethyl alcohol		0.0130000	0.0007000		
1119	ethyl Cellosolve		0.0100000	0.0069000		
1218	buthyl acetate		0.0130000	0.0090000		
1401	acetone		0.0090000	0.0080000		
1555	acetic acid		0.0120000	0.0080000		
2704	hydrocarbons			0.1190000	0.0610000	0.0310000000
5	other gaseous and liquid agents	0.0020000	0.0020000	0.0010000	0.0030000	0.0001500000
5	untreated					0.0001500000
342	gaseous fluorides		0.0020000	0.0010000	0.0030000	0.0001500000
2735	hydrocarbon oils		2.2340000			

21 5304986

"Avtoremont" stock company
PO "Krasnodaravtoremont"
16 Khalturina st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	1.8000000	2.8900000	1.7200000	3.6800000	3.36511160400
1	untreated	0.1000000			3.6800000	3.3651160400
2	including solid agents					0.4556360400
2	untreated					0.4556360400
123	welding spray					0.0147300000
143	manganese					0.0012000000
184	lead					0.0000160000
203	chromium oxide					0.0003400000
328	carbon black (coke dust, ashes)					0.0013900000
344	fluorides					0.0001600000
703	benzapyrene					0.0000000400
2902	paint spray					0.1190000000
2930	metal abrasive dust					0.3188000000
4	gaseous and liquid agents	1.7000000	2.7300000	1.7200000	3.6800000	2.9094800000
4	untreated				3.6800000	2.9094800000
301	nitrogen oxides		0.4340000	0.3100000	1.0190000	0.6114000000
301	untreated					0.6114000000
330	sulfur dioxide					0.0018600000
330	untreated					0.0018600000
337	carbon monoxide		1.5630000	1.1100000	2.6610000	1.5917100000
337	untreated					1.5917100000
6	volatile organic compounds		0.7300000	0.3000000		0.7023800000
6	untreated					0.7023800000
621	toluene					0.2417000000
1042	isobutyl alcohol					0.0807000000
1061	ethyl alcohol					0.1092000000
1119	ethyl Cellosolve					0.0455000000
1218	buthyl acetate					0.0474000000
1401	acetone		0.7300000	0.3000000		0.0446000000
2704	hydrocarbons					0.0080000000
2732	kerosene					0.1252800000
5	other gaseous and liquid agents					0.0021300000
5	untreated					0.0021300000
342	hydrogen fluoride					0.0000300000
2735	???					0.0021000000

23 5311363

Labinsky Bakery
109 Gagarina st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL	11.7670000	11.7670000	11.7670000	11.7013000	11.7670540450
1	untreated				11.7010000	11.7670540450
2	including solid agents	0.0730000	0.0730000	0.0730000	0.0073000	0.0730540450
2	untreated				0.0073000	0.0730540450
184	lead					0.0000540000
703	benzapyrene					0.0000000450
5045	meal dust	0.0730000	0.0730000	0.0730000	0.0073000	0.0730000000
4	gaseous and liquid agents	11.6940000	11.6940000	11.6940000	11.6940000	11.6940000000
4	untreated				11.6940000	11.6940000000
301	nitrogen oxides	1.6710000	1.6710000	1.6710000	1.6710000	1.6710000000
301	untreated					1.6710000000
337	carbon monoxide	10.0230000	10.0230000	10.0230000	10.0230000	10.0230000000
337	untreated					10.0230000000

24 3892633

LGB joint-stock company
"Labinsky" reinforced concrete works
Settlement of Sugar Refinery, town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL		202.2310000	202.2310000	24.3060000	23.2704100000
1	untreated				22.7860000	21.4794100000
1	directed for trearment				132.5610000	14.9250000000
1	caught				131.0410000	13.1340000000
2	including solid agents		179.3070000	179.3070000	2.3640000	2.3872000000
2	untreated				0.8440000	0.5962000000
2	directed for treatment				132.5610000	14.9250000000
2	caught				131.0410000	13.1340000000
123	iron oxide				0.2000000	0.1720000000
143	manganese and its compounds		0.0230000	0.0230000	0.0230000	0.0230000000
184	lead					0.0915000000
207	zinc and its compounds		0.6370000	0.6370000		
328	carbon black (coke dust, ashes)					0.0017000000
703	benzapyrene					
2918	cement dust		178.6470000	178.6470000	2.1410000	2.0990000000
4	gaseous and liquid agents		22.9240000	22.9240000	21.9420000	20.8832100000
4	untreated				21.9420000	20.8832100000
301	nitrogen oxides		11.9540000	11.9540000	5.4810000	6.3520000000
301	untreated					6.3520000000
330	sulfur dioxide		0.0020000	0.0020000		0.0026100000
330	untreated					0.0026100000
337	carbon monoxide		9.5900000	9.5900000	16.4430000	14.4951000000
337	untreated					14.4951000000
6	volatile organic compounds		1.3780000	1.3780000	0.0180000	0.0335000000
6	untreated					0.0335000000
2704	gazoline		1.3780000	1.3780000	0.0180000	0.0335000000

25 0001145 **Labinskaya service station (garage) "Kubankooptrans" 264 Pobedy st., town of Labinsk**

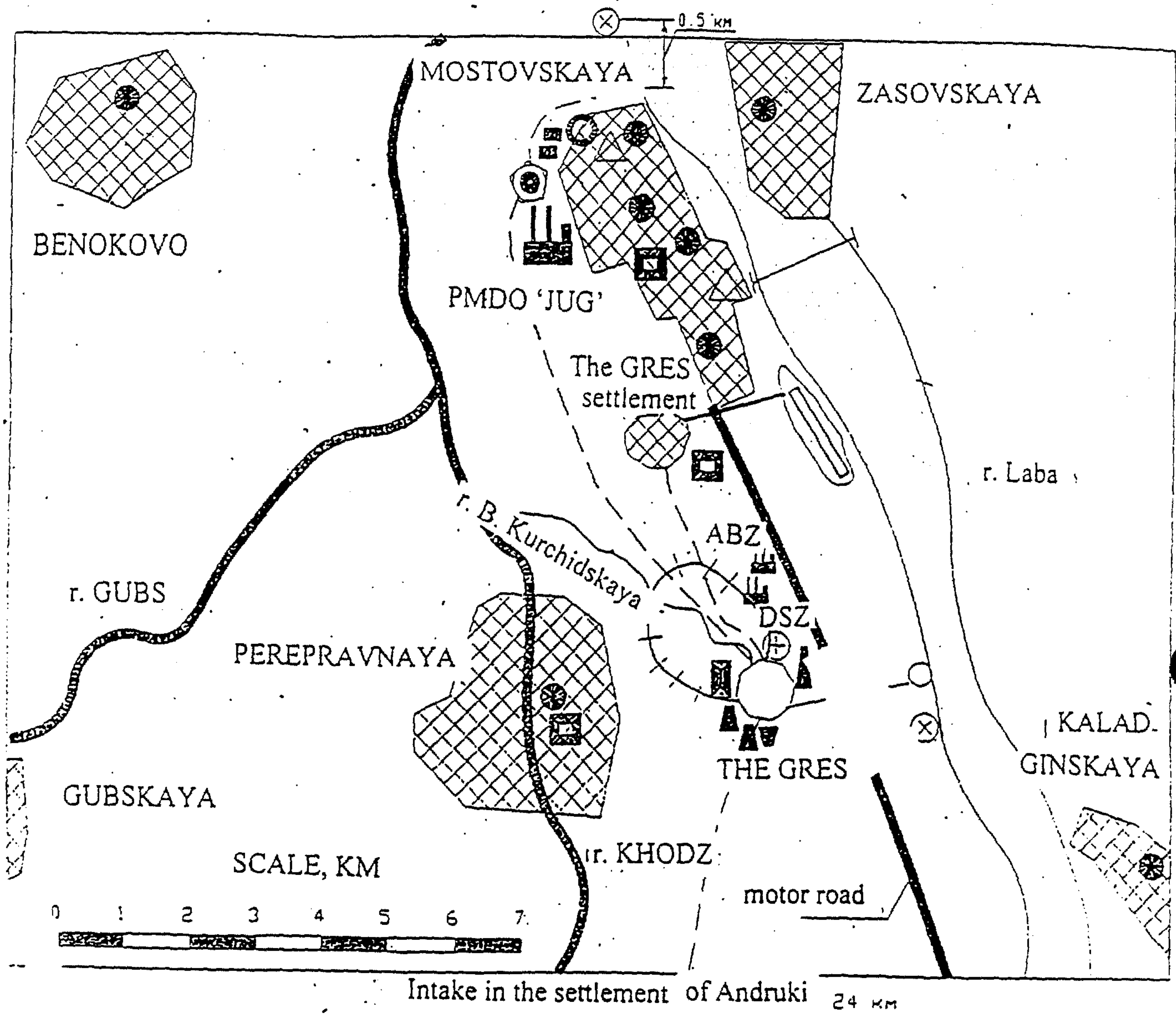
agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL				0.8353002	0.4580001000
1	untreated				0.8350000	0.4580001000
2	including solid agents				0.0103002	0.0030001000
2	untreated				0.0100000	0.0030001000
123	welding spray				0.0060000	
143	manganese				0.0010000	0.0002000000
184	lead				0.0003000	0.0003000000
328	carbon black				0.0030000	0.0025000000
703	benzapyrene				0.0000002	0.0000001000
4	gaseous and liquid agents				0.0250000	0.4550000000
4	untreated				0.0250000	0.4550000000
301	nitrogen oxides				0.0460000	0.0280000000
301	untreated					0.0280000000
330	sulfur dioxide				0.0050000	0.0040000000
330	untreated					0.0040000000
337	carbon monoxide				0.6510000	0.3510000000
337	untreated					0.3510000000
6	volatile organic compounds					0.0610000000
6	untreated					0.0610000000
2704	hydrocarbons					0.0610000000
5	other gaseous and liquid				0.1230000	0.0110000000
5	untreated					0.0110000000
322	sulfuric acid				0.0200000	0.0110000000
2735	mineral oil				0.1030000	

26 0001160

Labinskaya Bulk Plant
173 Pobedy st., town of Labinsk

agent code	agent description	discharges (tons per year)				
		1990	1991	1992	1993	1994
1	TOTAL				154.6560000	154.0172057000
1	untreated				154.6560000	154.0172057000
2	including solid agents					0.0004087000
2	untreated					0.0004087000
123	welding spray					0.0002655000
143	manganese					0.0000345000
184	lead					0.0000371000
328	carbon black					0.0000716000
703	benzapyrene					
4	gaseous and liquid agents				154.6560000	154.0167970000
4	untreated				154.6560000	154.0167970000
301	nitrogen oxides					0.0741000000
301	untreated					0.0741000000
330	sulfur dioxide					0.0002470000
330	untreated					0.0002470000
337	carbon monoxide					0.0741000000
337	untreated					0.0741000000
6	volatile organic compounds				154.6560000	153.8683500000
6	untreated					153.8683500000
2735	gazoline				154.6560000	153.8683500000

THE MAP OF SOURCES, OBJECTS AND IMPACT MONITORING OF THE DESIGNED KRASNODAR GRES



CONVENTIONAL SIGNS

SOURCES OF IMPACT

Existing

- Industrial enterprises
- Gas burning facilities
- Treatment facilities
- Existing drinking water intake with 13 wells (To be shut down after the construction of under-river bed water intake in the settlement of Andruki)

Designed

- The GRES stack
- The GRES cooling towers
- 4 tanks for storage of mineralized and toxic matters
- Fuel oil storage
- The GRES site
- Well intake
- Pipelines

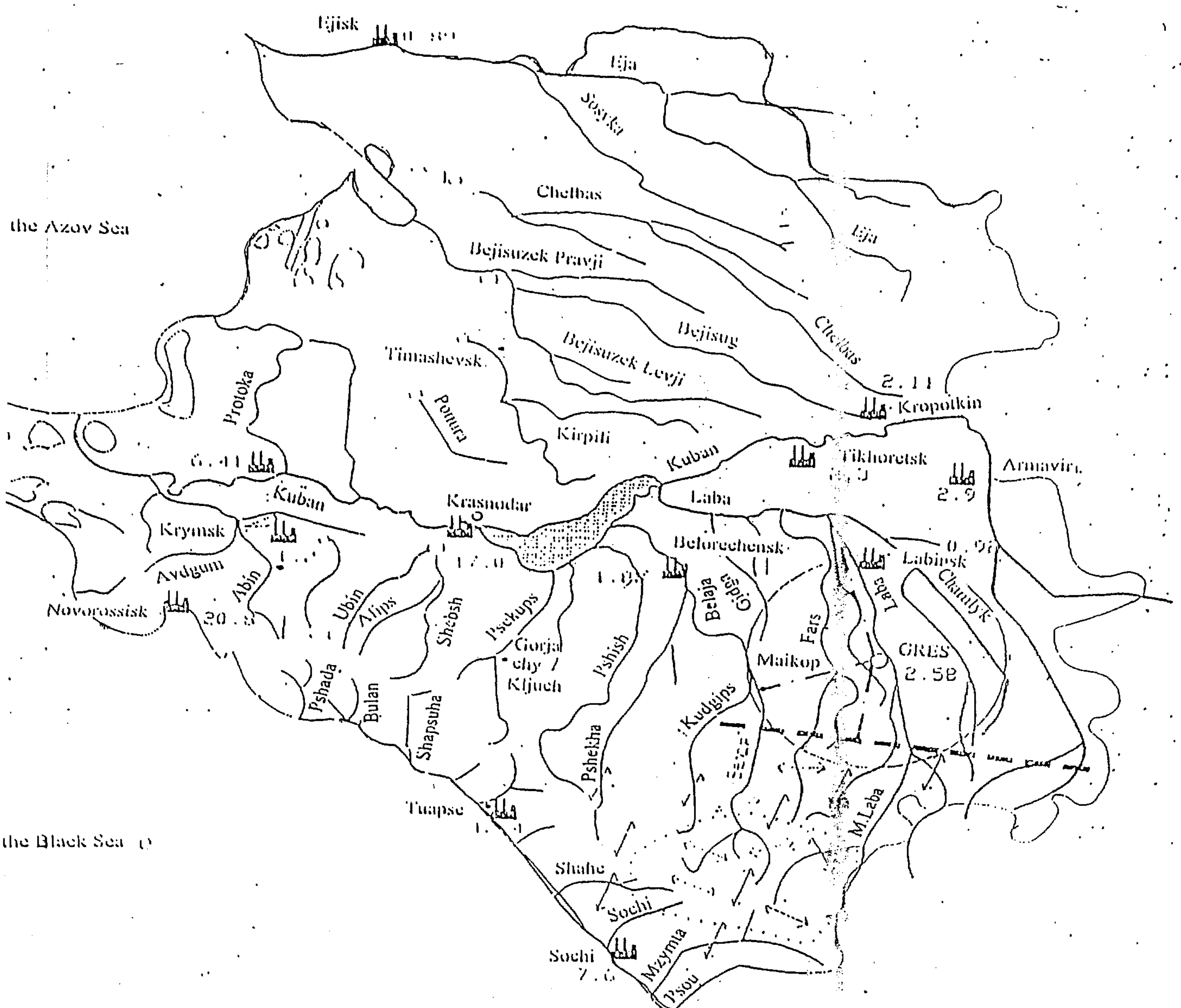
THE MONITORING NETWORK

- Sites of water quality control
- The place of air quality control
- The well of undersurface waters quality control

OBJECTS OF IMPACT

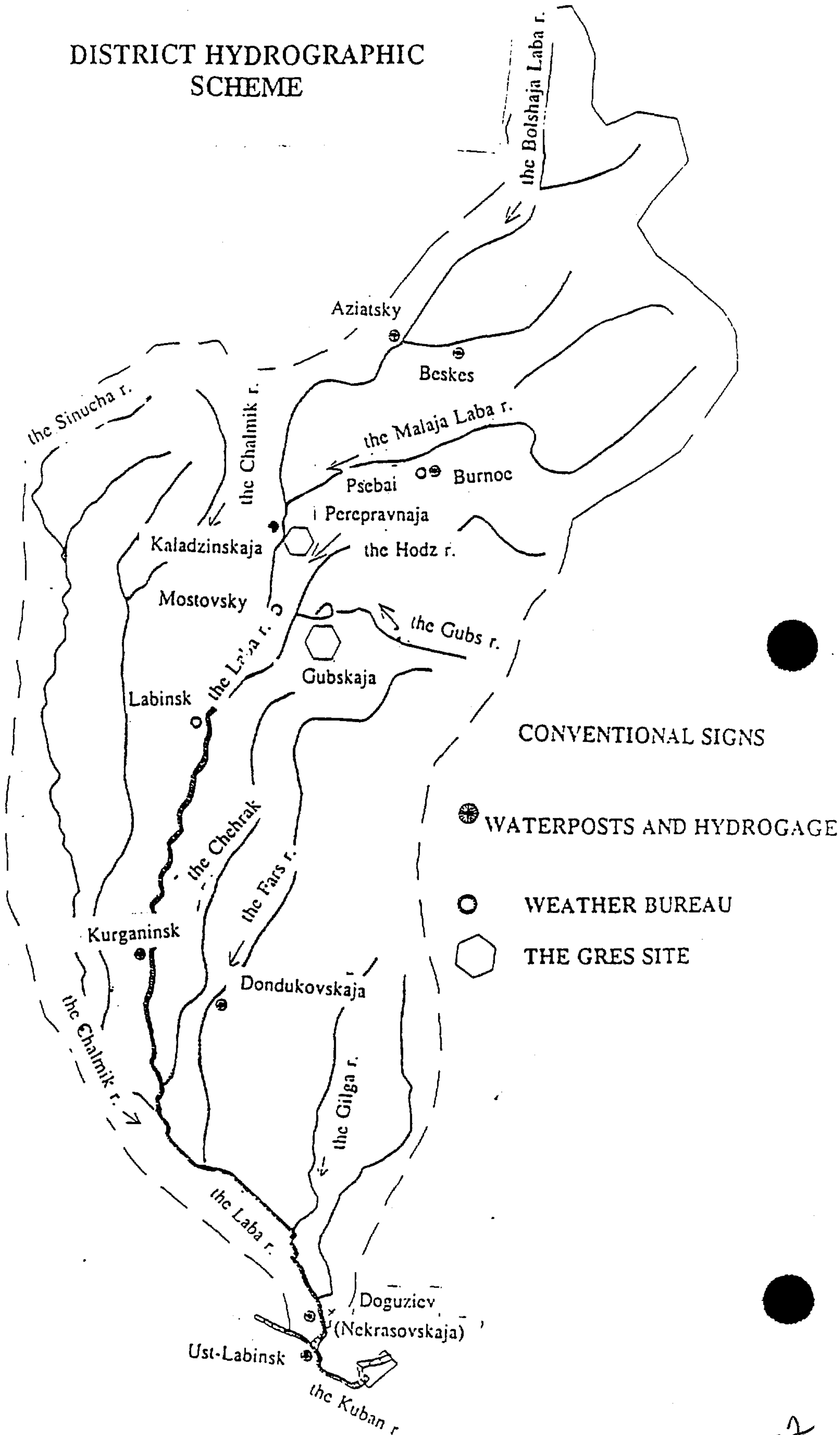
- Settlements
- Schools
- Medical institutions

KRASNODAR REGION MAP-SCHEME



APPENDIX 12

DISTRICT HYDROGRAPHIC SCHEME



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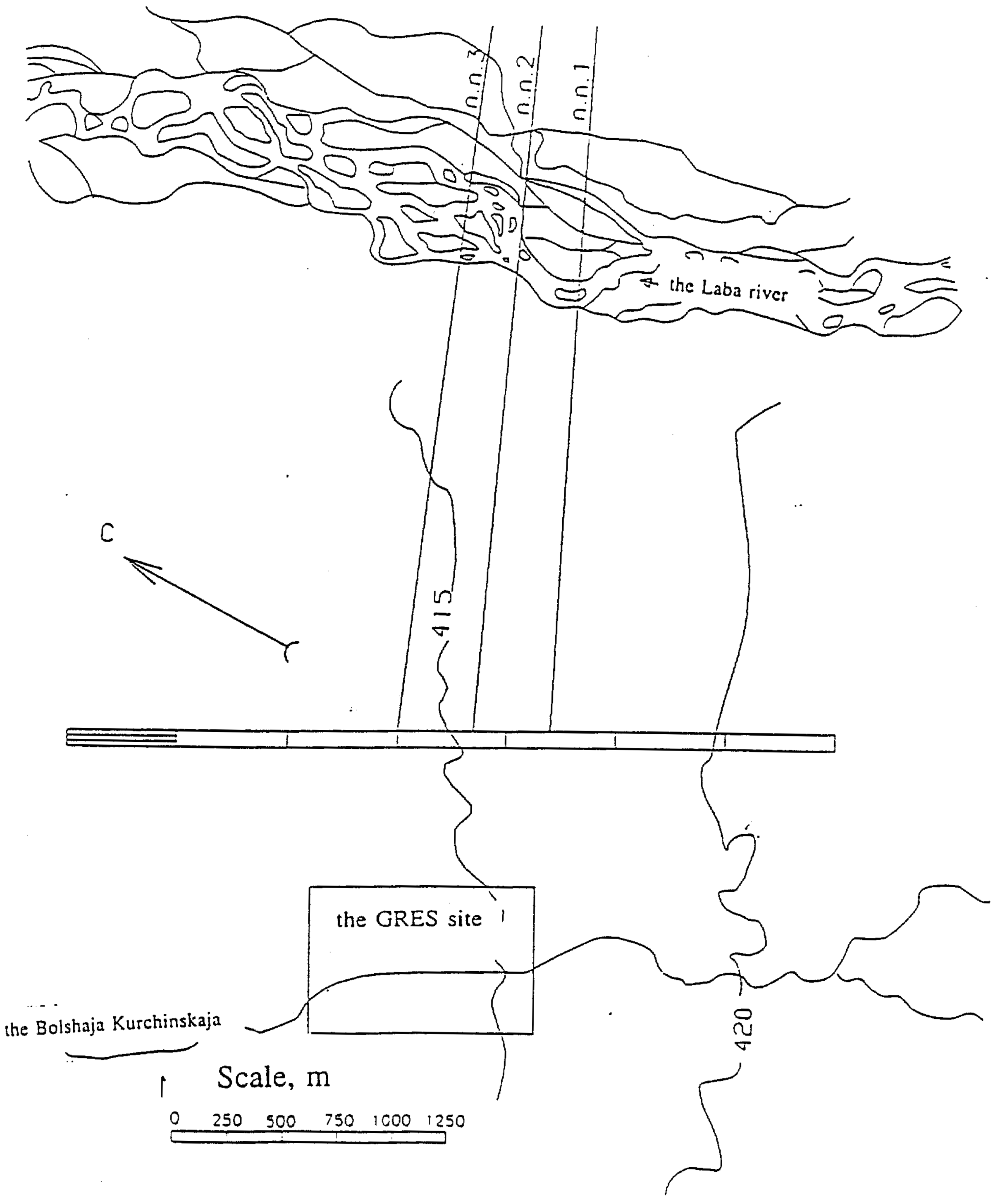
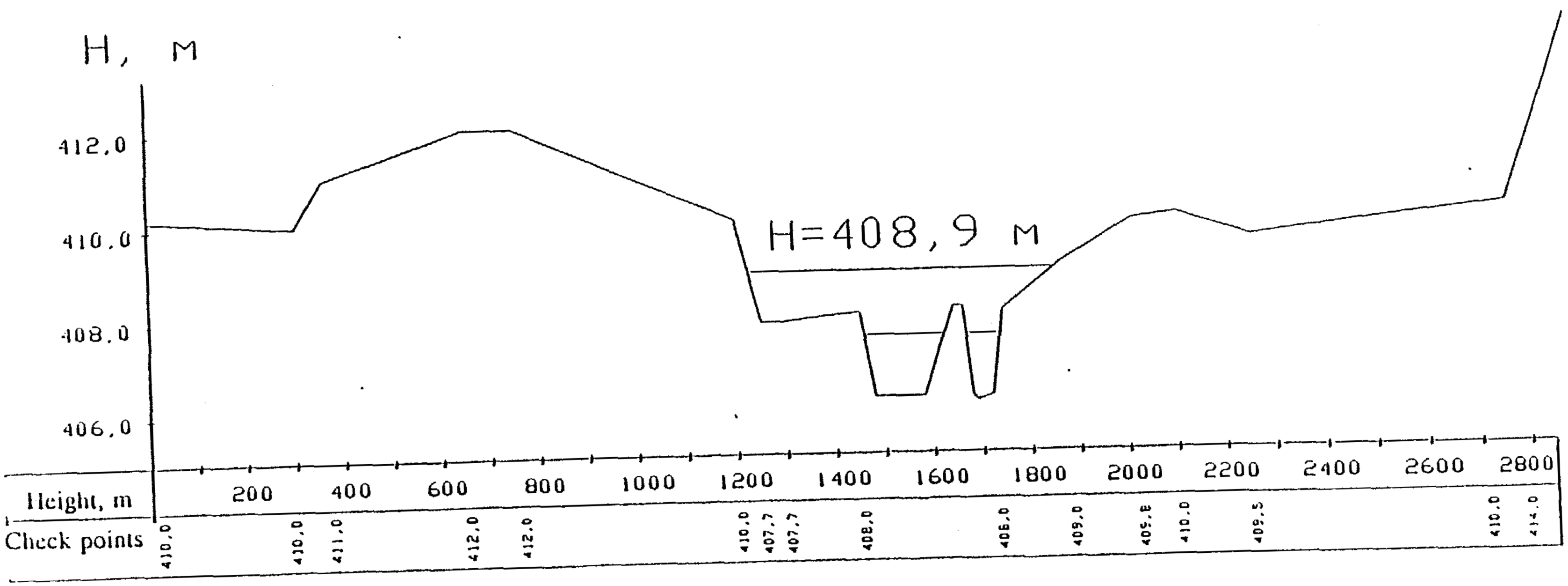
CALCULATED GAGES ON THE LABA RIVER NEAR THE GRES SITE

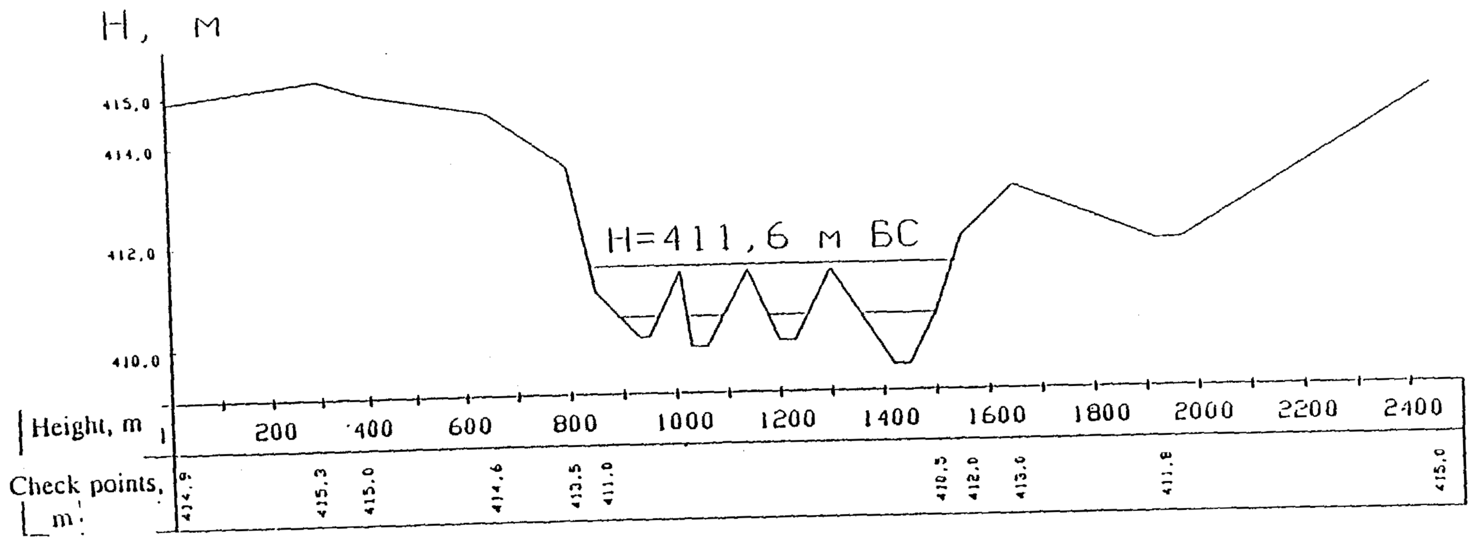


BROADSIDE PROFILE OF GAGE 3



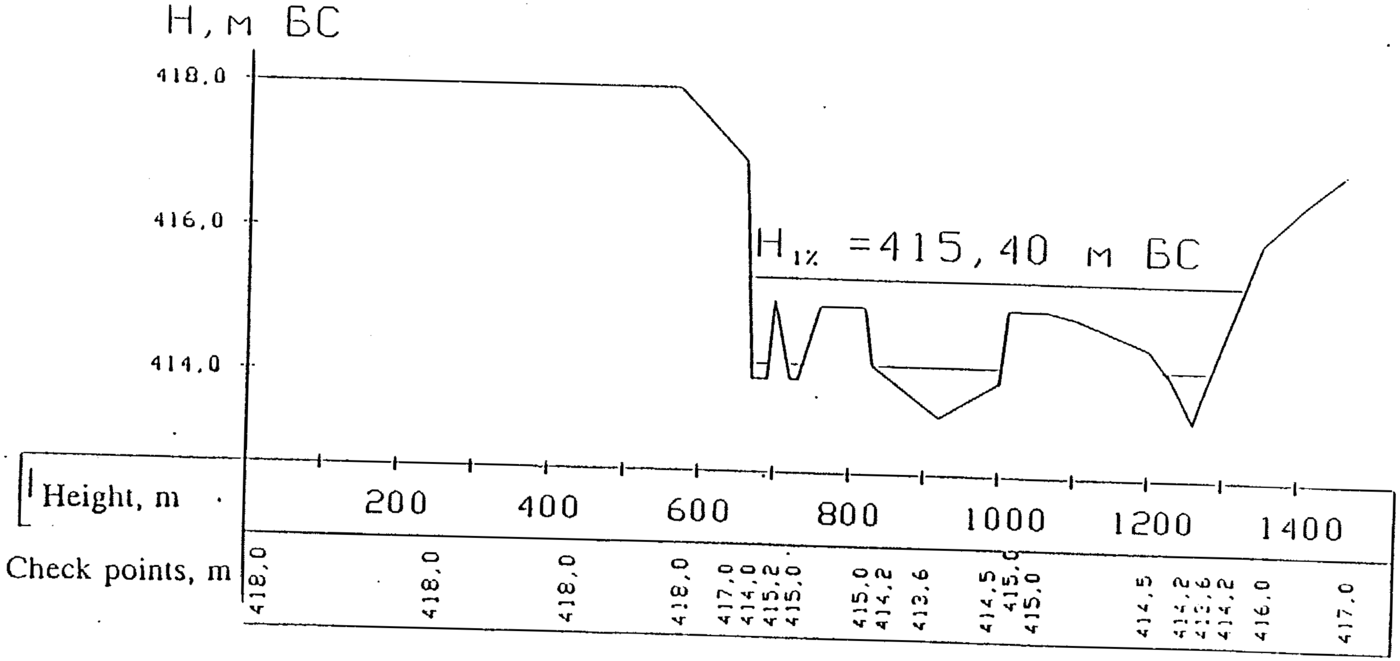
Appendix 14

BROADSIDE PROFILE OF GAGE 2



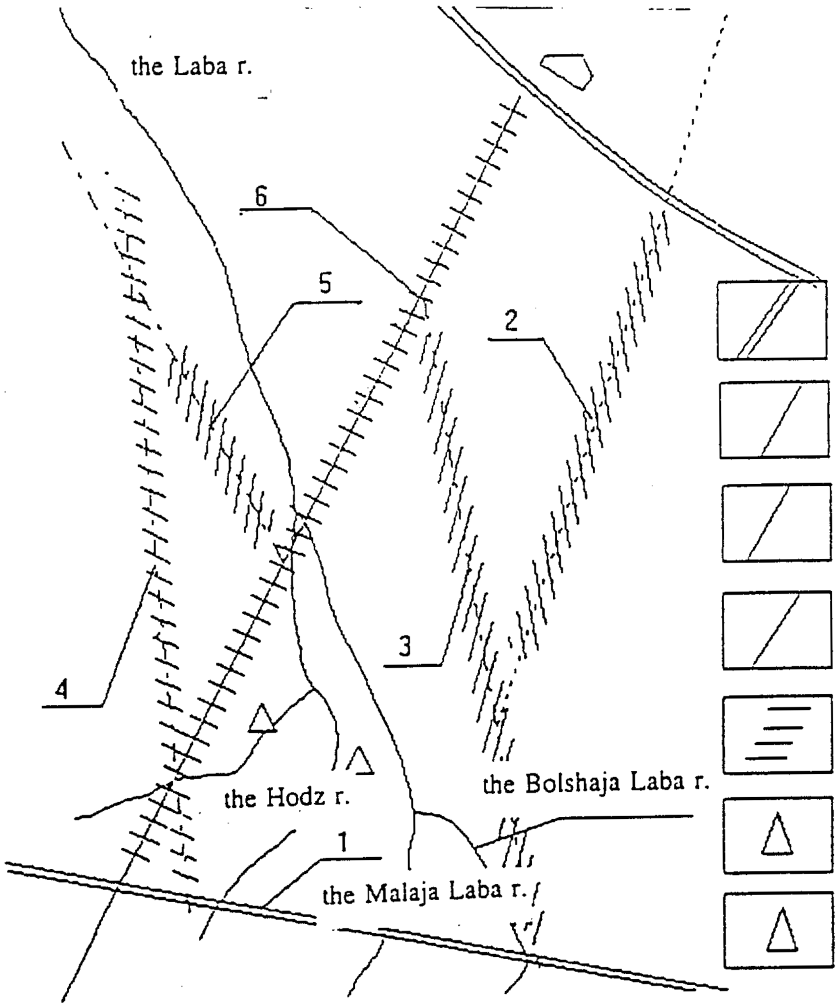
Appendix 15

BROADSIDE PROFILE OF GAGE 1

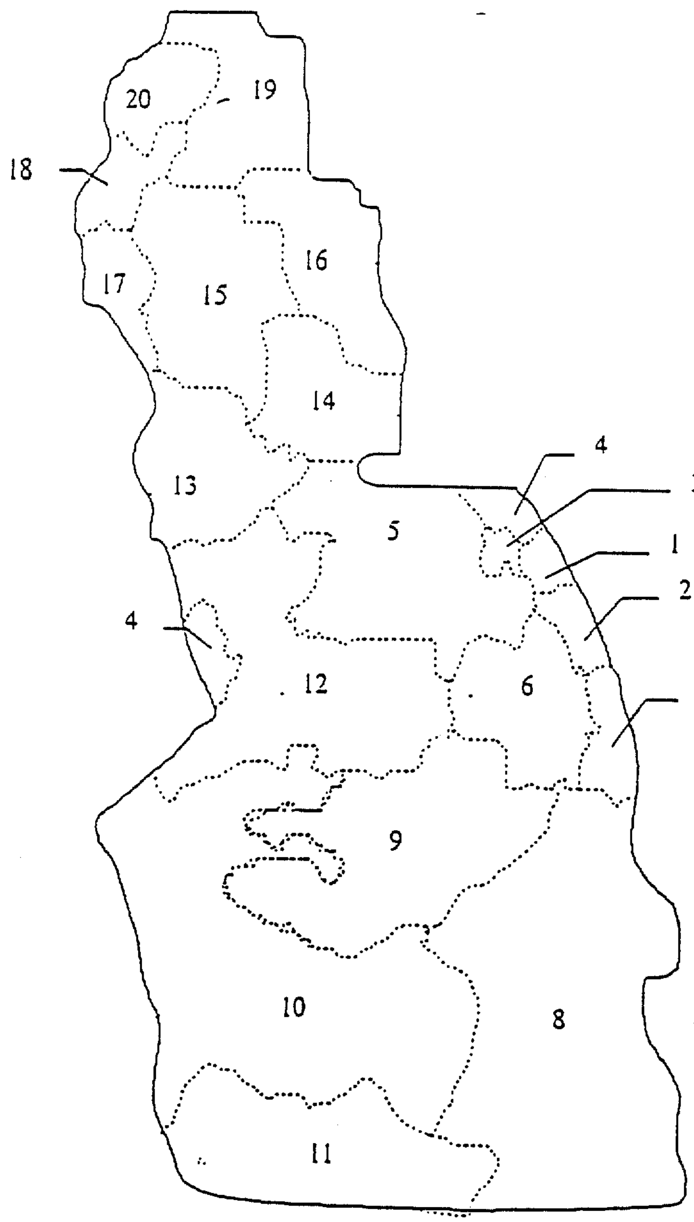


Appendix 16

The Scheme of the Krasnodar GRES Site Seismic Fractures



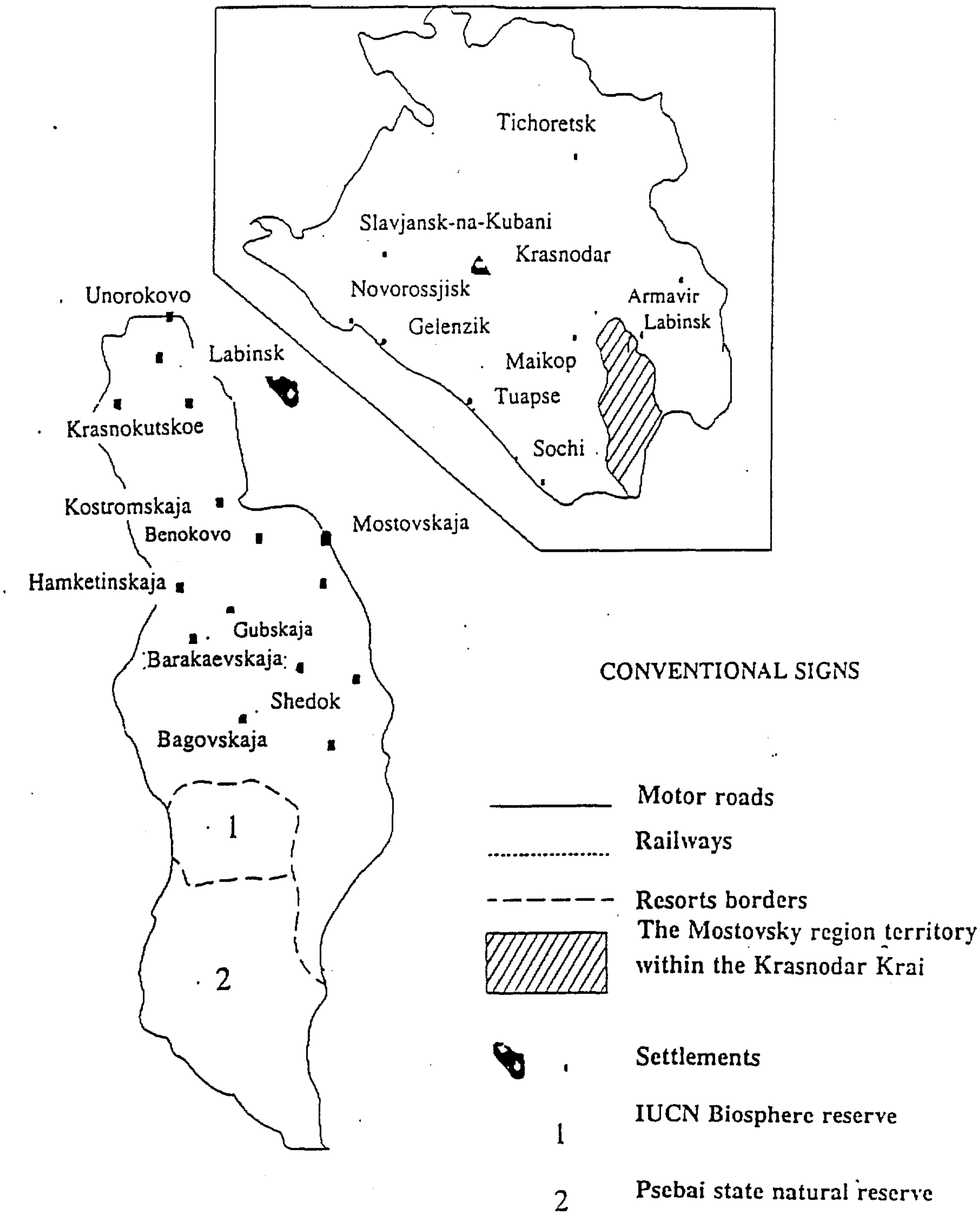
Main Land Users of the Mostovsky District



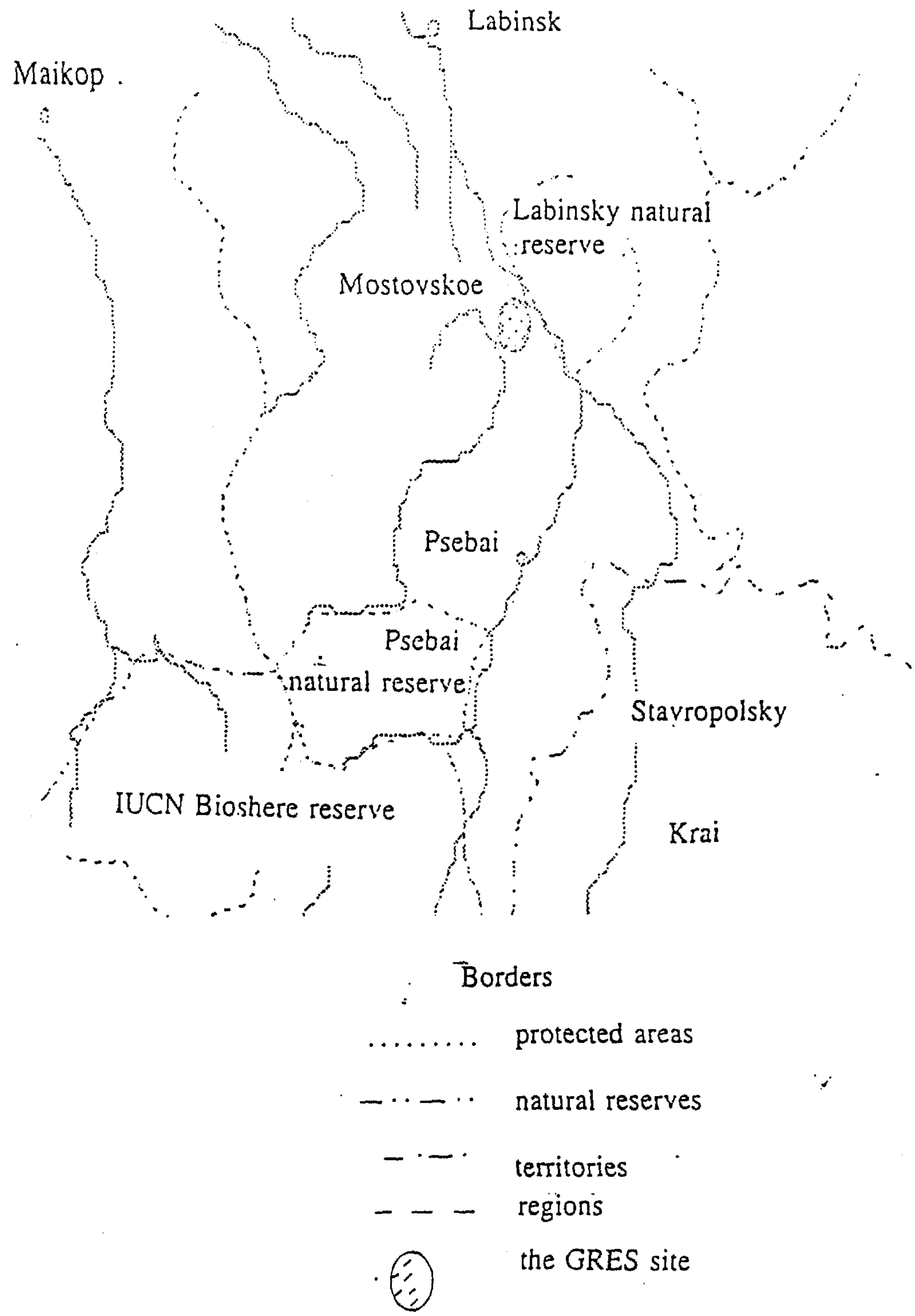
1. Mostovsky PGT
2. 'Klever' collective farm
3. 'Plodovosh' interfarm amalgamation
4. Mostovsky fruit farm
5. Dimitrov collective farm
6. 'Frunze' collecive farm
7. 'Svobodny mir' collective farm
8. 'Kuibishev' collective farm
9. Mostovsky interfarm complex
10. Mostovsky sawmill
11. Psebai state natural preserve
12. 'Put Ilichja' collective farm
13. Maikop experimental sawmill
14. 'Kostromsky' collective farm
15. 'XX CPSU Congress' collective farm
16. Labinsky stud farm No.19
17. Jaroslavsky sawmill
18. 'Predgorny' collective farm
19. 'Put k kommunizmu' collective farm
20. 'Pobeda' collective farm

Appendix 19

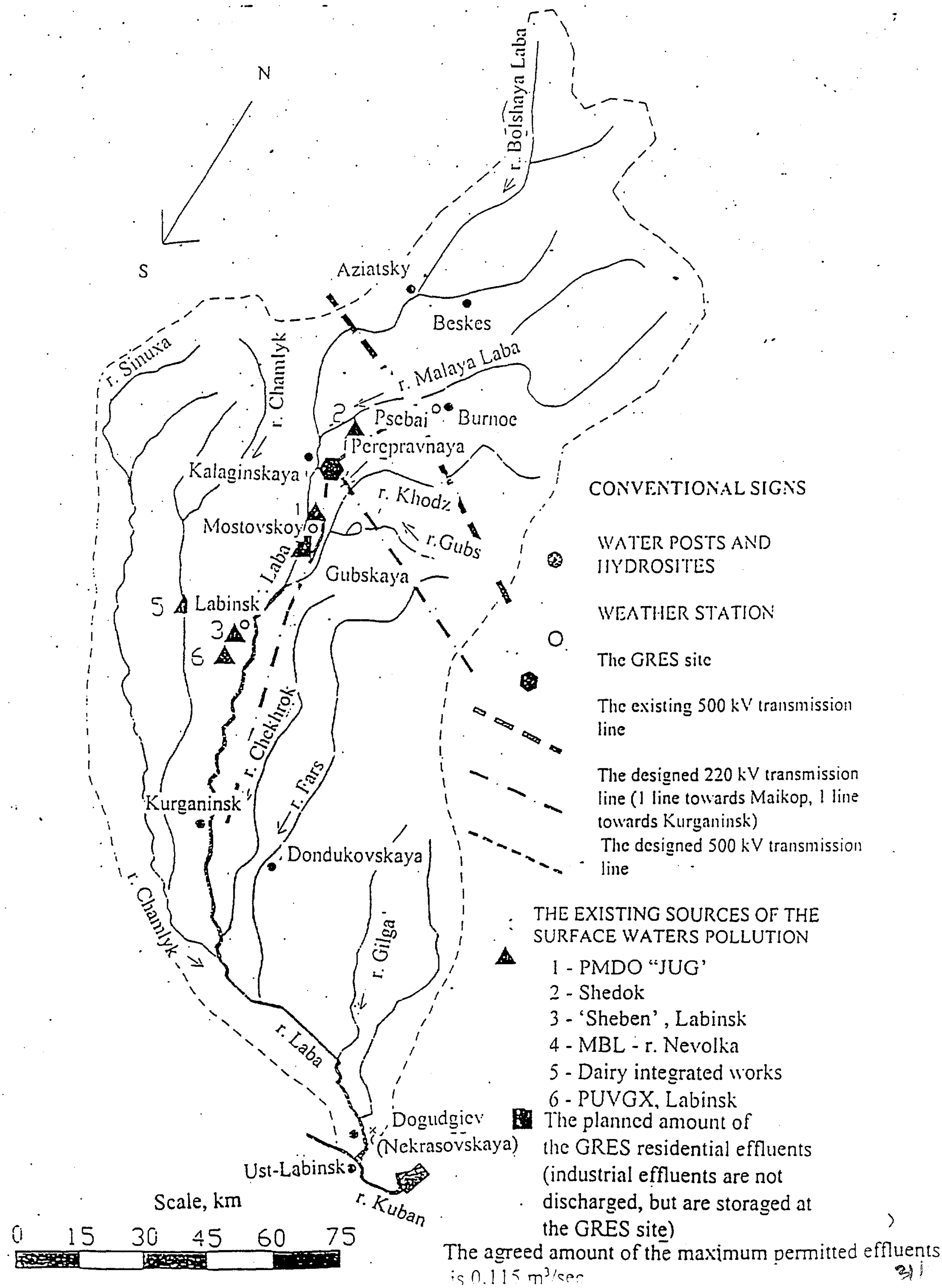
Mostovsky District Transport Network



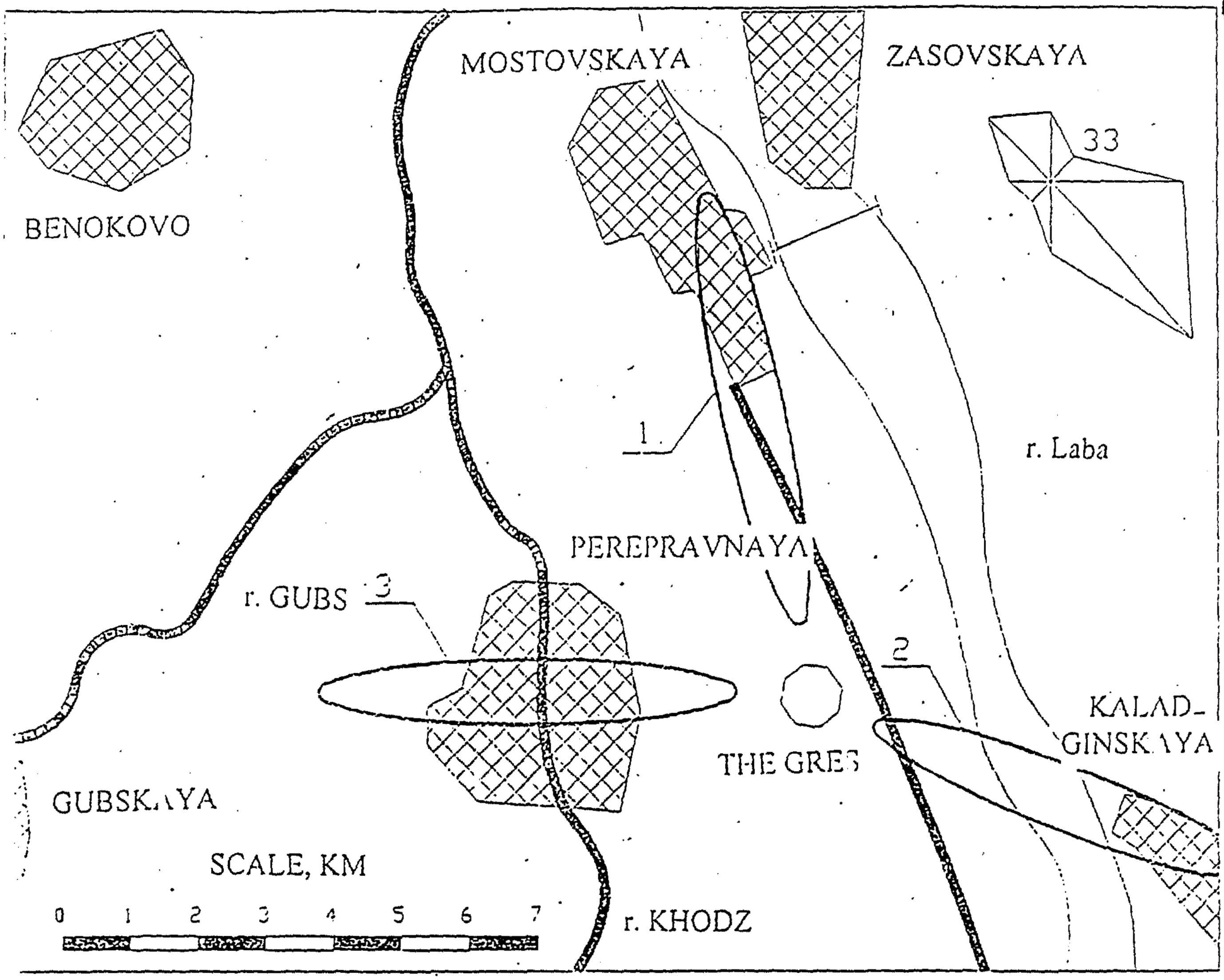
The scheme of the Specially Protected Areas, Located nearby the GRES Site



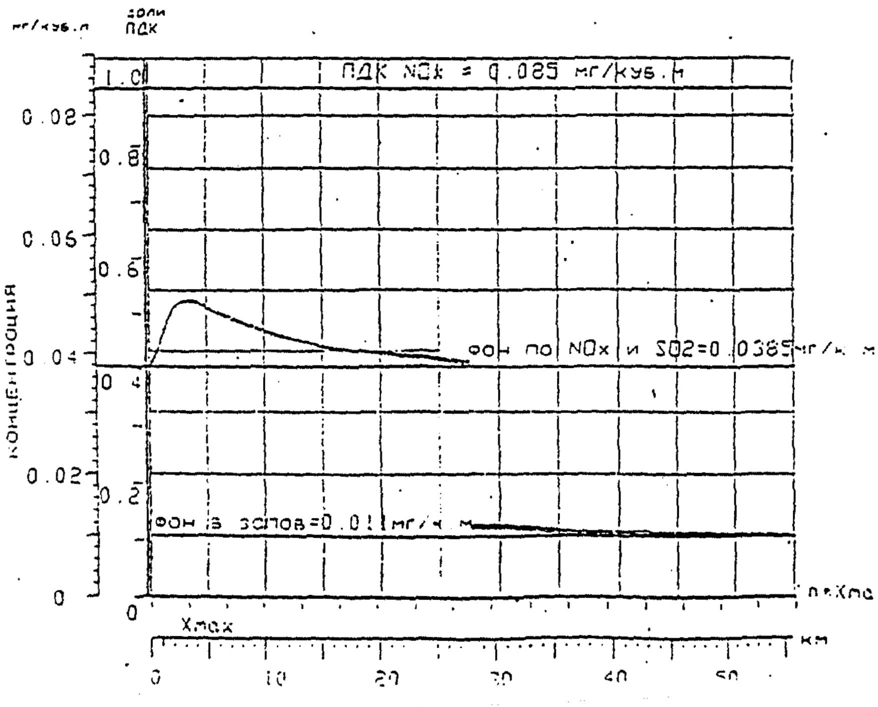
THE KRASNODAR GRES PROJECT IMPACT ON THE QUALITY OF THE LABA RIVER BASIN SURFACE WATERS



The Impact of the Krasnodar GRES Project on the Air Quality of the Mostovskoy District



Near surface NOx concentation under unfavourable weather conditions

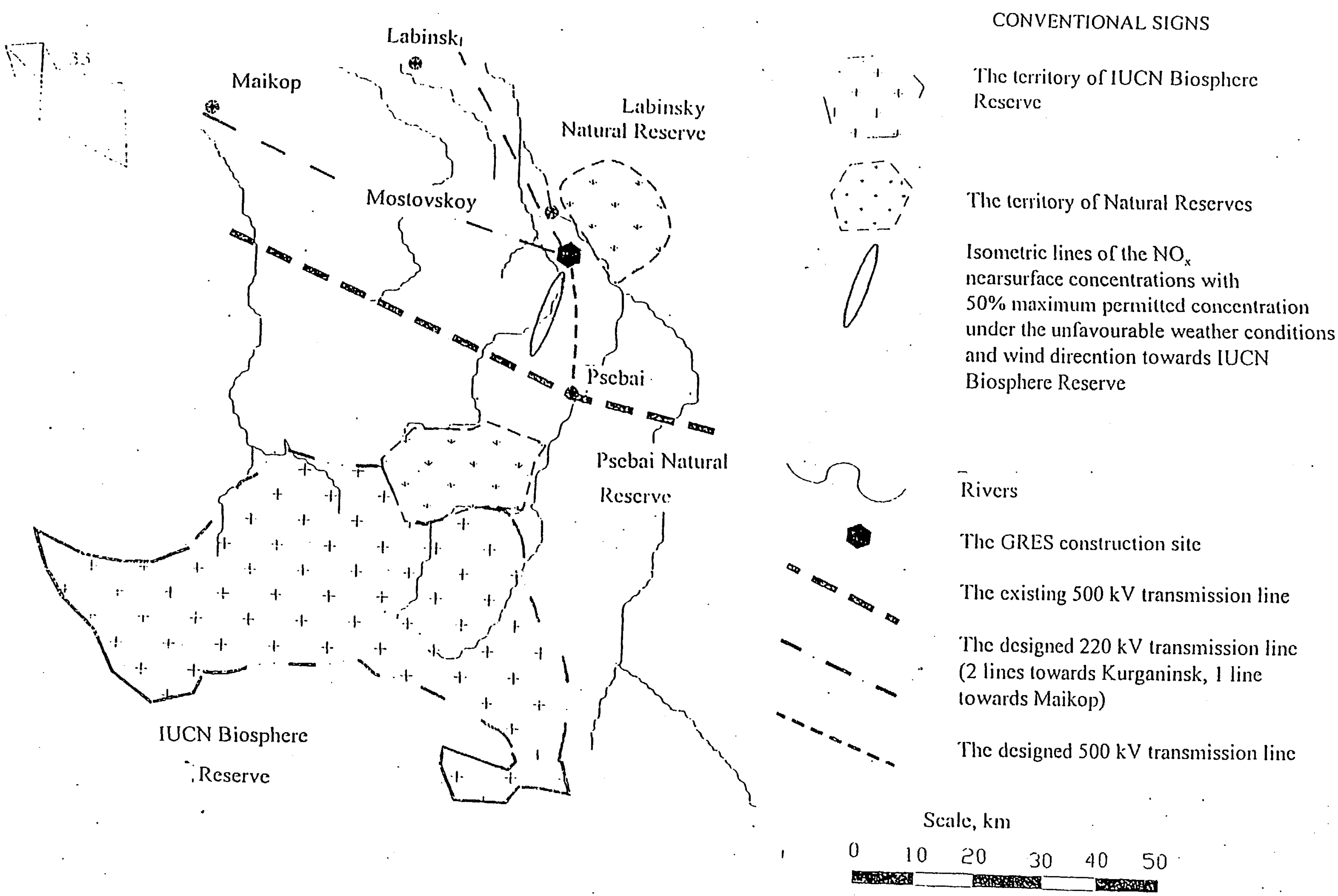


Isometric lines of near surface NOx concentrations that are 57% of maximum permissible concentrations under unfavourable weather conditions and wind direction.

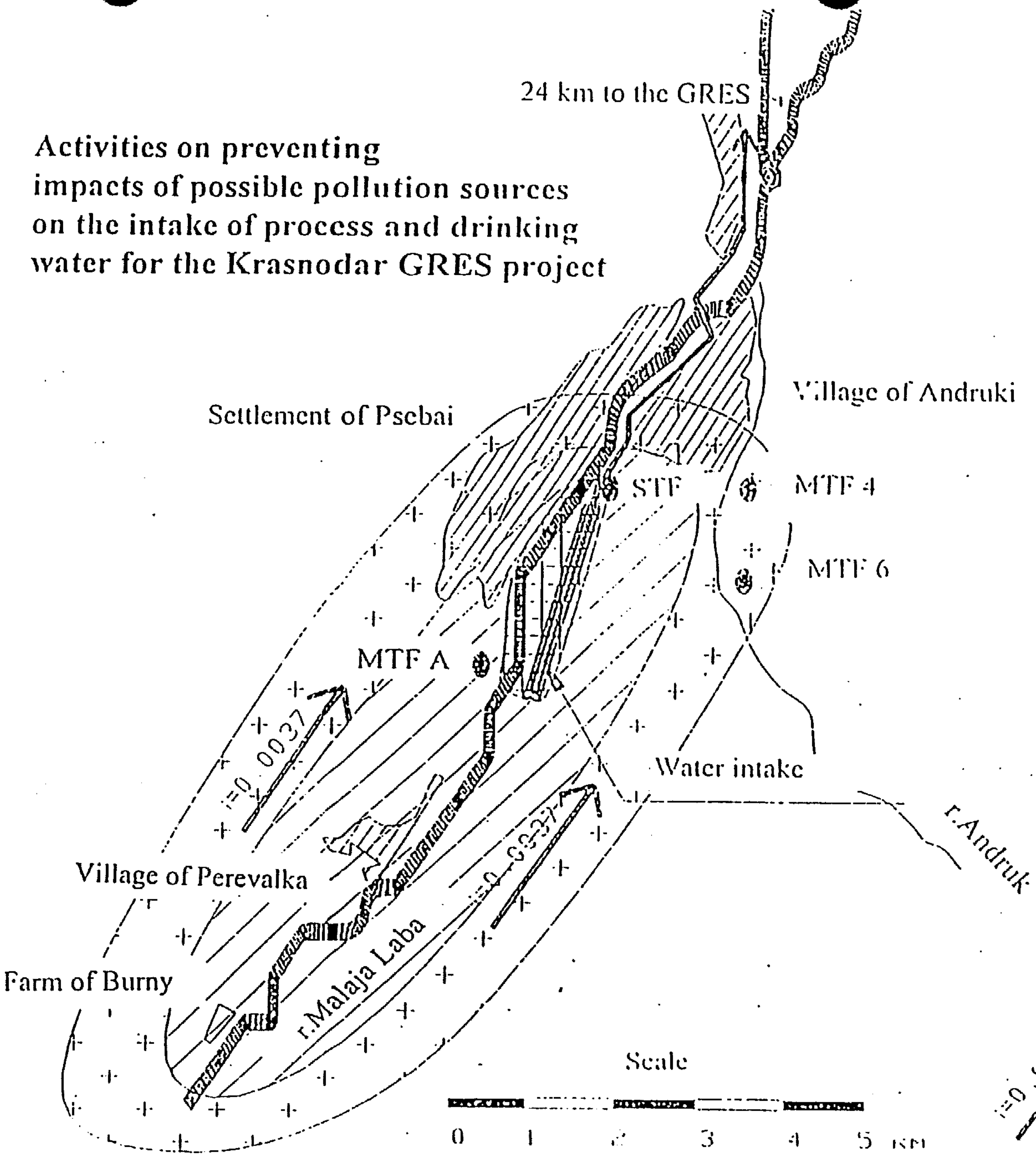
Wind direction:

1 - towards Mostovskoy
2 - towards Kaladzinskaya
3 - towards Perepravnaya

THE KRASNODAR GRES PROJECT IMPACT ON THE SPECIALLY PROTECTED AREAS



Activities on preventing impacts of possible pollution sources on the intake of process and drinking water for the Krasnodar GRES project



Possible sources of the underground water pollution of the water intake

a) have no impact on the water intake

MTF 4

MTF 6

MTF A

settlement of Psebai

village of Andruki

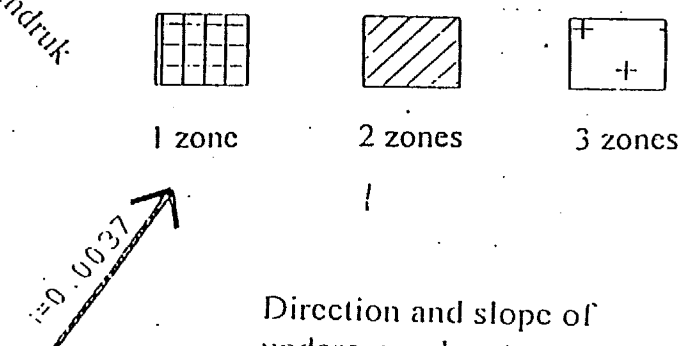
village of Perevalka

farm of Burny

b) have impact

STF

Zone of sanitarium protection of the process and drinking water intake for the Krasnodar GRES project



Direction and slope of underground water stream

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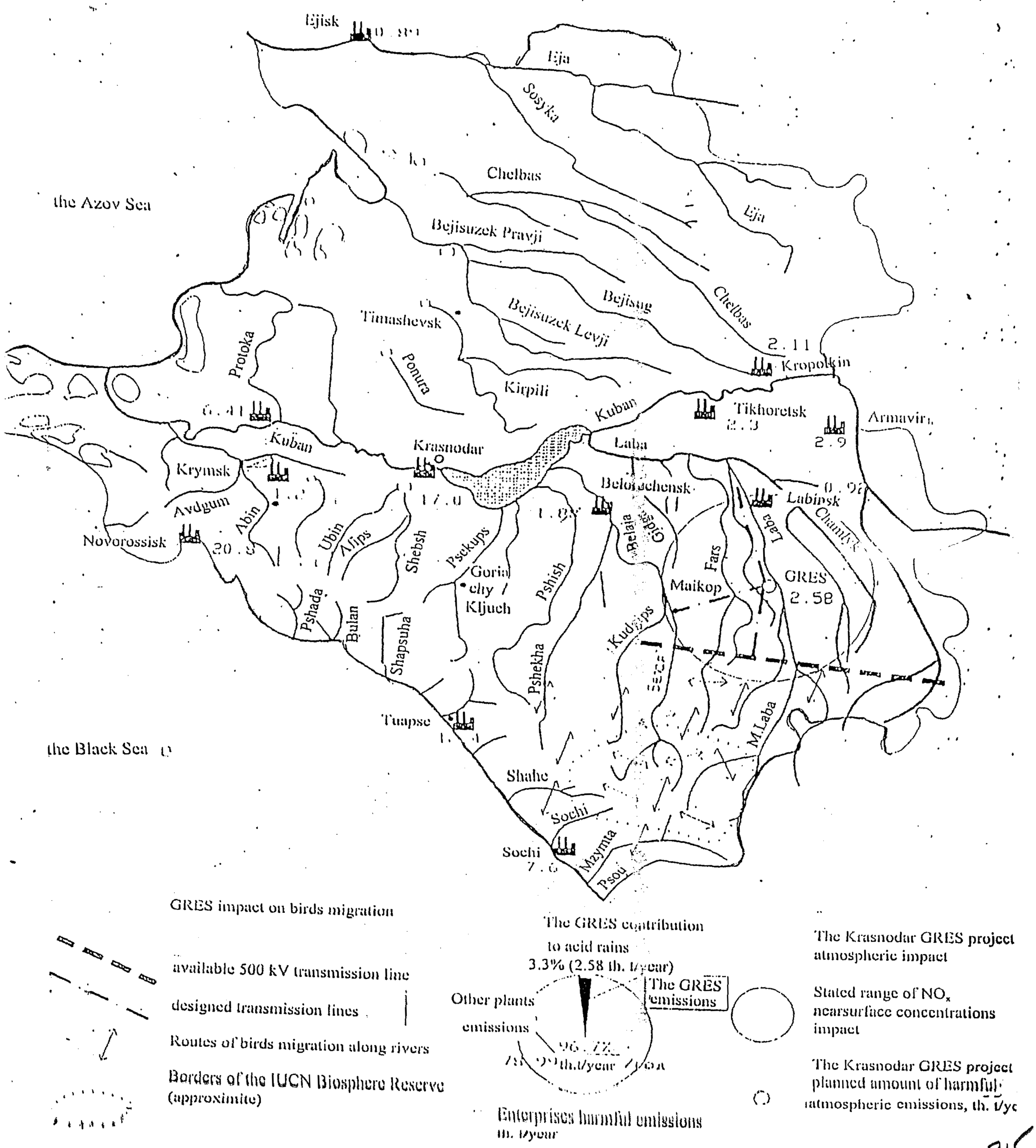
Impact of the Krasnodar GRES Project on the Ecological Systems of the Krasnodar Krai



Appendix 26

Sources and Types of the Krasnodar GRES Environmental Impact at Normal Operation and in Emergencies.

	GRES Installations	Impacts
1	Main building - 3x 450 MW CCU	Noise
2	Smoke stack with gas conduits H-150m	Air pollution
3	500 kW installation portals	Electomagnetic
4	220V ORU bus	Electomagnetic
5	500V ORU bus	Electomagnetic
•6	Evaporation system for sewage demineralization	Soil and ground water pollution
7	Open transformers system	Electomagnetic
8	Cooling towers	Heat pollution of the air
9	Storage of dry salts	Dust
10	Pump station	Noise
11	Auxiliary building	Sewage, garbage
12	Maintenance shop	Sewage, garbage
•13	Chemical treatment facilities for mineralized sewage	Soil and ground water pollution
•14	Concrete production facilities	Soil and ground water pollution
15	Garage for 25 cars	Air pollution
16	Compressor room	Noise
•17	Fuel oil room	Soil and ground water pollution
•18	Collecting and overflow facilities	Soil and ground water pollution
•19	3x 20000 cub.m diesel oil tanks and 2 fuel oil tanks	Soil and ground water pollution
•20	Start-up and heating boiler room	Soil and ground water pollution
•21	Oil storage	Soil and ground water pollution
•22	3x10000 cub.m tanks for mineralized and 1 tank for toxic sewage	Soil and ground water pollution

Plan-scheme of the GRES site